South Cambridgeshire District Council


# Short term air quality monitoring in Barton, Cambridgeshire

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**June 2024**

# Executive Summary

Air quality was monitored in the South Cambridgeshire village of Barton using Zephyr monitoring technology during the period December 2023 to April 2024 as part of a study into air quality around primary schools. Monitoring was carried out by South Cambridgeshire District Council outside Barton Primary School, as it is recognised that children are among the most vulnerable to the impacts of air pollution. It was found that concentrations of the main pollutants, nitrogen dioxide and particulate matter, were comfortably below the national objectives for annual mean concentrations and there were no exceedances of the short-term objectives, representing good air quality. Annual means for the more stringent World Health Organization (WHO) guideline values were also achieved for nitrogen dioxide and $PM_{10}$ although $PM_{2.5}$ levels slightly exceeded the WHO guideline values, which was expected given that over 90% of the world's population live in locations where this is exceeded. This is in line with long-term concentrations measured across the South Cambridgeshire district and reflects the rural nature of the area.

Differences were seen between the school holiday periods compared to term time for nitrogen dioxide, with generally lower concentrations in the holidays, which could be reflective of the reduced volume of school traffic during the holiday periods.

Short term particulate matter pollution events were identified by comparing results to other local monitoring points. It is likely that these are caused by domestic solid fuel burning. This demonstrates that domestic solid fuel burning can have a significant short term localised impact.

South Cambridgeshire residents can help to improve local air quality through actions such as reducing idling of car engines and increasing walking and cycling where possible. Reducing solid fuel burning and only burning Woodsure Ready to Burn certified wood will also help to reduce particulate pollution. This report can be read alongside the yearly Air Quality Annual Status Report (ASR) and the reports from other localised studies, which are available on our website.

# Glossary

**Annualisation –** a calculation process used to estimate an average concentration for a full year from a shorter period.

**Annual mean –** the average concentration across a full calendar year.

**AQMA – Air Quality Management Area –** an area where air pollutant concentrations exceed or are likely to exceed the relevant air quality objectives. AQMAs are declared for specific pollutants and objectives.

**Continuous monitor/monitoring station –** instruments which measure air pollution all the time and therefore can give a concentration attributed to a specific time.

**Diffusion tube –** small plastic tube containing a metal mesh which is coated with a chemical that absorbs nitrogen dioxide. This is exposed to the air in a fixed location for a known amount of time, usually a month, and then sent to a lab for analysis. This provides an average concentration for the time it is exposed.

**Nitrogen dioxide ($NO_2$) –** a gas predominantly formed following the burning of fossil fuels, which can cause irritation of the airways and exacerbate symptoms of other conditions.

**Particulate matter ($PM_{2.5}$ and $PM_{10}$) –** the number refers to the size of the particulates in micrometres (one millionth of a metre) – a mix of solid particles and liquid droplets of various sizes and composition, the smallest of which can get into the blood and be transported around the body contributing to conditions such as heart and lung disease.

**Real-time monitoring –** see also continuous monitoring – monitoring which uses an instrument that takes readings at regular intervals (e.g. every 10 seconds or every hour) and therefore can give a concentration attributed to a specific time, typically with results available in real-time via remote connectivity.

**$\mu g/m^3$ –** micrograms per cubic metre, the standard units of measurement of air pollutants including nitrogen dioxide and particulate matter.

**Zephyr –** a type of relatively compact and lightweight air pollution sensors that measure harmful gases and particle matter in real-time.

# Results of Zephyr air quality monitoring in Barton, Cambridgeshire

## Introduction

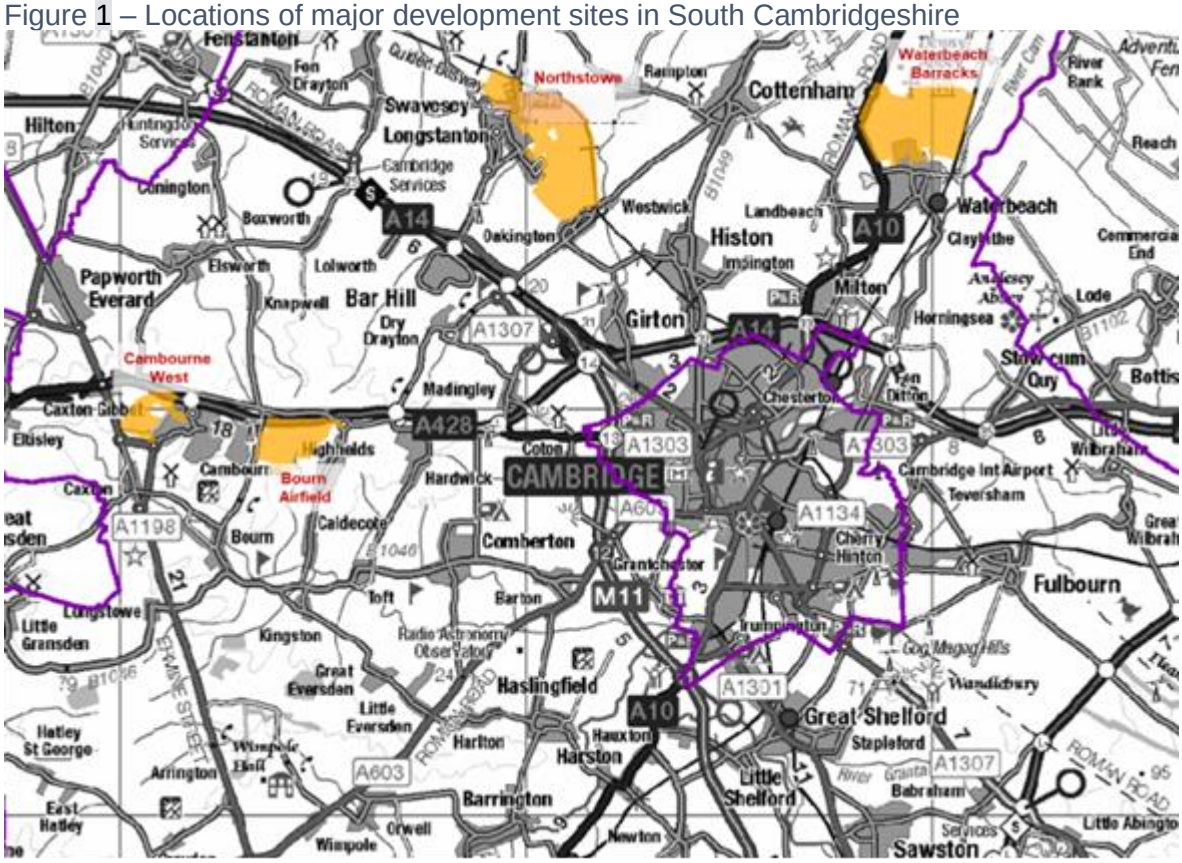
### Purpose of this report

This is a report to provide information on the short-term air quality monitoring study undertaken in the South Cambridgeshire village of Barton, using a ‘Zephyr’ monitoring technology. Monitoring was carried out during the period December 2023 to April 2024. The study was designed to be a short-term study monitoring air quality outside Barton Primary School as part of South Cambridgeshire District Council’s study into air quality around primary schools. It also serves to create additional local awareness of air quality in our area and enable people to make informed choices around how they can impact on improving air quality in their area.

### Air Quality in South Cambridgeshire

South Cambridgeshire is a rural district which enjoys generally good air quality, with both short-term and long-term pollution levels below the national objectives at all monitored locations in the most recent full year monitoring results. This means we benefit from cleaner air to breathe and less pollution related health problems. However, there is significant new evidence that there is no safe level of certain pollutants and the district is undergoing significant growth to keep up with the increase in demand for housing with major developments, including Northstowe (10,000 dwellings), Waterbeach Barracks (6000-10,000 dwellings), Bourn Airfield and Cambourne West, shown in Figure 1.

Figure 1 – Locations of major development sites in South Cambridgeshire




Air quality impacts in the district are mainly related to road traffic, which is likely to increase due to these areas of growth, and the major roads running through the district, including the A14 and M11/A11 corridors. Another important source of particulate matter pollution is domestic solid fuel burning, which nationally contributed 27% of the $PM_{2.5}$ emissions in 2021 according to Defra.

Air quality is an important topic as air pollution can impact our health, particularly effecting the most vulnerable, including children and those with underlying conditions such as asthma, lung conditions or heart disease. Air quality is monitored across the district using a network of diffusion tubes and continuous monitoring stations, which provide accurate air quality measurements in real-time, in addition to the new Zephyr monitors which are used for short term monitoring projects. Although the air quality in South Cambridgeshire is generally good when compared to more urban areas, there is emerging evidence that even low levels of pollutants can cause health impacts, and the World Health Organization (WHO) have published ambitious targets for some pollutants that are lower than the national objectives. South Cambridgeshire

District Council has, in it's Air Quality Strategy, committed to working towards the WHO guideline values.

For more information and detail on the importance of air quality and air quality in South Cambridgeshire, please refer to Appendix 1 – Air Quality Frequently Asked Questions or visit our website. Additionally, ideas on how anyone can play a role in improving local air quality can be found in Appendix 2 – How to get Involved with Local Air Quality.

## The 'Zephyr' Air Quality Sensor

Zephyr monitors are compact and lightweight air pollution sensors that measure harmful gases and particles in real-time, including the main pollutants of concern, nitrogen dioxide ($NO_2$) and particulate matter ($PM_{10}$ and $PM_{2.5}$). They can run off internal batteries or be powered by a solar panel and can therefore be fixed in a specific location, mostly commonly a lamp post, or used as a mobile monitor. The sensors provide detailed air quality measurements in real-time to help identify pollution hotspots at a localised level, for example busy junctions. Other potential studies include investigating air quality around schools and looking into the impacts of wood burning stoves. Zephyr sensors can be used in isolation or deployed as a network of sensors across a wider area to build up a more detailed picture.

The data from a Zephyr sensor cannot be treated with the same confidence as that from one of our continuous monitor stations, where the data is 'ratified' after checks, however, it has been shown to provide accurate indicative measurements and is comparable to the continuous monitors and therefore appropriate for a wide range of studies, including this.

## Monitoring Location

Barton was selected as part of a council study looking into air quality around schools after being approached by local representatives. The major reason for investigating air quality around primary schools is that children are amongst the most vulnerable to the effects of air pollution, which was reflected by the theme of Clean Air Day in 2021 of 'protect our children's health from air pollution'. This is due to children's airways and respiratory systems being less developed than an adult's and because they breathe more rapidly than adults.

The monitor was located on a lamp post on the road outside Barton Primary School, to be representative of the air quality at the school. It measured the main pollutants of concern, nitrogen dioxide ($NO_2$) and particulate matter ($PM_{10}$ and $PM_{2.5}$), among others. The location of the Zephyr can be seen on Figure 2.

Figure 2 – Location of the Zephyr sensor in Barton



## Monitoring Data and Comparison with Objectives

The average monthly concentrations measured in the period December 2023 to April 2024 are shown in Table 1, below, with the UK annual mean objective and the more stringent WHO guideline values shown for information. This data is also represented in Figures 3 to 5.

Table 1 – Zephyr Air Quality data – monthly average concentrations

| | Pollutant monthly average concentration / µg/m³ | | |
|---|---|---|---|
| Month | $NO_2$ | $PM_{2.5}$ | $PM_{10}$ |
| December 2023 | 6.4 | 3.7 | 6.6 |
| January 2024 | 8.3 | 7.0 | 11.0 |
| February 2024 | 7.8 | 6.6 | 9.9 |
| March 2024 | 8.3 | 10.4 | 16.0 |
| April 2024 | 6.4 | 5.8 | 8.5 |
| UK Objective (annual mean) | 40 | 10* | 40 |
| WHO Guideline values (annual mean) | 10 | 5 | 15 |

*target to be achieved by 2040

Figure 3 – Zephyr Air Quality data – monthly average concentrations compared to national and WHO annual mean objectives for nitrogen dioxide

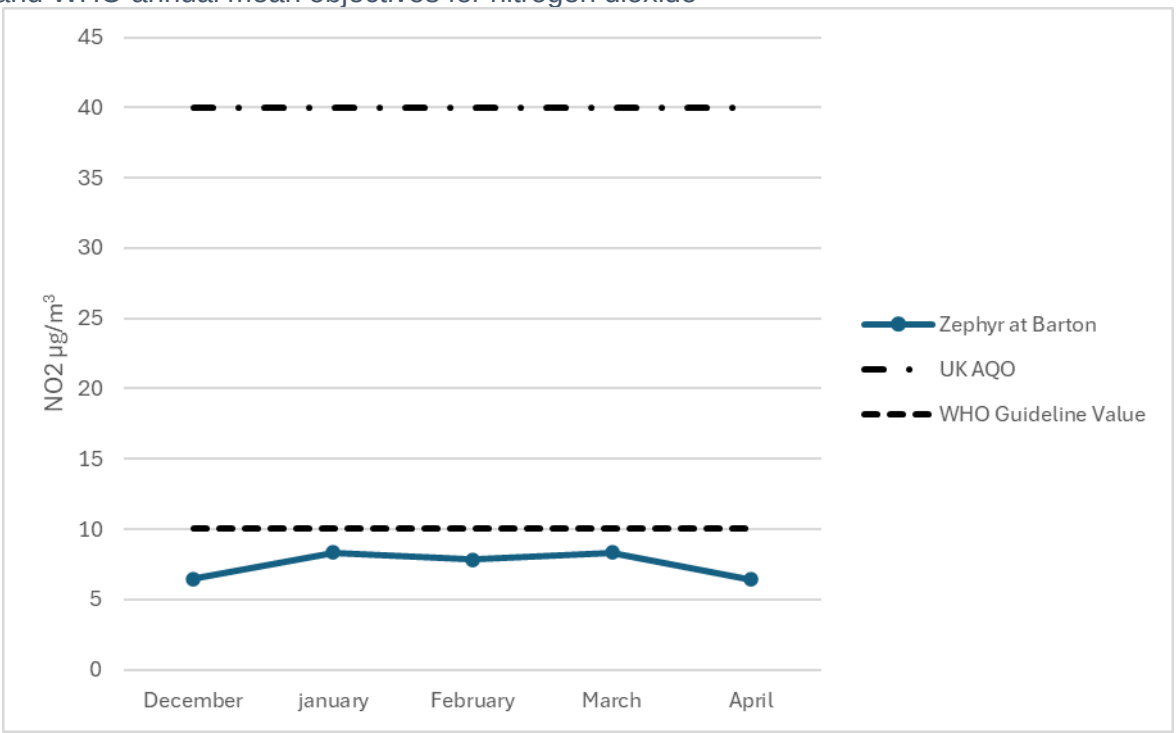


Figure 4 – Zephyr Air Quality data – monthly average concentrations compared to national and WHO annual mean objective for $PM_{2.5}$

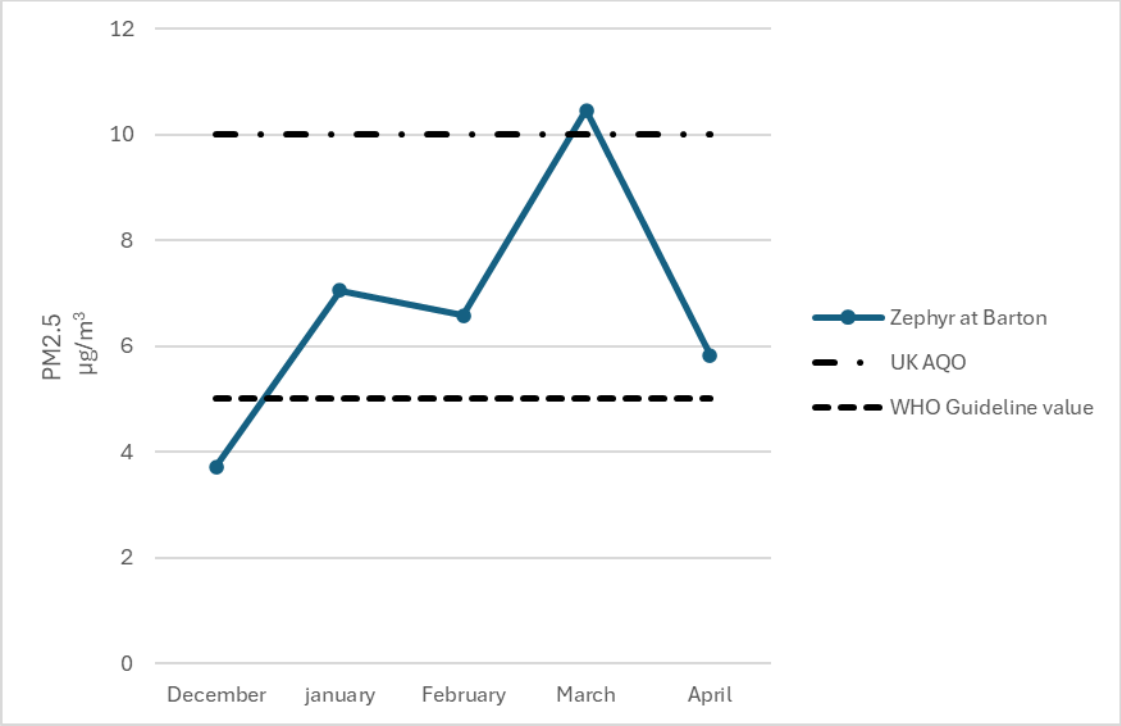
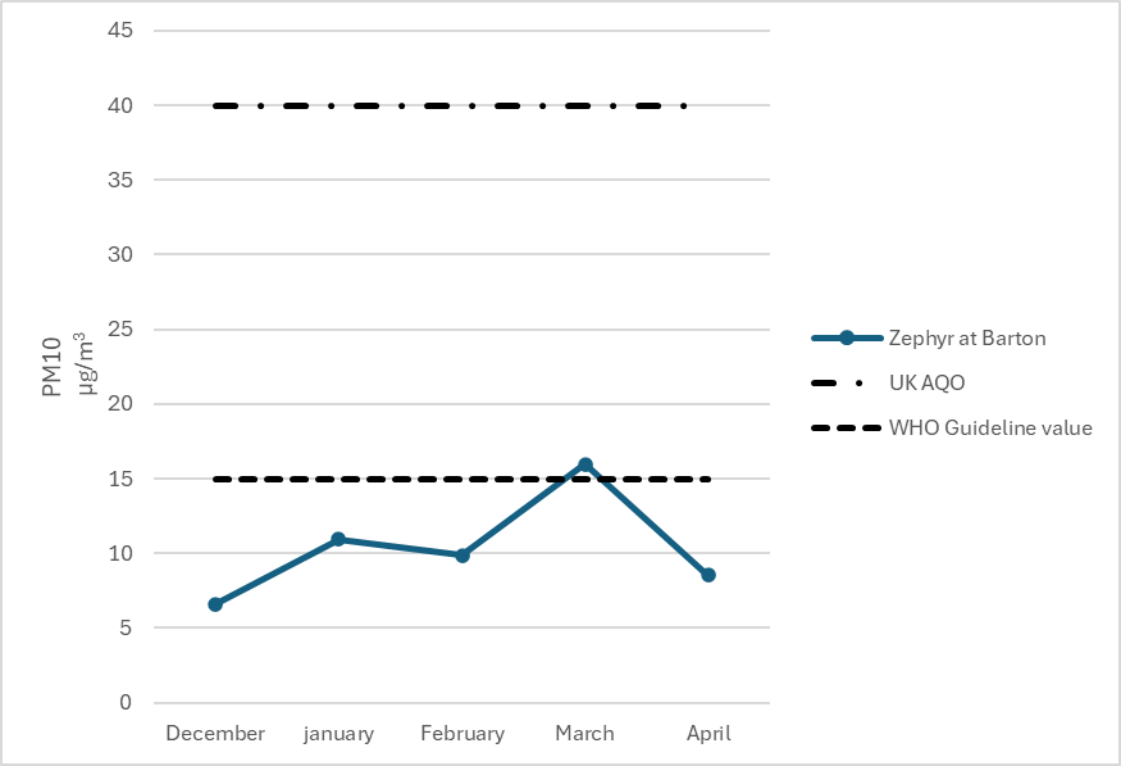



Figure 5 – Zephyr Air Quality data – monthly average concentrations compared to national and WHO annual mean objective for $PM_{10}$




The data recorded in Barton was also compared to that recorded in the same monitoring period by the Council's automatic monitoring stations for each pollutant.

As shown in Figures 6, 7 and 8 below, the data and trends recorded by the Barton Zephyr are consistent with those seen at other monitoring locations across the district. This suggests that there can be a reasonably high degree of confidence in the data collected by the Zephyr monitor.

Figure 6 – Comparison of Barton Zephyr data to automatic monitoring sites in South Cambridgeshire for nitrogen dioxide

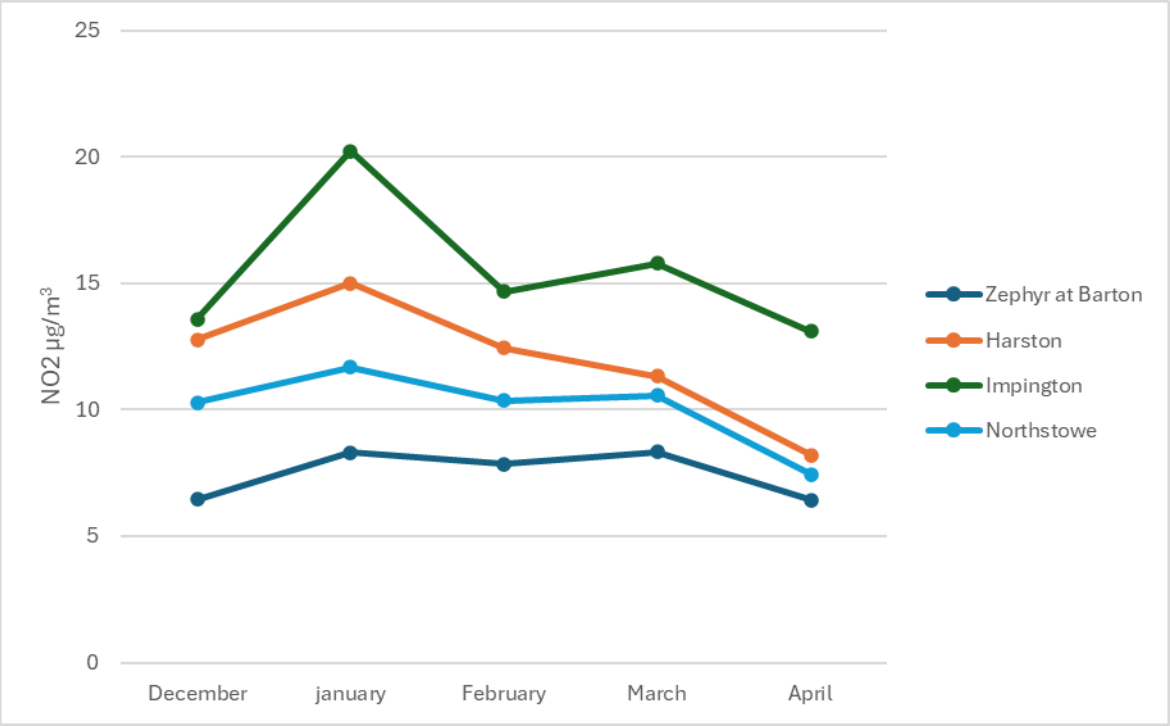



Figure 7 – Comparison of Barton Zephyr data to automatic monitoring sites in South Cambridgeshire for $PM_{2.5}$

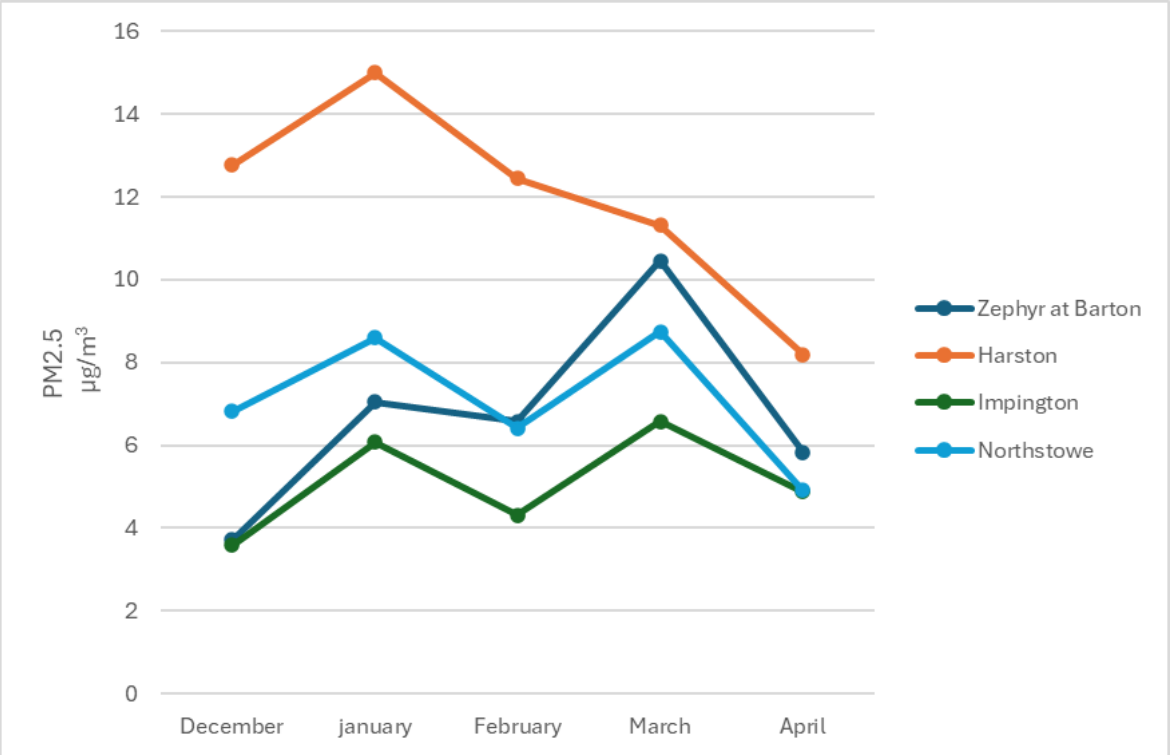
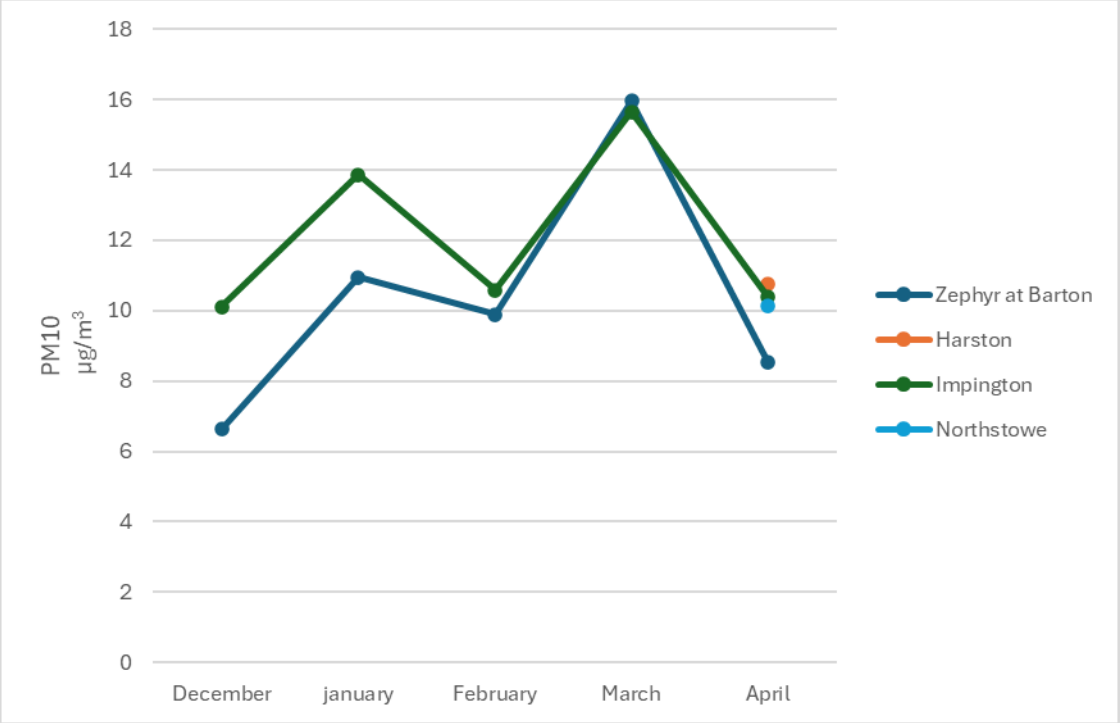


Figure 8 – Comparison of Barton Zephyr data to automatic monitoring sites in South Cambridgeshire for $PM_{10}$ (Please note data is limited for Harston and Northstowe sites)




In addition, the average concentrations of each pollutant for the whole period (December 2023 to April 2024) were calculated and then 'annualised' to give estimated annual mean concentrations to allow better comparison to the annual mean objectives. Annualisation is a calculation process used to estimate an average concentration for a full year from a shorter period, such as the approximately 6 months in this study. This is done to avoid the annual average being influenced by short-term events or seasonal changes, such as one day of high pollution like bonfire night, or pollution concentrations often being higher in the winter than the summer. The data was annualised using 2023/4 data from a range of continuous monitoring background sites and is shown in Table 2, below. Full annualisation details are available in Appendix 3 – Annualisation of short-term data.

Table 2 – Zephyr Data – annualised annual mean concentrations

| | Pollutant average concentration / µg/m$^3$ | | |
|---|---|---|---|
| | $NO_2$ | $PM_{2.5}$ | $PM_{10}$ |
| Measured data average December 2023 – April 2024 | 7.5 | 6.7 | 10.4 |
| Annualisation factor | 0.94 | 0.95 | 1.12 |
| **Annualised annual mean – Barton Zephyr** | 7.05 | 6.37 | 11.65 |
| UK Air Quality Objective (annual mean) | 40 | 10* | 40 |
| WHO Guideline value (annual mean) | 10 | 5 | 15 |

*to be achieved by 2040

As shown in Table 1 and Table 2, the long-term annual mean concentrations of the main pollutants of concern at the Barton Zephyr are significantly below the UK national objectives for $NO_2$, $PM_{10}$ and $PM_{2.5}$, indicating good air quality. The $PM_{2.5}$ concentration is above the ambitious World Health Organisation annual guidelines, announced in September 2021 of 5µg/m$^3$, although it should be noted that over 90% of the world's population live in an area where this guideline value is exceeded. $PM_{2.5}$ remains well below the current UK objective of 10 µg/m$^3$ to be achieved by 2040 as set in The Environmental Targets (Fine Particulate Matter) (England) Regulations 2022. Typically, $PM_{2.5}$ is a pollutant that is more regional than local as it can travel long distances suspended in the air. Therefore, its concentration is often more impacted by national and regional sources and less by local factors than other pollutants (such as nitrogen dioxide).

The Zephyr also allows measurements of the short-term concentrations of pollutants, which are studied through 1-hour means for $NO_2$ and 24-hour means for $PM_{10}$. These are presented and compared to the national objectives in Table 3, below. The short-term objectives are presented as hourly/daily concentrations that should not be exceeded more than a certain number of times in a year. There is currently no short-term objective for $PM_{2.5}$.

Table 3 – Zephyr Air Quality data – short-term average concentrations

| Month | Number of exceedances of short-term objective | |
|---|---|---|
| | $NO_2$ 1-hour mean | $PM_{10}$ 24-hour mean |
| December 2023 | 0 | 0 |
| January 2024 | 0 | 0 |
| February 2024 | 0 | 0 |
| March 2024 | 0 | 0 |
| April 2024 | 0 | 0 |
| UK Objective*** | 200 µg/m³* | 50 µg/m³** |

*Not to be exceeded more than 18 times a year
**Not to be exceeded more than 35 times per year
*** The WHO do not have short term objectives

As shown in Table 3, there were no exceedances of the short-term objectives for $NO_2$ with the highest hourly average was recorded at 7pm on the 24 February 2024 as 31.4µg/$m^3$ which is below the UK annual mean objective.

For $PM_{10}$ the maximum recorded 24-hour mean value was 41.8µg/$m^3$ on the 9th March 2024, which was associated with a regional event as extended high levels of pollutants were picked up at all monitoring locations within the district.

There were four hourly means recorded above 50µg/$m^3$, with the highest being 144.9 µg/$m^3$ at 1pm on the 10 February 2024. This was likely associated with a local event, such as bonfire or chimney smoke, as it was a very short lived peak that was not recorded at other monitoring locations (either the Zephyrs or the continuous monitors).

## Comparison between school holidays and term time

In addition to the overall picture outlined above, the difference between concentrations during term time and school holidays was looked at, as this can give an indication of the impact of traffic related to the school. The school holidays were: the Christmas holidays, February half term (19 to 23 February) and the Easter holidays. We have compared the Monday to Friday of the two weeks before and after the holiday (where possible) to the Monday to Friday period(s) during the

school holidays as there can be seasonal variations caused by weather (especially the amount of daylight) and other factors that impact the levels of pollutants, especially nitrogen dioxide.

Table 4 – Comparison of pollutant concentrations between the Christmas holidays and the weeks immediately before and after.

| | Pollutant average concentration / µg/m$^3$ | | |
|---|---|---|---|
| | $NO_2$ | $PM_{2.5}$ | $PM_{10}$ |
| Periods before and after Christmas holidays | 9.7 | 6.6 | 10.2 |
| Christmas Holiday | 5.7 | 2.8 | 5.6 |
| Drop in pollution during holidays | 41% | 57% | 44% |

Table 5 – Comparison of pollutant concentrations between the February half term and the weeks immediately before and after.

| | Pollutant average concentration / µg/m$^3$ | | |
|---|---|---|---|
| | $NO_2$ | $PM_{2.5}$ | $PM_{10}$ |
| Periods before and after February half term | 8.8 | 8.9 | 13.9 |
| February half term | 6.6 | 5.6 | 8.6 |
| Drop in pollution during holidays | 26% | 38% | 38% |

Table 6 – Comparison of pollutant concentrations between Easter holidays and the weeks immediately before and after.

| | Pollutant average concentration / µg/m$^3$ | | |
|---|---|---|---|
| | $NO_2$ | $PM_{2.5}$ | $PM_{10}$ |
| Periods before and after Easter holidays | 6.5 | 6.8 | 10.3 |
| Easter holidays | 7.0 | 5.6 | 8.2 |
| Drop in pollution during holidays | 7% Higher | 17% | 20% |

Tables 4, 5 and 6 show that during the Christmas and February half term holidays levels of nitrogen dioxide were lower in holiday periods when compared to the surrounding weeks, although during the Easter holidays nitrogen dioxide was recorded as slightly higher.

On average the reduction in nitrogen dioxide concentrations during the holidays was approximately 20%, whilst reductions in $PM_{2.5}$ were on average 37% and $PM_{10}$ was 34%.

The reductions in nitrogen dioxide could be a result of less traffic at the school during the holiday period as nitrogen dioxide concentrations are closely associated with vehicle exhaust emissions. However, the greatest reduction was recorded during the Christmas holidays when traffic is generally significantly reduced and a rise in nitrogen dioxide was recorded during the Easter holidays. It is therefore difficult to draw any strong conclusions with regards to the concentrations of nitrogen dioxide.

For particulate matter, significant reductions were recorded during all holiday periods. Although exhaust emissions do contribute to PM pollution, there are other sources and pollution events that tend to have a more significant influence and are more regional rather than localised. In this case, we don't believe that the reduced PM pollution levels are wholly related to a reduction in school traffic, although this may have a contributed.

## Short term PM events

As noted above, Particulate Matter pollution is normally dominated by regional events rather than local circumstances. When comparing results from monitors across the district the readings follow very similar results that show consistent trends and concentrations of particulate pollution. However, when a local pollution event, such as a bonfire or chimney smoke, occurs this can be identified by comparing results from several monitors and looking for short term 'spikes' in PM levels.

Figures 9 and 10, below show data from four monitors (three SCDC Zephyrs at Shelford, Girton, Barton and a DEFRA operated background monitor located at Wicken Fen in East Cambridgeshire) for periods covering 27 to 30 January and 1 to 5 of March 2024. On Figure 9 local pollution events can be seen during the afternoon of the 28 January and late morning on the 29 January. On Figure 10, short term local events can be identified at Barton in the early hours of 1 March and 5 March and late afternoon on the 3 and 5 March. Regional events can also be identified where levels increase at all monitors at the same time for a more extended period.

Figure 9: Comparison of $PM_{2.5}$ data from 27 to 30 January 2024 for four monitoring stations

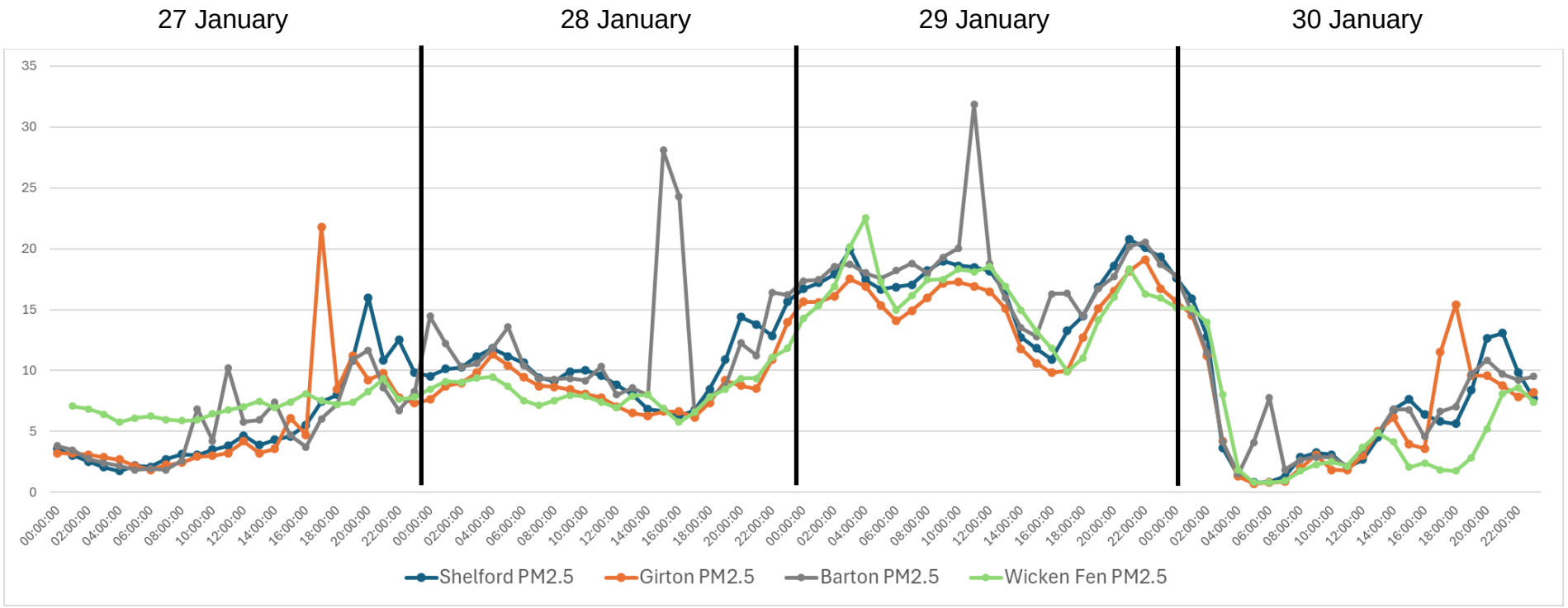
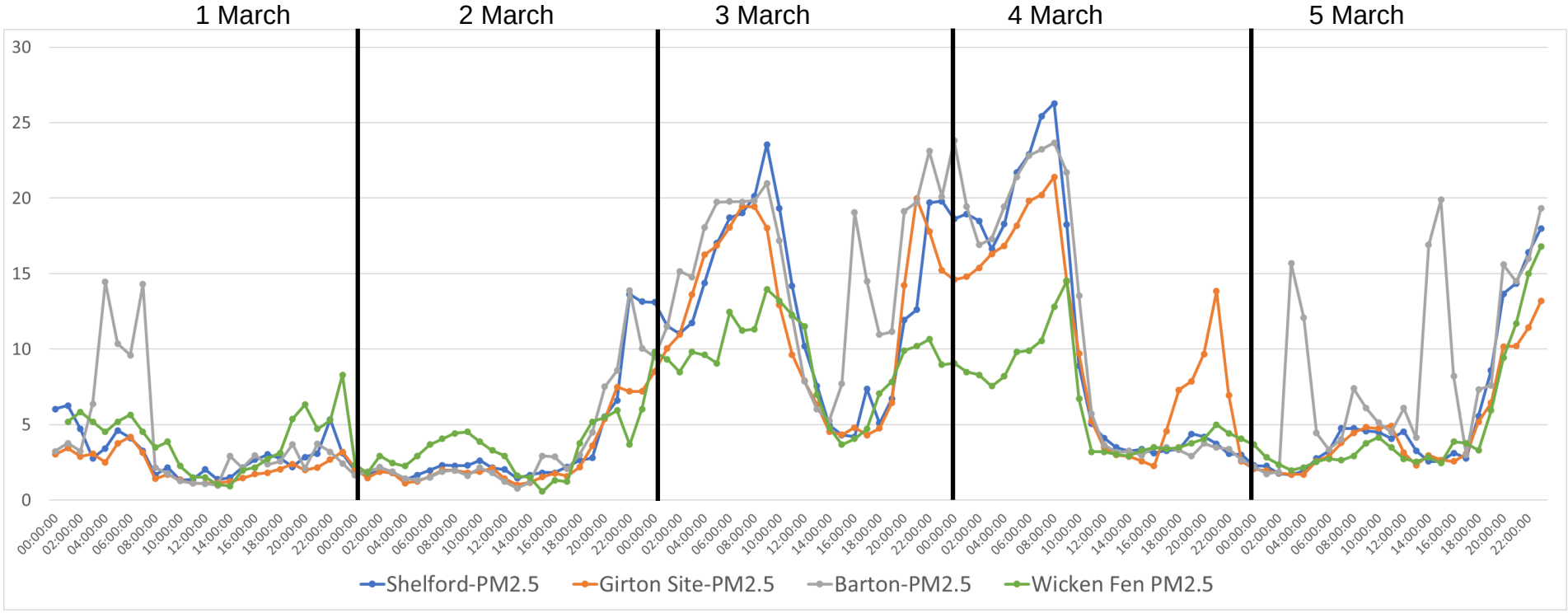


Figure 10: Comparison of $PM_{2.5}$ data from 1 to 5 March 2024 for four monitoring stations



## Summary

The data measured by the Zephyr real-time monitor in the period December 2023 to April 2024 shows that the air quality around Barton Primary School is good, with estimated annual mean concentrations of the main pollutants of concern well below all of the relevant national objectives. Nitrogen dioxide and $PM_{10}$ were also below the highly ambitious WHO guideline values. $PM_{2.5}$ was slightly above the WHO guideline value, however, over 90% of the worlds population live in locations where this is exceeded and this should not be taken as being poor air quality. There were no exceedances of the short-term national objectives.

It was found that concentrations of all the pollutants were lower during the school holidays (except for nitrogen dioxide during the Easter holidays, which was slightly higher). It was difficult to be conclusive, however, the reduction in pollutants could have been in part due to the reduced levels of school traffic.

When compared to other local monitoring stations, short term pollution events were identified by sudden increases in particulate matter pollution. These are likely to be caused by local sources such as domestic solid fuel burning or bonfires.

The data from the Zephyr was generally consistent with that from the rest of the monitoring sites in the district during the monitoring period, which provides confidence in the instrument. This also matches the general patterns seen across the South Cambridgeshire district of good air quality. However, due to the importance of air quality and its links to health, even at very low levels, it remains important to both monitor air quality across the district and take actions to improve air quality in our area.

Ideas on how to play a role in improving local air quality can be found in Appendix 2.

# Appendix 1 – Air Quality Frequently Asked Questions

## Why is air quality important?

There are a number of reasons air quality is important. In particular, polluted air is the biggest environmental threat to health in the UK. It is linked to up to 36,000 deaths per year from long-term exposure. The main impacts of poor air quality are contributing to heart and lung conditions, but air quality has also been linked to a wide range of issues. Air pollution also particularly effects the most vulnerable, including children and older people and those with existing lung and heart conditions. Air quality also strongly links to climate change, as many of the causes of the issues are the same, such as the burning of fossil fuels. This means that actions taken to improve air quality also helps prevent climate change.

## How does the Council monitor air quality?

South Cambridgeshire District Council operates a monitoring network of around 40 locations across the district, made up of diffusion tubes and three continuous monitoring sites, which measure air quality accurately in real-time. This existing monitoring network allows the long-term monitoring of trends and changes in air quality across the district. Live data from the three continuous monitoring stations are available at https://scambs-airquality.ricardo-aea.com/. In addition, the Council has purchased three Zephyr air quality sensors which provide real-time measurements for the main pollutants of concern from a single monitor. These can be used for shorter-term monitoring to identify hotspots of pollution or be used in a range of targeted studies to complement our existing monitoring network. The first of these instruments was installed in Harston, with subsequent monitors installed in Swavesey, Northstowe, Histon and most recently Swavesey.

## What else does the Council do around air quality?

As well as monitoring air quality, the Council acts to improve air quality through its Green to the Core focus, including an air quality strategy designed to go beyond simply meeting the national objectives, Zero Carbon Community Grants to fund community initiatives to improve sustainability, such as encouraging and enabling cycling which in turn helps air quality, and by considering air quality during the planning process[5,6]. Ideas on how anyone can play a role in improving local air quality can be found in Appendix 2 – How to get Involved with Local Air Quality.

## What are the main pollutants of concern?

The main pollutants of concern are:

- Nitrogen Dioxide ($NO_2$) – a gas predominantly formed following the burning of fossil fuels, which can cause irritation of the airways and exacerbate symptoms of other conditions
- Particulate Matter ($PM_{10}$ and $PM_{2.5}$), where the number refers to the size of the particulates in micrometres – a mix of solid particles and liquid droplets of various sizes and composition, the smallest of which can get into the blood and be transported around the body[7]

## What are the air quality objectives?

For $NO_2$ and $PM_{10}$ national objective levels have been set which must be achieved by local authorities, otherwise an Air Quality Management Area (AQMA) must be declared for the objective which is being exceeded. Objectives have been set for both long-term concentrations (measured as annual means) and short-term concentrations (hourly means for $NO_2$ and daily means for $PM_{10}$). South Cambridgeshire District Council does not currently have any AQMAs, although there has historically been an AQMA along a stretch of the A14, which was revoked in early 2022 due to sustained compliance with the relevant objectives in line with Defra guidance and the Council's constitution. The Air Quality Objectives applicable to local authorities through the Local Air Quality Management (LAQM) requirements in England are set out in Table 7. In addition, local authorities are expected to work towards reducing emissions and concentrations of $PM_{2.5}$ (particulate matter with a diameter of 2.5 µm or less), although there is currently no legal objective for local authorities, a national target, to be achieved by 2040, of 10µg/$m^3$ has been set with an associated exposure reduction target of 35% by 2040 (on a 2018 baseline).

Table 7 – Air Quality Objectives in England

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

# Appendix 2 – How to get Involved with Local Air Quality

Annual reports and details on air quality monitoring are available on our website, https://www.scambs.gov.uk/environment/pollution/air-pollution/local-air-quality-management/, and you can share your views via our email address, air.quality@scambs.gov.uk.

Although air quality in the South Cambridgeshire District is generally good, with concentrations below the objectives, there are actions we can all take to improve it further. Ways you can help to improve air quality in South Cambs include:

- Minimise car use wherever possible:
    - Avoid using your car for short trips (under 2 miles) - short trips are very polluting as modern engines needs to reach a very high temperature to work efficiently; on short trips it won't reach that temperature.
    - For short journeys try cycling or walking more often – this helps you stay healthy and saves you money in fuels costs.
    - For longer journeys consider public transport options.
    - Use journey-planning apps such as MyBusTrip or MotionMap for travel by bus, train, walking and cycling.
- Switch it off – don't leave your car engine idling if you are stationary e.g. waiting to pick someone up, in a traffic jam or waiting at level crossings.
- When driving, use techniques that help you use less fuel, like driving more slowly and smoothly .
    - You could use 10% less fuel by following the tips on the AA website http://www.theaa.com/motoring_advice/fuels-and-environment/drive-smart.html.
    - Like switching your engine off when stationary, this will not only reduce your emissions of air pollution but will save fuel and therefore money too!
- Consider making your next vehicle an electric vehicle.
- Join a car club or car-share regularly.
- Consider working at home where possible – the first Covid-19 lockdown showed widespread improvements in the air quality as the amount people travelled reduced.
- Use less energy at home – consider a smart meter to monitor usage and be aware of boiler standards.
- Opt for 'green energy' tariffs where available or switch to renewable sources of heating or power.
- Reduce the use of solid fuel stoves and open fires – domestic burning is now the single biggest source of particulate matter pollution in the UK (greater than traffic and industry).
    - If you are burning wood or coal ensure any fuel used meets the new standards of moisture content and emissions – more information is available at https://woodsure.co.uk/are-you-ready-to-burn/
- Make your children aware of the impact that day to day activities have on air quality.

# Appendix 3 – Annualisation of short-term data

Annualisation is a calculation process used to estimate an average concentration for a full year from a shorter period, such as the 6 months in this study. Annualisation ratios are worked out as a ratio of the average concentration in a full year (annual mean (Am)) to the average in the actual monitoring period measured (period mean (Pm)), using data from background continuous sites. The average concentration from the Zephyr data during the monitoring period is then multiplied by that ratio to give an estimate of the average concentration at the Zephyr for a full year.

The data from the period January to June 2022 was annualised according to the process set out in box 7.9 of Defra's Local Air Quality Management Technical Guidance (TG16). Continuous monitoring background sites were used for the annualisation calculations. A full year from 1 March 2022 to 28 February 2023 was used for the annual mean concentrations as the monitoring covered two calendar years.

$NO_2$:

| Background Site | Annual mean (Am) | Period mean (Pm) | Ratio (Am/Pm) |
|---|---|---|---|
| Wicken Fen | 4.8 | 5.3 | 0.91 |
| Northampton Spring Park | 9.2 | 10 | 0.92 |
| Norwich | 8.2 | 8.3 | 0.99 |
| Average ratio | - | - | **0.94** |

$PM_{10}$:

| Background Site | Annual mean (Am) | Period mean (Pm) | Ratio (Am/Pm) |
|---|---|---|---|
| Wicken Fen | 9.9 | 8.4 | 1.18 |
| Norwich | 11 | 10.3 | 1.07 |
| Average Ratio | - | - | **1.12** |

$PM_{2.5}$:

| Background Site | Annual mean (Am) | Period mean (Pm) | Ratio (Am/Pm) |
|---|---|---|---|
| Wicken Fen | 5.7 | 5.7 | 1 |
| Northampton Spring Park | 7.2 | 8.4 | 0.85 |
| Norwich | 6.9 | 6.8 | 1 |
| Average ratio | - | - | **0.95** |