

Annual Progress Report (APR)



2022 Air Quality Annual Progress Report (APR) for Stirling Council

In fulfilment of Part IV of the Environment Act 1995

Local Air Quality Management 05 December 2022

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Executive Summary: Air Quality in Our Area

Air Quality in Stirling Council

This Annual Progress Report provides an overview of air quality in the Stirling Council area. Air quality monitoring was performed at the automatic monitoring station on Craig's Roundabout in the City of Stirling (measuring nitrogen dioxide (NO₂) and particulate matter (PM_{2.5} and PM₁₀)), and passive monitoring for NO₂, using diffusion tubes at 12 sites in the wider urban area.

Based on the available monitoring data for NO₂, PM_{2.5} and PM₁₀ there were no exceedances of the relevant Air Quality Objectives and it is unlikely that they will be exceeded in the near future. Therefore, it is not considered necessary to declare an AQMA in the Stirling area.

Actions to Improve Air Quality

When we breathe polluted air, pollutants get into our lungs, they can enter the bloodstream and be carried to our internal organs such as the brain. This can cause severe health problems such as asthma, cardiovascular diseases and even cancer and reduces the quality and number of years of life. Vulnerable groups, namely children, people with chronic diseases, and the elderly, are particularly sensitive to the dangerous effects of toxic air pollution and so it is critical that human health and the environment are protected. Stirling Council has a number of initiatives and actions to improve air quality, such as, a sustainable transport strategy, a comprehensive monitoring programme and developmental control requirements.

Stirling Council has partnered with East Central Scotland Vehicles Emissions Partnership, which is a coalition of East Lothian, Falkirk, Midlothian and West Lothian Councils. The aim is to actively deal with reports from members of the public who identify idling vehicles. The remit of the Vehicles Emissions Partnership is to reduce

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vehicle emissions by encouraging drivers to switch off their engines and handle idling complaints. Further information can be found at:

<http://switchoffandbreathe.org/about/>

As part of the Sustainable Growth Agreement Actions, Stirling Council procured mobile air quality monitoring equipment called Zephyrs. The Zephyr is a compact and lightweight air pollution sensor measuring NO₂, NO, O₃, PM₁, PM_{2.5} and PM₁₀. Stirling Council purchased 10 Zephyr units and located them across urban areas of Stirling. Locations chosen (traffic junctions close to schools) can be used to determine trends in pollutant levels during school hours with the aim of spreading awareness to local schools regarding air quality.

Stirling Council has significantly increased the fleet of electric vehicles and installed additional charging bays.

New development in the Stirling Area is a key issue affecting air quality. Where relevant, development applications are requested to submit an Air Quality Impact Assessment to allow for the potential impact to be assessed and any necessary mitigation measures to be applied. Applications that this assessment, are those that include biomass installations and increased traffic emissions such as major housing developments.



Stirling Councils Local Transport Strategy (LTS) establishes a long-term strategic vision for transport management, provision and services, and sets out how Stirling Council will work to promote and deliver sustainable travel and transportation. Routine reviews of the LTS, and the

associated consultations, have identified that progress towards achieving many of the objectives is largely positive.

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The Local Transport Strategy is delivered via a number of supporting plans including the City Transport Plan 2013; the Towns, Villages and Rural Transport Plan 2014; and the Walking and Cycling to a Healthier Stirling: Active Travel Action Plan. The Active Travel Plan focuses on encouraging walking and cycling through improving infrastructure and changing behaviours via training and promotion activities.

Stirling Councils Sustainable Development Strategy establishes a collective vision to balance the needs of its communities and businesses with the needs of the environment. The strategy establishes objectives which focus on five main areas: energy, transport, sustainable eco-systems, sustainable resource/waste management and climate change adaptation. This includes reducing fuel poverty levels to zero by 2040; Stirling City Centre Emissions Free Zones by 2030; 40% natural vegetation cover by 2040; Zero Waste City by 2040; and 80% reduction in carbon emissions by 2050.



Stirling Council actively participates in and promotes the Cycle to Work Scheme and the NextBikes cycle hire scheme, encouraging staff to use sustainable methods of transport for both commuting and work purposes.

A number of Schools within the Stirling Council area deliver the Level 1 Bikeability Scotland Cycle Training, providing children with the skills, confidence and encouragement to cycle safely on the roads. Further information can be found at:

<http://www.bikeabilityscotland.org/>

Stirling Council are part of the Tactran Electric Vehicle Steering Group and have contributed to the Regional Electric Vehicle Strategy which was published at the end

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of 2019. Tactran stand for the Tayside and Central Scotland Transport Partnership and has the primary purpose of developing a regional transport strategy setting out a vision for the medium to long term future of transport in the area and to oversee its implementation.

Local Priorities and Challenges

The anticipated growth in traffic volume is seen as a priority air quality issue and the above plans were developed to manage this issue into the future. The reports and other related documents can be viewed at: <http://my.stirling.gov.uk/services/transport-and-streets/transport-policy>

An ongoing priority that Stirling Council have is to continue to meet the national objectives as has been done through the comprehensive monitoring programme. It is felt that the challenges presented in 2020 have been overcome and that there should be no further disruption to the monitoring programme.

How to Get Involved

A number of local and national organisations exist to promote more active and sustainable travel and members of the public can access further information or become directly involved by following the links below:

<https://www.livingstreets.org.uk/who-we-are/scotland>

<http://www.sustrans.org.uk/scotland>

<http://www.stirlingcyclehub.org>

<http://nextbike.co.uk>

Members of the public who wish to access information and advice on air quality across Scotland can do so at: <http://www.scottishairquality.co.uk/>

Air quality data specific to the Stirling Council area can be found at:

http://www.scottishairquality.co.uk/latest/site-info?site_id=STRL

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1 Local Air Quality Management

This report provides an overview of air quality in Stirling Council during 2021. It fulfils the requirements of Local Air Quality Management (LAQM) as set out in Part IV of the Environment Act (1995) and the relevant Policy and Technical Guidance documents.

The LAQM process places an obligation on all local authorities to regularly review and assess air quality in their areas, and to determine whether or not the air quality objectives are likely to be achieved. Where an exceedance is considered likely the local authority must declare an Air Quality Management Area (AQMA) and prepare an Air Quality Action Plan (AQAP) setting out the measures it intends to put in place in pursuit of the objectives. This Annual Progress Report (APR) provides a summary of the work being undertaken by Stirling Council to improve air quality and any progress that has been made.

Table 1.1 – Summary of Air Quality Objectives in Scotland

Pollutant	Air Quality Objective Concentration	Air Quality Objective Measured as	Date to be Achieved by
Nitrogen dioxide (NO ₂)	200 µg/m ³ not to be exceeded more than 18 times a year	1-hour mean	31.12.2005
Nitrogen dioxide (NO ₂)	40 µg/m ³	Annual mean	31.12.2005
Particulate Matter (PM ₁₀)	50 µg/m ³ , not to be exceeded more than 7 times a year	24-hour mean	31.12.2010
Particulate Matter (PM ₁₀)	18 µg/m ³	Annual mean	31.12.2010
Particulate Matter (PM _{2.5})	10 µg/m ³	Annual mean	31.12.2021
Sulphur dioxide (SO ₂)	350 µg/m ³ , not to be exceeded more than 24 times a year	1-hour mean	31.12.2004
Sulphur dioxide (SO ₂)	125 µg/m ³ , not to be exceeded more than 3 times a year	24-hour mean	31.12.2004
Sulphur dioxide (SO ₂)	266 µg/m ³ , not to be exceeded more than 35 times a year	15-minute mean	31.12.2005
Benzene	3.25 µg/m ³	Running annual mean	31.12.2010
1,3 Butadiene	2.25 µg/m ³	Running annual mean	31.12.2003
Carbon Monoxide	10.0 mg/m ³	Running 8-Hour mean	31.12.2003

2 Actions to Improve Air Quality

2.1 Air Quality Management Areas

Air Quality Management Areas (AQMAs) are declared when there is an exceedance or likely exceedance of an air quality objective. After declaration, the authority must prepare an Air Quality Action Plan (AQAP) within 12 months, setting out measures it intends to put in place in pursuit of the objectives.

Stirling Council currently does not have any AQMAs and the results of past and present monitoring indicate that it will not be necessary to declare any AQMA's in the future.

2.2 Cleaner Air for Scotland 2

[Cleaner Air for Scotland 2 – Towards a Better Place for Everyone \(CAFS2\)](#) is Scotland's second air quality strategy. CAFS2 sets out how the Scottish Government and its partner organisations propose to further reduce air pollution to protect human health and fulfil Scotland's legal responsibilities over the period 2021 – 2026. CAFS2 was published in July 2021 and replaces [Cleaner Air for Scotland – The Road to a Healthier Future \(CAFS\)](#), which was published in 2015. CAFS2 aims to achieve the ambitious vision for Scotland "to have the best air quality in Europe". A series of actions across a range of policy areas are outlined, a summary of which is available on the Scottish Government's website.

Progress by Stirling Council against relevant actions for which local authorities are the lead delivery bodies within this strategy is demonstrated below.

2.2.1 Placemaking – Plans and Policies

Local authorities with support from the Scottish Government will assess how effectively air quality is embedded in plans, policies, City Deals and other initiatives, and more generally in cross departmental working, identifying and addressing evidence, skills, awareness and operational gaps.

2.2.2 Transport – Low Emission Zones

Local authorities working with Transport Scotland and SEPA will look at opportunities to promote zero-carbon city centres within the existing LEZs structure.

Stirling Council has an Active Travel Action Plan – Walking and Cycling to a Healthier Stirling which identifies ways Stirling Council intends to build upon, and promote, existing work to increase opportunities for walking and cycling across the Stirling area.

2.3 Progress and Impacts of Measures to address Air Quality in Stirling Council

Stirling Council has taken forward a number of measures during the current reporting year of 2021 in pursuit of improving local air quality. Details of all measures completed, in progress or planned are set out in Table 2.2. Key completed measures are:

- The procurement of 48 additional electric fleet vehicles.
- Stirling Council are part of the Tactran Electric Vehicle Steering Group and have contributed to the Regional Electric Vehicle Strategy.
- Through the development control process, when required, AQIA were requested as part of the consultation process.

Stirling Council expects the following measures to be completed over the course of the next reporting year:

- Four electric minibuses will be added to the fleet in 2022
- A further 18 public charging bays, 56 fleet charging bays and 1 dedicated bus charging bay will be delivered in 2022. With suitable infrastructure in place, it is hoped that people will be encouraged to consider changing to EV's and also bus and taxi companies to consider switching their vehicles to electric.
- The Electric Vehicle Policy will be presented to Council for approval in autumn 2022.

Table 2.1 – Progress on Measures to Improve Air Quality

Measure No.	Measure	Category	Focus	Lead Authority	Planning Phase	Implementation Phase	Key Performance Indicator	Target Pollution Reduction in the AQMA	Progress to Date	Estimated Completion Date	Comments
1	Fleet	Alternatives to private vehicle use	Procurement of additional fleet EV's.	Sustainable Development	Delivery	2020	45% vehicles registered by 2032		5.8%	2032	
2	EV Policy	Promoting low emission transport	Transition to a fossil fuel-free climate ready area by 2045	Sustainable Development	Adopted Oct 22	2021/22	Increase in number of charging points across the region		Increase of 112 charging bays in 2021 = 203% increase	Ongoing	
3	Climate and Nature Emergency Plan	This will cover a number of the 9 categories	Transition to a fossil fuel-free climate ready area by 2045	Sustainable Development	Adopted June 2021	Delivery	Council area will be net zero by 2045		47.8%	2045	
4	Transport Scotlands Switched on Towns and Cities	Promoting low emission transport	To encourage the uptake of EV's in towns and cities	Sustainable Development	Delivery	2019-2023	Number of registered Plug-in vehicles in Council area		4245 registered PIVs at end 2021, increase of 90%	2023	
5	Planning Applications	Policy Guidance and Development Control	Requesting AQIA when necessary	Environmental Health	Delivery	Ongoing				Ongoing	

3 Air Quality Monitoring Data and Comparison with Air Quality Objectives

3.1 Summary of Monitoring Undertaken

3.1.1 Automatic Monitoring Sites

This section sets out what monitoring has taken place and how local concentrations of the main air pollutants compare with the objectives.

Stirling Council undertook automatic (continuous) monitoring at one site during 2021. Table A.1 in Appendix A shows the details of the site. National monitoring results are available at [Site Data | Scottish Air Quality](#).

A map showing the location of the automatic monitoring site is provided in Figure A.1 in Appendix A. Further details on how the monitors are calibrated and how the data has been adjusted are included in Appendix C.

3.1.2 Non-Automatic Monitoring Sites

Stirling Council undertook non-automatic (passive) monitoring of NO₂ at 12 sites during 2021. Table A.2 in Appendix A shows the details of the sites.

A map showing the location of the monitoring sites are provided in Figure A.2 in Appendix A. Further details on Quality Assurance/Quality Control (QA/QC) and bias adjustment for the diffusion tubes are included in Appendix C.

3.1.3 Other Monitoring Activities

Stirling Council has 10 Zephyr units located in and around the town centre which have been recording data throughout 2020 and 2021. The data will be analysed by Stirling Council's Environmental Technician as a separate matter, in due course.

3.2 Individual Pollutants

The air quality monitoring results presented in this section are, where relevant, adjusted for annualisation and bias. Further details on adjustments are provided in Appendix C.

3.2.1 Nitrogen Dioxide (NO₂)

Table A.4 in Appendix A compares the ratified continuous monitored NO₂ hourly mean concentrations for the past five years with the air quality objective of 200µg/m³, not to be exceeded more than 18 times per year.

For diffusion tubes, the full 2021 dataset of monthly mean values is provided in Table B.1 in Appendix B. Figure B.1 shows the trends in annual mean NO₂ concentrations between 2016 and 2021. There were no exceedences of the objectives.

3.2.2 Particulate Matter (PM₁₀)

Table A.5 in Appendix A compares the ratified and adjusted monitored PM₁₀ annual mean concentrations for the past five years with the air quality objective of 18µg/m³.

Table A.6 in Appendix A compares the ratified continuous monitored PM₁₀ daily mean concentrations for the past five years with the air quality objective of 50µg/m³, not to be exceeded more than seven times per year. There were no exceedences of the objectives.

3.2.3 Particulate Matter (PM_{2.5})

Table A.7 in Appendix A compares the ratified and adjusted monitored PM_{2.5} annual mean concentrations for the past five years with the air quality objective of 10µg/m³. Stirling Council has only been monitoring PM_{2.5} since 2019 and there is limited data for this pollutant. There have been no exceedences of the objectives so far.

3.2.4 Sulphur Dioxide (SO₂)

Stirling Council does not monitor for SO₂.

3.2.5 Carbon Monoxide, Lead and 1,3-Butadiene

Stirling Council does not monitor for Carbon Monoxide, Lead or 1,3-Butadiene.

4 New Local Developments

This section discusses the new developments that could potentially have a significant impact on air quality in the Stirling area.

4.1 Road Traffic Sources

A planning application was submitted and subsequently approved during 2019 for a new link road, including a pedestrian and cycle route, through the city centre of Stirling. The air quality assessment was reviewed as part of the planning consultation process.

Results from the detailed atmospheric dispersion modelling used in the assessment, predict that the annual mean concentrations of NO₂, PM₁₀ and PM_{2.5} are to be below the respective air quality objectives at all modelled sensitive receptors. Similarly, no exceedances of the short term NO₂ and PM₁₀ objectives were predicted at any of the identified sensitive locations.

It has been stipulated that prior to the commencement of construction, the applicant is to submit a construction environmental management plan (CEMP) in order to detail appropriate measures and mitigation to control fugitive dust emissions, site plant emissions and construction traffic emissions. At this stage (2021), works on this development have not progressed.

Apart from the above, there are no new road traffic sources, as listed below, that would have a significant impact on air quality.

- Narrow congested streets with residential properties close to the kerb.
- Busy streets where people may spend one hour or more close to traffic.
- Roads with a high flow of buses and/or HGVs.
- Junctions.
- Bus or coach stations.

4.2 Other Transport Sources

There are no new sources, as listed below, that would have a significant impact on air quality.

- Airports.
- Locations where diesel or stream trains are regularly stationary for periods of 15 minutes or more, with potential for relevant exposure within 15m.
- Locations with a large number of movements of diesel locomotives, and potential long-term relevant exposure within 30m.
- Ports for shipping.

The Stirling Council Public Transport Co-ordinator confirmed that the total number of movements at Stirling Bus Station for 2021 is 120,783. This approximates to a four-week average of 9291, or daily average of 332. The criterion for assessment where there is relevant exposure within 10m is 2,500 movements a day. It is therefore concluded that a DMRB assessment is not required.

4.3 Industrial Sources

It is confirmed that during 2021 none of the following would warrant further assessment:

- Industrial installations: new or proposed installations for which an air quality assessment has been carried out.
- Industrial installations: existing installations where emissions have increased substantially or new relevant exposure has been introduced.
- Industrial installations: new or significantly changed installations with no previous air quality assessment.
- Major fuel storage depots storing petrol.
- Poultry farms.

4.4 Commercial and Domestic Sources

The locations of previously assessed and proposed biomass installations are summarised in Table 4.4.1. There are no clusters of installations in 500 x 500 metre squares that could result in cumulative impacts of emissions of PM10.

With the exception of the Acharn Power Station (Killin) Development, which is operational, all are small scale plants with minimal potential for significant release of PM₁₀ or NO_x. Where required, the applications were screened using the DEFRA review and assessment tools and further assessment was not considered necessary.

4.5 New Developments with Fugitive or Uncontrolled Sources

There are no new developments with fugitive or uncontrolled sources, as listed below, that would have a significant impact on air quality:

- Landfill sites.
- Unmade haulage roads on industrial sites.
- Waste transfer stations.
- Other potential sources of fugitive particulate matter emissions.

5 Planning Applications

Stirling Councils Local Development Plan (LDP) identifies a number of sites for large scale development between 2014 and 2034. Each development site shall be assessed for its impact on air quality as it goes through the planning consultation process. Where appropriate detailed air quality impact assessments shall be required to be submitted.

A full application for a major housing and mixed development (Durieshill) is under consideration. This is an application for a 3,000-house residential development, village centre, employment land, community campus and primary school located on land between Plean and the Bannockburn Interchange. The air quality assessment has been reviewed. Modelling used in the assessment indicated that there are mainly negligible impacts on NO₂, PM₁₀ and PM_{2.5} from the development at the 29 receptors selected, with the exception of NO₂ which has a minor impact at 4 of the 29 receptors. The planning development approval process is ongoing.

Planning permission for a redevelopment of the Craigforth Campus (21/00552/FUL) to comprise offices, retail, leisure, public houses, restaurants, residential premises, hotel, care home, nursery, landscaping, car park and associated infrastructure is subject to a planning appeal (2022).

The Environment Impact Assessment air quality study for the extension of mineral extraction operations at land south of Cambusmore House, Doune, concluded that with the implementation of the recommended mitigation measures, the proposal was unlikely to lead to significant dust impacts at the receptors considered in the assessment.

Table 4.4.1 – Locations of Installed, Permitted and Proposed Biomass Combustion Plant within Stirling Council

Name Location	Planning Reference	Status	OS Easting	OS Northing
Broich Arngomery Kippen FK8 3EN	21/00417/LAW	Permitted Status: Unknown	128301	184967
Broich Arngomery Kippen FK8 3EN	21/00417/LAW	Permitted 30/06/2021 Status unknown	128510	188565
Lendrick Cottage Aberfoyle Callander FK17 8HR	2021/0283/LAW	Withdrawn	226904	340725
West Rossburn Lane Farm Stirling FK9 4AH	20/00142/FUL	Permitted Status: Unknown	14570	04297
West Rossburn Lane Farm, Stirling, FK9 4AH	20/00142/FUL (retrospective)	Permitted 18 May 2020 Status: Operational	146354	042009
Stockbridge Nursery Kilbryde and Brack Road, Doune, FK15 9ND	18/00712/FUL	Permitted 27 November 2018 Status: Unknown	191627	991943
Land adjacent to North and West of 27 Whitehouse Rd, Forthside Way	16/00775/FUL	Permitted 27/02/2017 Status: Unknown	280695	693347
Carsten Mews, Drumbeg Rd, Killearn	16/00749/FUL	Permitted 15/02/2017 Status: Unknown	250499	684139
48 Glasgow Road, Blanefield	15/00644/FUL	Permitted 30/11/2015 Status: Unknown	255744	679621

Muirmill Farm, Fintry	15/00436/FUL	Permitted 02/12/2015 Status: Unknown	272876	683932
Lochend Chalets, Port of Menteith	2014/00265/DET	Operational January 2015	259156	699702
Wallace View, Stirling	15/00251/FUL	Permitted 18/06/15 Status unknown	281462	696157
Blairdrummond House, Stirling	15/00239/FUL	Permitted 15/06/2015 Operational 9/16	273189	699059
Stewarts House, 14 Main St, Fintry	15/00151/FUL	Permitted 09/06/2015 Status: Unknown	261623	686730
1 Riverside Cottages, Deanston	15/00139/FUL	Permitted 09/07/2015 Status: Unknown	271475	701710
Finnich Malise, Blanefield	15/00044/FUL	Permitted Notice: 07/04/2015 Status: Unknown	247928	685329
14 Back 'o Hill Industrial Estate	14/00768/FUL	Operational	278999	694526
Coldoch, Thornhill	14/00761/FUL	Operational 2015	269836	698062
The Stables, Burnside Farm, Bannockburn	14/00331/FUL	Permitted 22/07/2014 Status: unkown	280619	689961
Buchanan Arms Hotel Drymen	2014/0051/DET	Not Installed	247500	688393
An T Seann Sgoil, Balquidder	2014/0150/DET	Operational early 2015	253660	720902

5.1 New Developments with Fugitive or Uncontrolled Sources

There are no new developments with fugitive or uncontrolled sources, as listed below that would have a significant impact on air quality:

- Landfill sites.
- Unmade haulage roads on industrial sites.
- Waste transfer stations.
- Other potential sources of fugitive particulate matter emissions.

6 Conclusions and Proposed Actions

6.1 Conclusions from New Monitoring Data

Based on the data in Tables A.3 to A.7 and the graph in Figure B.1 of Appendix B, it can be seen that there was a slight increase in NO₂ at the majority of the passive monitoring sites. However, this increase appears to be the result of the artificially low levels in 2020 resulting from Covid restrictions. However, the overall trend for the NO₂ data obtained from the NO₂ tubes and the automatic monitor (without the 2020 results) reflects a general reduction over the past five years.

A similar trend is seen for PM₁₀, with the levels showing a marginal increase from those of 2020.

PM_{2.5} has only been measured since 2019. The results for the annual mean are as follows:

2019 - 5.6 µg/m³, 2020 - 4.25 µg/m³, 2021 – 5 µg/m³

All results are well below the annual mean objective of 10 µg/m³. Therefore, future exceedances of the national objective are unlikely.

Based on the available monitoring data, the following conclusions can be made:

- Based on the air quality data collected in 2021, there are no exceedances of the relevant Air Quality Objectives and it is considered unlikely that they will be exceeded in the near future.
- On this basis it is not considered necessary to declare an AQMA within the Stirling area.

The results and conclusions of air quality monitoring in the Stirling area should be considered in relation to traffic data and, specifically, the impact of Covid in 2020. Vehicle miles travelled in Great Britain have had year-on-year growth in each year between 2011 and 2019. Following a sharp decline in 2020, traffic levels for 2021 have increased on the previous year but still remain lower than the 2011 levels. Source: [Road traffic statistics - Local authority: Stirling \(dft.gov.uk\)](#)

6.2 Conclusions relating to New Local Developments

In relation to new local developments, it is determined that the key issue regarding air quality is the potential for increased road traffic. It is recognised that future and pending applications may increase traffic numbers and as a result negatively impact on the air quality within the Stirling Council area.

Biomass installations are also still considered a potential source of increased emissions affecting air quality. As such, biomass applications are screened using the Defra review-and-assessment tools and are not expected to have a significant impact on local air quality.

It has been highlighted that there is an increased demand for domestic households to install alternative heat and power sources into their homes. The installation of wood burning stoves may require planning permission if a chimney/flue has to be installed and would protrude more than one metre. As such, reference is made to the Residential Alterations and Extensions Supplementary Guidance SG12.

6.3 Proposed Actions

Stirling Council will continue with the following actions:

- Monitor for NO₂, PM_{2.5} and PM₁₀ at the locations detailed in this report. Results of the monitoring and other air quality assessment work will be presented in the next Annual Progress Report in 2023.
- Require air quality assessments where a development may result in significant increases in traffic as outlined in Defra Local Air Quality Guidance Management, Technical Guidance (TG16).
- Screening of biomass applications to assess the potential impact on local air quality.
- Provide information and support to Stirling Council Sustainable Development Team on future developments in the Stirling area.

To deliver the Local Transport Strategy objectives, the Sustainable Development Team developed a City Transport Plan 2013/17 – 2015/16 and a Towns, Villages and Rural Area Transport Plan 2014. This includes an Active Travel Policy (The Walking and Cycling to a Healthier Stirling: Active Travel Action Plan 2017) to encourage walking and cycling by infrastructure improvements and behaviour change (training and promotion activities). Stirling Council will also be actively participating in and promoting, the Cycle to Work

Scheme and NextBikes cycle hire scheme, encouraging staff to use sustainable methods of transport for both commuting and work purposes.

The Stirling Council Sustainable Development Team have significantly increased the fleet of electric vehicles and electric vehicle charging points.

As part of the East Central Scotland Vehicle Emissions Partnership, Stirling will coordinate testing, idling and campaigning activities to promote better air quality in the Stirling area.

Reviews and assessment will include monitoring of the rate of development (which will be informed by the LDP Monitoring Reports); the rate of traffic growth; the rate of modal shift from car to walking, cycling and public transport, and a measure of congestion.

Stirling Council will continuously review the location of the NO₂ tubes. The current tubes have been in the same locations for a long period of time and so it would be ideal if some of them are relocated. Relocation may help to identify new areas that may potentially exceed the objectives.

The use of the Zephyr units is ongoing and they will be used to assess areas of concern. They will also be used to give us a snapshot of air quality in different parts of the city.

In relation to new electric vehicle work, Stirling Council are delivering Transport Scotland's Switched-on Towns and Cities to promote low emission transport.

Stirling Council is preparing a Climate and Nature Emergency Plan which has the vision of leading the transition to a fossil fuel-free climate ready area by 2045 through 5 objectives, with themes of energy; transport; resource efficiency; nature and biodiversity; and preparing for impacts of climate change.

Appendix A: Monitoring Results

Table A.1 – Details of Automatic Monitoring Sites

Site ID	Site Name	Site Type	X OS Grid Ref	Y OS Grid Ref	Pollutants Monitored	In AQMA? Which AQMA?	Monitoring Technique	Distance to Relevant Exposure (m) ⁽¹⁾	Distance to kerb of nearest road (m) ⁽²⁾	Inlet Height (m)
CM1	Craig's Roundabout	Roadside	279944	693005	PM ₁₀ ; PM _{2.5}	N	FDMS (Palas Fidas)	10m	3	2.2
CM2	Craig's Roundabout	Roadside	279944	693005	NO _x	N	Chemiluminescent (Serinus)	10m	3	2.2

Notes:

(1) 0m if the monitoring site is at a location of exposure (e.g., installed on the façade of a residential property).

(2) N/A if not applicable.

Table A.2 – Details of Non-Automatic Monitoring Sites

Site ID	Site Name	Site Type	X OS Grid Ref	Y OS Grid Ref	Pollutants Monitored	In AQMA? Which AQMA?	Distance to Relevant Exposure (m) ⁽¹⁾	Distance to kerb of nearest road (m) ⁽²⁾	Tube co-located with a Continuous Analyser?	Tube Height (m)
DT1	Dumbarton Road	Kerbside	279655	693240	NO ₂	N	2	0.5	N	
DT2	Port Street	Kerbside	279634	693160	NO ₂	N	2	0.5	N	
DT3	Craigs Roundabout no. 1	Roadside	279987	693043	NO ₂	N	10	2	N	
DT4A,B,C	Craigs Roundabout no.2	Roadside	279944	693005	NO ₂	N	10	3	Y	
DT5	Lennox Avenue, Stirling	Urban Background	279354	691933	NO ₂	N	4	1.5	N	
DT6	Barnsdale Road, Stirling	Roadside	279520	691252	NO ₂	N	18	1.5	N	
DT7	Main Street, Plean	Roadside	283222	687582	NO ₂	N	6	1.5	N	
DT8	Alloa Road	Roadside	282075	695057	NO ₂	N	9	2	N	
DT9	Henderson Street, Bridge of Allan	Roadside	279177	697497	NO ₂	N	7	1.5	N	
DT10	Stirling Road, Dunblane	Roadside	278081	700580	NO ₂	N	8	1.5	N	
DT11	Stirling University	Roadside	280346	696339	NO ₂	N	>50	2	N	
DT12	Airthrey Road, Stirling	Roadside	280505	695719	NO ₂	N	3	2	N	

Notes:

(1) 0m if the monitoring site is at a location of exposure (e.g., installed on/adjacent to the façade of a residential property).

(2) N/A if not applicable.

Figure A.1 – Automatic monitor location

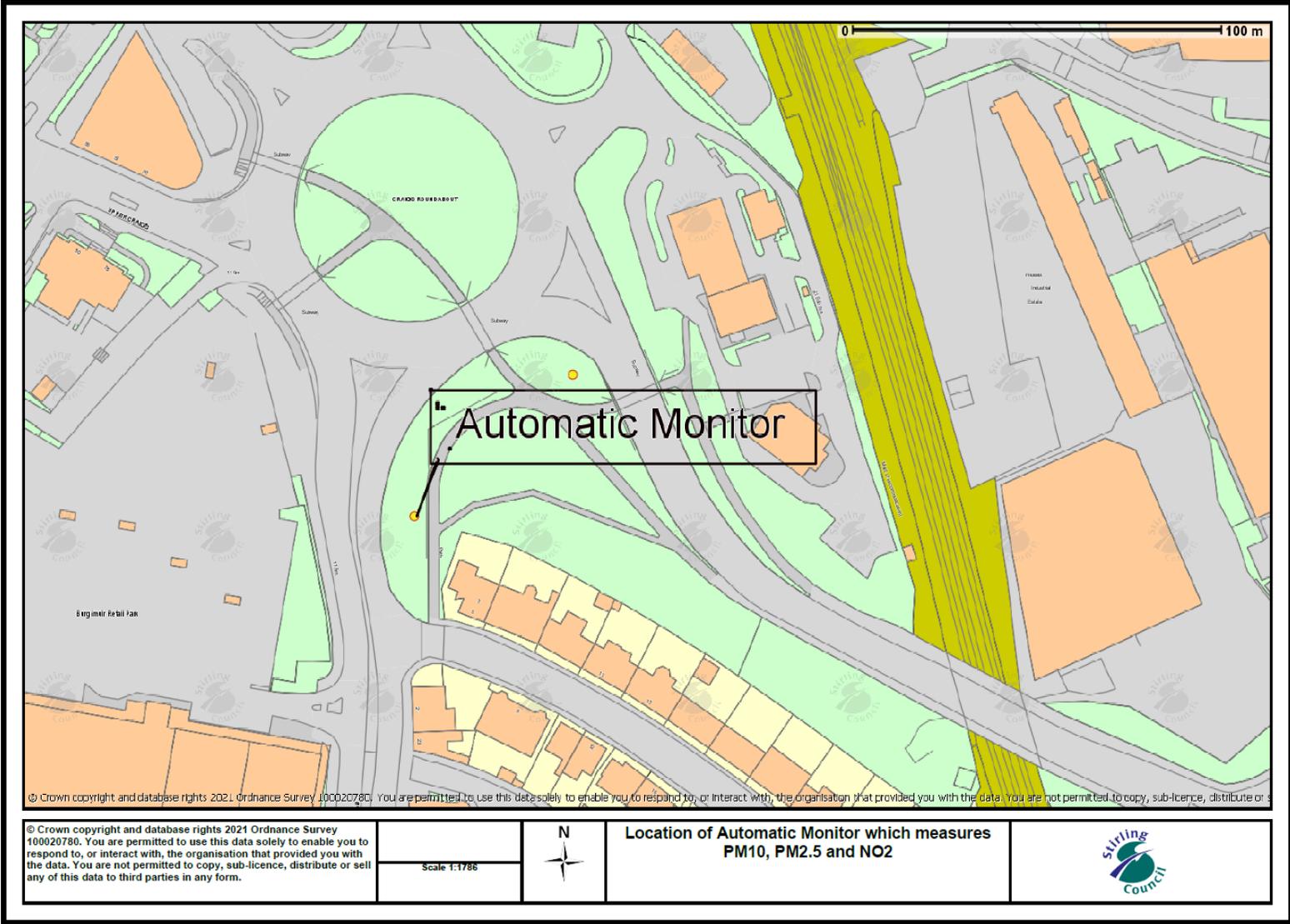


Figure A.2 – Diffusion tube locations



Table A.3 – Annual Mean NO₂ Monitoring Results (µg/m³)

Site ID	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) ⁽¹⁾	Valid Data Capture 2021 (%) ⁽²⁾	2017	2018	2019	2020	2021
CM1	Roadside	Automatic	96	96	22	23	20	14	15
DT1	Kerbside	Diffusion Tube	91.7	91.7	24.0	24.1	20.4	16.2	16.6
DT2	Kerbside	Diffusion Tube	100.0	100.0	24.1	21.7	19.7	14.6	15.7
DT3	Roadside	Diffusion Tube	100.0	100.0	25.1	20.5	22.0	17.6	16.8
DT4A,4B,4C	Roadside	Diffusion Tube	100	100	21.6	20.5	19.6	14.3	15.3
DT5	Urban Background	Diffusion Tube	100.0	100.0	10.2	11.5	10.3	8.3	8.5
DT6	Roadside	Diffusion Tube	100.0	100.0	15.7	16.5	14.0	10.5	12.6
DT7	Roadside	Diffusion Tube	83.3	83.3	16.0	16.4	13.8	10.5	12
DT8	Roadside	Diffusion Tube	91.7	91.7	23.5	26.8	22.3	16.2	15.3
DT9	Roadside	Diffusion Tube	100.0	100.0	21.2	22.7	17.6	12.2	14.3
DT10	Roadside	Diffusion Tube	91.7	91.7	16.1	15.4	11.6	9.1	10.5
DT11	Roadside	Diffusion Tube	100	100	19.4	19.0	16.3	11.5	11.4
DT12	Roadside	Diffusion Tube	100	100	21.9	22.4	16.7	14.0	13.2

Notes:

Exceedances of the NO₂ annual mean objective of 40µg/m³ are shown in bold.

NO₂ annual means exceeding 60µg/m³, indicating a potential exceedance of the NO₂ 1-hour mean objective are shown in **bold and underlined**.

Means for diffusion tubes have been corrected for bias. All means have been “annualised” as per LAQM.TG(16) if valid data capture for the full calendar year is less than 75%. See Appendix C for details.

(1) Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.

(2) Data capture for the full calendar year (e.g., if monitoring was carried out for 6 months, the maximum data capture for the full calendar year is 50%).

Table A.4 – 1-Hour Mean NO₂ Monitoring Results, Number of 1-Hour Means > 200µg/m³

Site ID	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) ⁽¹⁾	Valid Data Capture 2021 (%) ⁽²⁾	2017	2018	2019	2020	2021
CM2	Roadside	Automatic	96	96	0	0	0	0	0

Notes:

Exceedances of the NO₂ 1-hour mean objective (200 µg/m³ not to be exceeded more than 18 times/year) are shown in bold.

If the period of valid data is less than 85%, the 99.8th percentile of 1-hour means is provided in brackets.

(1) Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.

(2) Data capture for the full calendar year (e.g., if monitoring was carried out for 6 months, the maximum data capture for the full calendar year is 50%).

Table A.5 – Annual Mean PM₁₀ Monitoring Results (µg/m³)

Site ID	Site Type	Valid Data Capture for Monitoring Period (%) ⁽¹⁾	Valid Data Capture 2021 (%) ⁽²⁾	2017	2018	2019	2020	2021
CM1	Roadside	100	100	13	14	11	8.7	9

Notes:

Exceedances of the PM₁₀ annual mean objective of 18 µg/m³ are shown in bold.

All means have been “annualised” as per LAQM.TG(16), valid data capture for the full calendar year is less than 75%. See Appendix C for details.

(1) Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.

(2) Data capture for the full calendar year (e.g., if monitoring was carried out for 6 months, the maximum data capture for the full calendar year is 50%).

Table A.6 – 24-Hour Mean PM₁₀ Monitoring Results, Number of PM₁₀ 24-Hour Means > 50µg/m³

Site ID	Site Type	Valid Data Capture for Monitoring Period (%) ⁽¹⁾	Valid Data Capture 2020 (%) ⁽²⁾	2017	2018	2019	2020	2021
CM1	Roadside	100	100	0	0	0	0	0

Notes:

Exceedances of the PM₁₀ 24-hour mean objective (50 µg/m³ not to be exceeded more than seven times/year) are shown in bold.

If the period of valid data is less than 85%, the 98.1st percentile of 24-hour means is provided in brackets.

(1) Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.

(2) Data capture for the full calendar year (e.g., if monitoring was carried out for 6 months, the maximum data capture for the full calendar year is 50%).

Table A.7 – Annual Mean PM_{2.5} Monitoring Results (µg/m³)

Site ID	Site Type	Valid Data Capture for Monitoring Period (%) ⁽¹⁾	Valid Data Capture 2020 (%) ⁽²⁾	2017	2018	2019	2020	2021
CM1	Roadside	100	100	N/A	N/A	5.6	4.25	5

Notes:

Exceedances of the PM_{2.5} annual mean objective of 10 µg/m³ are shown in bold.

All means have been “annualised” as per LAQM.TG(16), valid data capture for the full calendar year is less than 75%. See Appendix C for details.

(1) Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.

(2) Data capture for the full calendar year (e.g., if monitoring was carried out for 6 months, the maximum data capture for the full calendar year is 50%).

Appendix B: Full Monthly Diffusion Tube Results for 2021

Table B.1 – NO₂ 2021 Monthly Diffusion Tube Results (µg/m³)

Site ID	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Mean: Raw Data	Annual Mean: Bias Adjusted ⁽¹⁾
DT1	26.4	20.3	15.0	20.6	20.0	18.2	21.0	19.4	9.9	20.8	23.2	missing	19.5	16.6
DT2	24.0	2.3	26.5	16.9	17.2	17.0	16.9	23.9	9.2	20.8	23.9	22.8	18.5	15.7
DT3	25.2	20.6	16.3	19.1	24.0	19.6	23.5	22.8	13.5	19.9	24.2	7.8	19.7	16.8
DT4A	23.7	17.2	16.5	13.9	15.0	16.0	16.1	18.0	8.6	21.9	23.2	24.9	17.9	15.2
DT4B	20.8	17.3	17.3	14.1	16.6	16.8	15.4	17.8	8.1	23.1	21.5	26.6	18.0	15.3
DT4C	23.8	17.2	17.0	14.4	14.9	16.5	15.6	17.8	8.5	21.9	25.2	23.6	18.0	15.3
DT5	13.1	14.4	8.6	9.0	7.6	10.2	9.5	9.5	4.8	9.8	11.2	11.6	9.9	8.5
DT6	20.1	12.8	10.3	12.1	12.0	11.9	16.1	25.1	7.3	14.9	16.7	18.7	14.8	12.6
DT7	20.2	15.1	12.0	12.3	14.7	15.2	14.1	15.2	5.0	17.1	missing	missing	14.1	12.0
DT8	21.2	18.8	missing	9.2	12.2	10.9	17.6	28.9	11.3	22.8	21.9	23.3	18.0	15.3
DT9	23.2	19.3	16.2	13.4	14.4	16.0	14.5	17.3	7.8	17.6	21.2	21.4	16.9	14.3
DT10	21.1	9.9	10.7	10.7	9.1	10.8	11.9	13.9	6.0	14.6	17.1	<1.0	12.3	10.5
DT11	18.4	11.1	10.9	11.8	10.5	14.9	13.0	15.1	7.1	14.0	15.8	18.0	13.4	11.4
DT12	21.7	13.2	13.8	13.2	14.1	12.8	13.3	18.7	7.3	17.7	20.6	20.6	15.6	13.2

Notes:

(1) See Appendix C for details on bias adjustment

Figure B.1 Trends in Annual Mean Concentration of NO₂ at Diffusion Tube Sites 2017-2021

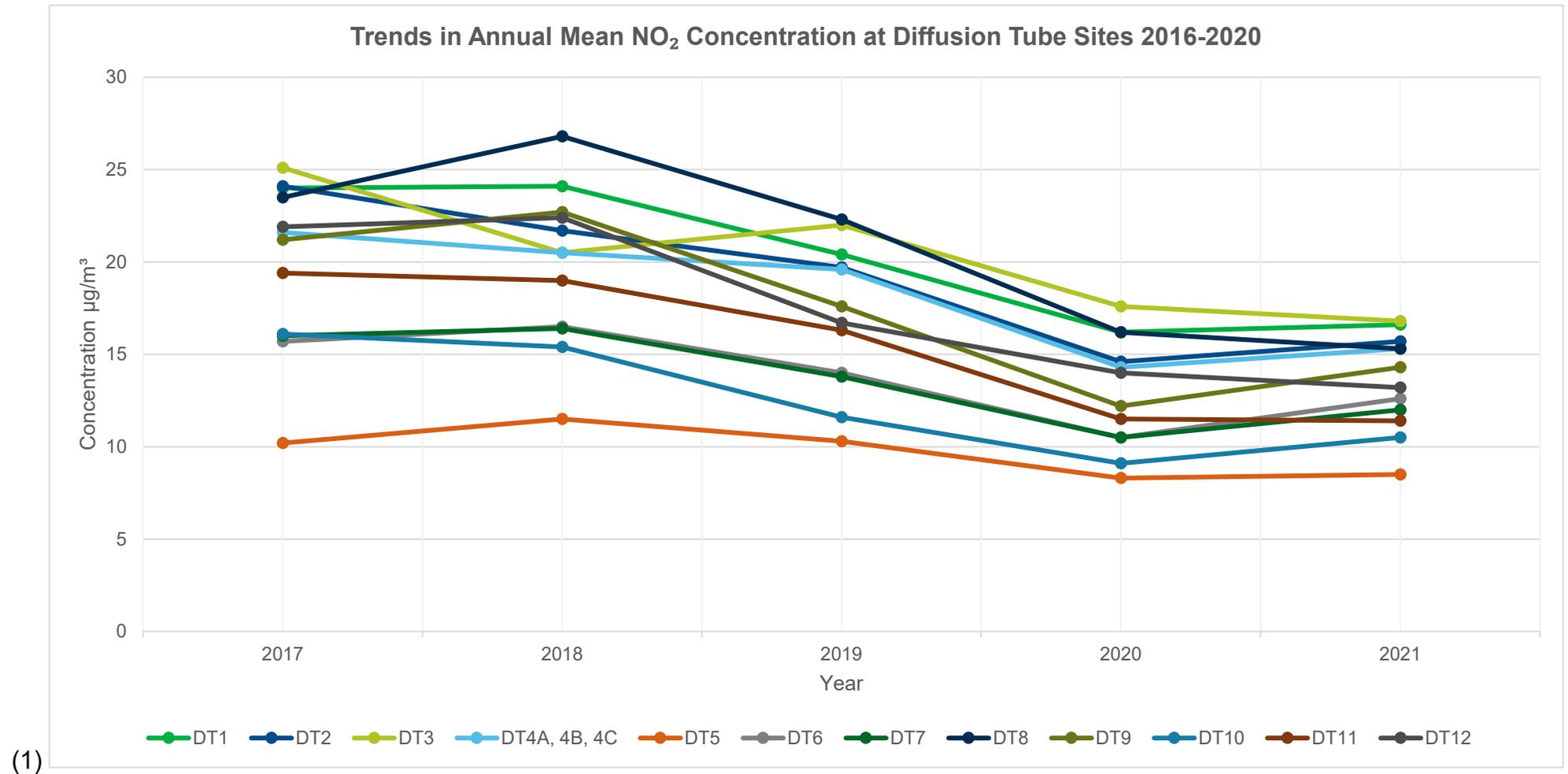
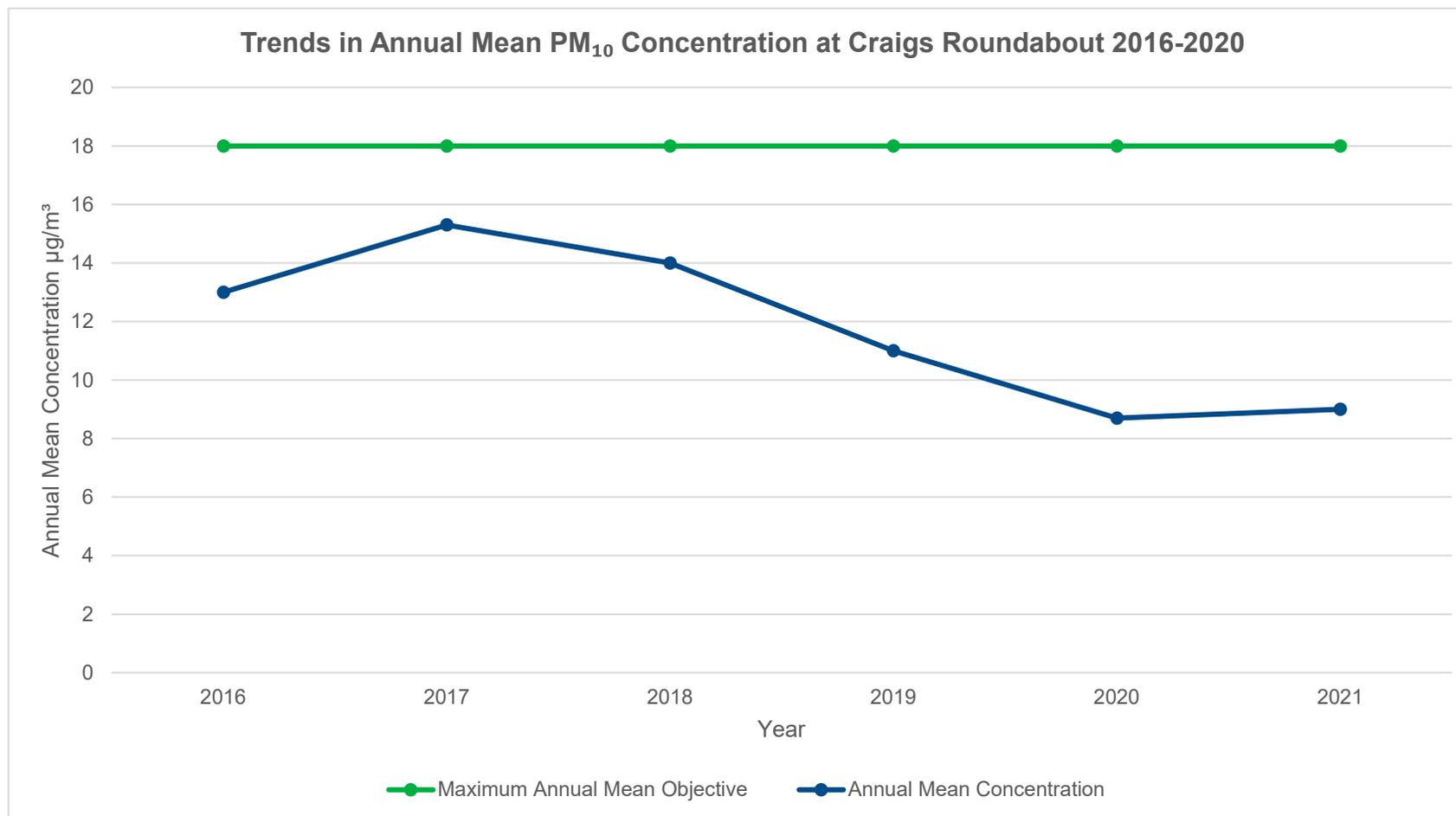


Figure B.2 Trends in Annual Mean PM₁₀ Concentration at Craigs Roundabout 2016-2020



Appendix C: Supporting Technical Information / Monitoring Data QA/QC

New or Changed Sources During 2021

Stirling Council has not identified any new sources relating to air quality within the reporting year of 2020.

Additional Air Quality Works Undertaken During 2021

Stirling Council has 10 Zephyrs located in and around the town centre which have been recording data throughout 2020 and 2021.

QA/QC of Diffusion Tube Monitoring

Stirling Council receive the tubes from Edinburgh Scientific Services who prepare the tubes themselves, using components sourced from a company called Gradko. The tubes are prepared using 50% TEA in acetone.

Edinburgh Scientific Services are a United Kingdom Accreditation Service (UKAS) accredited for the analysis method that they use. The analysis is a colorimetric method with the absorbance being measured at 540nm using a spectrophotometer.

Apart from their own internal quality control samples, they take part in two external quality analysis schemes; the first one run by the National Physics Laboratory (NPL) and the second scheme is the AIR_PT scheme, run by LGC.

The most recent results from the NPL were all graded as good, apart from one month where there were no results recorded due to COVID related issues and the tubes not being collected in time.

For the AIR_PT scheme, Edinburgh Scientific Services participated in 2 rounds in 2020 (February and October). The four results for October were all fine, with Z scores of less than 2. Two of the results for February were satisfactory, but two had a negative bias (Z scores of -2.46 and -4.01). After investigation, the laboratory believed that this was due to the solution in the tubes not being shaken and mixed sufficiently. There should have been

another round in July 2020, but LGC couldn't prepare the tubes in time due to COVID related issues.

Diffusion Tube Annualisation

All diffusion tube monitoring locations within Stirling Council recorded data capture of >75%, therefore, it was not necessary to annualise any monitoring data. In addition, any sites with a data capture below 25% do not require annualisation.

Diffusion Tube Bias Adjustment Factors

Stirling Council have applied a national bias adjustment factor of 0.85 to the 2021 monitoring data. This factor was taken from the 09/22 version of the national spreadsheet which can be viewed at the following link: <https://laqm.defra.gov.uk/bias-adjustment-factors/national-bias.html>. The local bias adjustment factor is 0.86 (Table C.2)

A summary of bias adjustment factors used by Stirling Council over the past five years is presented below in Table C.2. A national bias adjustment factor was chosen as this is the factor that has been used in Stirling Council for the last five years, ensuring consistency.

Table C.1 – Bias Adjustment Factor

Year	Local or National	If National, Version of National Spreadsheet	Adjustment Factor
2021	National	09/22	0.85
2020	National	03/21	0.90
2019	National	09/20	1.01
2018	National	06/19	1.05
2017	National	09/18	1.07
2016	National	06/17	1.08

Table C.2 – Local Bias Adjustment Factor

Adjustment of DUPLICATE or TRIPLICATE Tubes										Data Quality Check
Diffusion Tubes Measurements										Diffusion Tubes Precision Check
Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 μgm^{-3}	Tube 2 μgm^{-3}	Tube 3 μgm^{-3}	Triplicate Average	Standard Deviation	CV	95% CI mean	
1	06/01/2021	04/02/2021	23.7	20.8	23.8	22.8	1.70	7.48	4.23	Good
2	04/02/2021	04/03/2021	17.2	17.3	17.2	17.2	0.06	0.34	0.14	Good
3	04/03/2021	30/03/2021	16.5	17.3	17.0	16.9	0.40	2.39	1.00	Good
4	30/03/2021	05/05/2021	13.9	14.1	14.4	14.1	0.25	1.78	0.63	Good
5	05/05/2021	02/06/2021	15.0	16.6	14.9	15.5	0.95	6.15	2.37	Good
6	02/06/2021	30/06/2021	16.0	16.8	16.5	16.4	0.40	2.46	1.00	Good
7	30/06/2021	04/08/2021	16.1	15.4	15.6	15.7	0.36	2.30	0.90	Good
8	04/08/2021	31/08/2021	18.0	17.8	17.8	17.9	0.12	0.65	0.29	Good
9	31/08/2021	29/09/2021	8.6	8.1	8.5	8.4	0.26	3.15	0.66	Good
10	29/09/2021	03/11/2021	21.9	23.1	21.9	22.3	0.69	3.11	1.72	Good
11	03/11/2021	01/12/2021	23.2	21.5	25.2	23.3	1.85	7.95	4.60	Good
12	01/12/2021	06/01/2022	24.9	26.6	23.6	25.0	1.50	6.01	3.74	Good
13										

It is necessary to have results for at least two tubes in order to calculate the precision of the measurements

Site Name/ ID:	Craigs Roundabout
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Adjusted measurement (95% confidence level)
Without periods with CV larger than 20%

Bias calculated using 11 periods of data
Tube Precision: 3 Automatic DC: 99%

Bias factor A: 0.86 (0.71 - 1.08)
Bias B: 16% (-7% - 40%)

Information about tubes to be adjusted
Diffusion Tube average: 18 μgm^{-3}
Average Precision (CV): 4
Adjusted Tube average: 15 +/- 4 μgm^{-3}

Adjusted measurement (95% confidence level)
with all data

Bias calculated using 11 periods of data
Tube Precision: 3 Automatic DC: 99%

Bias factor A: 0.86 (0.71 - 1.08)
Bias B: 16% (-7% - 40%)

Information about tubes to be adjusted
Diffusion Tube average: 18 μgm^{-3}
Average Precision (CV): 4
Adjusted Tube average: 15 +/- 4 μgm^{-3}

Jaume Targa, for AEA
Version 04 - February 2011

NO₂ Fall-off with Distance from the Road

No diffusion tube NO₂ monitoring locations required distance correction during 2021.

QA/QC of Automatic Monitoring

The automatic monitoring equipment is audited every 6 months by Ricardo Energy and Environment and a routine service and breakdown call out service is contracted to Air Monitors. Local Site Operator (LSO) calibrations are also performed. Ricardo advises that they be done fortnightly but due to resourcing issues, Stirling Council is limited to monthly calibrations. Data recorded by the station is analysed by Ricardo Energy and Environment. The data used within this APR is ratified and live and historic data can be viewed through the Scottish Air Quality website which can be accessed via the below link:

http://www.scottishairquality.scot/latest/site-info?site_id=STRL

PM₁₀ and PM_{2.5} Monitoring Adjustment

The type of PM₁₀/PM_{2.5} monitors utilised within Stirling Council do not require the application of a correction factor.

Automatic Monitoring Annualisation

All automatic monitoring locations within Stirling Council recorded data capture of greater than 75% therefore it was not required to annualise any monitoring data. In addition, any sites with a data capture below 25% do not require annualisation.

NO₂ Fall-off with Distance from the Road

No automatic NO₂ monitoring locations within required distance correction during 2021.

QA/QC of Automatic Monitoring

The automatic monitoring equipment is audited every 6 months by Ricardo Energy and Environment and a routine service and breakdown call out service is contracted to Air Monitors. Local Site Operator (LSO) calibrations are also performed. Ricardo advises that they be done fortnightly but due to resourcing issues, Stirling Council is limited to monthly calibrations. Data recorded by the station is analysed by Ricardo Energy and Environment. The data used within this APR is ratified and live and historic data can be viewed through the Scottish Air Quality website which can be accessed via the below link:

http://www.scottishairquality.scot/latest/site-info?site_id=STRL

Glossary of Terms

Abbreviation	Description
AQAP	Air Quality Action Plan - A detailed description of measures, outcomes, achievement dates and implementation methods, showing how the LA intends to achieve air quality limit values'
AQMA	Air Quality Management Area – An area where air pollutant concentrations exceed / are likely to exceed the relevant air quality objectives. AQMAs are declared for specific pollutants and objectives
APR	Air quality Annual Progress Report
AURN	Automatic Urban and Rural Network (UK air quality monitoring network)
Defra	Department for Environment, Food and Rural Affairs
DMRB	Design Manual for Roads and Bridges – Air quality screening tool produced by Highways England
FDMS	Filter Dynamics Measurement System
LAQM	Local Air Quality Management
NO ₂	Nitrogen Dioxide
NO _x	Nitrogen Oxides
PM ₁₀	Airborne particulate matter with an aerodynamic diameter of 10µm (micrometres or microns) or less
PM _{2.5}	Airborne particulate matter with an aerodynamic diameter of 2.5µm or less
QA/QC	Quality Assurance and Quality Control
SO ₂	Sulphur Dioxide

References

- (1) http://www.scottishairquality.scot/latest/site-info?site_id=STRL
- (2) http://www.scottishairquality.scot/latest/site-info?site_id=STRL&view=statistics
- (3) <https://laqm.defra.gov.uk/technical-guidance/index.html>
- (4) <https://laqm.defra.gov.uk/technical-guidance/index.html?d=Chapter7>
- (5) <https://laqm.defra.gov.uk/bias-adjustment-factors/bias-adjustment.html>
- (6) 2019 Air Quality Annual Progress Report for Stirling Council