



**South
Cambridgeshire
District Council**



Short-term air quality in Northstowe

March 2022



Executive Summary

Air quality was monitored in Northstowe using new Zephyr monitoring technology in the period July 2021 to January 2022 as part of a study into air quality around primary schools. Monitoring was carried out outside The Pathfinder C of E Primary School, as it is recognised that children are among the most vulnerable to the impacts of air pollution. Northstowe was selected as a monitoring site as it is located in an area of ongoing growth and development as part of a new town. 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. This is in line with long-term concentrations measured across the South Cambridgeshire district and reflects the rural nature of the area. For nitrogen dioxide, concentrations were lower during school holiday periods than term time, likely reflecting reduced school traffic. For particulate matter, there was less pattern to the differences between school holidays and term time, likely suggesting local construction work is probably the main source of particulate matter rather than road traffic. 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. 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 (NO₂) – 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 PM₁₀) – 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.

Real-time monitoring – see also continuous monitoring – monitoring which takes place at regular intervals all the time and therefore can give a concentration attributed to a specific time.

µg/m³ – 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.



Update on Zephyr monitor in Northstowe

Introduction

Purpose of this report

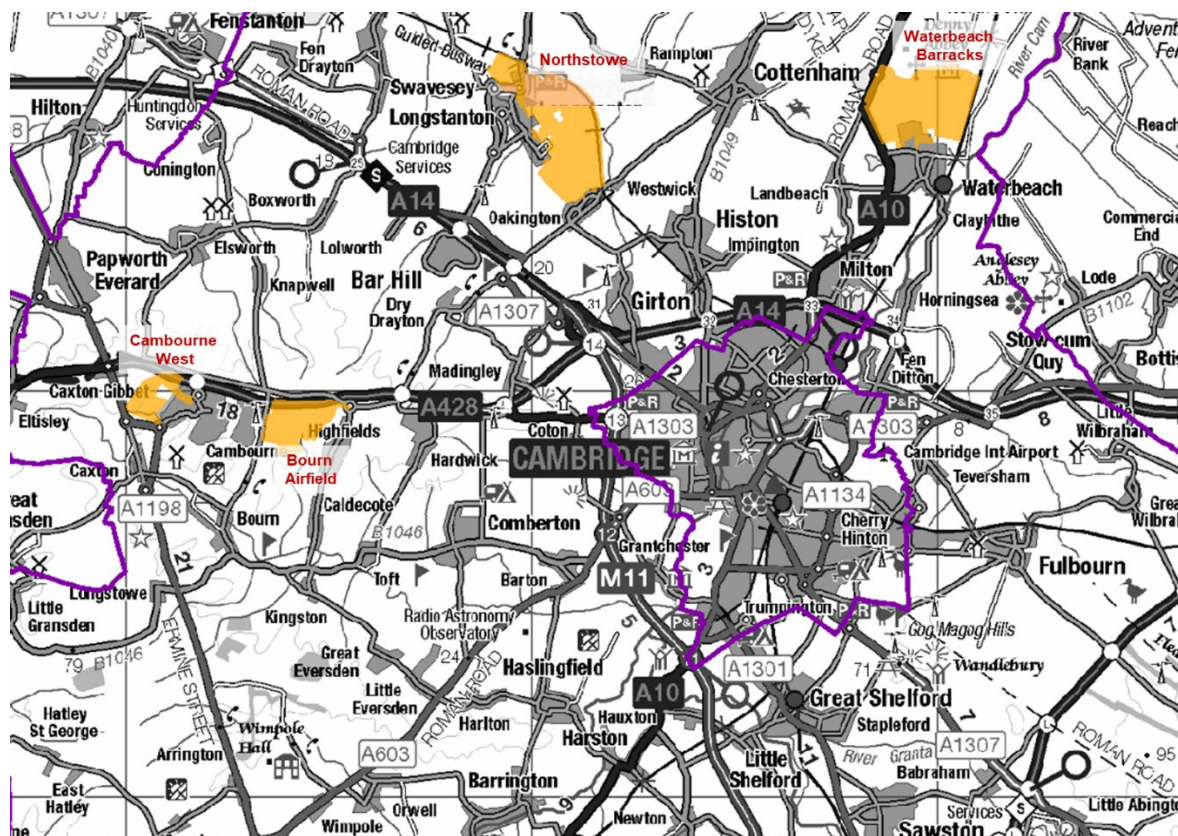
This is a report to provide an update on the short-term air quality monitoring study in Northstowe using new Zephyr monitoring technology. Monitoring was carried out in the period July 2021 to January 2022. The study was designed to be a short-term study monitoring air quality outside The Pathfinder C of E 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. This means we benefit from cleaner air to breathe and less pollution related health problems. The area is undergoing significant growth with major developments to keep up with the increase in demand for housing, including Northstowe (10,000 dwellings), Waterbeach Barracks (6000 to 10,000 dwellings), Bourn Airfield and Cambourne West, shown in Figure 1. Air quality impacts in the district are mainly related to these areas of growth and the major roads running through the district, including the A14 and M11/A11 corridors, and therefore this remains an important issue.



Figure 1. Locations of Major Development sites in South Cambridgeshire



Air quality is an important topic as air pollution can impact our health, particularly affecting the most vulnerable, including children and those with underlying conditions. 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 to be used for short term monitoring. 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 (NO₂ and PM₁₀ and PM_{2.5} particulate matter). 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 individually or deployed as a network of sensors across a wider area to build up a more detailed picture.¹

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 therefore appropriate for a wide range of studies, including this.

Monitoring Location

Northstowe was selected as part of a council study looking into air quality around schools. The Pathfinder C of E Primary School was chosen as it is a primary school located in one of the areas of major growth in the district as part of Northstowe new town. 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](https://www.cleanairday.org.uk/) in 2021 of 'protect our children's health from air pollution'². 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.

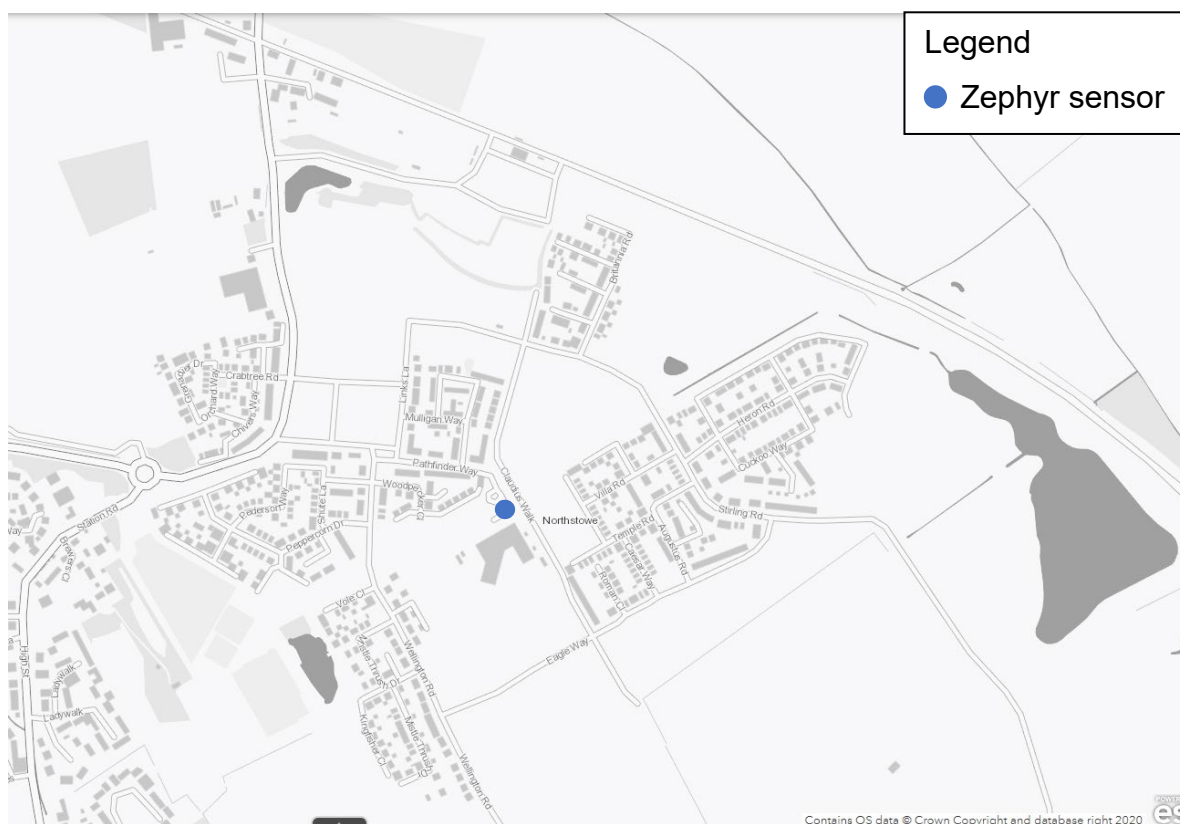
¹ <https://www.earthsense.co.uk/zephyr>

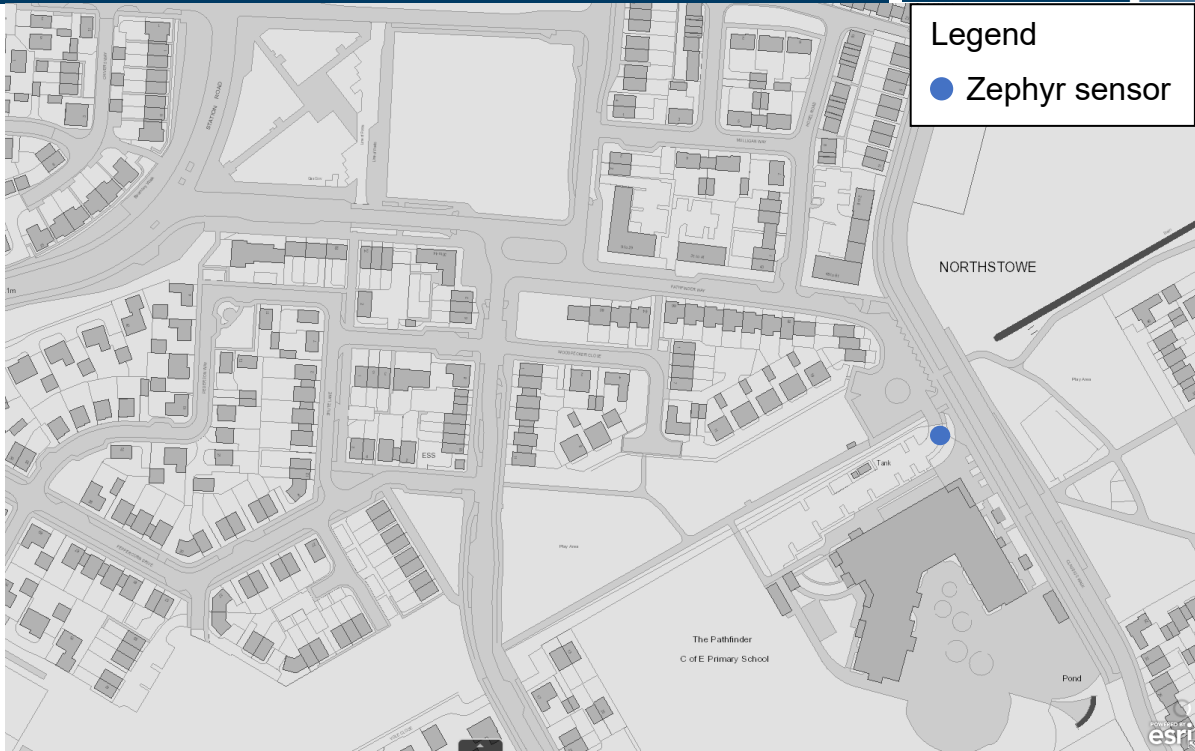
² <https://www.cleanairday.org.uk/>



The monitor was located on a lamp post within the school grounds of The Pathfinder C of E Primary School, just inside the school gate. It measured the main pollutants of concern, nitrogen dioxide (NO₂) and particulate matter (PM₁₀ and PM_{2.5}), among others. The location of the Zephyr can be seen on Figure 2, below.

Figure 2. Location of the Zephyr sensor in Northstowe







Monitoring Data and Comparison with Objectives

The average monthly concentrations measured in the period July 2021 to January 2022 are shown in Table 1, below, with the annual mean objective shown for information. The exact date range was from 12 July to 31 January, which followed an initial 'settling in' period of the instrument. This data is also represented in Figure 3. There were a small number of occasions where there were instrument errors, confirmed by the manufacturer as where power was lost followed by a 'warm-up' spike in data as the instrument regained power, similar to the initial settling in period. The data resulting from these spikes was confirmed as invalid by comparison to the data from the continuous monitors in the district as well as other zephyrs in the same time period. Therefore, as per the Defra guidance in Technical Guidance TG16³, it was decided not to include these instrument error spikes and a short period of time after to allow the instrument to return to normal operation (48-hours).

Table 1. Zephyr Air Quality data – monthly average concentrations

Month	Pollutant monthly average concentration / $\mu\text{g}/\text{m}^3$		
	NO ₂	PM ₁₀	PM _{2.5}
July 2021*	7.9	16.4	14.9
August 2021	5.5	20.4	18.6
September 2021	7.1	19.8	17.4
October 2021	8.1	12.6	10.3
November 2021	13.0	17.7	14.1
December 2021	16.0	13.3	8.9
January 2022	16.4	16.8	12.3
Objective (annual mean)	40	40	25 [†]

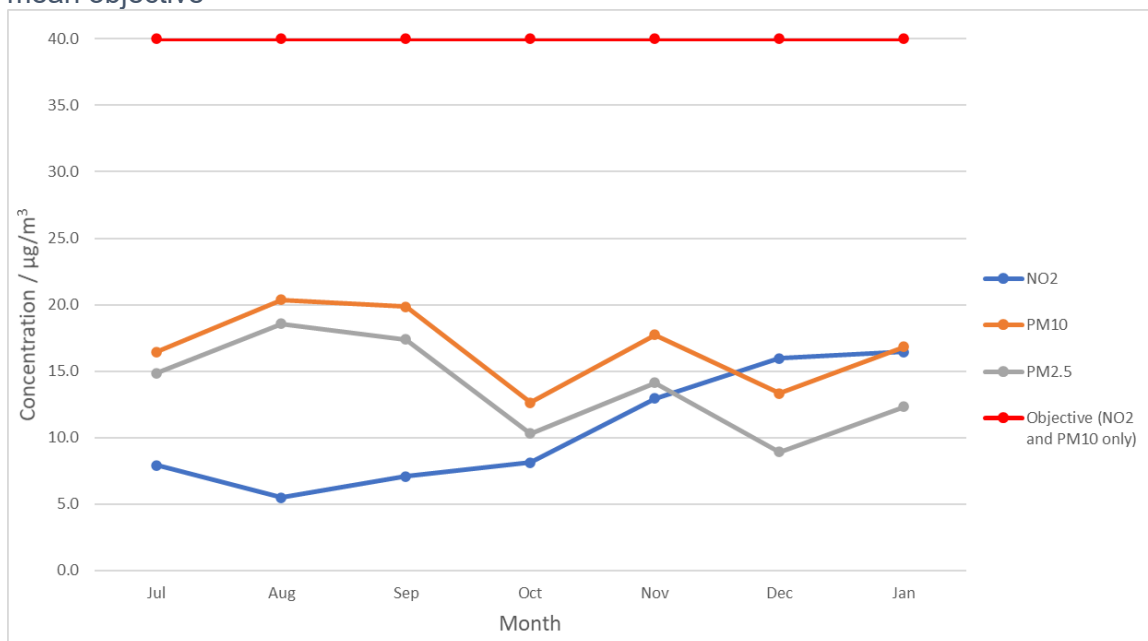
* 12/7/2021 – 31/7/2021

† not part of the Local Air Quality Management (LAQM) requirements

³ Defra Local Air Quality Management (LAQM) Technical Guidance TG(16), 2018, <https://laqm.defra.gov.uk/documents/LAQM-TG16-February-18-v1.pdf>

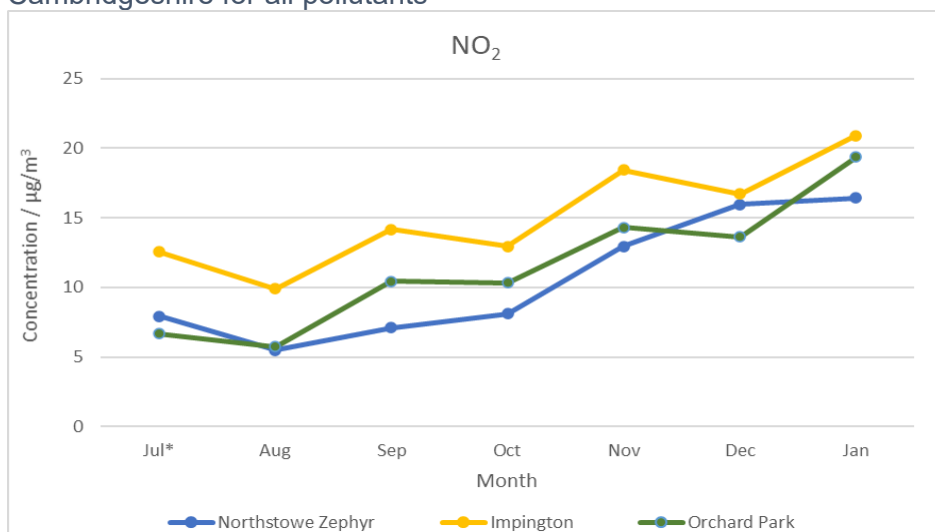


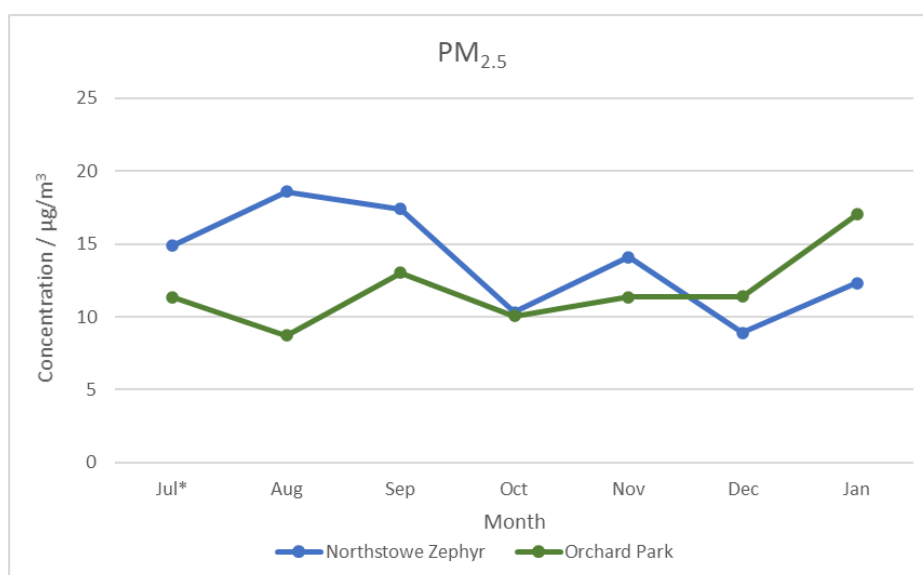
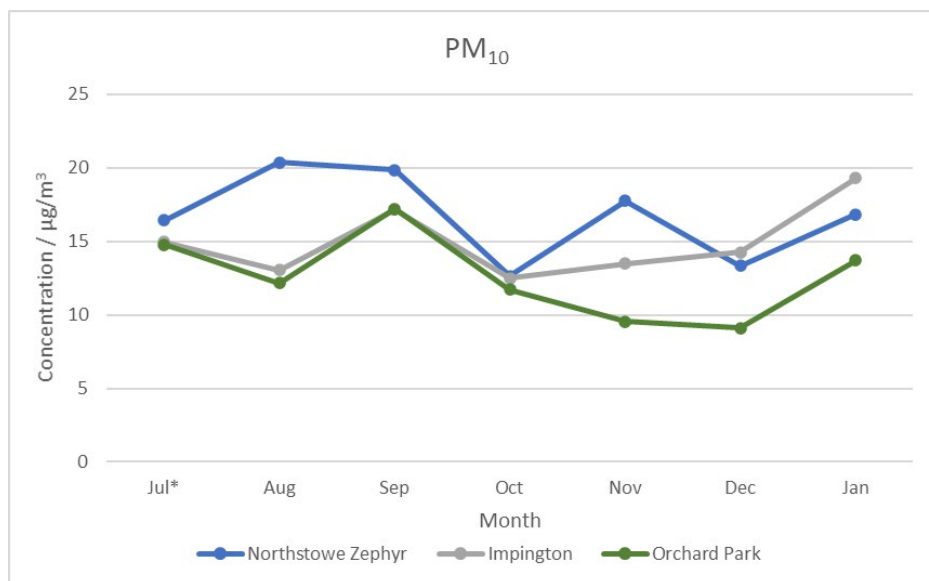
Figure 3. Zephyr Air Quality data – monthly average concentrations and national annual mean objective



The data recorded in Northstowe was also compared to that recorded in the same monitoring period by the Council's automatic monitoring stations for each pollutant. As shown in Figure 4, below, the data and trends recorded by the Northstowe Zephyr are generally 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 4. Comparison of Northstowe Zephyr data to automatic monitoring sites in South Cambridgeshire for all pollutants





In addition, the average concentrations of each pollutant for the entire monitoring period July 2021 to January 2022 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 six 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 2021 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 Air Quality Data – annualised annual mean concentrations – 2021 annual mean

–	Pollutant average concentration / $\mu\text{g}/\text{m}^3$		
	NO ₂	PM ₁₀	PM _{2.5}
Measured data average Jul 2021 – Jan 2022	10.6	16.7	13.7
Annualisation factor	0.92	0.99	0.99
Annualised annual mean – Northstowe Zephyr	9.8	16.5	13.6
Objective (annual mean)	40	40	25*

*not part of the Local Air Quality Management (LAQM) requirements

As shown in Table 1 and Table 2, the long-term annual mean concentrations of the main pollutants of concern at the Northstowe Zephyr are significantly below the national objectives for NO₂ and PM₁₀, indicating good air quality. The PM_{2.5} concentration is above the ambitious World Health Organisation guidelines announced in September 2021, although it remains well below the current UK objective of 25 $\mu\text{g}/\text{m}^3$ (this objective does not form part of the Local Air Quality Management regime which covers local authorities).

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 NO₂ and 24-hour means for PM₁₀. 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
July 2021	0	0
August 2021	0	0
September 2021	0	0
October 2021	0	0
November 2021	0	0
December 2021	0	0
January 2022	0	0
Objective	200 µg/m ³ *	50 µg/m ³ **

*Not to be exceeded more than 18 times a year

**Not to be exceeded more than 35 times per year

As shown in Table 3, there were no exceedances of the short-term objectives for NO₂ or PM₁₀. The relevant maximum short-term concentrations of the pollutants were also recorded. For NO₂ the maximum 1-hour concentration measured during the six-month period was 62.7 µg/m³, which occurred on 12 December. It is not clear what caused this as it occurred at a weekend and is therefore unlikely to be due to rush hour traffic, however this is well under the 200 µg/m³ threshold and was the only 1-hour concentration above 60 µg/m³ recorded. For PM₁₀, the maximum 24-hour concentration recorded was 41.1 µg/m³, recorded on 9 September, which is below the 50 µg/m³ objective. This was the only occasion a concentration over 40 µg/m³ was recorded. This was at the end of a spell of warm weather and high pressure in England at the beginning of September and is likely a reflection that high pressure leads to still air, which allows pollutant levels to build up without being dispersed by wind or rain, leading to higher concentrations. This is the same date that the maximum PM₁₀ concentration was recorded on during monitoring in Cambourne for another completed study. This highlights that this was a time of higher pollution on a wider scale and that regional or national effects have a



significant impact on particulate matter. The full report on monitoring at Cambourne can be found on our website.

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: summer holidays (23 July to 2 September 2021), October half-term (22 to 29 October 2021) and the Christmas holidays (20 December 2021 to 4 January 2022). These are presented in Table 4, Table 5 and Table 6 respectively.

Table 4 Comparison of pollutant concentrations between term time and the summer holidays

Period	Pollutant average concentration / $\mu\text{g}/\text{m}^3$		
	NO ₂	PM ₁₀	PM _{2.5}
Term time	12.3	16.2	13.0
Summer holidays	5.7	19.7	17.8
Reduction from term time (%)	53.7	-21.3	-37.0

Table 5 Comparison of pollutant concentrations between term time and October half term

Period	Pollutant average concentration / $\mu\text{g}/\text{m}^3$		
	NO ₂	PM ₁₀	PM _{2.5}
Term time	12.3	16.2	13.0
October half term holiday	7.8	9.5	8.1
Reduction from term time (%)	36.4	41.6	38.0

Table 6 Comparison of pollutant concentrations between term time and the Christmas holidays

Period	Pollutant average concentration / $\mu\text{g}/\text{m}^3$		
	NO ₂	PM ₁₀	PM _{2.5}
Term time	12.3	16.2	13.0
Christmas holiday	11.8	16.6	11.2
Reduction from term time (%)	3.4	-2.0	14.2



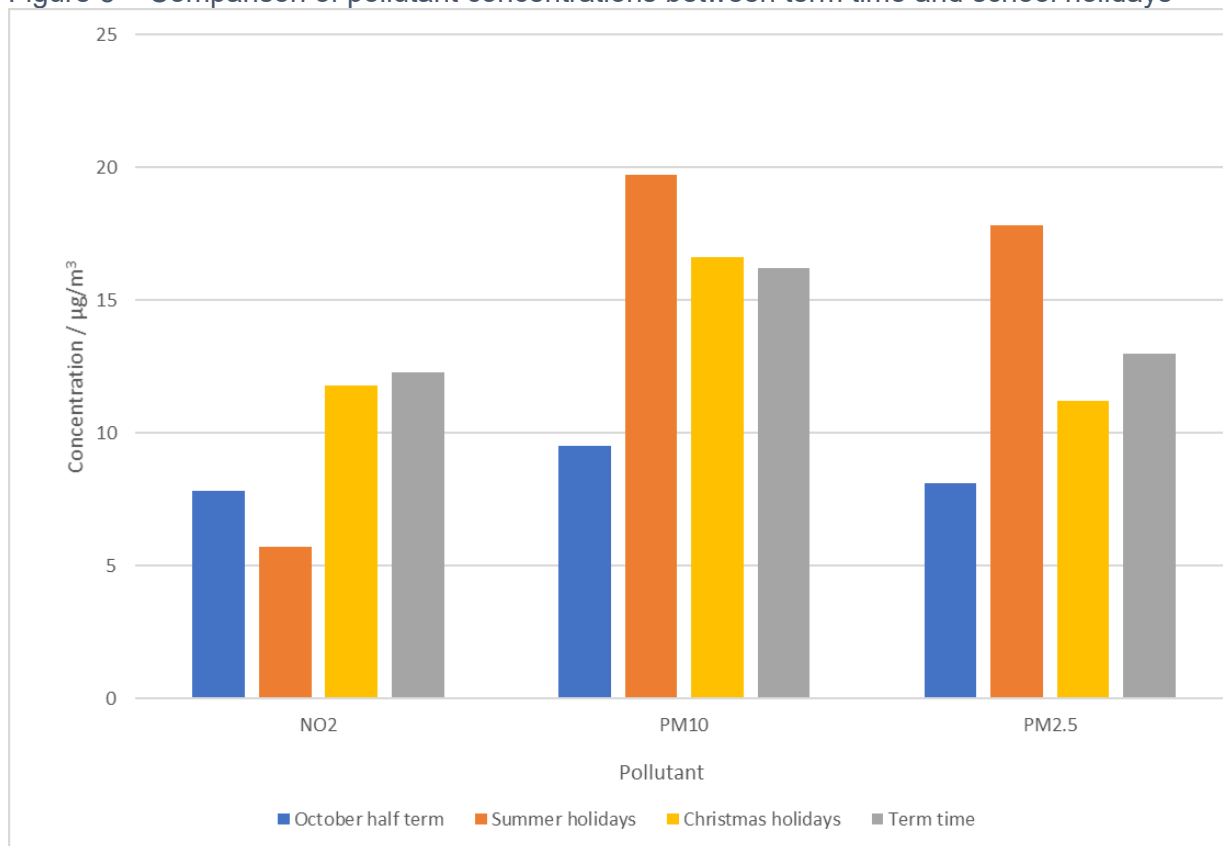
As shown in Tables 4, 5 and 6, concentrations for nitrogen dioxide (NO₂) were lower in all school holiday periods compared to term time. However, a smaller reduction in the concentration was seen in the Christmas holidays compared to the other holidays (a reduction of 3.4% compared to 53.7% in the summer holidays and 36.4% in October half term). This suggests that traffic related to the school likely has a significant impact on the concentrations of NO₂, although the differences in the reductions in concentration seen suggests other factors such as weather conditions during these periods may also have played a role. This reflects that NO₂ is the pollutant most impacted by road traffic.

For particulate matter (PM₁₀ and PM_{2.5}) however, there was less pattern in the differences between term time and school holidays, with concentrations higher in the summer holidays than term time but much lower during October half-term. This is likely because, as a growing new town currently under development, there is significant construction work ongoing in Northstowe. Combined with the fact the school is not located immediately next to a busy road, it is therefore likely that this is the main source of particulate matter in this area rather than traffic, and this construction work is not impacted by school holiday periods.

The data from Tables 4-6 is also presented in figure 5, below.



Figure 5 – Comparison of pollutant concentrations between term time and school holidays



Summary

The data measured by the Zephyr real-time monitor in the period July 2021 to January 2022 shows that the air quality in Northstowe remains good, with estimated annual mean concentrations (as well as the measured monthly averages) of the main pollutants of concern well below the national objectives. There were no exceedances of the short-term national objectives. It was found that concentrations of nitrogen dioxide, the pollutant most impacted by local traffic, were lower during the school holidays than term time. This likely highlights the impacts of school related traffic and the potential air quality benefits of cycling and walking over driving. For particulate matter, both PM_{10} and $\text{PM}_{2.5}$, there was less pattern in the differences in concentration between term time and school holidays, with concentrations higher in some holidays and lower in others. This is likely to reflect that due to ongoing construction in the area as a developing new town this is probably the main source of particulate matter locally rather than road traffic. 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, 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 – How to get Involved with Local Air Quality.



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 exposure⁴. 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 issues⁵. Air pollution also particularly affects 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 over 30 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

⁴ Defra. Air quality appraisal: damage cost guidance, July 2020

⁵ Public Health England. Air Quality: A Briefing for Directors of Public Health, 2017



instruments was installed in Harston, with subsequent monitors installed in Cambourne, Northstowe, Histon and, most recently, Swavesey.

What else does the Council do around air quality?

As well as monitoring air quality, we act to improve air quality through our 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^{6,7}. 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 (NO₂) – 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 (PM₁₀ 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 body⁸

What are the air quality objectives?

For these pollutants 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

⁶ Being green to our core <https://www.scambs.gov.uk/your-council-and-democracy/performance-and-plans/our-business-plan/>

⁷ Zero Carbon Communities Grant <https://www.scambs.gov.uk/community-development/grants/zero-carbon-communities-grant/>.

⁸ Defra, Clean Air Strategy, 2019



both long-term concentrations (measured as annual means) and short-term concentrations (hourly means for NO₂ and daily means for PM₁₀). South Cambridgeshire District Council currently had one AQMA, along the A14 between Bar Hill and Milton, which was declared in 2008 for NO₂ annual mean and PM₁₀ 24-hour mean. This AQMA 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 for 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.

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

If air pollution is a result of vehicles utilising the A14, how can local residents change this?

There are a number of way local residents can have an impact on air quality through everyday actions. Many of these are very small changes that can add up to a big impact.



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 need 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 fuel 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, for example, 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 of 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://woodsurre.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 approximately 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 July 2021 to January 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. Full year data for 2021 was used for the annual mean concentrations.

NO₂:

Background Site	Annual mean (Am)	Period mean (Pm)	Ratio (Am/Pm)
Wicken Fen	5.8	6.3	0.91
Northampton Spring Park	10.1	11.1	0.91
Norwich Lakenfields	9.9	10.4	0.95
Average ratio	-	-	0.92

PM₁₀:

Background Site	Annual mean (Am)	Period mean (Pm)	Ratio (Am/Pm)
Orchard Park	12.4	12.6	0.98
Norwich Lakenfields	13.0	13.0	1.00
Average ratio	-	-	0.99



PM_{2.5}:

Background Site	Annual mean (Am)	Period mean (Pm)	Ratio (Am/Pm)
Orchard Park	11.8	11.7	1.01
Northampton Spring Park	10.4	10.5	0.98
Norwich Lakenfields	8.5	8.7	0.99
Average ratio	-	-	0.99