Bath Clean Air Zone
Quarterly Monitoring Report
July - September 2021

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 around 600 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 July to September 2021 (Quarter 3). 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 will be included in the Clean Air Zone Annual Report to be released in 2022.

Due to Covid-19 having an unprecedented impact on travel behaviour in 2020, baseline data from the last representative year (2017-2019) 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 third quarter of the year (July to September), referred to as Q3.

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

- 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 14 per cent lower than the same period in 2019 (Q3), representing a reduction of -4.1 µg/m^3. This is the average reading from a total of 35 monitoring sites within the CAZ that recorded full quarterly data from July to September in both 2019 and 2021.

  (Note: This is in the context of national traffic levels in this quarter returning to pre-pandemic levels with usage of LGV's and HGV's exceeding pre-pandemic levels (Department of Transport).

- Compared with the same quarter in 2019, six fewer locations in Bath are now recording quarterly annual average levels of NO_2 concentrations over 40 µg/m^3 and twelve fewer locations are recording over 36 µg/m^3.

- Similar levels of NO_2 reduction were found in the Bath urban areas outside the zone's boundary, including Batheaston and Bathampton, averaging a 9 per cent reduction, or -1.9 µg/m^3, from a total of 41 CAZ_Boundary monitoring sites that recorded full quarterly data from July to September in both 2019 and 2021.

- Acknowledging this general improvement, quarterly average concentrations of NO_2 at nine monitoring sites still record results greater than 40 µg/m^3. The average change between these nine sites was 0.7 µg/m^3 or a 1.6 per cent increase.

- Of the nine sites which recorded an average NO_2 concentration greater than 40 µg/m^3 during the current quarter, four sites (Gay Street Lower, Walcot Parade 2, Gay Street 2 and Upper Bristol Road 4) recorded lower average NO_2 concentrations. One site (Dorchester Street) remained the same. The four remaining sites (Wells Road, Victoria Buildings, Broad Street 4 and Chapel Row 2) recorded an increase in NO_2 concentration.

- Some of these sites are located on, or impacted by, diversion routes for the Cleveland Bridge closure. We are monitoring at these locations and it is anticipated that these concentrations will stabilise once the bridge reopens to most traffic.

- Of the four sites recording a quarterly average greater than 40 µg/m^3 and with an increase in NO_2 concentration when compared to the baseline quarter (2019 Q3), Wells Road increased by 1.3 µg/m^3 to 48.2 µg/m^3 (an increase of 3%), Victoria Buildings increased by 3.2 µg/m^3 to 44.2 µg/m^3 (an increase of 8%), Broad Street 4 increased by 6.9 µg/m^3 to 43.1 µg/m^3 (an increase of 19%), Chapel Row 2 increased by 9.0 to 48.9 µg/m^3 (an increase of 23%).

- Of the five sites which recorded an average NO_2 concentration greater than 40 µg/m^3 and with a reduction or stable change in NO_2 concentration when compared to 2019 Q3, Dorchester Street remained stable at 47.0 µg/m^3, Gay Street

Lower decreased by 1.6 µg/m^3 to 41.6 µg/m^3 (a decrease of 4%), Walcot Parade 2 decreased by 10.4 µg/m^3 to 45.5 µg/m^3 (a decrease of 19%), Gay Street 2 decreased by 0.7 to 42.7 µg/m^3 (a decrease of 2%) and Upper Bristol Road 4 decreased by 1.5 µg/m^3 to 41.2 µg/m^3 (a decrease of 4%).

- It is important to remember these results are quarterly and so do not determine whether the scheme is successful. 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 later in this report. Data may be missing for multiple reasons including damaged diffusion tubes or invalid results.

- Our primary focus now is monitoring the traffic and air quality in locations with high quarterly NO_2 concentrations and researching what additional action is required to tackle these problem areas and any upward trends in NO_2 concentration. Diversions, roadworks and an ongoing reluctance of residents/visitors to the city to use public transport due to high levels of Covid-19 in the area, may be contributing to the situation.

- This report refers to the quarter of July to September, during which Cleveland Bridge has been closed for the entirety of the period (since 28th June 2021).

- 91% of all taxis travelling in the zone are now compliant, whereas only 67% of taxis were compliant prior to the launch of the zone. By the end of September 2021, 82 higher polluting taxis have been replaced with cleaner, compliant ones with support from the Financial Assistance Scheme.

- Out of a total fleet of 226 scheduled buses, 87 were non-compliant when the bus retrofit programme started. By the end of September, 84 had been successfully retrofitted to meet CAZ emission standards with financial support from the government. Three vehicles are awaiting a retrofit solution which is now in development.

- An average of 40,358 individual vehicles were seen in the zone each day during the quarter, which is comparable to the 40,799-daily average for 2021 Q2.

- Many vehicles recorded in the zone are private cars, with an average of 29,485 unique private cars seen in the zone each day during 2021 Q3. This equates to 72% of all unique vehicles in the CAZ.

- An average of 709 non-compliant vehicles (including all non-compliant vehicle classes) were seen in the zone each day, during 2021 Q3 compared to 1742 during the launch week in March, a decrease of 59%.

- 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 1.7% between July and September.

- Traffic flows within Bath and the CAZ have not been representative during July-September 2021 due to some major roadworks and diversionary routes.

- 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).

- Average traffic flows within the CAZ have probably returned to around pre-pandemic levels, however the closure of Cleveland Bridge has impacted traffic flows around Bath. The two sites for which we have both baseline and current data show a 12% decrease in traffic when compared to the baseline, but we do not believe this sample (which is the only like-for-like comparison available for this quarter, due to the temporary nature of some traffic counters) to be representative of the overall quarterly traffic flows. See the section 'Traffic flow data results' for more information.

- Average traffic flows in the urban areas outside the zone's boundary, which include Batheaston and Bathampton, were 2% lower than the baseline.

- Average traffic flows across the Wider B&NES region were 1% lower than the baseline.

- 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 2,500 enquiries about its financial assistance scheme (FAS) which offers local businesses and individuals grants and interest-free loans to replace or upgrade non-compliant vehicles regularly driving in the zone.

- To the end of September 2021, owners of 1,495 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.

- 591 vehicles have already been replaced with cleaner, compliant ones, and hundreds more are due to be replaced in the coming months. As a result, the number of chargeable, non-compliant vehicles seen in the zone has fallen.

*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 provides an update and indicative view of the CAZ's performance during July to September 2021 (Quarter 3). 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 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 third quarter (Q3) of 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:

- All 2021 air quality data is provisional until the release of the annual CAZ report in 2022.
- 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 July to September 2019 i.e. the third quarter (Q3)
- 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 July to September (Q3) 2017/18.
- We also compare data from March 2021 (the launch of the zone) until the end of September 2021 (the end of the reporting period).
- We also look at longer-term trends from 2017 to end of June 2021.

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 July – September 2021

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.

- July began unsettled with cool and wet weather but became dry and warm by mid-month with hot temperatures and lots of sunshine. The mean temperature was above the 1981-2010 long-term average.
- August was mostly cool and unsettled to begin with, while the second half of the month was drier and calmer. Temperatures were around average for the month and sunshine levels were below average.
- September was largely settled and warm, with a higher-than-average mean temperature for the month.

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

Air quality data in this report is provisional and has not been adjusted to take account of weather conditions – a process known as de-weathering. This process is used to remove the impact of weather variations from trends so that 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.

Diversionary routes have been affecting traffic flows, and therefore air quality around the city. We are monitoring several areas that are experiencing abnormal conditions due to the bridge closure. Once the bridge has fully re-opened in 2022, we will continue to monitor these locations to assess the situation. Find more information 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. In mid-September 2021, light goods vehicles increased to 112% of their pre-pandemic levels whilst heavy goods vehicles increased to 110% and cars reduced to 97%, respectively (Department for Transport statistics)[1].

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

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

- 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 success 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 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[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 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
- 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 (launching on 29 November 2021), 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.

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

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 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.

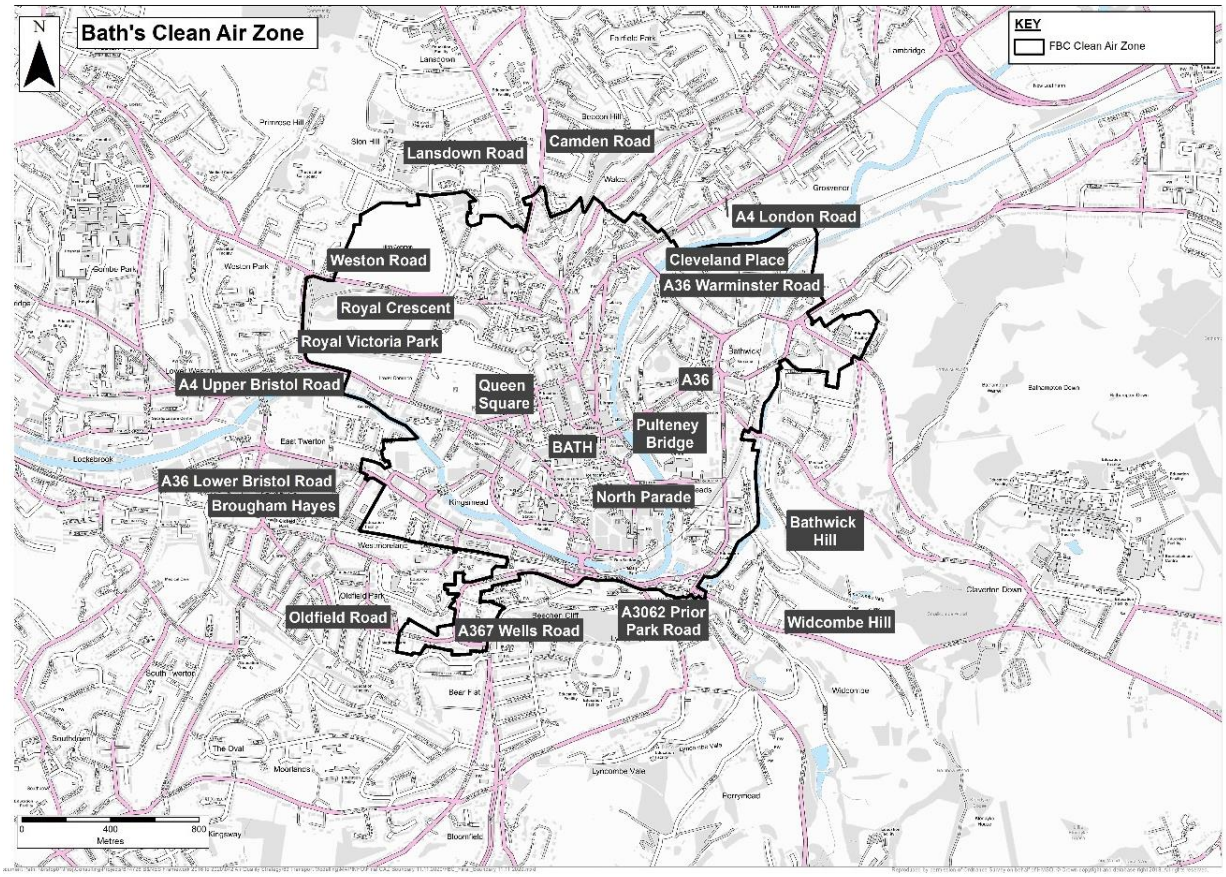
Revenue from charges and fines is used to pay for the running of the scheme. Any money made over and above this must be reinvested in sustainable transport projects.

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 financial assistance scheme is now closed to new applicants with all available funds allocated. The Bus retrofit scheme is largely complete, with three outstanding retrofits delayed due to the need to develop a specific retrofit solution for the vehicles.

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 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 our quarterly reports is to provide an indicative view of the zone's performance across its first year of operation, 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.

We will report on further, secondary measures later in the annual CAZ report, to be released in 2022 and 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. It will also be reviewed in the context of the emerging roadmap on 'achieving success' which is the process being introduced by JAQU in which the Council will need to initially demonstrate success at all monitoring sites, before maintaining this success for at least a further 2 years. At this point, it will be considered that the necessary behaviour change will have become embedded

enough to ensure that, even if the measures were removed, nitrogen dioxide concentrations are likely to remain below air quality objective threshold limits.

The Council is aware that the World Health Organisation (WHO) has recently published ambitious guidelines for nitrogen dioxide and particulates which are much lower than the current objective threshold limits. A central government consultation will be taking place in 2022 on how these guidelines will be enshrined into UK legislation, which will inform future thinking on how the Council will continue to achieve and maintain success with the Ministerial Direction.

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) does not exceed 40 $\mu g/m^3$. This will require 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 success 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 two main sections:
1. How we collect and measure air quality data
2. Provisional air quality data, July to September 2021

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. Whilst 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

As of 2021 Q3 there are a total of 162 monitoring sites across Bath and North East Somerset, with 65 located in the clean air zone (see Figure 2) and 57 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.

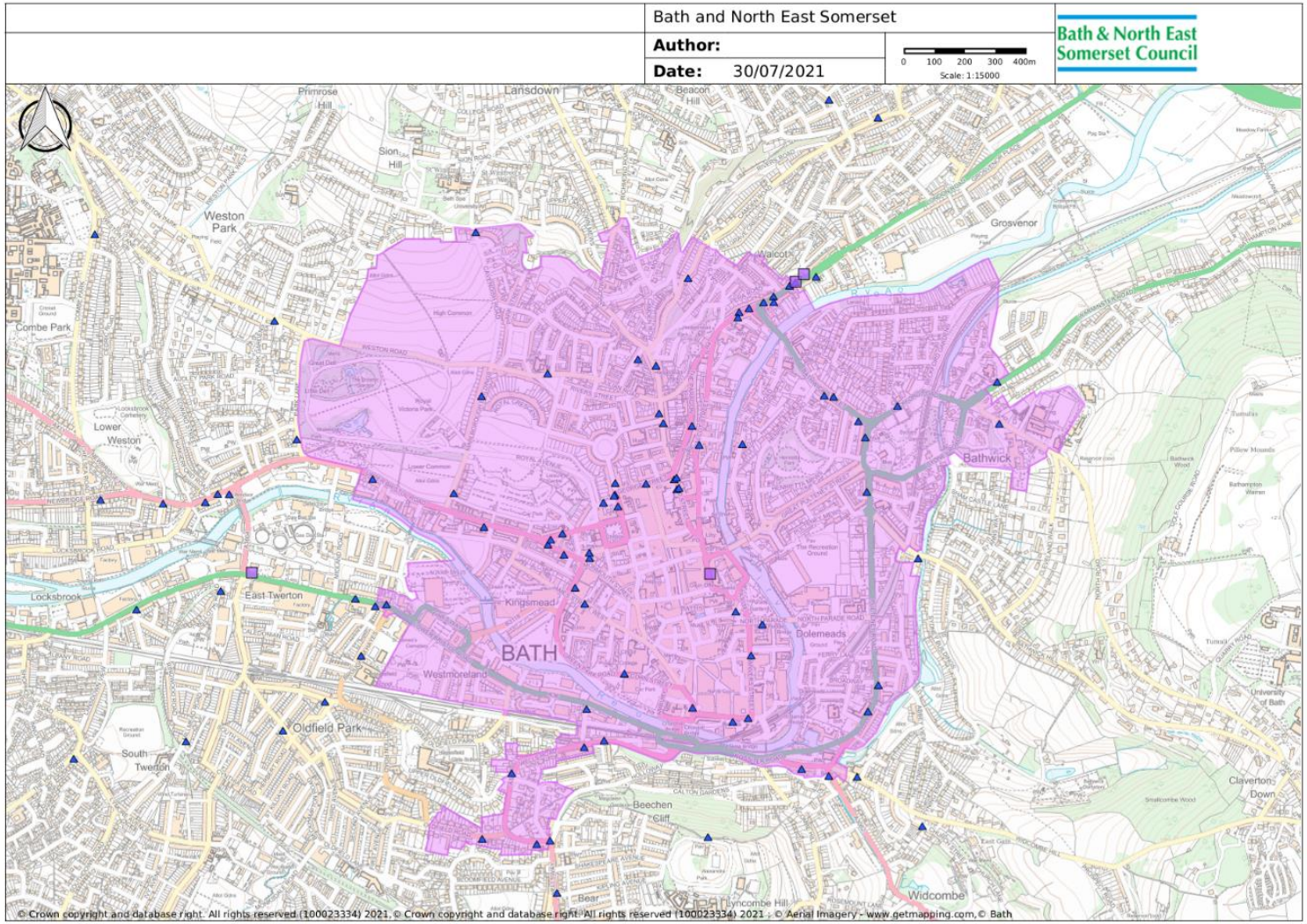
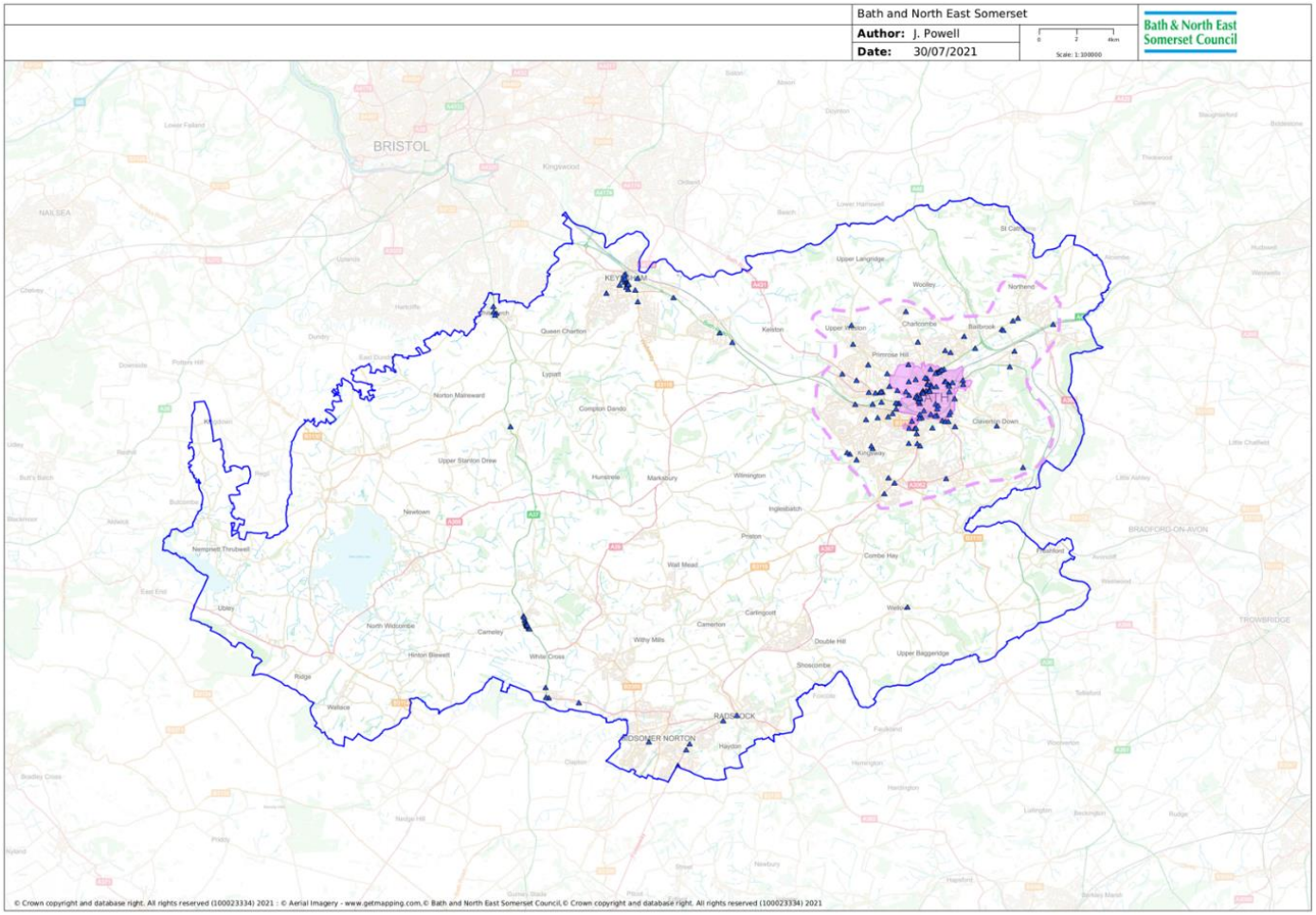


Figure 3 - A map showing diffusion tube locations in three site groupings: The wider area of Bath and North East Somerset (the blue line), the urban area outside of the CAZ (the dotted pink line) and in the CAZ (the pink area). Diffusion tubes in the wider area are not distributed evenly. The majority 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 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 Q3 to 2021 Q3 in the three site groupings. This is the total number of sites and will not reflect the number of sites reporting full quarterly data. Data may be missing for multiple reasons including damaged diffusion tubes or those recording invalid results.

Period	CAZ_Only	CAZ_Boundary	Wider_B&NES
2019 Q3	65	55	29
2019 Q4	65	56	29
2020 Q1	65	56	33
2020 Q2	65	56	34
2020 Q3	65	56	34
2020 Q4	65	56	34
2021 Q1	65	56	36
2021 Q2	65	56	40
2021 Q3	65	57	40

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

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 third quarter (July to September) of 2021 with the third quarter (July to September) 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 provisional NO_2 data for the three months of July to September 2021, or 2021 Quarter 3. We compare it with baseline data from the third 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 (CAZ_Only) and Bath's wider urban area (CAZ_Boundary) that provisionally recorded greater than 40 µg/m^3, 36 µg/m^3 or recorded an increase in NO_2 concentration when compared to 2019 Q3.
- 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.
- Figure 4: Trends in monthly average NO_2 concentrations in B&NES since 2017.
- Table 7: Provisional quarterly average NO_2 concentration in 2019 Q3 and 2021 Q3 grouped by locations inside and outside the zone.
- Figure 5: Provisional quarterly change in average NO_2 concentrations compared with 2019 Q3.
- Figure 6: Trends in NO_2 roadside increment (Rinc) in B&NES since 2017.
- Table 8: Updated provisional quarterly average NO_2 concentration in 2019 Q3 and 2021 Q3 grouped by locations inside and outside the zone.

Tables 3 to 6 below focus on locations in the city (inside and outside the zone) with provisional NO_2 levels above 40 µg/m^3 , 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.

Table 3- NO_2 concentrations at locations where the quarterly average exceeded 40 µg/m^3 in 2021 Q3, 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 Q3 NO_2 concentration (µg/m^3)	2021 Q3 NO_2 concentration (µg/m^3)	Change (µg/m^3)	Missing data?	Reason missing
DT020 (TA)	Wells Road	CAZ_Only	46.9	48.2	1.3		
DT042	Dorchester Street	CAZ_Only	47.0	47.0	0.0		
DT060	Victoria Buildings	CAZ_Only	41.0	44.2	3.2	2 months in 2021 Q3	Invalid result
DT182 (TA)	Gay Street Lower	CAZ_Only	43.2	41.6	-1.6		
DT224 (TA)	Walcot Parade 2	CAZ_Only	55.9	45.5	-10.4	1 month in 2019 Q3	Site new in Aug 2019
DT234 (TA)	Gay Street 2	CAZ_Only	43.4	42.7	-0.7	1 month in 2019 Q3	Site new in Aug 2019
DT239 (TA)	Broad Street 4	CAZ_Only	36.2	43.1	6.9	1 month in 2019 Q3	Site new in Aug 2019
DT248 (TA)	Chapel Row 2	CAZ_Only	39.9	48.9	9.0	1 month in 2019 Q3	Site new in Aug 2019
DT230 (TA)	Upper Bristol Road 4	CAZ_Boundary	42.7	41.2	-1.5	1 month in 2019 Q3	Site new in Aug 2019

Table 4- NO_2 concentrations at locations 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 Q3 NO_2 concentration (µg/m^3)	2021 Q3 NO_2 concentration (µg/m^3)	Change (µg/m^3)	Missing data?	Reason missing
DT043	St. James Parade	CAZ_Only	39.9	39.1	-0.8	1 month in 2019 Q3	Invalid result
DT227 (TA)	Wells Road 3	CAZ_Only	40.8	36.7	-4.1	1 month in 2019 Q3	Site new in Aug 2019
DT235 (TA)	Wells Road 4	CAZ_Only	39.6	36.3	-3.3	1 month in 2019 Q3	Site new in Aug 2019
DT237	Broad Street 2	CAZ_Only	32.6	39.9	7.3	1 month in 2019 Q3	Site new in Aug 2019
DT062	Argyle Terrace	CAZ_Boundary	34.7	37.1	2.4		

Table 5- NO_2 concentrations at locations where the quarterly average increased in 2021 Q3 when compared to 2019 Q3, 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 Q3 NO_2 concentration (µg/m^3)	2021 Q3 NO_2 concentration (µg/m^3)	Change (µg/m^3)	Missing data?	Reason missing
DT003	Broad Street	CAZ_Only	34.2	35.1	0.9		
DT004	George Street	CAZ_Only	26.1	28.9	2.8	1 month in 2019 Q3 and 2021 Q3	Invalid results
DT005	Gay Street Top	CAZ_Only	24.6	25.2	0.6		

DT009	Upper Bristol Road	CAZ_Only	24.3	25.8	1.5		
DT020 (TA)	Wells Road	CAZ_Only	46.9	48.2	1.3		
DT060	Victoria Buildings	CAZ_Only	41.0	44.2	3.2	2 months in 2021 Q3	Invalid results
DT157	Charles Street	CAZ_Only	23.4	27.7	4.3	1 month in 2021 Q3	Invalid result
DT158	Paragon 2	CAZ_Only	25.5	28.2	2.7	1 month in 2019 Q3 and 2021 Q3	Invalid results
DT183	Chapel Row	CAZ_Only	26.7	32.0	5.3		
DT213 (TA)	Marlborough Lane	CAZ_Only	19.0	21.3	2.3		
DT215 (TA)	Queen Parade Place	CAZ_Only	15.3	15.5	0.2		
DT216 (TA)	Monmouth Place	CAZ_Only	24.4	24.9	0.5		
DT219	Morford Street	CAZ_Only	17.9	18.2	0.3		
DT237	Broad Street 2	CAZ_Only	32.6	39.9	7.3	1 month in 2019 Q3	Site new in Aug 2019
DT238 (TA)	Broad Street 3	CAZ_Only	35.2	35.8	0.6	1 month in 2019 Q3	Site new in Aug 2019
DT239 (TA)	Broad Street 4	CAZ_Only	36.2	43.1	6.9	1 month in 2019 Q3	Site new in Aug 2019
DT248 (TA)	Chapel Row 2	CAZ_Only	39.9	48.9	9.0	1 month in 2019 Q3	Site new in Aug 2019
DT026	Upper Wellsway	CAZ_Boundary	24.7	25.1	0.4		
DT062	Argyle Terrace	CAZ_Boundary	34.7	37.1	2.4	2 months in 2021 Q3	Invalid results
DT094	London Road West B, Batheaston	CAZ_Boundary	24.2	24.8	0.6		

DT143	Rackfield Place	CAZ_Boundary	22.0	23.1	1.1		
DT154	Bradford Road	CAZ_Boundary	21.1	23.4	2.3		
DT167	Weston High Street	CAZ_Boundary	17.6	19.2	1.6		
DT171	Frome Road/ Upper Bloomfield	CAZ_Boundary	23.8	26.5	2.7		
DT179 (TA)	Upper Bristol Road 3	CAZ_Boundary	31.3	31.7	0.4		
DT189	Old Newbridge Hill	CAZ_Boundary	26.5	29.8	3.3		
DT195	Lansdown Lane	CAZ_Boundary	16.9	19.6	2.7		
DT201	The Hollow	CAZ_Boundary	19.4	20.9	1.5		
DT244	Whiteway	CAZ_Boundary	16.5	18.8	2.3	1 month in 2019 Q3 and 2021 Q3	Site new in Aug 2019 and invalid result

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 Q3 and 2021 Q3. 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.

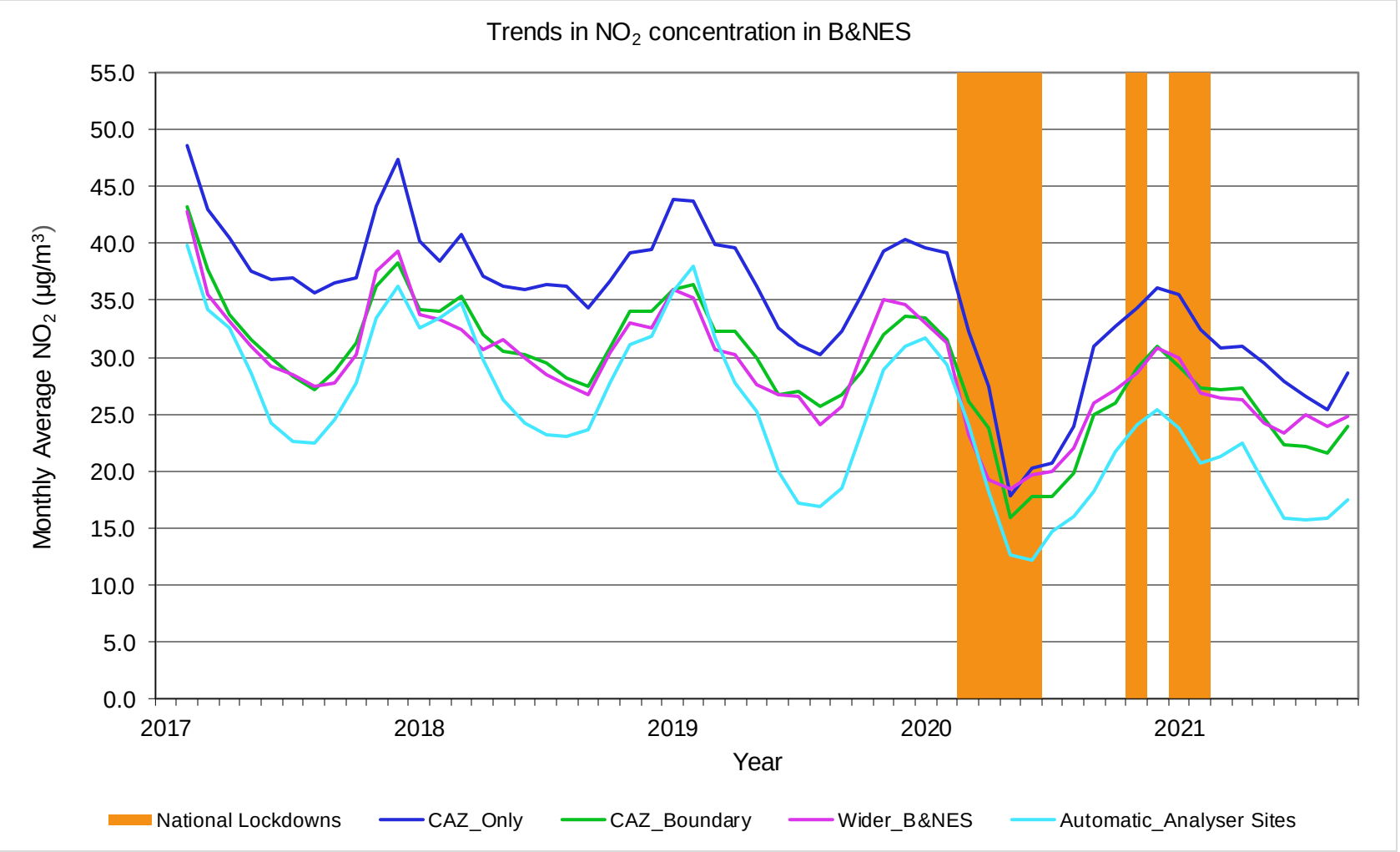
CAZ_Only and CAZ_Boundary	Total no. sites reporting	No. sites >40 µg/m^3 average	Proportion sites >40 µg/m^3 (%)	No. sites >36 µg/m^3	Proportion sites >36 µg/m^3 (%)
2019 Q3	120	15	13	26	22
2021 Q3	122	9	7	14	11
Change	2	-6	-5	-12	-10

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.

Comments and key findings:

- This data for each quarter has been averaged across every site reporting for that quarter, in the location group. Some of the results include quarters that did not record full data, as one 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 Q3 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.
- Four sites which recorded a quarterly average greater than 40 $\mu g/m^3$ also had an increased NO_2 concentration when compared to the same quarter in 2019. These areas are being closely monitored.
- 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 impacted these results.
- While nine sites recorded results greater than 40 $\mu g/m^3$ in the third quarter of the year, it is anticipated 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, six fewer sites in Bath recorded quarterly annual average levels of NO_2 concentrations over 40 $\mu g/m^3$ and twelve fewer sites over 36 $\mu g/m^3$.

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 three automatic analyser sites in Bath (Chelsea House, Guildhall, Windsor Bridge). A fourth automatic analyser site at the A4 roadside has limited NO_2 data so was omitted from the analysis.



Comments and key findings:

- Please note this is not an indication of the CAZ success as the lines represent average levels across multiple sites and some sites remain above 40 µg/m^3
- 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.
- For comparison purposes, we have only included and compared sites that have been in place since 2017 (dozens of 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. Due to Covid-19, the natural replacement rate has stalled as new vehicle registrations declined during the pandemic, so the effect of the CAZ has been to maintain some of this replacement rate, rather than increase it.[7]
- There is a clear seasonal trend in the data, with increased NO_2 concentrations in the winter. This is part of the reason why there is an upturn in the trend at the end of 2021, despite improvements, as well as traffic returning to pre-pandemic levels.
- 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.
- A marked decrease in mid-2020 is due to significantly less traffic on the roads because of Covid-19 restrictions.

[7] Department for Transport, 2021 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1021032/vehicle-licensing-statistics-april-to-june-2021.pdf

2021 Q3 quarterly trend analysis

For our Q3 report, we have updated the way we analyse quarterly data.

Firstly, it is important to point out that we include the full quarterly diffusion tube data (regardless of if there are any month's missing data for whatever reason), for all site groupings in both 2019 Q3 and 2021 Q3, in an appendix to this report.

For *analysing* quarterly data, the new approach is to 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 full months data.

For our quarterly analysis we also *only* compare sites that have *full quarterly data* from both the baseline, 2019 Q3, and this year, 2021 Q3. This means that the data we are considering is like-for-like, comparable and robust. We have therefore also provided fresh analysis for Q2 data, originally published in September of this year, in the next section of this report.

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. This practice remains unchanged.

Table 7- Quarterly average NO_2 concentrations in 2019 Q3 and 2021 Q3 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 Q3 and 2021 Q3 are included.

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 Q3	29.3	22.2	30.0
2021 Q3	25.1	20.2	29.2
Change 2019 Q3 – 2021 Q3 ($\mu g/m^3$)	-4.1	-1.9	-0.7
Change 2019 Q3 – 2021 Q3 (per cent)	-14.1%	-8.8%	-2.5%
Number of sites reporting full results during both quarters	35	41	21

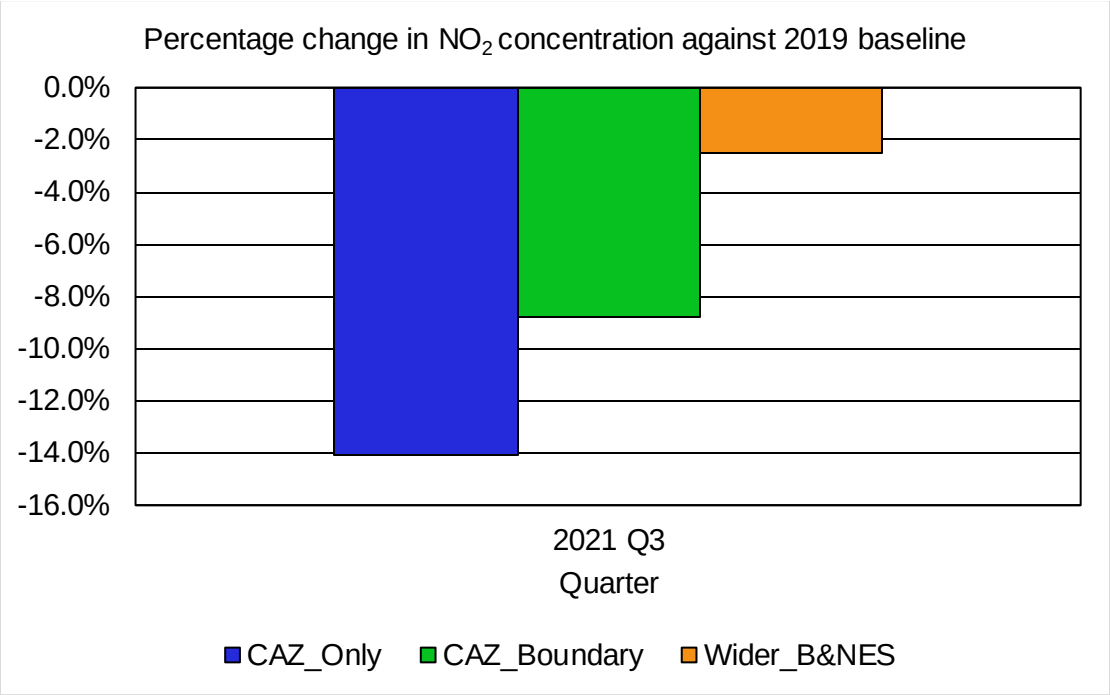
Comments and key findings:

- 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 Q3, and this year, 2021 Q3. 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 Q3) or current (2021 Q3) 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 14.1 per cent lower than the same period in 2019 (Q3), representing an average **reduction** of 4.1 µg/m^3. This is the average reading from a total of 35 monitoring sites within the CAZ that recorded full quarterly data from July to September in both 2019 and 2021.

  Note: This is in the context of national traffic levels in this quarter returning to pre-pandemic levels with usage of LGV's and HGV's exceeding pre-pandemic levels (Department of Transport).
- There was also an NO_2 reduction found in the Bath urban areas outside the zone's boundary, including Batheaston and Bathampton, averaging an 8.8 per cent **reduction**, or 1.9 µg/m^3 on average, from a total of 41 CAZ_Boundary monitoring sites that recorded full quarterly data from July to September in both 2019 and 2021.
- There was also an NO_2 reduction found in the Wider_B&NES site grouping, averaging a 2.5 per cent **reduction**, or 0.7 µg/m^3 on average, from a total of 21 Wider_B&NES monitoring sites that recorded full quarterly data from July to September in both 2019 and 2021.
- 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.
- Clean Air Zones 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.
- 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 and perhaps 2021, as traffic flows have returned to those seen pre-pandemic, and above.

Figure 5, below, shows the quarterly average change in NO_2 concentration between the baseline, 2019 Q3, and current reporting quarter, 2021 Q3, in each site grouping.

Figure 5- Quarterly change in average NO_2 concentrations compared with 2019 Q3.



Comments and key findings:

- Sites within the CAZ (CAZ_Only sites) show a 14.1% **reduction** in average quarterly NO_2 concentrations, compared with the same period (Q3) in our baseline year, 2019.
- Sites outside of the CAZ but within the urban area of Bath (CAZ_Boundary sites) show an 8.8% **reduction** in average quarterly NO_2 concentrations, compared with the same period (Q3) in our baseline year, 2019.
- It appears that levels of NO_2 outside of the CAZ boundary are decreasing as well as within the CAZ. It illustrates that air quality is not worsening in areas surrounding the CAZ because of the zone and any non-compliant vehicles choosing to divert around it.
- Furthermore, sites in the CAZ_Boundary site grouping record a lower average NO_2 concentration as seen in Figure 4 and Table 7 and less sites recorded greater than 36 µg/m^3 or 40 µg/m^3 as seen in Tables 3 and 4.
- Despite covering a small central area, the CAZ was designed to improve air quality across the whole of Bath and the data demonstrates that this is working.
- Sites outside of the CAZ and Bath urban area (Wider_B&NES sites) show a 2.5% **reduction** in average quarterly NO_2 concentrations, compared with the same period (Q3) in our baseline year, 2019.
- There are Air Quality Management Areas in Keynsham, Saltford, Temple Cloud and Farrington Gurney where some monitoring sites continue to record quarterly averages greater than 40 µg/m^3. These areas are outside the scope of this

report. Find out more at: www.bathnes.gov.uk/services/environment/pollution/air-quality.

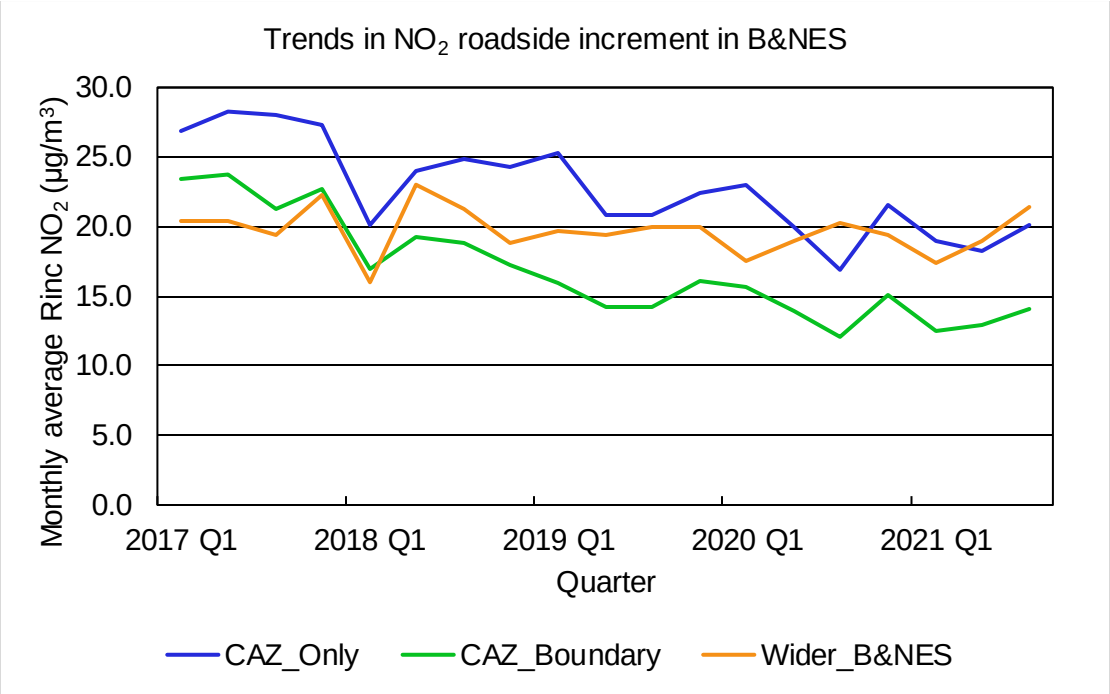
- These results only consider like-for-like data, meaning only diffusion tube sites which recorded full (all three months) quarterly data in both 2019 Q3 and 2021 Q3 are included.
- Quarters with missing months have been omitted from this analysis because average quarterly result would be skewed with less than three month's data.
- However, the full data is included in Tables 3-6 (detailing sites that recorded above 40 µg/m^3, 36 µg/m^3 or increasing NO_2 concentration, during the quarter), as well as in an appendix at the end of this report.
- 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%[8]. Home working has increased significantly among urban dwellers during the pandemic.
- The natural replacement of older, more polluting vehicles with cleaner, compliant ones could also be contributing to the decrease in NO_2 concentrations.
- 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.

[8] 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

Roadside increment (2021 Q3)

Figure 6, below, shows the changes in traffic related NO_2 concentration derived by subtracting the background NO_2 concentration from the average NO_2 concentration in each site grouping.

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 background NO_2 concentration from the monthly average roadside NO_2 levels.
- Background sites are positioned away from roads to avoid the localised pollution from road traffic. In Bath, the long-term urban background location is at Alexandra Park.
- We have sited new background locations around B&NES to improve data collection in this area and will update the process so that the site groupings have more localised background data removed once we have enough data.
- 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.
- In this analysis, the Bath urban background data from Alexandra Park was removed from all the site groupings to assess the Rinc.

Updated 2021 Q2 quarterly trend analysis

In our Quarter 2 report (April - June 2021) we included data in the quarterly analysis from all sites reporting data. We have since changed the way we analyse quarterly data to only include data from sites that have been in place since the baseline period, and only to include data from sites where data from all three months is available, in both the current and baseline period. We have therefore updated the Q2 results, as outlined below in Table 8.

Table 8- Quarterly average NO_2 concentrations in 2019 Q2 and 2021 Q2 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 Q2 and 2021 Q2 are included.

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	32.0	24.9	30.1
2021 Q2	25.8	20.5	26.4
Change 2019 Q2 – 2021 Q2 ($\mu g/m^3$)	-6.2	-4.4	-3.6
Change 2019 Q2 – 2021 Q2 (per cent)	-19.2%	-17.7%	-12.1%
Number of sites reporting full results during both quarters	33	36	22

Comments:

The percentage decrease in NO_2 concentrations between 2019 Q2 and 2021 Q2 is now greater than the percentage decrease in concentrations that we noted in our 2021 Q2 report in September. This is because we have recently installed many more diffusion tube sites to measure the impact of the CAZ and to monitor the impact of traffic displacement. These sites are located more often in areas of pre-existing lower air quality or potential traffic displacement to assess the situation in these areas. By using only sites existing in the baseline and current quarter, we improve the robustness of the results.

It is important to note that some of the newer sites are recording poor air quality, but for the sake of establishing trends based on our original sites and recordings in our baseline year, we cannot include these figures to analyse a trend. We have instead highlighted the sites performing poorly in Tables 3-6 (sites that recorded above 40 $\mu g/m^3$, 36 $\mu g/m^3$ or increasing NO_2 concentrations, during the quarter), and in an appendix at the end of this report.

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.

This section is split into four:

1. How we measure changes in traffic flow
2. Traffic flow data 2021 Q3
3. Locations of concern
4. Areas of potential traffic displacement

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.

To understand the impact of the zone on changes to traffic flows, we compare 2021 Q3 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 the majority of vehicles have no need to avoid the zone or seek alternative routes. By the end of September 2021, of the approximately 4,000 buses, coaches, HGV's, LGV's, taxis and PHVs entering the zone daily, only 13% percent are still required to pay zone charges. Our traffic counts record any traffic movement, regardless of the vehicle type or compliance status.

Online shopping and home-deliveries are increasing, which is leading to more commercial vehicles on the roads. In mid-September 2021, light goods vehicles increased to 112% of their pre-pandemic levels whilst heavy goods vehicles increased to 110% and cars reduced to 97%, respectively (Department for Transport statistics).

Figure 7 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 9, 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. Unfortunately, due to a lack of continuous historical data, some of the sites featured in the Q2 report, cannot be used in this analysis because the counts were not in place.

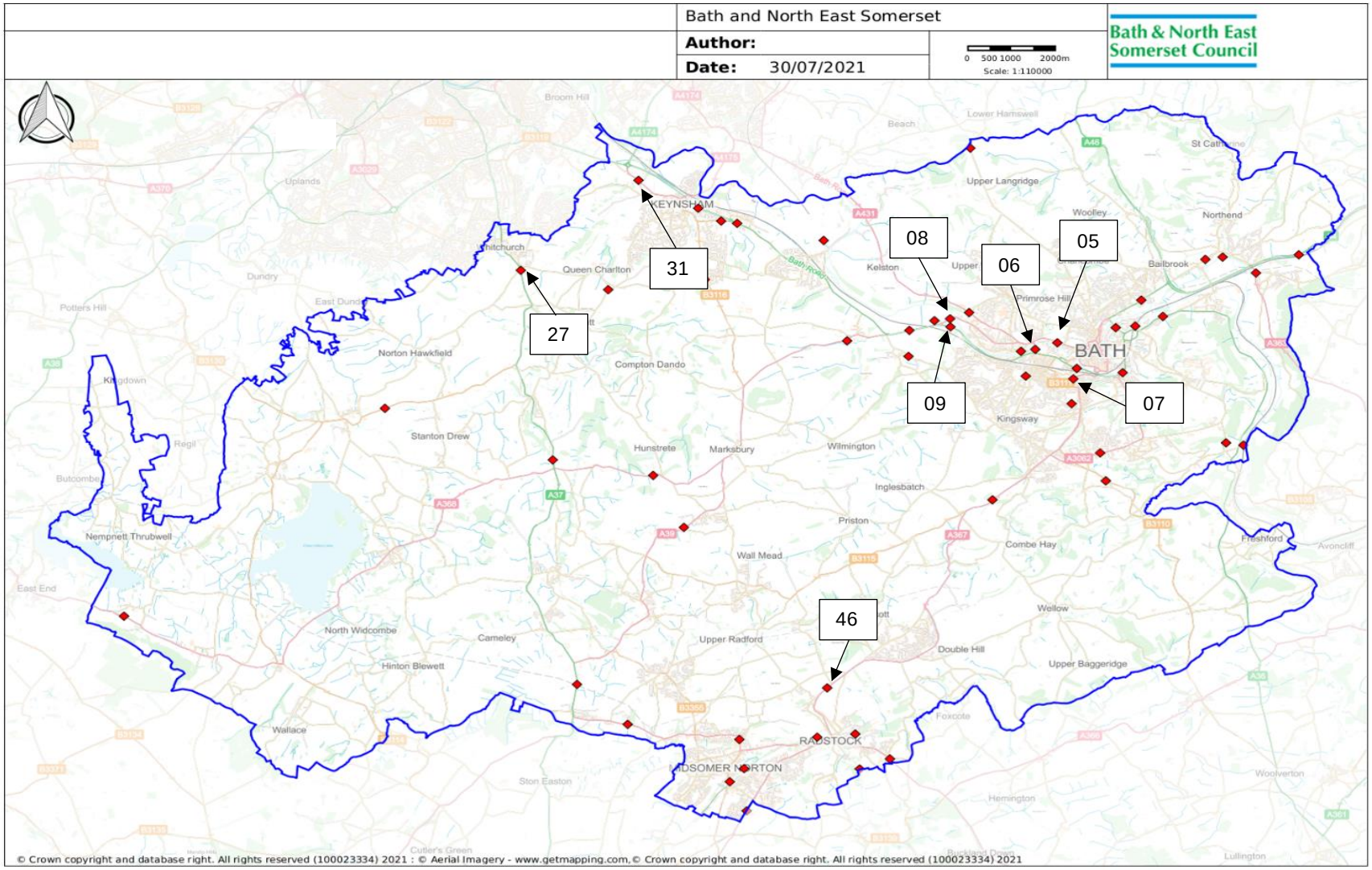
We have good baseline data from the Wider_B&NES sites (from 2018), and these sites remain unchanged from the Q2 report. We have less reliable data from within the CAZ and CAZ_Boundary as fewer ATCs located in these areas were in place during the baseline or current period. For example, ATC site 40 on Bathwick Street was removed from the analysis because it is located next to Cleveland Bridge which was closed throughout 2021 Q3.

We used three sites from outside the CAZ in both other site groupings (CAZ_Boundary and Wider_B&NES) 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.

Table 9- ATC locations from Figure 7 (following page), along with their site category.

Site ID	Location	Site Category	Baseline data from year
05	A4 Upper Bristol Road, West of Marlborough Lane	CAZ_Only	2017
06	A3064 Windsor Bridge, North of Stable Yard	CAZ_Boundary	2018
07	A367 Wells Road- North of Hayesfield Park	CAZ_Only	2017
08	A4 Newbridge Road, East of A36 Lower Bristol Road	CAZ_Boundary	2017
09	A36 Lower Bristol Road, East of Newbridge	CAZ_Boundary	2018
27	A37 Bristol Road Whitchurch, South of Norton Lane	Wider_B&NES	2018
31	A4175 Durley Hill, West of Durley Lane	Wider_B&NES	2018
46	A367 Bath New Road, North of Clandown	Wider_B&NES	2018

Figure 7- ATC locations (red diamonds) used for traffic flow analysis. The number refers to the site ID which can be found in Table 9. © Crown Copyright 2021. License number 100023334.



Traffic flow data results

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

Table 10- Two-way traffic flow data for ATCs by site grouping from the last year with representative data (2017 or 2018), 2020, and 2021. CAZ_Only last representative year was 2017.

Year	Month	5-Day Average			7-Day Average		
		CAZ_Only	CAZ_Boundary	Wider_B&NES	CAZ_Only	CAZ_Boundary	Wider_B&NES
2017 or 2018	July	17630	16325	16127	16683	14931	15064
	August	16592	15644	15651	15738	14352	14763
	September	17848	16318	16823	16940	15115	15769
2020	July	13509	12884	14436	12735	11880	13580
	August	15336	13694	15300	14497	12702	14487
	September	13744	14707	15808	13161	13730	14976
2021	July	15116	15242	15729	14361	14196	14923
	August	14760	15318	15830	14084	14247	15065
	September	15717	15980	15852	14996	14944	15155

Table 11- Percentage change in average monthly traffic flows from 2017/18 to 2021. The bottom row shows the average change for the entire quarter (July-September), 2017/18 Q3 to 2021 Q3.

	5-Day Average			7-Day Average		
	CAZ_Only	CAZ_Boundary	Wider_B&NES	CAZ_Only	CAZ_Boundary	Wider_B&NES
July	-14.3%	-6.6%	-2.5%	-13.9%	-4.9%	-0.9%
August	-11.0%	-2.1%	1.1%	-10.5%	-0.7%	2.0%
September	-11.9%	-2.1%	-5.8%	-11.5%	-1.1%	-3.9%
2017/18 Q3-2021 Q3 average	-12.4%	-3.6%	-2.4%	-12.0%	-2.3%	-0.9%

Comments and key findings:

- Nationally, traffic levels have generally returned to pre-pandemic levels (Department for Transport)[9].
- 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), Table 9 (a description of the ATC locations from which we analysed data), Table 10 (the data on vehicle numbers passing the selected ATCs: in the baseline period either 2017 or 2018; 2020 for reference; this year 2021, and Table 11 (change in traffic flow between 2017/18 Q3 and 2021 Q3).
- General traffic flows (i.e. both compliant and non-compliant traffic) across an average seven-day week reduced by 12% inside the CAZ, a 2% reduction in the urban area of the city outside the CAZ, and a 1% reduction of traffic in the wider area, compared with the baseline.
- The CAZ_Only baseline figures were drawn from 2017 due to a lack of 2018 data; and we know that traffic levels have been returning to pre-pandemic levels; and the Cleveland Bridge closure has impacted traffic flows in Bath.
- **Therefore, we would heavily caveat the CAZ results in that they may not be representative of true traffic flows during the current period.**
- The data from the available permanent ATC's 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.
- Traffic flows fell dramatically in 2020 due to Covid-19 and lockdowns. Traffic levels are returning to pre-pandemic levels, but increased home-working and changes in business models continue to impact traffic flows.

Locations of concern

We are carefully monitoring traffic where average NO_2 concentrations remain above 40 µg/m^3 for 2021 Q3, and where concentrations have increased. In some locations we have traffic flow data collected from either ATCs or CAZ ANPR cameras, which are located very close to diffusion tube sites. These locations can be used to assess the relationship between traffic flows and NO_2 concentration in a specific location. It is important to recognise vehicle emissions are not the only source of NO_2, so traffic volume and composition is not the only determining factor in the total NO_2 concentration.

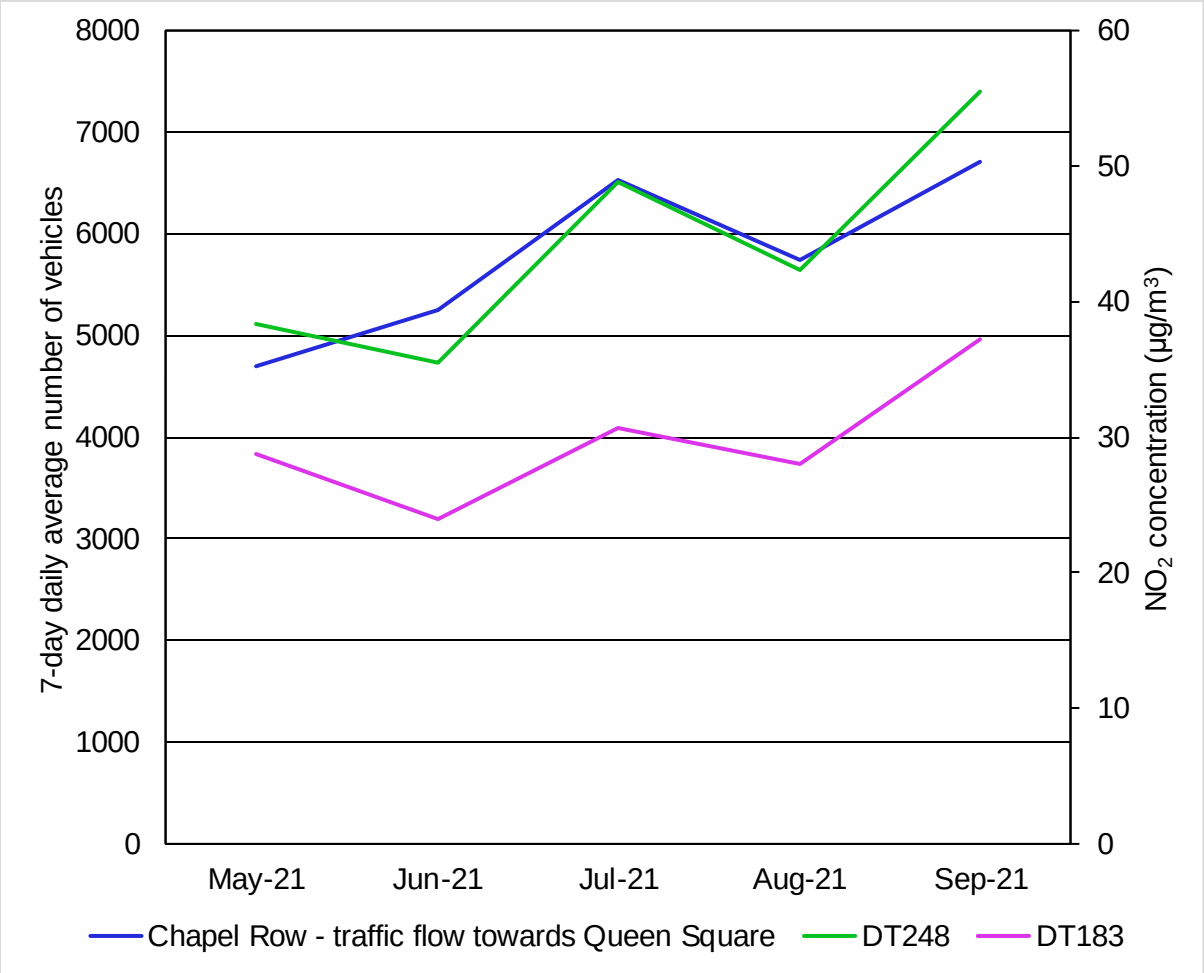
In 2021 Q3, of the four sites which recorded an average NO_2 concentration above 40 µg/m^3 as well as increased NO_2 concentration, when compared to 2019 Q3 (Broad

[9] 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

Street 4, Chapel Row 2, Victoria Buildings, Wells Road), there are two sites (Chapel Row 2 and Wells Road) which have both diffusion tube data and traffic flow data located within 20 metres of each other.

At Chapel Row, NO_2 concentrations have increased in recent months and it appears the likely cause is an increase in the traffic volume through this area.

Figure 8- One-way traffic flow on Chapel Row (towards Queen Square) plotted alongside NO_2 concentrations of two diffusion tubes (DT248 and DT183).



Work on Cleveland Bridge started on 4 May 2021 and closed to traffic on 28 June 2021. The official diversion directs vehicles over Windsor Bridge, with expected increases in traffic on the A4 and A36. Vehicles below 7.5 T are able to use central routes through Bath. Traffic flows over the summer have been affected by the closure with drivers finding alternative routes through Bath. As of November 2021, the bridge has reopened to light traffic.

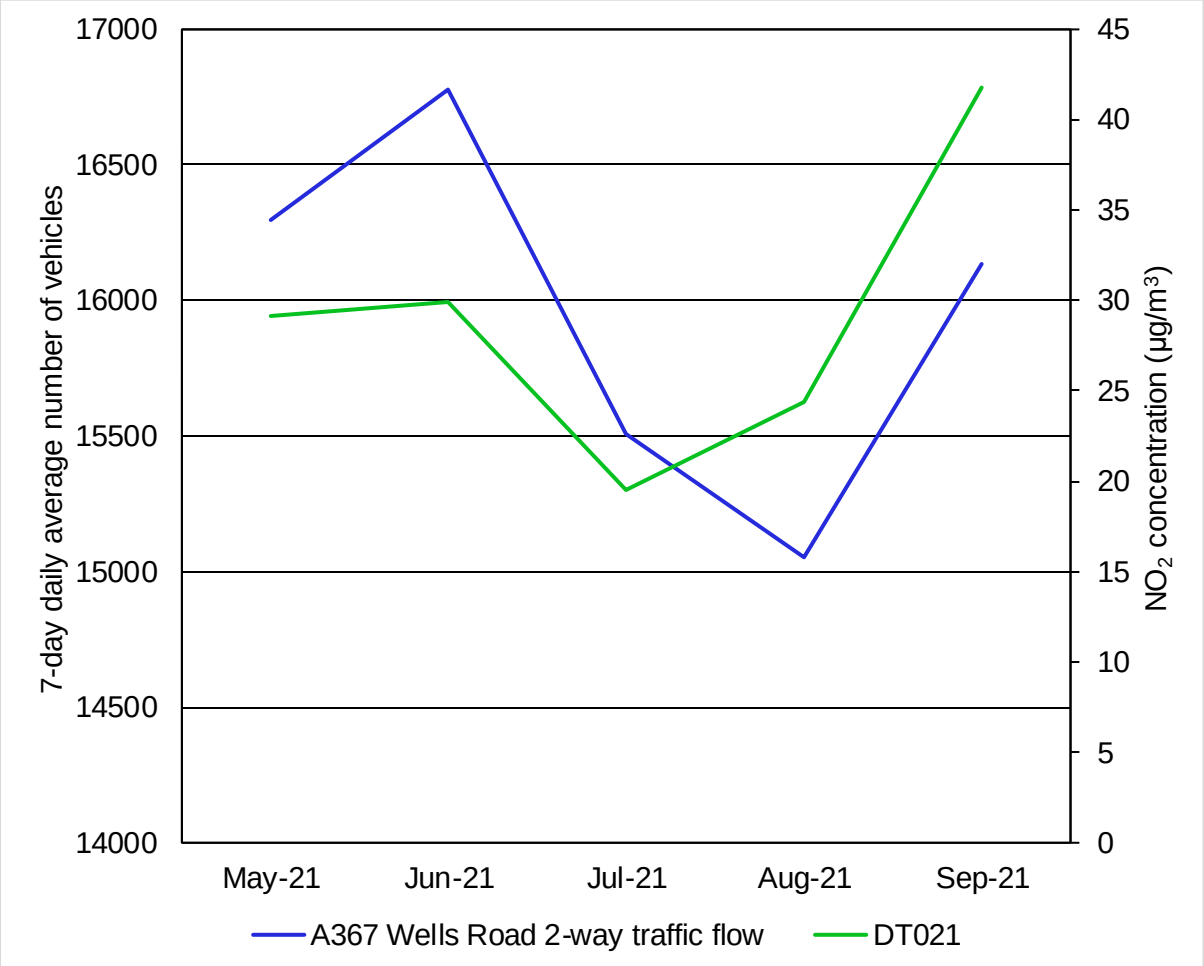
The cause of the increased traffic volume on Chapel row (towards Queen Square) is linked to the Cleveland Bridge diversionary route. From the closure of the bridge in late June, there was an increase in traffic flow northwards from Charles Street to

Queen Square from around 5,300 vehicles per week to around 6,500 per week by July, as seen in Figure 8. The NO_2 concentrations at both diffusion tubes located on Chapel Row, mirror the traffic flow trend into Queen Square. DT248 is located on the north side of the road (the side the traffic flow data comes from) whilst DT183 is located on the south side of the road.

The other site which has both ATC and diffusion tube locations within a short distance of each other, is Wells Road. The two-way traffic flow and closest diffusion tube are shown in Figure 9. Again, the trend for NO_2 concentrations, closely follows the trend for traffic volumes. These results demonstrate how fluctuating traffic flows can directly affect local air quality.

We will continue to monitor the impact of changing traffic flows and how we can reduce the air pollution at these locations.

Figure 9- Two-way traffic flow on A367 Wells Road (north of Hayesfield Park) plotted alongside NO_2 concentration of diffusion tube site Wells Road/ Upper Oldfield Park (DT021).



Areas of potential traffic displacement

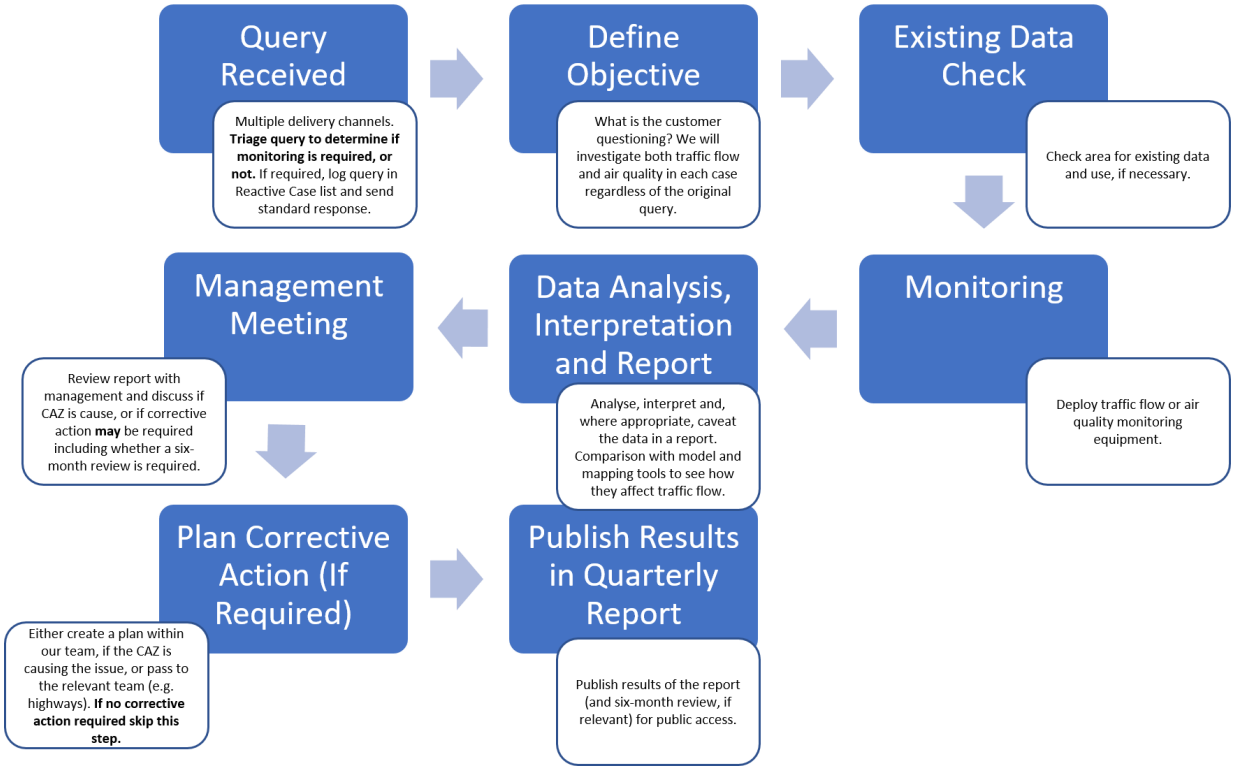
A key commitment of the Council during the business case development stage of the project was to monitor any concerns arising from the introduction of the CAZ. The purpose of the CAZ is to improve vehicle compliance rates whilst minimising the impact on normal traffic flows. Nationally, average traffic 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 18 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.

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

Figure 10- 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[10], 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.
- It is unsurprising that reports of increased numbers of commercial vehicles have been received and people are understandably concerned the reason for these changes is the CAZ, as it commenced as pandemic restrictions were being lifted.

Overview of cases:

Please see Appendix 2 for more detailed traffic displacement monitoring information.

- Some cases required temporary ANPR camera installation to allow for detailed vehicle classification, to understand the types of vehicle classes using the routes.
- We installed ANPR cameras at Lyndhurst Road (Oldfield Park), Whiteway Road and Lansdown Lane to understand the vehicle classification in these areas.
- There were some increases in the numbers of LGVs and HGVs at some of these locations. Small increases were predicted at some of these locations in the traffic modelling forecasts in the Full Business Case. Some of the increase will be attributed to the general increase in these commercial vehicles as previously. Further, the closure of Cleveland Bridge has disrupted traffic flows.
- We will be carrying out further monitoring at these three sites in 2022 to understand the state of the traffic flow once the situation has stabilised.
- We are reviewing the weight restriction limits on Old Newbridge Hill by introducing a new Traffic Regulation Order, as a result of monitoring undertaken showing larger vehicles were using the hill inappropriately.
- We are aware that recent monitoring at Charlcombe Lane may have been affected by conditions not representative of normal traffic flow in the area. Therefore, further monitoring is being carried out and data will be re-analysed.
- We are continuing to monitor NO_2 concentrations at Twerton High Street.
- Monitoring at Shophouse Road, Prior Park Road, Bradford Road and Brassknocker Hill, Penn Hill Road, Englishcombe Lane, Norton St Philip and Cavendish Road will be reviewed in 2022.
- We completed monitoring at the following locations where no discernible increase or concerning traffic issues were found: Colliers Lane, Upper Camden Place, Southdown Road, Rosemount lane and Sham Castle Lane. We will review each case 6-months from the original monitoring.

[10] 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. 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.

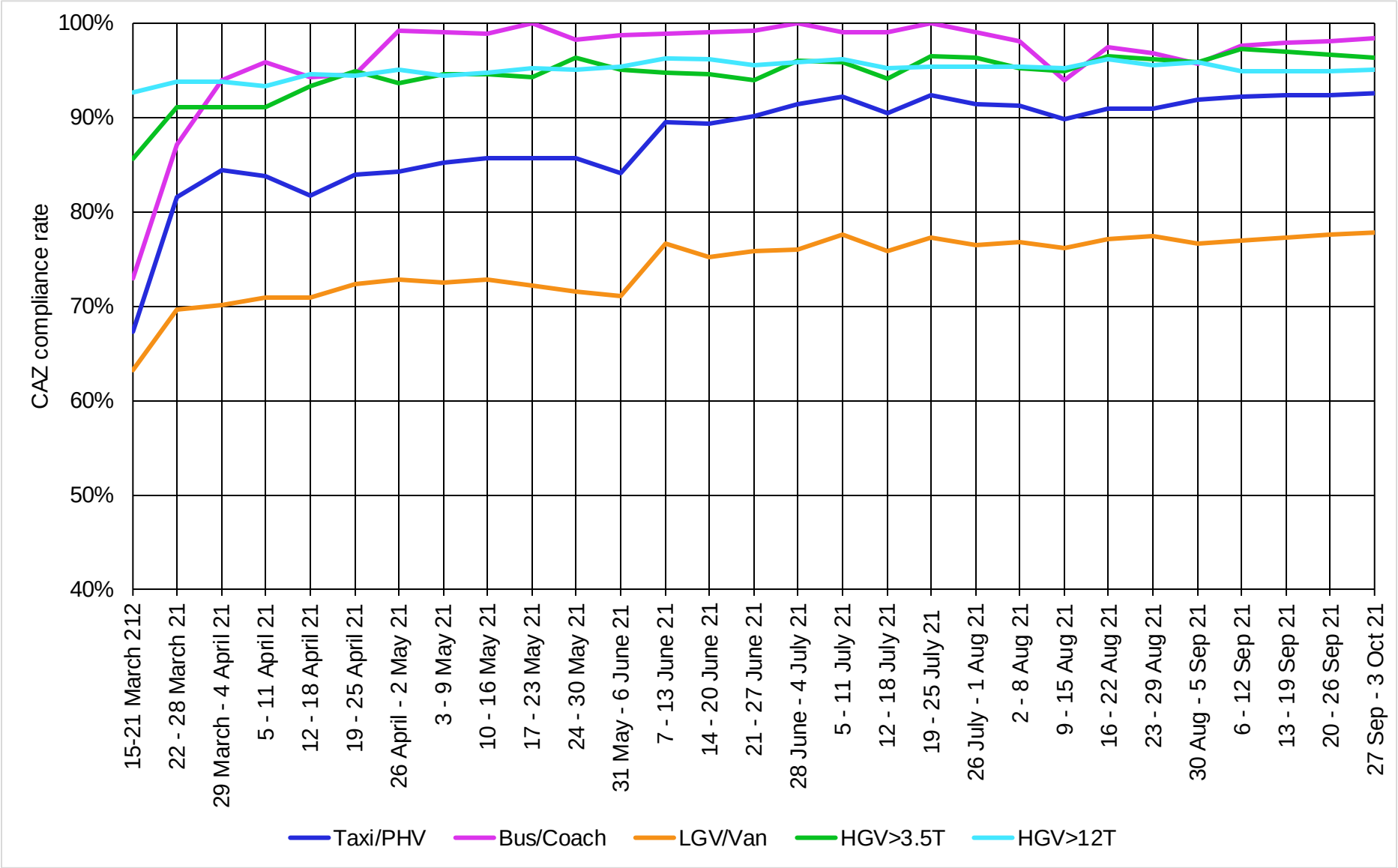
Vehicle compliance data for Bath CAZ

Figure 11 (below) shows the vehicle compliance rates within the CAZ as a 7-day average, since the CAZ launch.

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 1.7% between July and September.
- An average of 709 non-compliant vehicles was seen in the zone each day, during 2021 Q3 compared to 1742 during the launch week in March, a decrease of 59%.
- An average of 40,358 unique vehicles were seen in the zone each day during the quarter, which is comparable to the 40,799-daily average for 2021 Q2.
- Most vehicles recorded in the zone are private cars, with an average 29,485 unique private cars seen in the zone each day during 2021 Q3. This equates to 72% of all vehicles in the CAZ.
- Bus/coach compliance rate averaged 98% during the quarter, with an average 111 individual vehicles seen per day.
- HGV (>12 tonne) compliance rate averaged 96% during the quarter, with an average 264 individual vehicles seen per day.
- HGV (>3.5 tonne) compliance rate averaged 96% during the quarter, with an average 108 individual vehicles seen per day.
- Taxi/ private hire vehicle compliance rate averaged 91% during the quarter, with an average 418 individual vehicles seen per day.
- Light goods vehicles/ vans compliance rate averaged 77% during the quarter, with an average 2997 individual vehicles seen per day.
- Rates of compliance are anticipated to continue to improve in the next quarter, particularly with respect to the supply of compliant LGVs which have been impacted most significantly by the pandemic.
- Compliance has been encouraged and supported through the government-funded bus retrofit and financial assistance scheme, in addition to drivers upgrading outside of the scheme.

Figure 11- Vehicle compliance rates within the CAZ as a 7-day average.



Bathampton in-depth analysis

Prior to introducing the zone within Bath's city centre further areas were modelled for inclusion subject to traffic and air quality monitoring. One potential outlier zone included Bathampton, which would include Bathampton Lane, Down Lane, Devonshire Road, and the High Street.

During consultation there were concerns that the current boundary would lead to large amounts of traffic diverting over the toll bridge and through Bathampton, resulting in increased congestion and air pollution concentrations. However, modelling predicted that traffic was not expected to increase excessively across the toll bridge and it did not indicate that NO_2 concentrations would exceed the 40 µg/m^3 limit value.

To ensure that the models were accurate and that Bathampton did not see an increase in traffic volumes after the implementation of the category C charging zone, a plan of monitoring was introduced whereby five ANPR cameras were installed within Bathampton and on the toll bridge. The data from these cameras allows a post-CAZ comparison to be drawn from any existing data, so any changes in traffic flow could be understood.

Findings and results

Figure 12, below, shows the per cent of vehicle types recorded on the ANPR cameras within Bathampton in June/July 2021. 'Other' includes motorcycles, tractors, minibuses, and smaller HGVs.

Key findings and comments:

- In 2018 cars accounted for 82% of traffic in Bathampton and light goods vehicles accounted for 14%. Figure 12 shows that in June/July 2021, after the launch of the CAZ, cars and light good vehicles were split 85/14% respectively.
- Due to the charge associated with non-compliant light goods vehicles it was of concern that these vehicles may divert through Bathampton to avoid zonal charges. However, the data suggests that this is not the case.

Figure 12- Per cent of vehicle types recorded within Bathampton

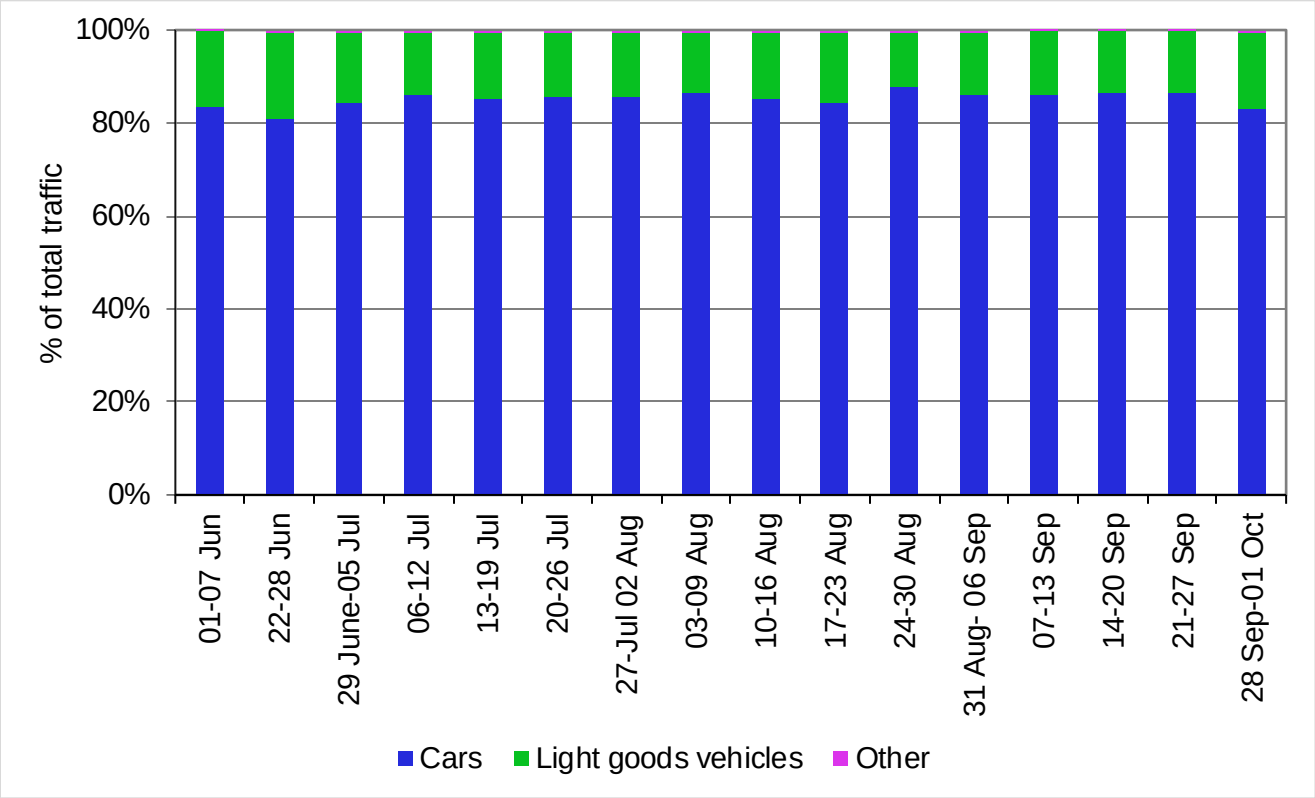
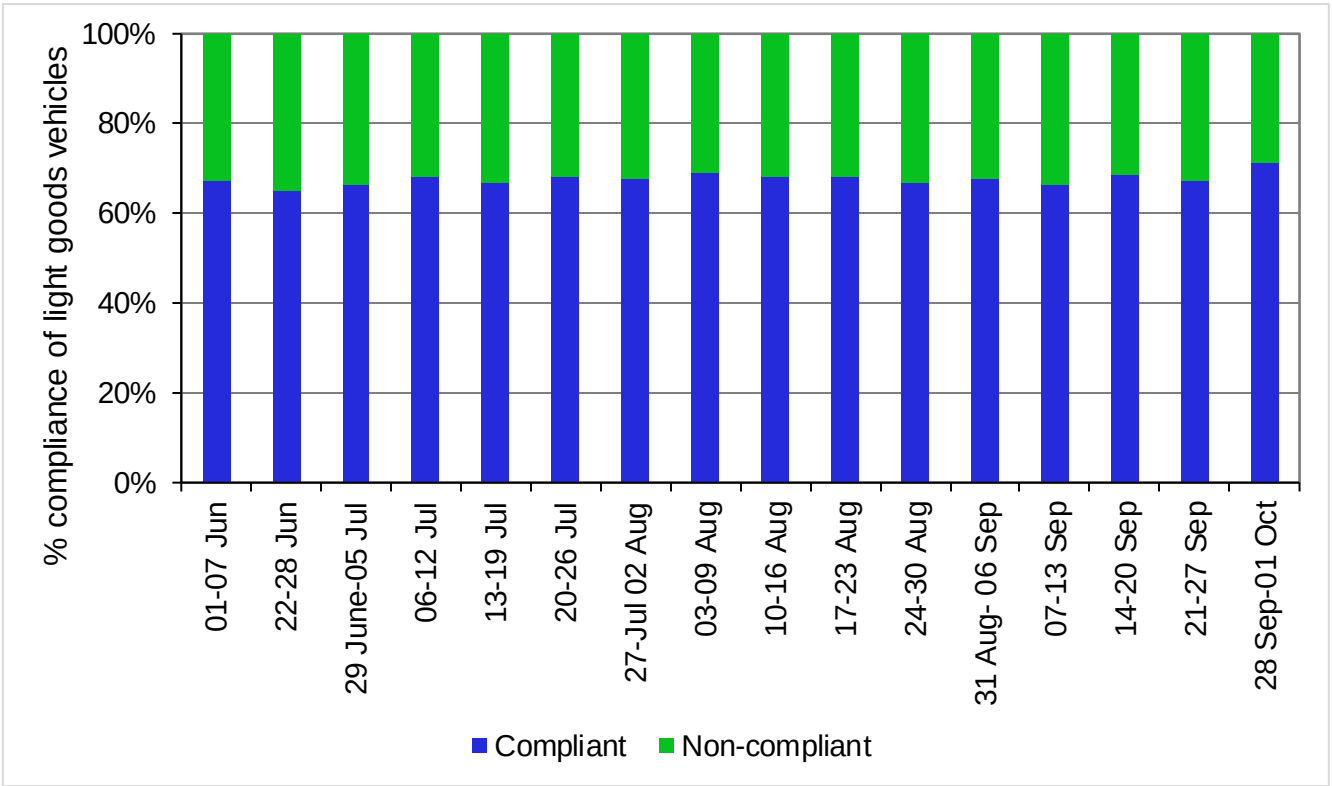


Figure 13- Compliance split of light goods vehicles recorded within Bathampton



Compliance split of vehicles

Figure 13, above, shows the compliance split of the light goods vehicles registered on the ANPR cameras within Bathampton in June and July 2021.

Key findings and comments:

- In assessments carried out in 2017 as part of the Bath Clean Air Plan business case development, 86% of light goods vehicles were non-compliant. The Bath Clean Air Plan forecast that a 'do-nothing' scenario with natural fleet improvement would lead to a compliance rate of 58% in 2021.
- Figure 13 shows that with the CAZ in place, on average 68% of light goods vehicles within Bathampton in June and July 2021 were compliant.
- This suggests that non-compliant vehicles are not diverting through Bathampton to avoid zonal charges.

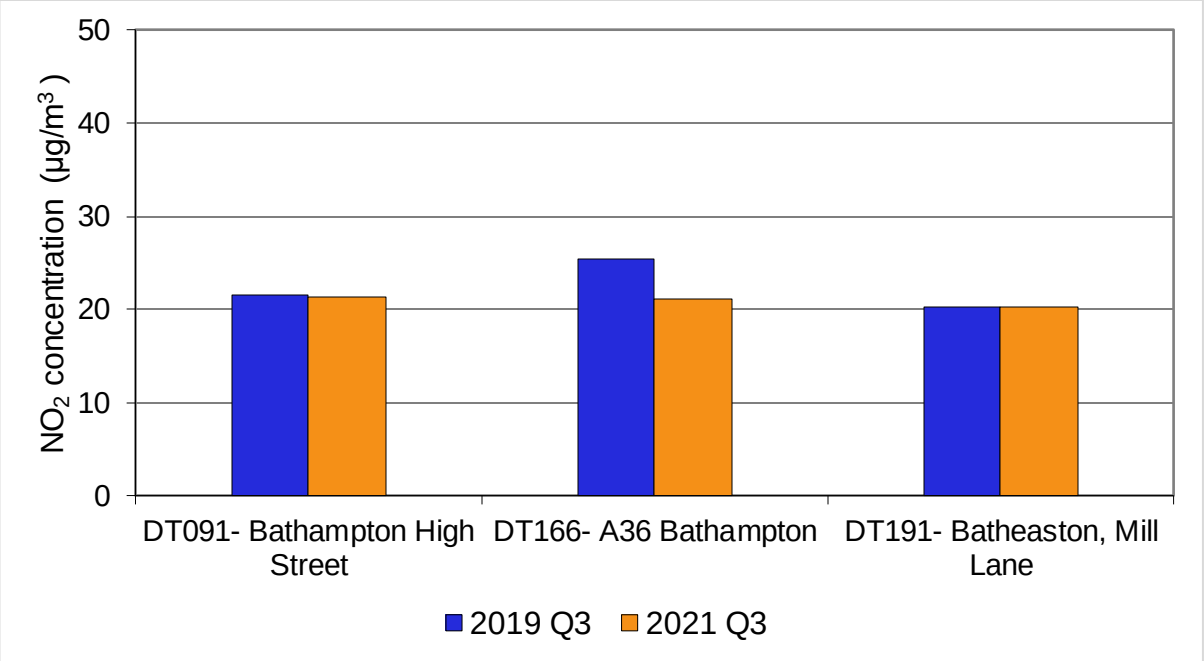
Air quality

Figure 14, below, shows the quarterly average NO_2 concentrations at sites around Bathampton for 2021 Q3 compared against our baseline (2019 Q3).

Key findings and comments:

- All quarterly average concentrations of NO_2 are below 40 µg/m^3.
- Concentrations at Bathampton High Street and A36 Bathampton have reduced.
- Concentrations of NO_2 at Batheaston Mill Lane remain at 20 µg/m^3 for both 2019 Q3 and 2021 Q3.

Figure 14- Trends in NO_2 concentrations at sites near Bathampton



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 September 2021 (six months after the launch of the zone), 84 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 most of the final retrofits are scheduled for completion by the end of 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 12 below shows the number of vehicles that, by the end of September, were eligible to be replaced and the number of vehicles replaced. The Council expects to help replace up to 1,500 non-compliant vehicles regularly travelling in the zone by the end of 2021.

Table 12- Vehicles eligible for the financial assistance scheme and the number of vehicles already replaced up to the end of September 2021.

Vehicle category	Number vehicles eligible for FAS funding to upgrade/ retrofit	Number vehicles upgraded at end of Sept 21
M1 (taxis or private hire vehicles; as private cars are compliant)	148	82
M2 (minibuses)	4	2
M3 (buses and coaches)	21	18
N1 (light goods vehicles i.e. vans)	1288	476
N2; N3 (heavy goods vehicles <12T; HGVs >12T)	34	13
Total	1495	591

*The two minibuses upgraded are considered LGVs so will be discussed with LGVs and vans in the comments

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 September 2021, 1,495 vehicles have passed basic eligibility tests, and 591 vehicles have already been replaced.

- 478 non-compliant LGVs (including 2 minibuses) regularly travelling in the zone and 82 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, 34 HGVs regularly travelling into Bath have been approved for finance and 13 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.
- To date, 167 vehicles have been approved for the affordability exemption
- 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.
- At the end of September, approx. £3.4 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 concentration 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 July to September 2021, and, as highlighted in our Executive Summary, the emerging trends are encouraging.

Air quality

We are heartened to note that provisional average nitrogen dioxide (NO_2) concentrations within the CAZ for 2021 Q3 are 14% lower than the same period in 2019 Q3, representing a reduction of 4.1 µg/m^3. There was an average reduction of 9% or 1.9 µg/m^3 in the CAZ_Boundary site grouping.

We also note that despite this general improvement, quarterly average concentrations of NO_2 at nine monitoring sites still exceed 40 µg/m^3 and we will continue to monitor these sites closely. However, compared with baseline data for the same quarter in 2019 (Q3), six fewer sites recorded NO_2 concentrations over 40 µg/m^3 and twelve fewer sites recorded NO_2 concentrations over 36 µg/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 2% lower than the baseline. Average traffic flows in the Wider_B&NES region were 1% 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.

Average traffic flows within the CAZ have probably returned to around pre-pandemic levels, however the closure of Cleveland Bridge has impacted traffic flows around Bath. The two sites we have data from show a 12% decrease in traffic when compared to the baseline, but we do not believe this to be representative.

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.

Vehicle compliance

The aim of the zone is to improve the emission standards of vehicles driving in Bath. An average of 709 non-compliant vehicles were seen in the zone each day, during 2021 Q3 compared to 1742 during the launch week in March, a decrease of 59%. This is despite the overall number of vehicles travelling in the zone increasing each week as lockdown eased, to around 40,500 unique vehicles per day during 2021 Q3, the vast majority of which are private cars.

91% of all taxis now entering the zone are compliant, compared with 67% prior to the zone's launch. And at the end of September 2021, 84 out of 87 non-compliant public buses on scheduled routes in Bath have now been upgraded to meet standards. Apart from three, all the city's scheduled bus fleet (226 buses) should be compliant by the end of 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, 591 vehicles have been replaced, including 478 vans. 1,495 vehicles have passed the Council's eligibility tests, so hundreds more vehicles are due to be replaced in the coming months.

Next steps

As we move in to the fourth and final quarter of 2021 we will continue to review and monitor air quality, traffic flows and vehicle compliance rates with a view to publishing our annual report for the whole of 2021 in Spring 2022. By this time, we will also have a better understanding of how the Council will demonstrate achieving success with the Ministerial Direction as the roadmap for this is being determined by Joint Air Quality Unit (JAQU).

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 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.