Bath's Clean Air Zone
Quarterly Monitoring Report
April-June 2021

Bath & North East Somerset Council

Improving People's Lives

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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 compliance 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, there is significant financial support for affected individuals and businesses to replace non-compliant vehicles regularly driving in the zone. 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 early, indicative view of the first three months performance of Bath's Clean Air Zone (CAZ) in terms of 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 complying with the Government's directive, all of which will be included in the Clean Air Zone Annual Report next year.

Due to Covid-19 having an unprecedented impact on travel behaviour in 2020, baseline data from 2019 and 2018 has been used to measure the impact and effectiveness of the zone. Due to seasonal effects, we also compare against similar seasons in this initial quarterly report, in this case the second quarter of the year (April to June), referred to as Q2.

You can find out more about how we measure and present the data in: 'How to use this report'.

Key findings

- Provisional air quality, traffic and vehicle compliance data indicates that Bath's Clean Air Zone is having the intended effect of improving fleet compliance, changing behaviours, and improving the city's air quality in general.
- Average nitrogen dioxide (NO_2) concentrations within the CAZ are 12.6 per cent lower than the same period in 2019 (Q2), representing a reduction of 4 $\mu g/m^3$. This is the average reading from a total of 64 monitoring sites within the CAZ, over the first three months of operation.
- Similar levels of NO_2 reduction were found in the Bath urban areas outside the zone's boundary, including Batheaston and Bathampton. Average NO_2 concentrations are also lower across the B&NES district.
- Despite this general improvement, quarterly average concentrations of NO_2 at eight monitoring sites still record results greater than 40 $\mu g/m^3$ which indicates a potential exceedance of the annual average level.[1] Whilst at one of these sites (Wells Road) there was an increase in NO_2 concentrations, at four of these sites (Dorchester Street, Victoria Buildings, Anglo Terrace, Walcot Parade) there was a decrease in NO_2 concentration between 2019 Q2 and 2021 Q2. Three sites (Anglo Terrace Façade, Walcot Parade 2, Wells Road 4) only started recording in 2019 Q3 and so we do not have a baseline for comparison.
- Across the five sites that were recording in 2019 Q2 (Dorchester Street, Victoria Buildings, Anglo Terrace, Wells Road, Walcot Parade), the average NO_2 concentration reduced from 50.1 $\mu g/m^3$ to an average 44.3 $\mu g/m^3$ (a decrease of 13%).
- Of these eight sites, the only site which showed an increase in NO_2 concentration (Wells Road) rose by 2.7 $\mu g/m^3$ to 46.7 $\mu g/m^3$ (an increase of 6%).
- There is still time for air quality improvements to be made, and the following four areas continue to be closely monitored: Cleveland Place East Junction, Dorchester Street, Wells Road (close to the Churchill Bridge gyratory) and Victoria Buildings.
- However, compared with the same quarter in 2019, three fewer locations in Bath now recorded quarterly annual average levels of NO_2 concentrations over 40 $\mu g/m^3$ and two fewer locations over 36 $\mu g/m^3$.
- This report refers to the period of April- June and is before the full closure of Cleveland Bridge in Bath. The impact of this closure on air quality and traffic

[1] Diffusion tube data is reported as measured at the site with no adjustments for local bias, or to the point of nearest exposure. All air quality data is provisional until accepted by DEFRA at the end of the calendar year

flows will be reported in the second quarterly report which will follow later in the year.

- 90% (equating to approximately 400 vehicles) of all taxis travelling in the zone at the end of June are now compliant, whereas only 67% (equating to approximately 180 vehicles) of taxis travelling in the zone during the week of launch, were compliant. By the end of June 2021, 71 higher polluting taxis have been replaced with cleaner, compliant ones with support from the Financial Assistance Scheme and approximately 50 remain to be upgraded.
- Out of a total fleet of 226 scheduled buses, 87 were non-compliant when the bus retrofit programme started, and to the end of June 2021, 73 have been successfully retrofitted to meet CAZ emission standards with financial support from the government. It's anticipated that by the end of August 2021 all, but three scheduled buses will be compliant.
- 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 2.1% in the last full week of June 2021.
- Of the chargeable vehicle categories, the percentage of compliant unique vehicles seen in the zone and meeting emission standards (as a 7-day daily average), rose from 33% in the week of the launch to 82% in the last week in June- **an improvement of 49%.** This is despite the overall number of vehicles travelling into the zone increasing each day as pandemic restrictions have eased.
- Traffic flows are 9% lower in the CAZ compared with the same period (April to June) in 2018 (the last year for which the Council has relevant representative data). Average national traffic flows also remain below pre-pandemic levels*
- Average traffic flows in the urban areas outside the zone's boundary, which include Batheaston and Bathampton, are similarly 12% lower than the same period (April to June) in 2018.
- Average traffic flows across the whole of B&NES are 9% lower when compared with the same period (April to June) in 2018.
- Whilst many residents and businesses are upgrading using their own resources or as part of planned replacement programmes, the Council has to date received over 2,000 enquiries about its financial assistance scheme (FAS) which offers local businesses individuals grants and interest-free loans to replace or upgrade non-compliant vehicles regularly driving in the zone.
- To the end of June 2021, owners of 1,003 vehicles have so far 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. 344 vehicles have already been replaced with cleaner, compliant ones, and hundreds more are due to be replaced in the coming months.

*Covid-19 pandemic conditions continue to effect traffic flows and travel behaviours. Further analysis and time will be required to assess the longer-term impact of the pandemic on air quality.

How to use this report

This report presents initial findings and indicative trends on the success of the CAZ, based on the first three months data, including:

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

This report does not attempt to establish whether compliance 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).

That information will be included in the Clean Air Zone Annual Report, published as soon as possible in 2022, and/or in other subsequent quarterly reports later in the year.

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 second quarter (Q2) of 2021, because the scheme launched on 15 March 2021.

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:

- We use data from 2019 to compare air quality monitoring results.
- Air pollution is affected by the seasons, therefore baseline air quality data for this report is from April to June 2019 i.e. the second quarter (Q2).
- We use data from 2018 for comparing traffic flows, because the Council has insufficient data for the year 2019.
- Traffic flows also vary according to the seasons, so we compare current traffic flow data from with data from April to June (Q2) 2018.
- We also compare data from April 2021 (the launch of the zone) until the end of June 2021 (the end of the reporting period),
- We also look at trends from 2017 to end of June 2021.
- This is the first time that provisional air quality data is being published during the reporting year and before it is formally accepted by DEFRA; therefore, fluctuations in the data will be seen before the annual average level is confirmed at the end of the reporting year.

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')

Covid-19 and air quality in 2020

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). However, an annual status report for air quality in 2020 will be published on our website in September: https://www.bathnes.gov.uk/services/environment/pollution/air-quality/reports

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 issue an Annual Status Report

(ASR) in June of each year. This sets out and comments on air quality data from the previous 12 months across the wider area. These can be found at: https://www.bathnes.gov.uk/services/environment/pollution/air-quality/reports

- You can also view an interactive map of historical NO_2 data collected from monitoring locations around the area, here: https://www.bathnes.gov.uk/services/environment/pollution-noise-nuisance/air-quality/air-quality-data-long-term

- We will prepare an additional Clean Air Zone Annual Report that will focus on compliance with the government's directive and results against 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 Clean Air Zone. 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[2].

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[3]. 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

[2] 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

[3] 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

emissions contribute 35 per cent of all UK nitrogen oxide emissions (NO_x) which is the single greatest source[4].

How does air pollution affect our health?

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

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

Air pollution in Bath

In Bath, annual average nitrogen dioxide (NO_2) levels exceed the legal limit of 40 $\mu g/m^3$ 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
- It irritates and inflames the lining of airways – which can worsen asthma and make breathing difficult among those with lung disease (such as bronchitis and emphysema). In Bath, around 12,000 people suffer from asthma
- Research shows that high levels of NO_2 can affect children's lung development and that children who grow up in highly polluted areas are more likely to develop asthma.

[4]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

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 50 key sites with higher levels of pollution where three diffusion tubes are located at each location to improve data confidence.

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

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

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, Bradford, Bristol, Manchester, Liverpool, Sheffield and Rotherham, and Newcastle and Gateshead 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[5]. 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 compliance were a Class D charging clean air zone, charging all higher emission vehicles including cars and motorbikes or a Class C charging clean air zone, charging all higher emission vehicles except private cars and motorbikes but including some additional traffic management.

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.

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

Technical modelling suggested that we could achieve compliance with a Class C CAZ provided we also introduced additional traffic measures at Queen Square to address a particular NO_2 exceedance 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 projects.

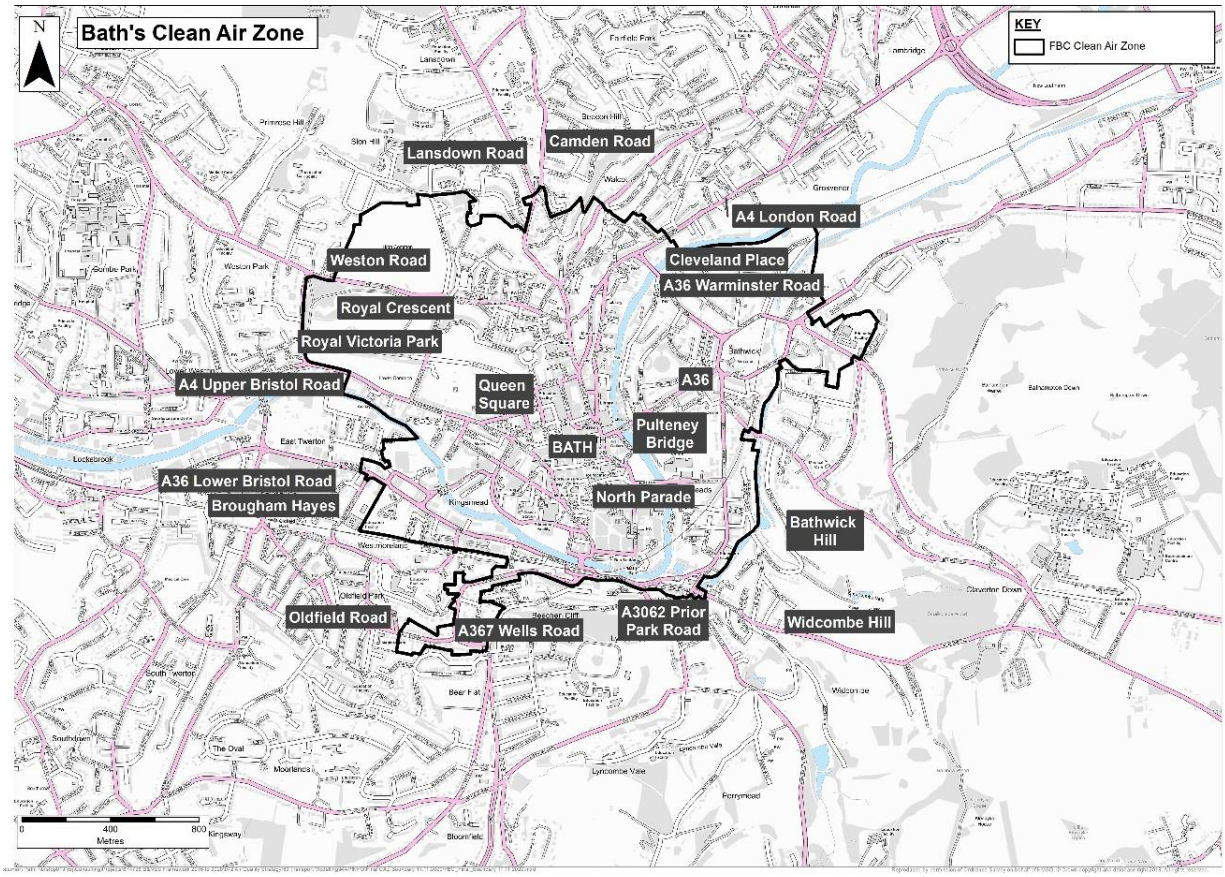
Zone boundary

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 has 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 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)

For more information on the financial assistance scheme and how it works, go to www.bathnes.gov.uk/CAZsupport.

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) is below 40 $\mu g/m^3$. This will require (at least) a full 12 months of data from each individual site and the results will be published in the annual Clean Air Zone Report, to be published as soon as possible in 2022.

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 Appendix 2.

The purpose of this initial quarterly report is to provide an early, indicative view of the first three months performance of Bath's Clean Air Zone (CAZ), looking at three key measures: air quality data, traffic flow data and vehicle compliance data (Table 1). This report also includes data on the financial assistance and bus retrofit schemes because of their influence on fleet compliance.

We will report on further, secondary measures later in the year and/or at the end of the year in the annual report, based on the timeline published Appendix 1.

However, this may be subject to review by the government's Joint Air Quality Unit (JAQU) in view of Covid-19 pandemic conditions which continue to effect traffic flows and travel behaviours.

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[6].

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) is below 40 $\mu g/m^3$. This will require (at least) a full 12 months of data from each individual site and the results will be published in the annual report, to be published as soon as possible in 2022.

We cannot yet determine whether we have achieved compliance with the government's directive, but in the meantime the data presented here gives an indication of the impact of the zone on air quality since launch on 15 March 2021.

This section is split into three sections:
1. How we collect and measure air quality data
2. Air quality data, April to June 2021
3. The impact of the Queen Square traffic management scheme on air quality

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

[6] 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

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 µg/m^3 for PM_{10} and 25 µg/m^3 for $PM_{2.5}$, except at times when there were meteorological or other events that caused spikes in these pollutants, nationally. While we continue to measure it, PM data will not form part of these quarterly or annual reports.

Comparing air quality data inside and outside of the zone

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

To establish the impact of the zone on air quality in surrounding areas, and trends inside and outside of the zone, 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

There are a total of 156 monitoring sites across Bath and North East Somerset, with 65 located in the clean air zone (see Figure 2) and 56 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.

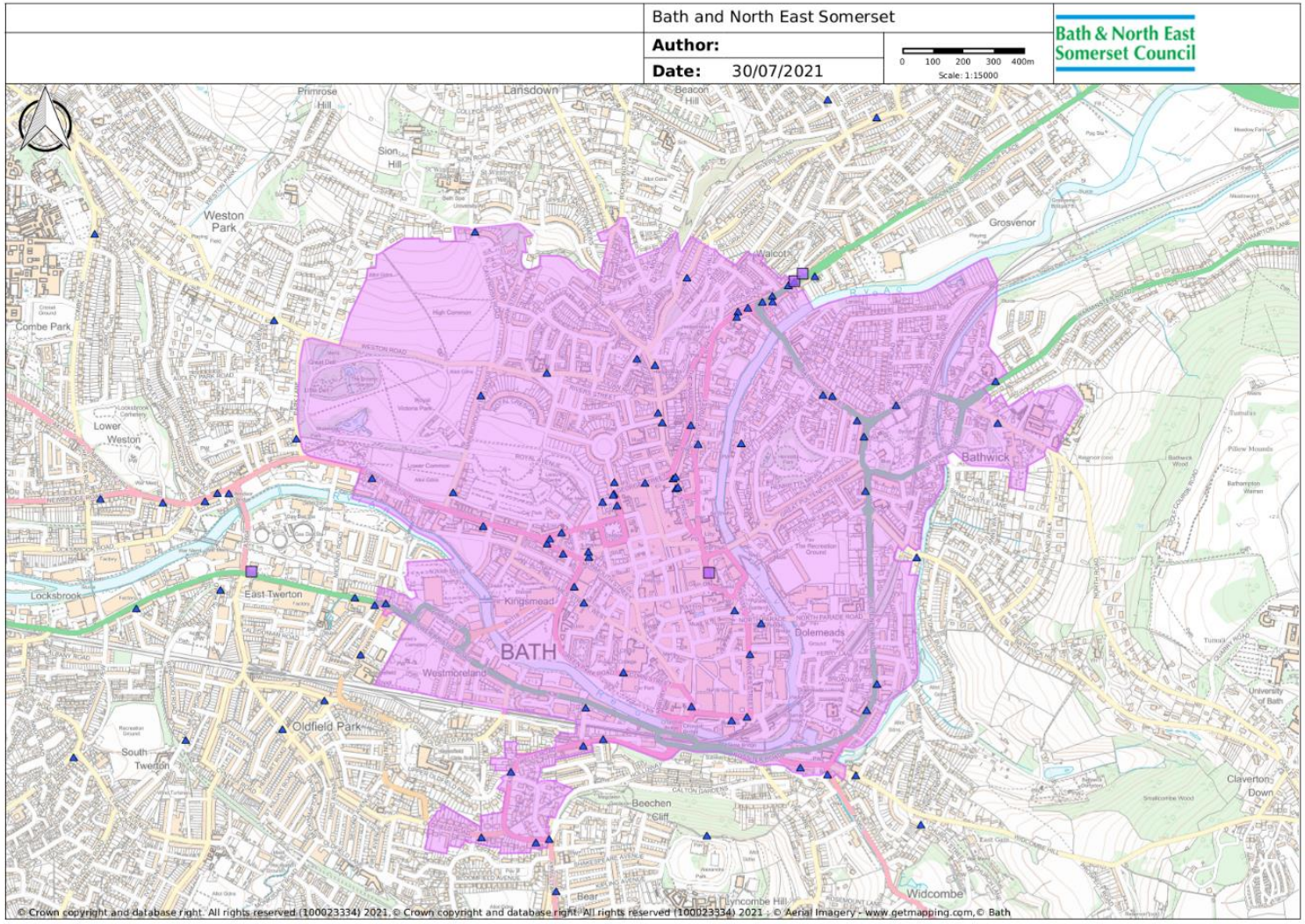
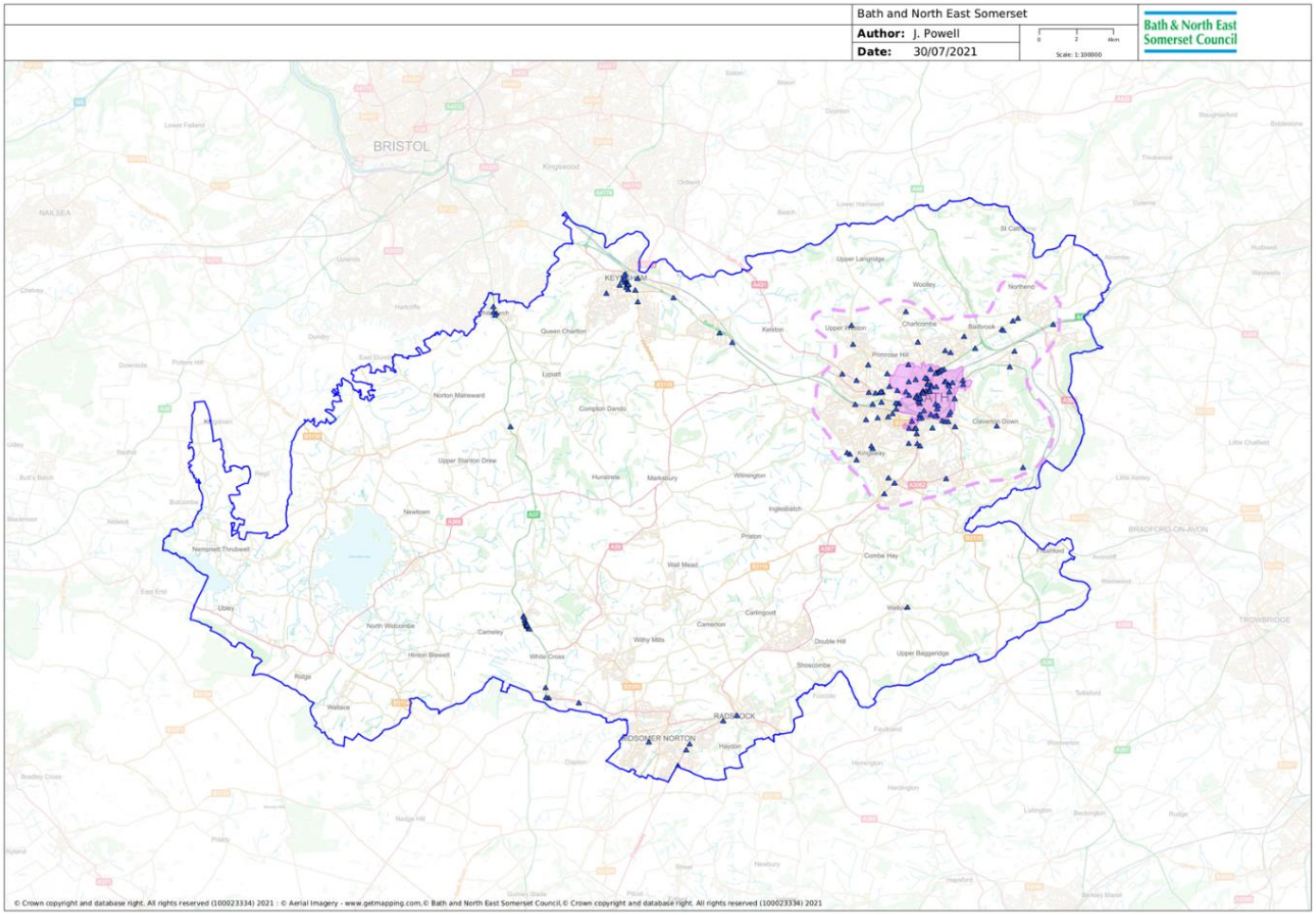


Figure 3 - A map showing diffusion tube locations in three site groupings: The wider area of Bath and North East Somerset (the blue line), the urban area outside of the CAZ (the dotted pink line) and in the CAZ (the pink area). Diffusion tubes in the wider area are not distributed evenly. The majority are located within Farrington Gurney, Keynsham, Midsomer Norton and Radstock area and Temple Cloud. © Crown Copyright 2021. License number 100023334.



Numbers of diffusion tube sites in each location

Table 2, below shows how the number of diffusion tube sites has increased across the area since 2017. Additional diffusion tube 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.

Table 2- The total number of diffusion tube sites (triplicate sites are recorded as one site) added over time in the various site groupings.

Site Groupings	CAZ_Only	CAZ_Boundary	Wider_B&NES
Number of sites reporting at the start of the year (triplicates considered as one site)	Diffusion tube locations within the CAZ	Diffusion tube locations outside the CAZ but within Bath, including Bathampton and Batheaston	Diffusion tube locations within B&NES but outside of the CAZ, Bath, Bathampton and Batheaston
2017	18	11	27
2018	30	26	29
2019	38	48	30
2020	65	56	36
2021	65	56	35

Unless otherwise stated, air quality data shown in this report comes from averaging monthly diffusion tube results.

In general, we report the average NO_2 concentrations from all the monitoring sites in use at the time within the specified area, unless otherwise stated.

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.

This is also why we compare air quality data against similar time periods, for example comparing data for the second quarter (April to June) of 2021 with the second quarter (April to June) of 2019.

Further information on air quality monitoring can be found in the ‘Monitoring Explained’ section at the end of this report.

Air quality data results

To identify emerging trends, we present NO_2 data for the first three months of the clean air zone's operation which is the second quarter of the year (April to June 2021). We compare it with baseline data from the second 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 data has been discounted as a baseline because of Covid-19's unprecedented effect on traffic and travel behaviour.

Table and figures included in this section:

- Tables 3 to 5: Sites within the CAZ and Bath urban area that recorded greater than 40 µg/m^3, 36 µg/m^3 or recorded an increase in NO_2 concentration when compared to 2019 Q2
- Table 6: The number of sites that recorded greater than 40 µg/m^3, 36 µg/m^3 and their proportion within the total number of monitoring sites at the time
- Figure 4: Trends in monthly average NO_2 concentrations in B&NES since 2017
- Table 7: Quarterly average levels of NO_2 from Q2 2019 to Q2 2021 grouped by locations inside and outside the zone
- Figure 5: Quarterly change in average NO_2 concentrations compared with 2019 Q2.
- Figure 6: Trends in NO_2 roadside increment (Rinc) in B&NES since 2017

Tables 3 to 6 below focus on locations in the city (inside and outside the zone) with NO_2 levels above 36 µg/m^3, or where NO_2 pollution has increased compared to levels recorded in our baseline year, 2019.

All other areas across the city have quarterly average levels of below 36 µg/m^3 or have falling levels of NO_2 and are therefore excluded from the tables.

To meet the government's directive at the end of 2021, annual average levels of NO_2 at every monitoring site in Bath needs to be below 40 µg/m^3 but we cannot determine whether we have achieved compliance until after the end of the year.

Table 3- Quarterly average NO_2 concentrations in 2021 Q2 compared with 2019 Q2 at locations in the clean air zone, where average NO_2 concentrations were greater than 40 µg/m^3 during 2021 Q2. TA= triplicate average site.

Site ID	Site	Site Grouping	2019 Q2 NO_2 concentration (µg/m^3)	2021 Q2 NO_2 concentration (µg/m^3)	Change
DT020 (TA)	Wells Road	CAZ_Only	44.0	46.7	2.7
DT042	Dorchester St	CAZ_Only	50.6	43.5	-7.1
DT060	Victoria Buildings	CAZ_Only	44.7	44.4	-0.3
DT090 (TA)	Anglo Terrace	CAZ_Only	56.3	41.8	-14.5
DT198 (TA)	Walcot Parade	CAZ_Only	53.5	45.0	-8.5
DT222 (TA)	Anglo Terrace façade	CAZ_Only	Monitor added August 2019	46.0	-
DT224 (TA)	Walcot Parade 2	CAZ_Only	Monitor added August 2019	50.2	-
DT235 (TA)	Wells Road 4	CAZ_Only	Monitor added August 2019	42.1	-

Table 4- Quarterly average NO_2 concentrations in 2021 Q2 compared with 2019 Q2 at locations in the clean air zone and outside the boundary but within in the urban areas of Bath, where average NO_2 concentrations were greater than 36 µg/m^3 but lower than 40 µg/m^3 during 2021 Q2. TA= triplicate average site.

Site ID	Site	Site Grouping	2019 Q2 NO_2 concentration (µg/m^3)	2021 Q2 NO_2 concentration (µg/m^3)	Change
DT043	St. James Parade	CAZ_Only	41.1	36.7	-4.4
DT172 (TA)	London Road 2	CAZ_Only	45.5	36.0	-9.5
DT230 (TA)	Upper Bristol Road 4	CAZ_Boundary	Monitor added August 2019	38.9	-
DT234 (TA)	Gay Street 2	CAZ_Only	Monitor added August 2019	39.4	-
DT248 (TA)	Chapel Row 2	CAZ_Only	Monitor added August 2019	36.2	-

Table 5- Quarterly average NO_2 concentrations in 2021 Q2 compared with 2019 Q2 at locations in the clean air zone and outside the boundary but within in the urban areas of Bath, where average NO_2 concentrations increased. TA= triplicate average site.

Site ID	Site	Site Grouping	2019 Q2 NO_2 concentration ($\mu g/m^3$)	2021 Q2 NO_2 concentration ($\mu g/m^3$)	Change
DT020 (TA)	Wells Road	CAZ_Only	44.0	46.7	2.7
DT193	Granville Road	CAZ_Boundary	8.7	10.0	1.3

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 2021 Q2 and 2019 Q2. 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.

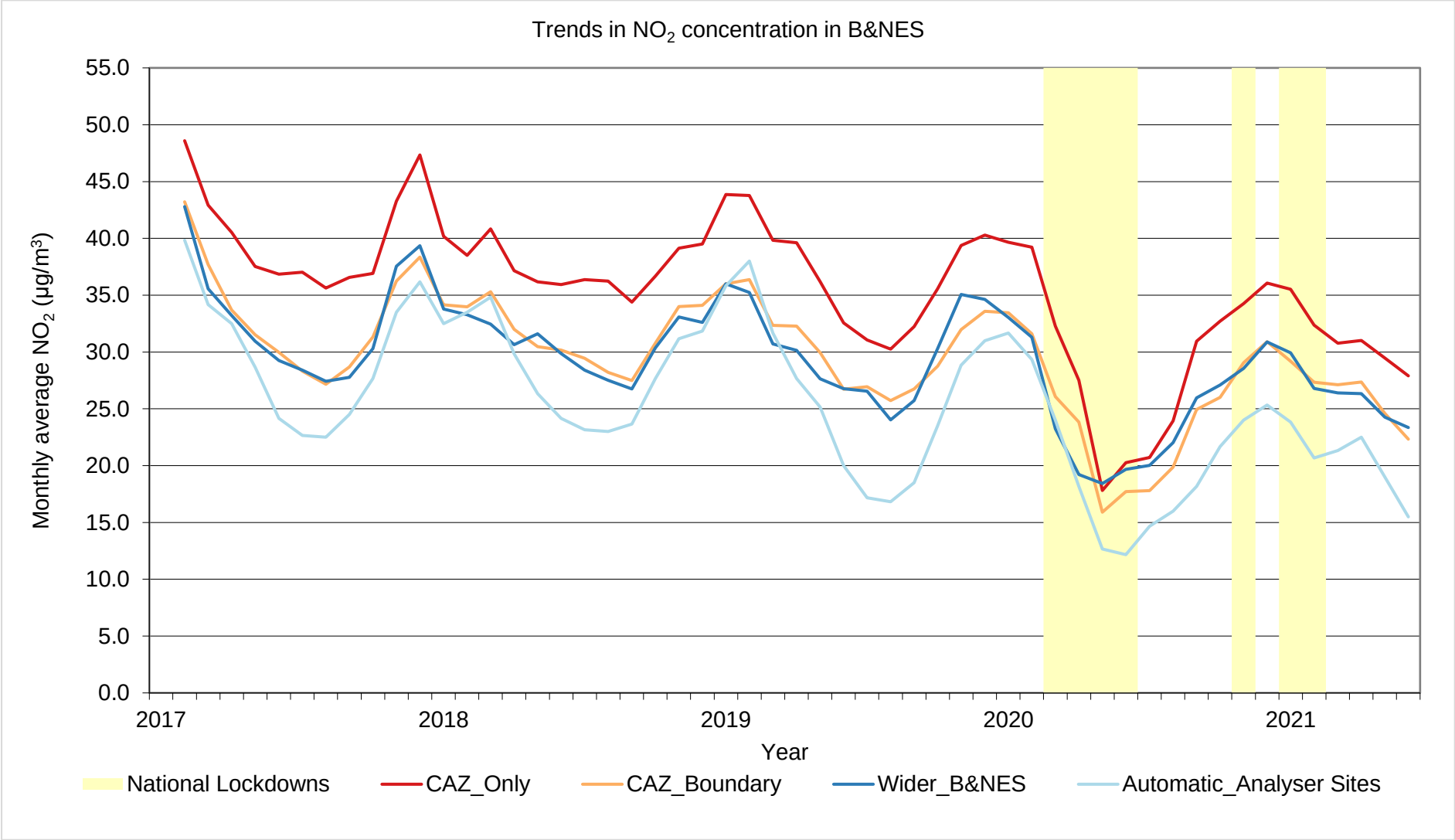
CAZ_Only	**Total no. sites reporting**	**No. sites >40 µg/m^3 average**	**Proportion sites >40 µg/m^3 (%)**	**No. sites >36 µg/m^3**	**Proportion sites >36 µg/m^3 (%)**
2019 Q2	44	9	20	11	25
2021 Q2	64	8	13	12	19
Change	20	-1	-7	1	-6
CAZ_Boundary	**Total no. sites reporting**	**No. sites >40 µg/m^3 average**	**Proportion sites >40 µg/m^3 (%)**	**No. sites >36 µg/m^3**	**Proportion sites >36 µg/m^3 (%)**
2019 Q2	49	2	4	4	8
2021 Q2	56	0	0	1	2
Change	7	-2	-4	-3	-6
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 Q2	93	11	12	15	16
2021 Q2	120	8	7	13	11
Change	27	-3	-5	-2	-5

N.B. It should be noted that new sites were added for a variety of reasons including in response to requests and model predictions and verification

Comments and key findings:

- This data for each quarter has been averaged across every site in the location group. Dozens of monitoring locations have been added since 2019 Q2 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 model predictions and verification.
- Average concentrations for NO_2 during Q2 at Walcot Parade are 50 µg/m^3. This area is being closely monitored.
- Wells Road is the only site which recorded a quarterly average greater than 40 µg/m^3 where average levels have risen. This area is also being closely monitored. The only other site that has greater levels of NO_2 compared with the same quarter in 2019 is Granville Road, but the levels here are low at 10.0 µg/m^3 (2 µg/m^3 higher than recorded in 2019 Q2).
- While 8 sites recorded results greater than 40 µg/m^3 in the second quarter of the year, its hoped that continued improvements in vehicle compliance rates will bring about the required reductions by the end of the year.
- However, compared with the same quarter in 2019 overall, three fewer sites in Bath recorded quarterly annual average levels of NO_2 concentrations over 40 µg/m^3 and two fewer sites over 36 µg/m^3.

Figure 4- Monthly average NO_2 concentrations in B&NES from 2017 to 2021 separated into the three site groupings, as well as the average of the automatic analyser sites in Bath.



Comments and key findings:

- Monthly average readings were taken from 54 long-term monitoring diffusion tube sites (18 within the CAZ_Only, 12 in the CAZ_Boundary outside of the CAZ but within the Bath urban area, and 24 in the Wider_B&NES grouping) and three automatic analysers at Chelsea House, the Guildhall and Windsor Bridge in Bath.
- The original monitoring sites that were in place in 2017 have been compared (72 additional monitoring sites have been added across B&NES since 2017 which are not included).
- There is a general downward trend with average monthly NO_2 concentrations falling since 2017. This is likely due to the natural replacement of older, more polluting vehicles with cleaner, compliant ones (clean air zones seek to accelerate natural replacement rates to rapidly improve fleet compliance).
- Despite this general downward trend, there are several individual sites where quarterly average levels of NO_2 are greater than 40 µg/m^3 (see Table 3 for details). To comply with the government's directive, by the end of the year, annual average levels of NO_2 at all sites in Bath must be below 40 µg/m^3.
- A marked decrease in mid-2020 is due to significantly less traffic on the roads because of Covid-19 restrictions.
- There is a clear seasonal trend in the data, with increased NO_2 concentrations in the winter. 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 (NO_2 is broken down by sunlight).

Table 7- Quarterly average NO_2 concentrations from 2019 Q2 to 2021 Q2 in the three site groupings. The results are from the total number of diffusion tube monitoring sites recording during that period.

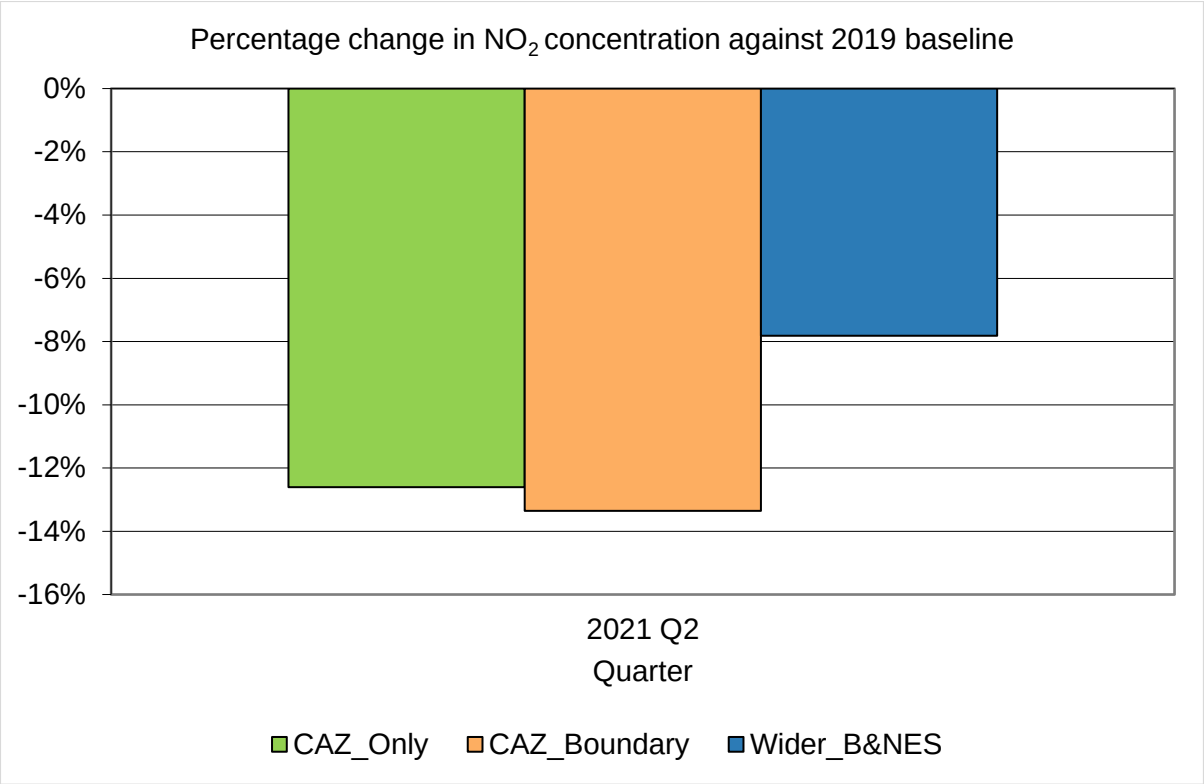
Period	CAZ_Only NO_2 ($\mu g/m^3$)	CAZ_Boundary NO_2 ($\mu g/m^3$)	Wider_B&NES NO_2 ($\mu g/m^3$)
2019 Q2	31.3	24.5	28.9
2019 Q3	31.0	23.1	26.5
2019 Q4	37.2	30.7	33.4
2020 Q1	34.0	26.5	27.1
2020 Q2	19.1	15.7	22.4
2020 Q3	24.8	20.1	26.3
2020 Q4	33.9	27.3	30.6
2021 Q1	30.7	24.6	28.4
2021 Q2	27.3	21.3	26.6
Reduction 2019 Q2 – 2021 Q2 ($\mu g/m^3$)	-3.9	-3.3	-2.3
Reduction 2019 Q2 – 2021 Q2 (per cent)	-12.6%	-13.4%	-7.8%

* Quarters affected by Covid-19 are highlighted orange.

Comments and key findings:

- The data for each quarter has been averaged across every site in the location group. Dozens of monitoring locations have been added since 2019 Q2 across B&NES. See Table 2 for details. In this instance, we have not omitted stations that have been added since 2019.
- Quarterly average levels of NO_2 within the CAZ have fallen by 3.9 $\mu g/m^3$ since 2017 (a 13% reduction). This is almost double the 2.3 $\mu g/m^3$ reduction seen in the wider region outside of Bath (8%).
- Sites outside of the zone but in the city of Bath reduced by 3.3 $\mu g/m^3$ which equates to a 13% reduction, very similar to sites within the CAZ.
- This is likely due to the natural replacement of older, more polluting vehicles with cleaner, compliant ones.
- Clean air zones seek to improve natural replacement rates to rapidly improve fleet compliance, so it's anticipated that we will see further air quality improvements.
- Significant reductions in NO_2 seen in 2020 are likely as a result of Covid-19 restrictions reducing traffic.
- Despite the quarterly average NO_2 concentration being below 40 $\mu g/m^3$, there are still individual sites in Bath & North East Somerset that recorded a result greater than the limit of 40 $\mu g/m^3$ as a quarterly average.

Figure 5- Quarterly change in average NO_2 concentrations compared with 2019 Q2.



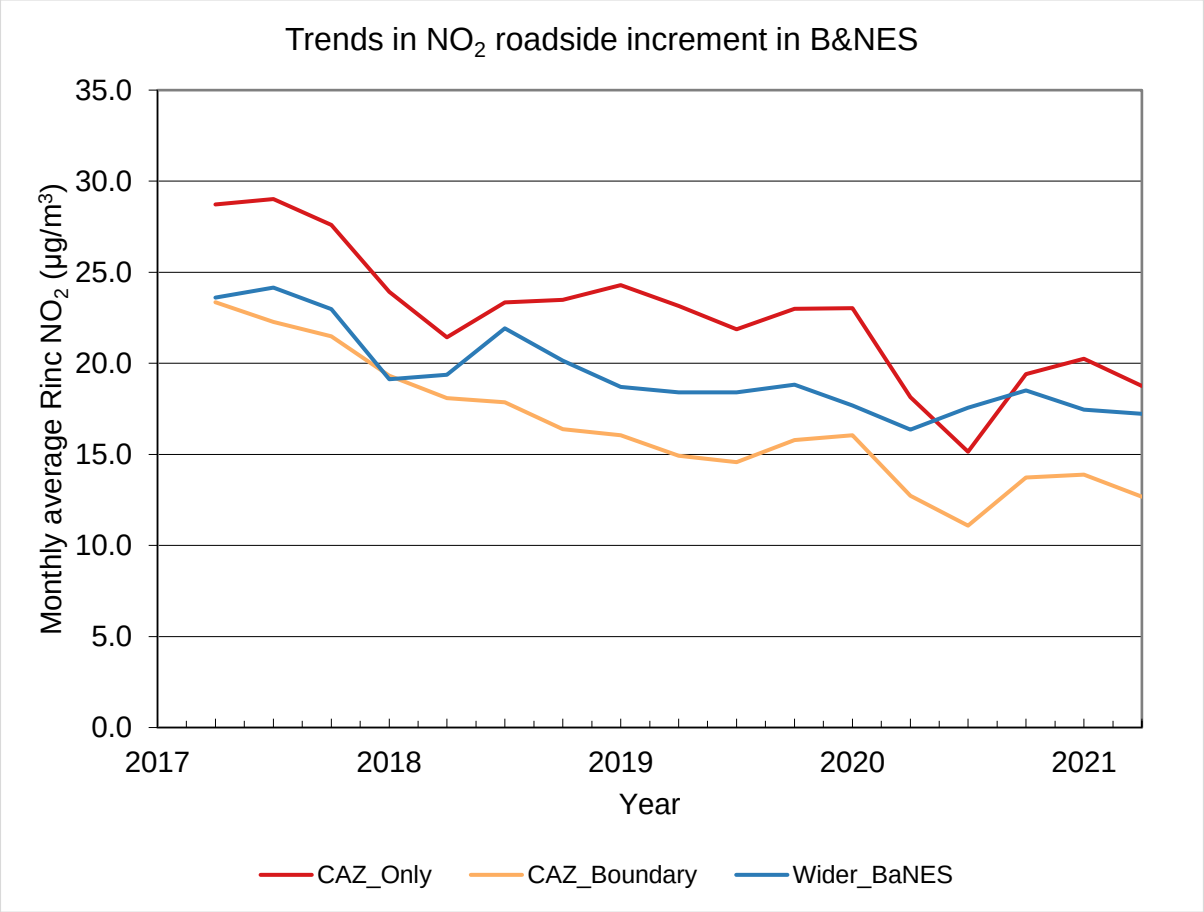
Comments and key findings:

- Sites outside of the clean air zone, but within the urban areas of Bath show a 13.4% reduction in average quarterly levels of NO_2 compared with the same quarter (April to June) in 2019.
- It appears that levels of NO_2 outside of the CAZ boundary are decreasing at a similar rate to levels within the CAZ. This is important because of concerns expressed by the public that air quality would worsen in areas surrounding the CAZ as a result of traffic avoiding the zone – despite covering a small central area the CAZ was designed to improve air quality across Bath and this data demonstrates that this is the case.
- Sites within the CAZ show a 12.6% reduction in average quarterly NO_2 levels, compared with the same period in our baseline year, 2019.
- The wider area experienced the smallest improvement in NO_2 levels (7.8%), and there are Air Quality Management Areas in Keynsham, Saltford, Temple Cloud and Farrington Gurney where some monitoring sites exceed 40 $\mu g/m^3$. These areas are outside the scope of this report. Find out more at: www.bathnes.gov.uk/services/environment/pollution/air-quality.
- This data includes all diffusion tube locations averaged during each quarter and for both years.
- Covid-19 is likely to have contributed to reductions in NO_2 concentrations. Pre-Covid statistics show that rural areas traditionally have higher rates of home

working at around 32% compared with urban areas at around 13%[7]. Home working has increased significantly among urban dwellers during the pandemic.

- The reduction is also likely to be due to the natural replacement of older, more polluting vehicles with cleaner, compliant ones.
- Clean air zones seek to improve natural replacement rates to rapidly improve fleet compliance, so it's anticipated that we see further air quality improvements.
- Significant reductions in NO_2 seen in 2020 are likely because of Covid-19 restrictions reducing traffic.

Figure 6- Trends in NO_2 roadside increment (Rinc) in B&NES since 2017.



Comments and key findings:

- The roadside increment (Rinc) is useful as it demonstrates the proportion of NO_2 pollution from road traffic sources, as opposed to other sources e.g., gas boilers. It is found by subtracting the urban background NO_2 concentration from the monthly average roadside NO_2 levels.

[7] 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

- Urban background sites are positioned away from roads to avoid the localised pollution from road traffic. In Bath, the urban background location is at Alexandra Park.
- Rinc enables you to calculate what proportion of NO_2 pollution comes from vehicles on local roads, thereby giving a representative measurement of background air pollution over several square kilometres.
- In accordance with the natural fleet upgrades and the impact of Covid 19, the proportion of roadside NO_2 has decreased over time.

The impact of the Queen Square traffic management on air quality

During the development of the Full Business Case, modelling demonstrated that a Class C charging CAZ would fail to meet compliance on Gay Street, which is situated between Queen Square and George Street in Bath.

To make a Class C charging CAZ feasible (which was the preference of the public), a temporary traffic management scheme was developed to moderate traffic flow through the square to help limit air pollution and address the NO_2 exceedance on Gay Street.

How the traffic scheme works

The overall aim of the scheme, which comprises new temporary traffic signals at Chapel Row and Charlotte Street, is to moderate the flow of traffic through the square and deter drivers from using this route through so that the pollution is dispersed and NO_2 limits are not exceeded in any location surrounding the square.

The scheme includes an innovative system linking an air quality monitor with the traffic signals to regulate the traffic flows through the square in response to live NO_2 monitoring. This is designed to limit queues on Gay Street where there is an exceedance of NO_2 limits. Public realm improvements were also installed, including additional pedestrian crossings designed to support walking and prioritise cycling.

The recent restriction of traffic to just buses in Milsom Street between the hours of 10 am to 6pm is also serving to reduce queues in the Gay Street and George Street areas.

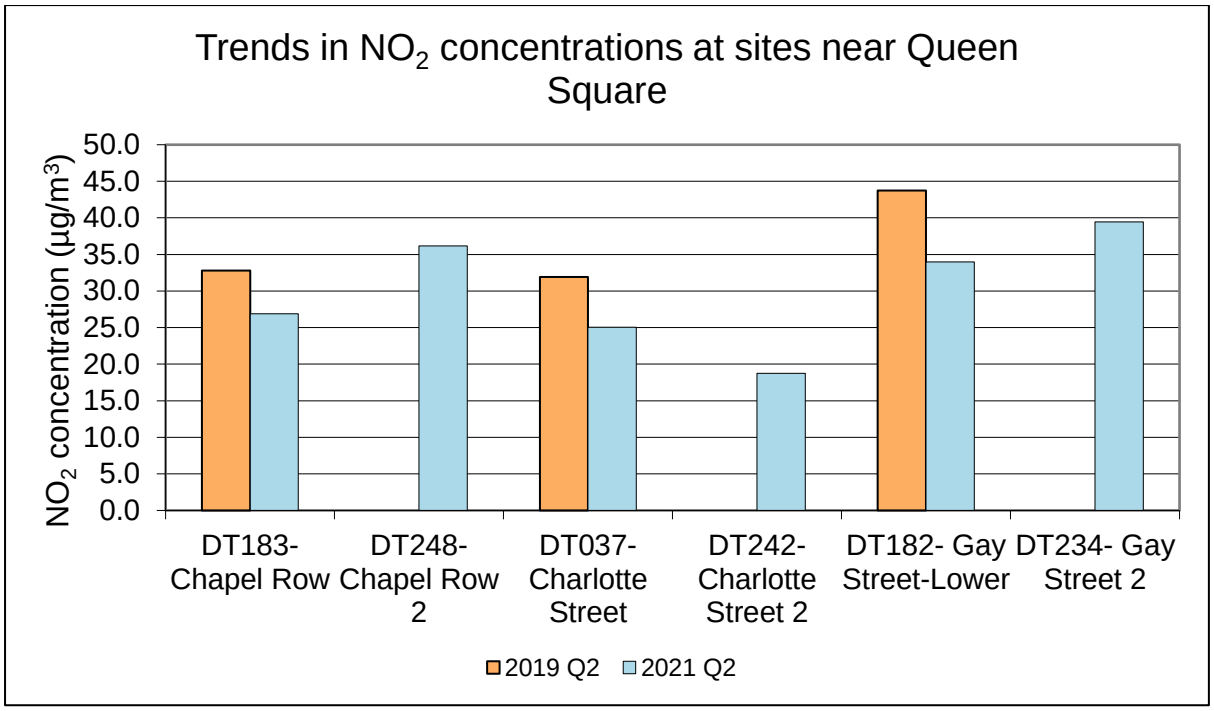
Potential traffic displacement

It was predicted that some areas surrounding Queen Square may see a rise in traffic or queuing due to traffic displacement. We are closely monitoring both traffic and air quality in these areas.

Monitoring and evaluation

Figure 7 shows the quarterly average NO_2 concentrations around Queen Square for 2021 Q2 compared against our baseline (2019 Q2).

Figure 7- Average NO_2 concentrations at Queen Square for 2021 Q2.



Comments and key findings:

- Three new monitors were added in preparation for the launch of the zone, so data for 2019 is not available for Gay Street 2, Chapel Row 2 and Charlotte Street 2.
- All quarterly average concentrations of NO_2 are below 40 µg/m^3.
- Compared to 2019 Q2, all quarterly average concentrations in 2021 have reduced.
- Whilst currently below 40 µg/m^3, NO_2 levels at Gay Street 2 remains a concern and will continue to be closely monitored.

The following sections investigate two major factors affecting air pollution: traffic flows and vehicle compliance rates.

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 it's important to monitor any changes in traffic flow in and around the zone and on the highway network around the city. This data will help us understand whether there are any changes in traffic flow that may negatively impact air quality and/or road safety as a result of introducing the zone.

This section is split into three:
1. How we measure any changes in traffic flow
2. Traffic flow data 2021 Q2
3. How we are investigating possible traffic displacement

How we measure any changes in traffic flow

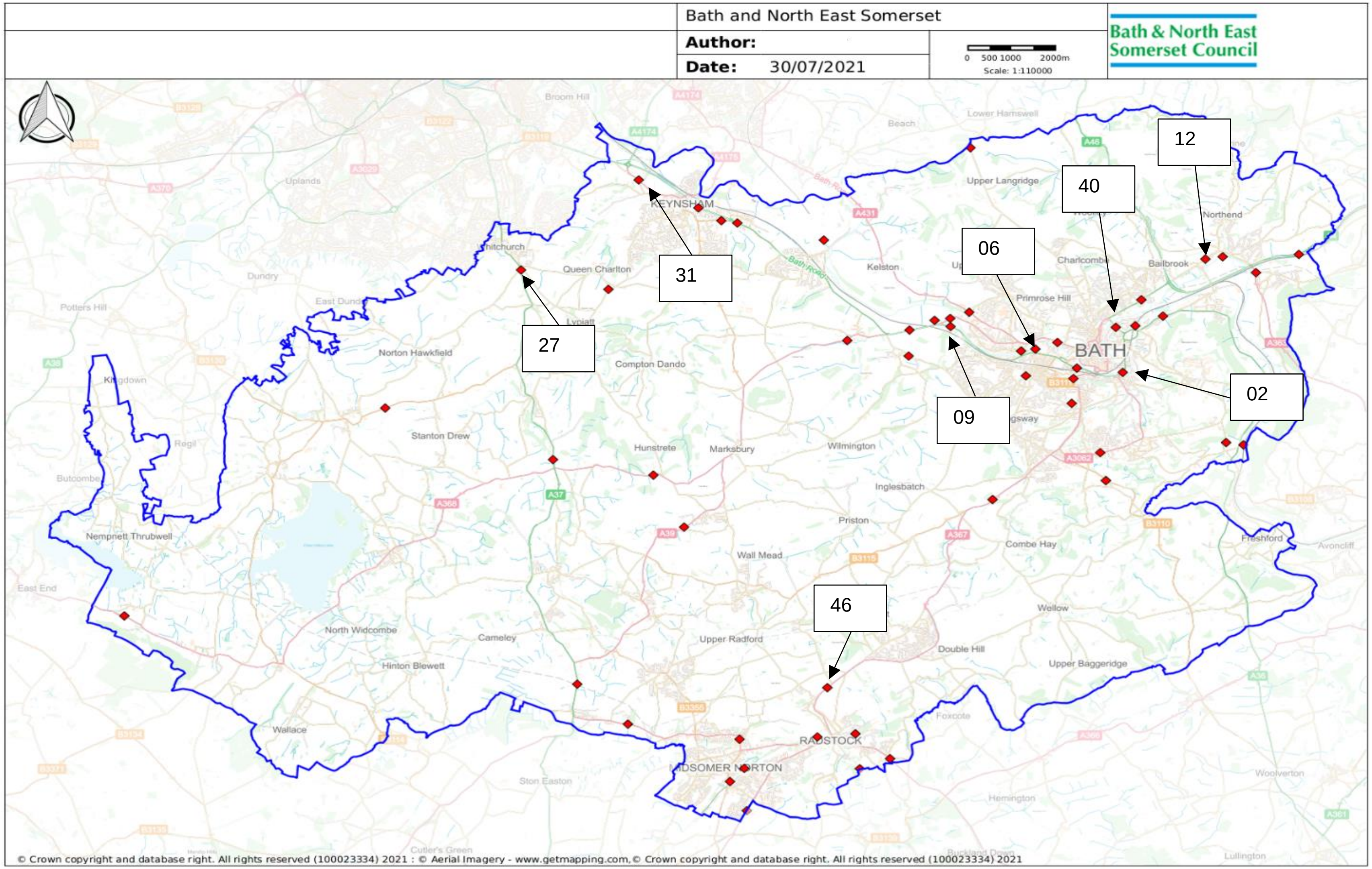
We monitor traffic flows i.e., where traffic is going and the volume of traffic on particular routes, using manual classified counts (MTC), automated traffic counts (ATC) and automatic number plate recognition (ANPR) cameras.

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, will be reported quarterly.

To understand the impact of the zone on any changes to traffic flows, we will compare 2021 Q2 data with a similar time frame before the zone was introduced in 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. Also, 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 therefore the majority of vehicles have no need to avoid the zone or seek alternative routes. By the end of June 2021, of the approximately 4,000 buses, coaches, HGV's, LGV's, taxis and PHVs entering the zone, only 18% percent are still required to pay zone charges (not including nationally or locally exempt vehicles). Our traffic counts will record any traffic movement, regardless of the type of vehicle or the compliance of that vehicle.

Figure 8 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. These permanent ATCs have been selected as they were in use prior to the introduction of the CAZ and are therefore able to be used for comparison purposes. Only two ATCs within the CAZ have data from 2018. We used three sites from outside the CAZ in both other site groupings because more data was available. Other monitoring methods such as temporary ANPR cameras will be used to monitor areas of perceived concern as per Appendix 2.



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Norton Hawkfield
Compton Dando
Stanton Drew
Hunstrete
Marksbury
Wilmington
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Priston
Wall Mead
Combe Hay
Freshford
Nempnett Thrubwell
North Widcombe
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Figure 8- ATC locations (red diamonds) used for traffic flow analysis. The number refers to the site ID which can be found in Table 8.

Table 8- ATC locations from Figure 8, along with their site category.

Site ID	Location	Site Category
02	A36 Pulteney Road, South of Archway Street	CAZ_Only
06	A3064 Windsor Bridge Road, North of Stable Yard	CAZ_Boundary
09	A36 Lower Bristol Road, East of A4 Newbridge	CAZ_Boundary
12	High Street Batheaston, East of Victoria Gardens	CAZ_Boundary
27	A37 Bristol Road Whitchurch, South of Norton Lane	Wider_B&NES
31	A4175 Durley Hill, West of Durley Lane	Wider_B&NES
40	A36 Bathwick Street, South of St Johns Road	CAZ_Only
46	A367 Bath New Road, North of Clandown	Wider_B&NES

Traffic flow data results

The data from ATCs can be used to compare traffic flows so that trends can be considered over time.

Table 9- Two-way traffic flow data for ATCs inside and outside the CAZ in 2018 (the last year with representative data), 2020, 2021.

Year / Month		5-Day Average			7-Day Average		
		CAZ_Only	CAZ_Boundary	Wider_B&NES	CAZ_Only	CAZ_Boundary	Wider_B&NES
2018	April	17274	12642	17638	16610	11673	16437
	May	17771	12625	17176	17041	11714	16124
	June	18504	12911	16535	17669	11978	15520
2020	April	6169	4854	6636	5480	4329	5900
	May	9157	6599	10049	8450	6050	9134
	June	13028	8778	12648	12243	8180	11888
2021	April	16501	10845	14933	15576	10047	14096
	May	16019	11520	15398	15537	10714	14699
	June	15884	11375	16094	15587	10522	15259

Table 10- Percentage change in average monthly traffic flows from 2018 to 2021. The bottom row shows the average change for the entire quarter (April-June), 2018 Q2 to 2021 Q2.

	5-Day Average			7-Day Average		
	CAZ_Only	CAZ_Boundary	Wider_B&NES	CAZ_Only	CAZ_Boundary	Wider_B&NES
April	-4.5%	-14.2%	-15.3%	-6.2%	-13.9%	-14.2%
May	-9.9%	-8.7%	-10.4%	-8.8%	-8.5%	-8.8%
June	-14.2%	-11.9%	-2.7%	-11.8%	-12.2%	-1.7%
2018 Q2-2021 Q2 average	-9.5%	-11.6%	-9.5%	-8.9%	-11.5%	-8.3%

Comments and key findings:

- Traffic flows are being monitored to understand any changes in the CAZ, in the urban area of Bath outside the CAZ, and in the wider Council area, as presented in Figure 7 (a map of the ATC locations), Tables 8 (a description of the ATC locations from which we analysed data), Table 9 (the data on vehicle numbers passing the selected ATCs in 2018, 2020 and 2021, and Table 10 (change in traffic flow between 2018 Q2 and 2021 Q2).
- General traffic flows (i.e. both compliant and non-compliant traffic) across an **average five-day week** were down by 9.5% inside the CAZ, 11.6% in the urban area of the city outside the CAZ, and by 9.5% in the wider area, compared with the same quarter in 2018.
- General traffic flows across an **average 7-day week** were down by 8.9% in the CAZ, 11.5% in the urban area outside of the CAZ, and 8.3% in the wider B&NES area, compared with the same quarter in 2018.
- This is an average decrease in traffic of 9.9% across all site groupings for the quarter compared with 2018.
- Traffic flows fell dramatically in 2020 but are now slowly rising. However, we are not seeing the same level of traffic in 2021 as we saw in 2018 (in any area), and this is likely due to Covid-19 and the changes to social and working behaviour and changes in business models due to pandemic restrictions.
- Importantly, in general, levels of traffic outside of the zone's boundary in Bath has not increased because of the zone, when compared with a similar period in 2018

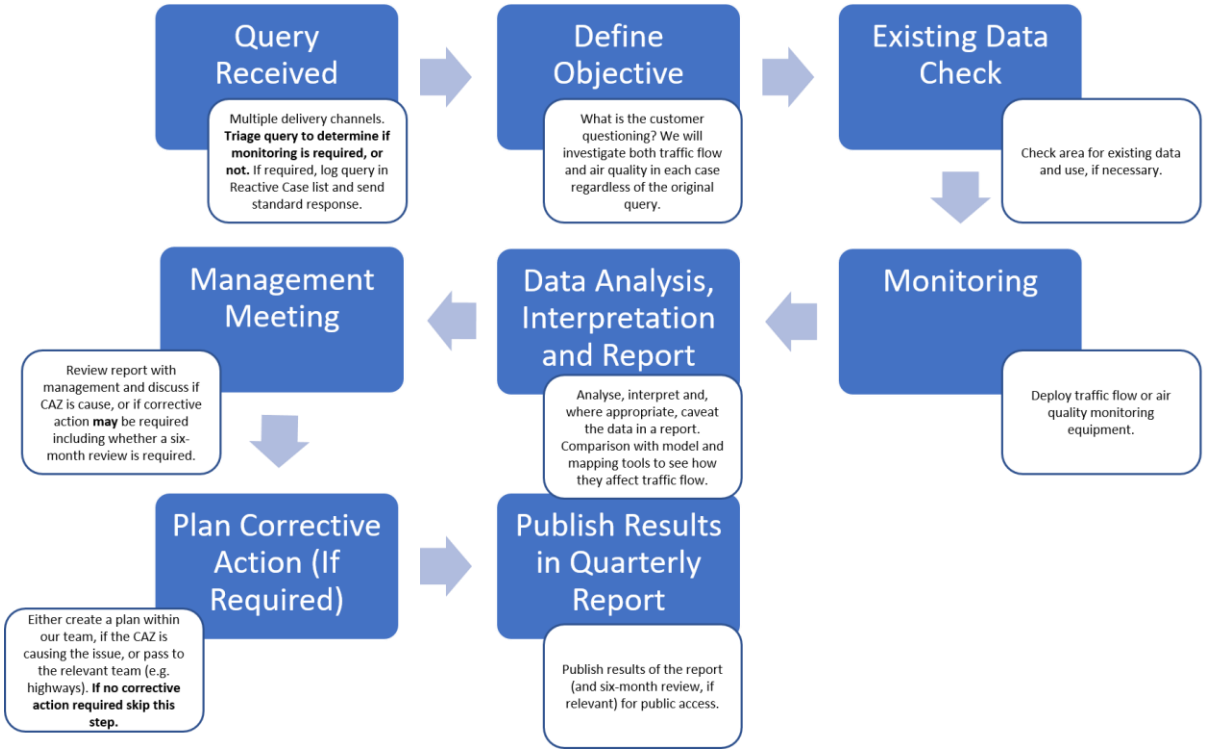
Specific concerns about traffic displacement

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. While traffic flows have been substantially impacted by the Covid-19 restrictions with lower morning peaks and higher interpeak flows, they are still to return to pre-pandemic levels. Bearing this current situation in mind, we are actively investigating 15 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 since the end of July are set out in Appendix 2.

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 9 shows the process we have put into place when following up these queries.

Figure 9- A process map showing the details of the traffic displacement process followed when a query is received.



Comments on concerns 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. At the beginning of 2021, there were much lower levels of traffic, particularly cars, although the increase of online sales requiring deliveries has increased to a record 35% of all retail spend[8], which could account for at least a percentage of the greater visibility and presence of LGVs and HGVs in local communities. As lockdown restrictions have been lifted and businesses returned to normal operation, numbers of commercial vehicles have increased beyond pre-pandemic levels.
- In this context, it is unsurprising that reports of increased numbers of commercial vehicles have been received and people are understandably concerned that the reason for these changes is the CAZ, as it was introduced as pandemic restrictions were being lifted.
- Concerns relating to Charlcombe Lane, Colliers Lane, Upper Camden Place and Southdown Road have been investigated and have shown no discernible increase in traffic at the time of monitoring. We will keep these under review.

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

- Initial traffic monitoring has identified some small potential increases in the volumes of commercial vehicles (either HGV's or LGV's) relating to Shophouse Road and Whiteway Road. Small increases were predicted at these locations in the traffic modelling forecasts in the Full Business Case. However, further investigation is being undertaken to understand the vehicle compliance rates in these locations using temporary ANPR cameras.
- The initial monitoring for Brook Road/West Avenue/Lyndhurst Road/Bellotts Road indicated that there was a potential significant increase in larger vehicles in this location. This could be associated with local shop deliveries re-routing and is being investigated using temporary ANPR cameras to understand vehicle compliance splits and whether the increase in traffic is drivers of non-compliant vehicles avoiding the zone.
- The initial monitoring for Lansdown Lane identified a small potential increase in the volume of LGV's and this is being investigated further using temporary ANPR cameras to understand vehicle compliance rates and the split between through traffic and commercial vehicles visiting local addresses in Weston.
- Concerns relating Penn Hill Road, Prior Park Road, Rosemount Lane, Sham Castle Lane and Old Newbridge Hill, have been investigated and monitoring and analysis is currently being completed.
- Concerns relating to Twerton High Street (air quality only) are being monitored in August 2021.
- Concerns relating to Englishcombe Lane are awaiting monitoring which is planned for September 2021.

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.

This section is split into two:
1. How we measure fleet compliance in Bath
2. Vehicle compliance data for Bath's CAZ

How we measure fleet compliance in Bath

We measure changes in fleet composition using data gathered from 68 automatic number plate recognition 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. See: Appendix 2.

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. We will include data from our additional temporary monitors in future quarterly reports.

Vehicle compliance data for Bath's CAZ

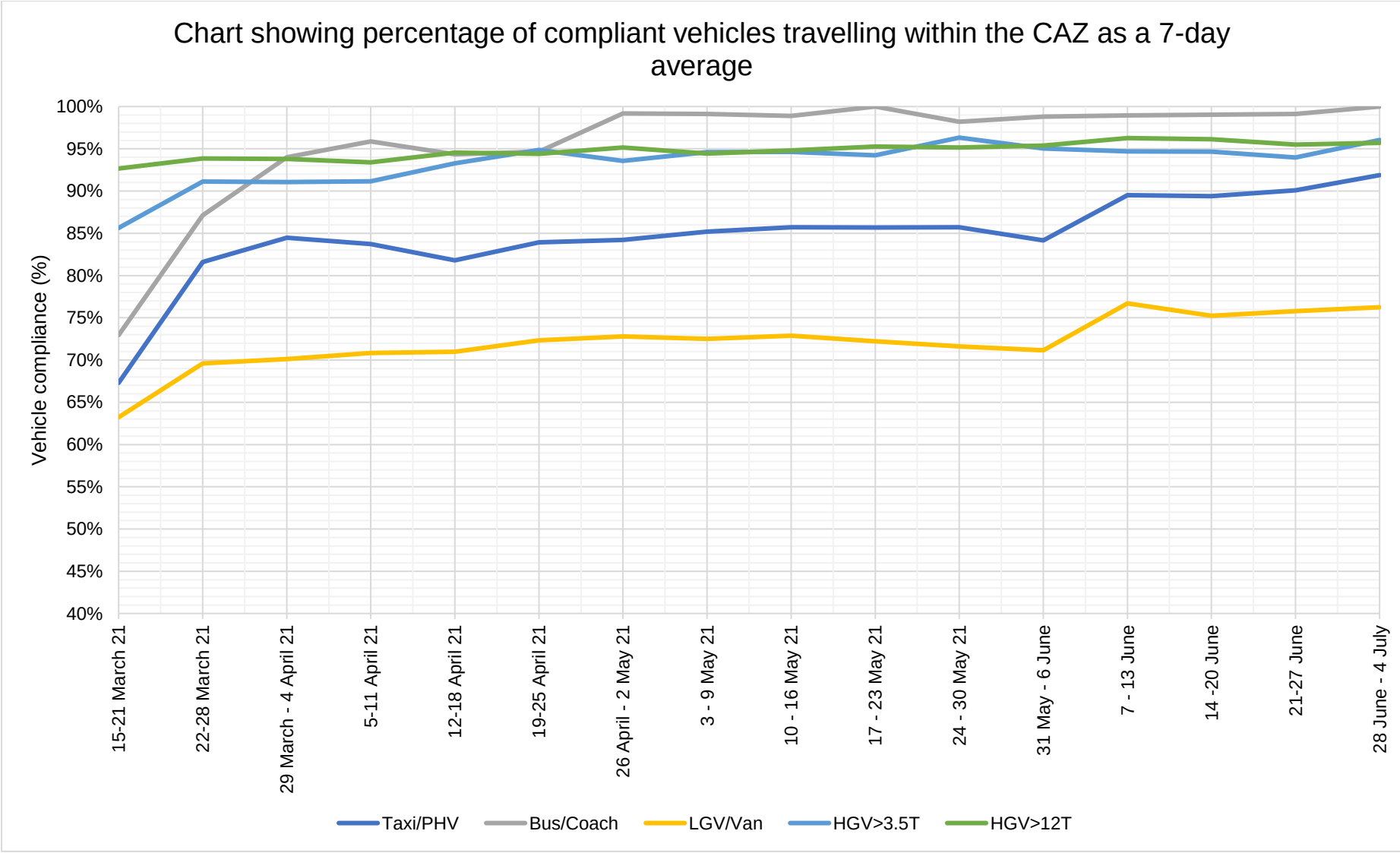
Figure 10 below shows the percentage of compliant vehicles travelling within the CAZ as a 7-day average.

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.
- Of the chargeable vehicle categories, the percentage of compliant unique vehicles as a 7-day daily average seen in the zone and meeting emission standards rose from 33% in the week of launch to 82% in the last week in June- a rise of 49%. At the same time, the total number of unique vehicles seen in the zone increased from around 32,000 at the start of the zone to around 40,000 at the end of June, as Covid-restrictions lifted.
- Bus/coach compliance rose sharply after the launch of the zone and continues to improve, with high rates of compliance (reaching 100% compliance in the last week of June).
- HGV (>12 tonne) compliance was already high at 93% at launch, rising to 96% by the end of June.

- HGV (>3.5 tonne) compliance was already high at 86% at launch, rising to 96% by the end of June.
- Taxi compliance has risen from 67% to 92% since the zone was launched
- LGVs/vans had a compliance rate at 63% rising to 76% by the end of June, showing good progress with the help of the financial assistance scheme. This is despite global shortages in semi-conductors and microchips which is impacting vehicle production.
- At launch there were 1,571 unique non-compliant vans seen in the zone as a 7-day daily average. By the end of June this has reduced to 741 unique non-compliant vans, however LGV/vans comprises 94% of total non-compliant unique vehicles at the end of the reporting period.
- Rates of compliance are anticipated to continue to improve in the next quarter.
- Compliance has been encouraged and supported through the government-funded bus retrofit and financial assistance scheme, outlined below, in addition to drivers upgrading outside of the scheme.

Figure 10- Chart showing percentage of compliant vehicles travelling within the CAZ as a 7-day average.



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 VI) 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 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 2021 (three months after the launch of the zone), 74 out of a total of 87 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.
- Overall compliance for buses is close to 100% and the majority of the final retrofits are scheduled for completion by the end of August 2021.

Financial assistance scheme

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 June, were eligible to be replaced and the number of vehicles replaced to date. The Council expects to help replace up to 1,500 non-compliant vehicles regularly travelling in the zone by the end of 2021.

Table 11: Vehicles eligible for the financial assistance scheme and the number of vehicles already replaced

Vehicle category	No. vehicles eligible for FAS funding to upgrade or retrofit	No. vehicles upgraded
M1 (taxis or private hire vehicles as private passenger cars are compliant)	110	71
M2 (minibus) and M3 (bus/ coach)	25	6
N1 (LGV <=3.5T)	848	260
N2 and N3 (HGVs)	20	7
Total	**1003**	**344**

Comments:

- The Council's financial assistance scheme is on track to replace around 1,500 non-compliant vehicles with cleaner compliant ones by the end of 2021.
- By the end of June 2021, 1,003 vehicles have passed basic eligibility tests, and 344 vehicles have already been replaced.
- 260 non-compliant vans regularly travelling in the zone and 71 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, 20 HGVs regularly travelling into Bath have been approved for finance.

- 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.
- To date, only 11% of all those who passed eligibility tests have failed financial checks with the Council's finance providers. These businesses/individuals have been offered exemptions in the zone for up to 2 years and are able to reapply when their finance recovers. Full details of the scheme are at www.bathnes.gov.uk/CAZsupport
- At the end of June, approx. £1.7 million had been spent upgrading and retrofitting vehicles via the financial assistance scheme.

Conclusions

The Council is committed to reporting on the impact of the CAZ on air quality, traffic flow and vehicle compliance on a quarterly basis so that we can monitor progress towards our target. This target is to reduce NO_2 concentrations to within the annual mean limit of 40 µg/m^3 by the end of 2021 at all individual monitoring locations in Bath.

This report has set out related data and key findings from the first three months of operation of the CAZ, and, as highlighted in our Executive Summary, the emerging trends are encouraging.

Air quality

We are heartened to note that average nitrogen dioxide (NO_2) concentrations within the CAZ for Q2 2021 are 12.6% lower than the same period in 2019 (Q2), representing a reduction of 4 µg/m^3. Similar levels of reduction are being seen in the surrounding urban areas of Bath, including Batheaston and Bathampton.

We also note, however, that despite this general improvement, quarterly average concentrations of NO_2 at eight monitoring sites still recorded over 40 µg/m^3 and we will continue to monitor these sites closely. To put this in context, however, compared with baseline data for 2019 Q2 overall, three fewer sites in Bath recorded NO_2 concentrations over 40 µg/m^3 and two fewer sites over 36 µg/m^3, indicating progress towards our target.

Vehicle compliance

The aim of the zone is to improve the emission standards of vehicles driving in Bath. We note that of the chargeable vehicle categories, the percentage of compliant unique vehicles as a 7-day daily average seen in the zone and meeting emission standards rose from 33% in the week of launch to 82% in the last week in June- a rise of 49%. This is despite the overall number of vehicles travelling in the zone increasing each week as lockdown eased.

90% of all taxis now entering the zone are compliant, compared with 67% prior to the zone's launch. And at the end of June 2021, 74 out of 87 non-compliant public buses on scheduled routes in Bath have now been upgraded to meet standards. Apart from 3, all the city's scheduled bus fleet (226 buses) should be compliant by the end of August 2021.

To support the natural replacement of vehicles that happens as a result of a charging CAZ, the Council is on course to support the replacement of 1,500 non-compliant vehicles (regularly travelling in the zone) by the end of the year. So far, 334 vehicles have been replaced, including 260 vans. 1,003 vehicles have passed the Council's

eligibility tests, so hundreds more vehicles are due to be replaced in the coming months.

Traffic flow

Traffic flows are 9% lower in the CAZ compared with the same period in 2018 and average national traffic flows remain below pre-pandemic levels. 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 similar period in 2018.

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 and are still to return to pre-pandemic levels, we are investigating a number of locations where the public have expressed concerns over a perceived increase in traffic in their communities since the launch of the CAZ. These are outlined in Appendix 2.

Next steps

As we move in to the third quarter we will continue to review and monitor air quality, traffic flows and vehicle compliance rates with a view to publishing our second quarterly report (effectively for 2021 Q3) later in the Autumn.

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 that you are exposed to, the bigger the risk and the 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; and people with lung conditions such as asthma, chronic obstructive pulmonary disease (COPD) and lung cancer, and people with heart conditions such as coronary artery disease, heart failure and high blood pressure.

We'd therefore 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 8. 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.