



# 2019 Air Quality Annual Progress Report (APR)

for Stirling Council

In fulfillment of Part IV of the

Environment Act 1995

Local Air Quality Management

June 2019

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<b>Report Reference number</b>	LAQM/APR/2019
<b>Date</b>	June 2019

## 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 at Craig's Roundabout in the City of Stirling (nitrogen dioxide (NO<sub>2</sub>) and Particulate Matter (PM<sub>10</sub>) and passive monitoring for NO<sub>2</sub>, using diffusion tubes, at ten sites in the wider urban area, with one site collated information from three monitoring tubes.

Based on the available monitoring data for NO<sub>2</sub> and PM<sub>10</sub> there were no exceedances of the relevant Air Quality Objectives and it is considered 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

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 primarily require this, are those that include biomass installations and increased traffic emissions e.g. major housing developments.



Stirling Council's 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.

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/>

For 2019 Stirling Council have partnered up with East Central Scotland Vehicles Emissions Partnership, which is a coalition of East Lothian, Falkirk, Midlothian and West Lothian Councils. With the aim to actively deal with reports from members of the public who identify idling vehicles. The remit of the Vehicles Emissions

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

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

For 2019, Stirling Council formulated an Air Quality Strategy to include mobile air quality monitoring using Zephyr units. The Zephyr is a compact and lightweight air pollution sensor measuring NO<sub>2</sub>, NO, O<sub>3</sub>, PM<sub>1</sub>, PM<sub>2.5</sub> and PM<sub>10</sub>. Stirling Council recently purchased 10 Zephyr units and located them across urban areas of Stirling. This includes locating units close to schools to determine trends in pollutant levels during school hours with the aim to spread awareness to local schools regarding air quality.

As part of the Sustainable Growth Agreement Actions, Stirling Council now have 8 electric vehicles within its fleet, and have installed 28 charging points across the Stirling area.

### **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 in to the future. The reports and other related documents can be viewed at:

<http://my.stirling.gov.uk/services/transport-and-streets/transport-policy>

### **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](http://www.scottishairquality.co.uk/latest/site-info?site_id=STRL)

## 1. Local Air Quality Management

This report provides an overview of air quality in Stirling Council during 2018. 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) summarises 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		Date to be achieved by
	Concentration	Measured as	
Nitrogen dioxide (NO <sub>2</sub> )	200 µg/m <sup>3</sup> not to be exceeded more than 18 times a year	1-hour mean	31.12.2005
	40 µg/m <sup>3</sup>	Annual mean	31.12.2005
Particulate Matter (PM <sub>10</sub> )	50 µg/m <sup>3</sup> , not to be exceeded more than 7 times a year	24-hour mean	31.12.2010
	18 µg/m <sup>3</sup>	Annual mean	31.12.2010
Particulate Matter (PM <sub>2.5</sub> )	10 µg/m <sup>3</sup>	Annual mean	31.12.2020
Sulphur dioxide (SO <sub>2</sub> )	350 µg/m <sup>3</sup> , not to be exceeded more than 24 times a year	1-hour mean	31.12.2004
	125 µg/m <sup>3</sup> , not to be exceeded more than 3 times a year	24-hour mean	31.12.2004
	266 µg/m <sup>3</sup> , not to be exceeded more than 35 times a year	15-minute mean	31.12.2005
Benzene	3.25 µg/m <sup>3</sup>	Running annual mean	31.12.2010
1,3 Butadiene	2.25 µg/m <sup>3</sup>	Running annual mean	31.12.2003
Carbon Monoxide	10.0 mg/m <sup>3</sup>	Running 8-Hour mean	31.12.2003

Pollutant	Air Quality Objective		Date to be achieved by
	Concentration	Measured as	
Lead	0.25 µg/m <sup>3</sup>	Annual Mean	31.12.2008



## **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 AQMAs in the future.

## **2.2 Cleaner Air for Scotland**

Cleaner Air for Scotland – The Road to a Healthier Future (CAFS) is a national cross-government strategy that sets out how the Scottish Government and its partner organisations propose to reduce air pollution further to protect human health and fulfil Scotland’s legal responsibilities as soon as possible. A series of actions across a range of policy areas are outlined, a summary of which is available at <https://www.gov.scot/Publications/2015/11/5671/17>. Progress by Stirling Council against relevant actions within this strategy is demonstrated below.

### **2.2.1 Transport – Avoiding travel – T1**

All local authorities should ensure that they have a corporate travel plan (perhaps within a carbon management plan) which is consistent with any local air quality action plan. 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.

### **2.2.2 Climate Change – Effective co-ordination of climate change and air quality policies to deliver co-benefits – CC2**

Scottish Government expects any Scottish local authority which has or is currently developing a Sustainable Energy Action Plan to ensure that air quality considerations are covered. Stirling Council has a Sustainable Development Strategy that aims: ‘to enable all people throughout the Stirling Council area to satisfy their basic needs and enjoy a good quality of life without compromising the quality of life of future generations.’

### **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 2018. Table A.1 in Appendix A shows the details of the sites. National monitoring results are available at

[http://www.scottishairquality.co.uk/latest/site-info?site\\_id=STRL&view=graphing](http://www.scottishairquality.co.uk/latest/site-info?site_id=STRL&view=graphing)

Maps showing the location of the monitoring sites are provided 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 NO<sub>2</sub> at twelve sites during 2018. Figure A.1 - General Location of Automatic Monitoring Site**

**Figure A.2 - Detailed location of Automatic Monitor**

Table A.2 in Appendix A shows the details of the sites.

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

### **3.2 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 (NO<sub>2</sub>)**

##### **Figure A.3 - Location of Diffusion Tube Sites**

Table A.3 in Appendix A compares the ratified and adjusted monitored NO<sub>2</sub> annual mean concentrations for the past 5 years with the air quality objective of 40µg/m<sup>3</sup>.

For diffusion tubes, the full 2018 dataset of monthly mean values is provided in Appendix B.

Table A.4 in Appendix A compares the ratified continuous monitored NO<sub>2</sub> hourly mean concentrations for the past 5 years with the air quality objective of 200µg/m<sup>3</sup>, not to be exceeded more than 18 times per year.

The limited data recovery for the automatic monitor in 2014 and 2015 makes interpretation and prediction less reliable. Since then, there has been no major issue with data recovery. The available results indicate that the above objectives have not been exceeded and are unlikely to be exceeded in the future.

On this basis an AQMQ was not considered necessary.

### **3.2.2 Particulate Matter (PM<sub>10</sub>)**

Table A.5 in Appendix A compares the ratified and adjusted monitored PM<sub>10</sub> annual mean concentrations for the past 5 years with the air quality objective of 18µg/m<sup>3</sup>.

Table A.6 in Appendix A compares the ratified continuous monitored PM<sub>10</sub> daily mean concentrations for the past 5 years with the air quality objective of 50µg/m<sup>3</sup>, not to be exceeded more than 7 times per year.

The limited data recovery for the automatic monitor in 2014 and 2015 makes interpretation and prediction less reliable. Since then, there has been no major issue with data recovery. The following comments are made:

The available results indicate that the above objectives have not been exceeded and are unlikely to be exceeded in the future.

On this basis an AQMA was not considered necessary.

### **3.2.3 Particulate Matter (PM<sub>2.5</sub>)**

Stirling Council did not monitor for PM<sub>2.5</sub> in 2018. .

### **3.2.4 Sulphur Dioxide (SO<sub>2</sub>)**

Stirling Council does not monitor for SO<sub>2</sub>.

### **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

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.
- New roads constructed or proposed.
- Bus or coach stations.

### 4.2 Other Transport Sources

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

- Airports.
- Locations where diesel or steam trains are regularly stationary for periods of 15 minutes or more, with potential for relevant exposure within 15m.
- Locations with a large number of movement 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 in the Thistle Centre was approximately 12,226 every 4 weeks, or less than 475/day. 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.



It should be noted that since 16 April 2018, one of the main arterial roads (Kerse Road) within Stirling City Centre was closed in both directions due to the rail electrification works as part of the Edinburgh Glasgow Improvement Programme. The road was closed from April 16<sup>th</sup> 2018 to 19<sup>th</sup> October 2018 to enable carriageway completion and removal of temporary structures. The automatic monitor and four of the NO<sub>2</sub> tubes are situated within 75m of this site, however there was no substantial variations of results during this period.

### **4.3 Industrial Sources**

It is confirmed that there are none of the following that 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.

An application has been received for a new roadside service station near Dunblane comprising a petrol filling station, truck stop, restaurants and drive-thru. Comments were provided and are currently awaiting response. The effect this would have on air quality is unknown at present.

An air quality assessment should be undertaken to identify existing air quality in the surrounding area and to quantify the impact of the proposed development on local air quality using methodology outlined in the guidance from Environmental Protection UK and Institute of Air Quality Management for the consideration of air quality within the land-use planning and development control processes (January 2017).

### **4.4 Commercial and Domestic Sources**

The locations of previously assessed, new and proposed biomass installations are summarised in Table 4.1. There are no clusters of installations in 500 x 500 metre squares that could result in cumulative impacts of emissions of PM<sub>10</sub>. With the exception of the Acharn Development, which has been approved and is operational, all are small scale plants with minimal potential for significant release of PM<sub>10</sub> or NO<sub>x</sub>. The applications were screened using the DEFRA review and assessment tools and further assessment was not considered necessary.

**Table 4.1 – Locations of Installed, Permitted and Proposed Biomass Combustion Plant within Stirling Council**

Name Location	Planning Reference	Status	OS Easting	OS Northing
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
Upper Drumbane Farm	13/00785/FUL	Permitted 30/05/2014 Status: Unknown		
Cambusmore House, Doune	13/00774/FUL	Permitted 07/02/2014 Status: unknown	265088	706218
Land 50m North Ballagan House, Strathblane	13/00690/FUL	Permitted 16/12/2013 Status; unknown		
Aucheneck Lodge, Stockiemuir Rd, by Killearn	13/00562/FUL	Permitted 08/11/2013 Status: unknown		
Gem House West Plean Industrial Estate	13/00348/FUL	Permitted 36/08/2013 Status: unknown		
Sauchie Estate, Sauchieburn,	12/00472/FUL	Permitted 21/09/2012 Status: unknown	277933	688963
Acharn Biomass Energy Plant 5.4MW	2011/0011/DET	Permitted Status: Operational	255500	731000
Fintry Sports Club, Fintry	11/00175/FUL	Permitted 16/02/2011 Status: unknown		

#### 4.5 New Developments with Fugitive or Uncontrolled Sources

There are no new road traffic 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.

A planning application was received to extend Cambusmore quarry in Callander. An Environmental Impact Assessment was requested. The impact on air quality is to be assessed in terms of PAN 50 and the Institute of Air Quality Management Guidance on the Assessment of Mineral Dust Impacts for Planning May 2016 (v1.1).

## 5. Planning Applications

Stirling Council's 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 development site called Durieshill has been received. 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 NO<sub>2</sub>, PM<sub>10</sub> and PM<sub>2.5</sub> from the development at the 29 receptors selected, with the exception of NO<sub>2</sub> which has a minor impact at 4 of the 29 receptors.

We will monitor this site as development takes place.

A development site called South Stirling Gateway was included in the Local Development Plan. The development proposals include affordable housing, superstore, school and a linear park. Stirling Council's Strategic Infrastructure Plan identifies a range of infrastructure projects required to support the LDP Spatial Strategy as a whole, of which development at South Stirling Gateway forms a strategic part.

A planning application for a new crematorium in Bannockburn has been received and approved. SEPA will have regulatory control over the process, but it is not anticipated that air quality objectives will be breached as a result of the operation of the crematorium.

## **6. Conclusions and Proposed Actions**

### **6.1 Conclusions from New Monitoring Data**

Based on the data in Tables B.1 to B.5 and the graph in Figure B.1 of Appendix B, it can be seen that there is an overall falling trend in those areas monitored for NO<sub>2</sub> with a slight rise in 2018. With regards to PM<sub>10</sub>, there was a falling trend up until 2016 but levels did start to increase in 2017. Despite this, all sites are still below the national objectives for each parameter measured. Based on the available monitoring data, the following conclusions can be made:

- Looking at all the air quality data throughout 2018, 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.

### **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 (e.g. Durieshill & South Stirling Gateway) may increase traffic numbers and as a result negatively impact on the air quality within the Stirling area.

Biomass installations are also still considered a potential source of increased emissions affecting air quality. As such, biomass applications were screened using the Defra review-and-assessment tools and were 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 depending if a chimney/flue has to be installed and would protrude more than one metre. As such, the Residential Alterations & Extensions Supplementary Guidance SG12 is referred to.

### **6.3 Proposed Actions**

Stirling Council will continue with the following actions:

- Monitor for NO<sub>2</sub> and PM<sub>10</sub> at the locations detailed in this report. Data recovery from the automatic monitor appears to be reasonably stable for 2019, to date. Results of the monitoring and other air quality assessment work will be presented in the next Annual Progress Report in 2020.
- 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.

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 NO<sub>2</sub> tubes. Since the current tubes have been in the same locations for a long period of time, some of these will be relocated. Relocation may help to identify new areas that may potentially exceed the objectives.

The new Zephyr units will be utilised to establish areas of concern.

## Appendix A: Monitoring Results

**Table A.1 – Details of Automatic Monitoring Sites**

Site Name	Site Type	X OS Grid Ref	Y OS Grid Ref	Pollutants Monitored	In AQMA?	Monitoring Technique	Distance to Relevant Exposure (m) <sup>(1)</sup>	Distance to kerb of nearest road (m) <sup>(2)</sup>	Inlet Height (m)
Craig's Roundabout	Roadside	279944	693005	NO <sub>2</sub>	N	Chemiluminescence	10m	3m	2.2
Craig's Roundabout	Roadside	279944	693005	PM <sub>10</sub>	N	TEOM	10m	3m	2.2



Figure A.1 - General Location of Automatic Monitoring Site

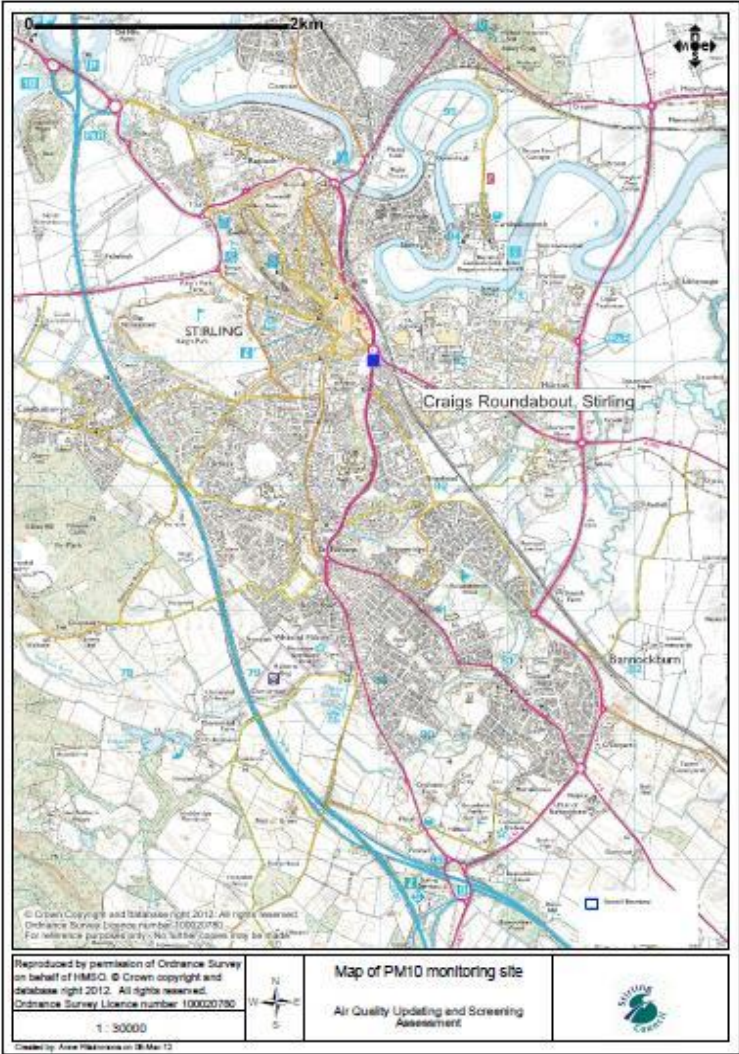


Figure A.2 - Detailed location of Automatic Monitor

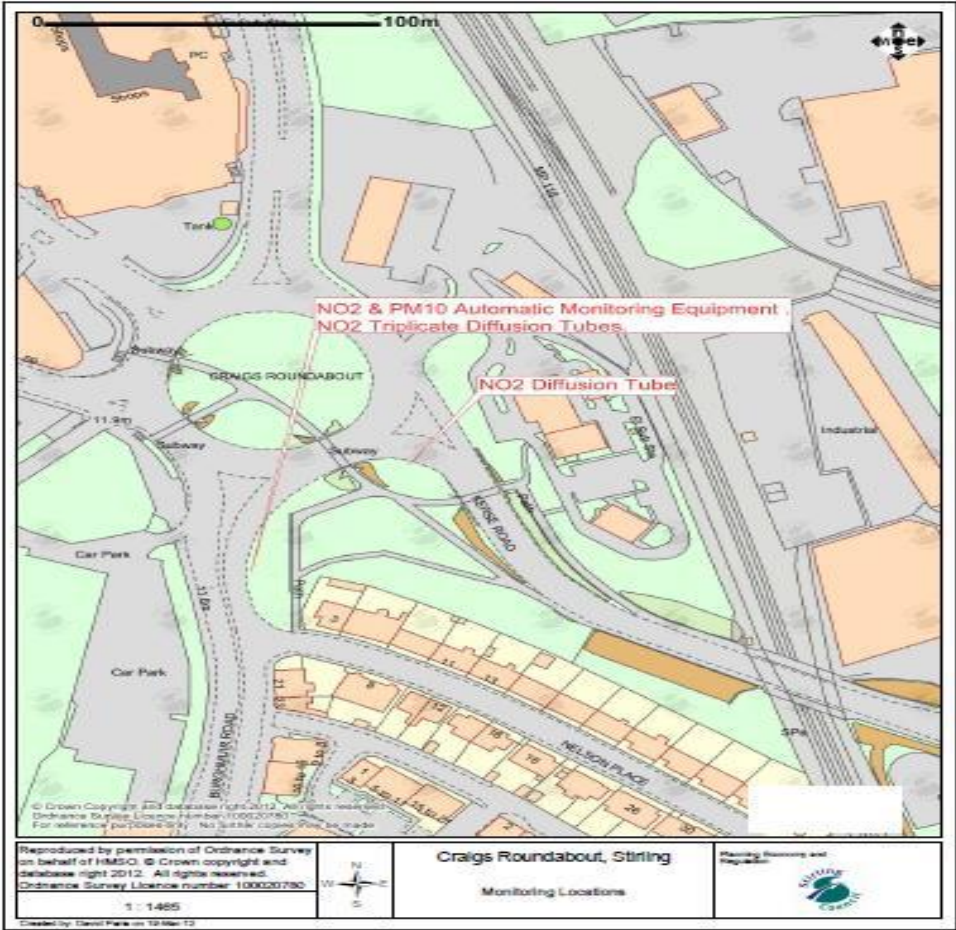


Table A.2 – Details of Non-Automatic Monitoring Sites

Site ID	Site Name	Site Type	X OS Grid Ref	Y OS Grid Ref	Pollutants Monitored	In AQMA?	Distance to Relevant Exposure (m) <sup>(1)</sup>	Distance to kerb of nearest road (m) <sup>(2)</sup>	Tube co-located with a Continuous Analyser?
1	Dumbarton Road, Stirling	Kerbside	279655	693240	NO <sub>2</sub>	N	2	0.5	N
2	Port Street, Stirling	Kerbside	279634	693160	NO <sub>2</sub>	N	2	0.5	N
3	Craig's Roundabout no. 1	Roadside	279987	693043	NO <sub>2</sub>	N	10	2	N
4A,B,C	Craig's Roundabout no. 2 (automatic analyser)	Roadside	279944	693005	NO <sub>2</sub>	N	10	3	Y
5	Lennox Avenue, Stirling	Urban background	279354	691933	NO <sub>2</sub>	N	4	1.5	N
6	Barnsdale Road, Stirling	Roadside	279520	691252	NO <sub>2</sub>	N	18	1.5	N
7	Main Street, Plean	Roadside	283222	687582	NO <sub>2</sub>	N	6	1.5	N

8	Alloa Road Roundabout	Roadside	282075	695057	NO <sub>2</sub>	N	9	2	N
9	Henderson Street, Bridge of Allan	Roadside	279177	697497	NO <sub>2</sub>	N	7	1.5	N
10	Stirling Road, Dunblane	Roadside	278081	700580	NO <sub>2</sub>	N	8	1.5	N
11	Stirling University	Roadside	280346	696339	NO <sub>2</sub>	N	>50	2	N
12	Airthrey Road	Roadside	280505	695719	NO <sub>2</sub>	N	3	2	N

Figure A.3 - Location of Diffusion Tube Sites

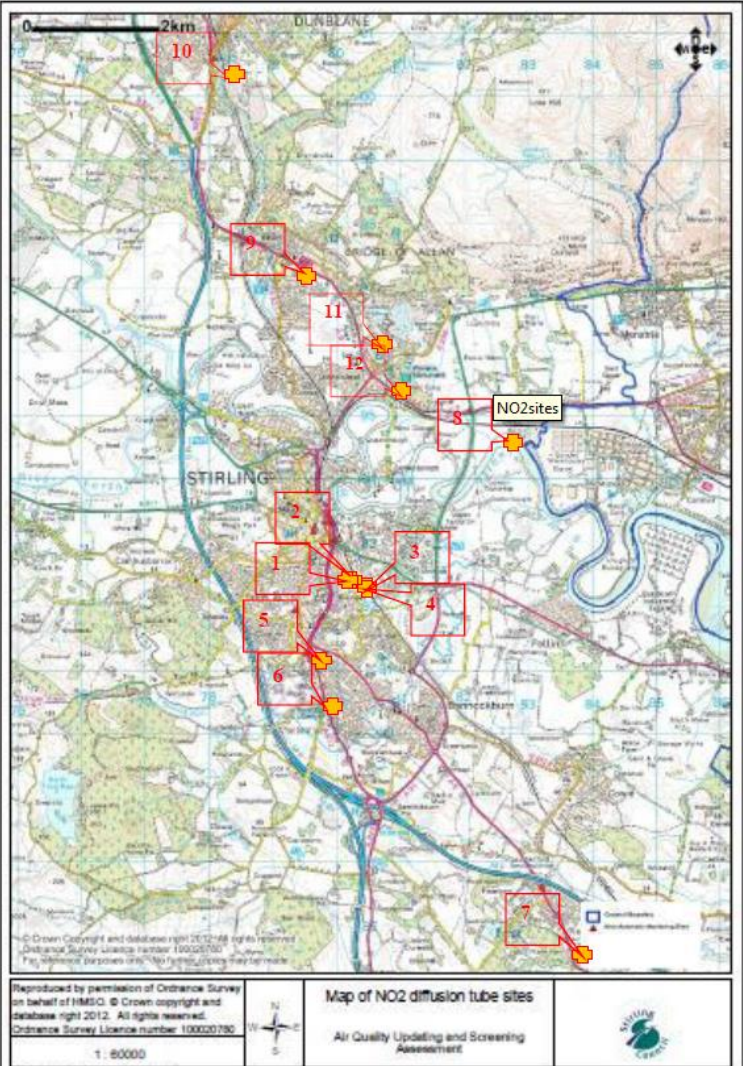


Table A.3 – Annual Mean NO<sub>2</sub> Monitoring Results

Site ID	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) <sup>(1)</sup>	Valid Data Capture 2018 (%) <sup>(2)</sup>	NO <sub>2</sub> Annual Mean Concentration (µg/m <sup>3</sup> ) <sup>(3)</sup>				
					2014	2015	2016	2017	2018
<b>Craigs Rbt</b>	Roadside	Automatic	89.21	89.21	See C.1.2	See C.1.2	23	22	22
<b>1</b>	Kerbside	Diffusion Tube	100	100	38.4	30.5	28.7	24.0	24.1
<b>2</b>	Kerbside	Diffusion Tube	100	100	37.8	28.8	23.2	24.1	21.7
<b>3</b>	Roadside	Diffusion Tube	100	100	38.4	31.5	27.2	25.1	20.5
<b>4A</b>	Roadside	Diffusion Tube	100	100	33.0	27.6	21.0	23.4	21.3
<b>4B</b>	Roadside	Diffusion Tube	100	100	32.7	27.4	21.2	20.5	21.2
<b>4C</b>	Roadside	Diffusion Tube	91.7	91.7	32.0	27.9	21.7	21.1	18.9
<b>5</b>	Roadside	Diffusion Tube	100	100	18.0	14.7	11.3	10.2	11.5
<b>6</b>	Roadside	Diffusion Tube	100	100	23.4	19.1	15.2	15.7	16.5
<b>7</b>	Roadside	Diffusion Tube	100	100	27.3	20.9	17.5	16.0	16.4
<b>8</b>	Roadside	Diffusion Tube	100	100	37.9	31.5	25.4	23.5	29.9
<b>9</b>	Roadside	Diffusion Tube	75	75	33.7	29.5	20.8	21.2	27.5
<b>10</b>	Roadside	Diffusion Tube	100	100	22.4	19.6	16.0	16.1	20.6
<b>11</b>	Roadside	Diffusion Tube	100	100		26.7	21.9	19.4	19.0
<b>12</b>	Roadside	Diffusion Tube	100	100		28.4	22.9	21.9	22.4

Notes: Exceedances of the NO<sub>2</sub> annual mean objective of 40µg/m<sup>3</sup> are shown in **bold**.

NO<sub>2</sub> annual means exceeding 60µg/m<sup>3</sup>, indicating a potential exceedance of the NO<sub>2</sub> 1-hour mean objective are shown in **bold and underlined**.

(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%).

(3) 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.

Table A.4 – 1-Hour Mean NO<sub>2</sub> Monitoring Results

Site ID	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) <sup>(1)</sup>	Valid Data Capture 2018 (%) <sup>(2)</sup>	NO <sub>2</sub> 1-Hour Means > 200µg/m <sup>3</sup> <sup>(3)</sup>				
					2014	2015	2016	2017	2018
<b>Craigs Rbt</b>	Roadside	Automatic	89	89	3	0	0	0	0

Notes: Exceedances of the NO<sub>2</sub> 1-hour mean objective (200µg/m<sup>3</sup> not to be exceeded more than 18 times/year) are shown in **bold**.

(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%).

(3) If the period of valid data is less than 85%, the 99.8<sup>th</sup> percentile of 1-hour means is provided in brackets.



Table A.5 – Annual Mean PM<sub>10</sub> Monitoring Results

Site ID	Site Type	Valid Data Capture for Monitoring Period (%) <sup>(1)</sup>	Valid Data Capture 2018 (%) <sup>(2)</sup>	PM <sub>10</sub> Annual Mean Concentration (µg/m <sup>3</sup> ) <sup>(3)</sup>				
				2014	2015	2016	2017	2018
<b>Craigs Rbt</b>	Roadside	96.21	96.21	15.8 <sup>A</sup>	15	13	13	14

<sup>A</sup> – From SAQ data (65% data capture)

Notes: Exceedances of the PM<sub>10</sub> annual mean objective of 18µg/m<sup>3</sup> are shown in **bold**.

(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%).

(3) 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.

Table A.6 – 24-Hour Mean PM<sub>10</sub> Monitoring Results

Site ID	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2018 (%) (2)	PM <sub>10</sub> 24-Hour Means > 50µg/m <sup>3</sup> (3)				
				2014	2015	2016	2017	2018
<b>Craigs Rbt</b>	Roadside	97	97	0	0	0	0	0

Notes: Exceedances of the PM<sub>10</sub> 24-hour mean objective (50µg/m<sup>3</sup> not to be exceeded more than 7 times/year) are shown in **bold**.

(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%).

(3) If the period of valid data is less than 85%, the 98.1<sup>st</sup> percentile of 24-hour means is provided in bracke





## Appendix B: Full Monthly Diffusion Tube Results for 2018

Table B.1 – NO<sub>2</sub> Monthly Diffusion Tube Results for 2018

Site ID	NO <sub>2</sub> Mean Concentrations (µg/m <sup>3</sup> )													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Mean	
													Raw Data	Bias Adjusted (1)
<b>Dumbarton Road, Stirling</b>	35.3	39.4	26.4	21.3	19.3	13.6	19.6	lost	missing	26.2	32.7	34.2	26.8	24.1
<b>Port Street, Stirling</b>	34.3	34.2	24.5	22.4	26.4	18.0	18.1	16.3	17.7	24.2	defective	29.6	24.2	21.7
<b>Craigs Rbt, Stirling</b>	33.9	30.8	22.4	24.8	19.8	16.7	15.0	14.4	12.0	24.0	defective	36.3	22.7	20.5
<b>Craigs Rbt, Stirling</b>	32.9	29.1	23.8	23.3	18.9	16.0	14.6	16.8	14.7	30.3	33.2	29.9	23.6	21.3
<b>Craigs Rbt, Stirling</b>	31.5	30.3	19.1	22.6	21.3	16.6	16.0	16.4	16.0	28.7	34.5	30.0	23.6	21.2
<b>Craigs Rbt, Stirling</b>	31.4	31.9	21.9	19.8	21.2	17.4	15.7	16.8	16.2	13.0	defective	25.9	21.0	18.9
<b>Lennox Ave, Stirling</b>	20.1	19.8	11.5	9.2	10.9	8.4	8.1	7.8	6.2	11.8	20.6	19.4	12.8	11.5
<b>Barnsdale Rd, Stirling</b>	25.8	27.2	16.9	18.5	17.5	15.8	11.3	12.1	11.2	18.2	21.9	23.9	18.4	16.5
<b>Main St, Plean</b>	25.2	27.4	20.2	19.2	18.0	14.1	10.0	12.7	10.6	19.7	defective	23.6	18.2	16.4
<b>Alloa Rd Rbt, Stirling</b>	37.3	37.4	29.3	32.9	32.8	29.0	24.8	24.1	17.1	33.1	70.2	30.0	33.2	29.9

## Stirling Council

<b>Henderson St, BOA</b>	34.4	27.7	24.7	19.7	19.5	17.5	missing	missing	missing	28.2	73.7	30.0	30.6	27.5
<b>Stirling Rd, Dunblane</b>	26.3	25.1	20.8	15.1	15.6	11.3	11.7	12.4	11.5	18.0	87.0	20.1	22.9	20.6
<b>Stirling University</b>	27.3	28.3	19.0	19.4	23.1	17.5	16.8	15.4	12.3	20.5	32.4	20.7	21.1	19.0
<b>Airthrey Road</b>	34.5	25.1	24.6	<1.0	45.0	18.9	17.2	17.0	17.4	23.5	23.9	26.6	24.9	22.4

(1) See Appendix C for details on bias adjustment

Figure B.1 – Diffusion Tubes: Trends in Annual Mean Concentration of NO<sub>2</sub> AT Diffusion Tube Sites 2014-2018

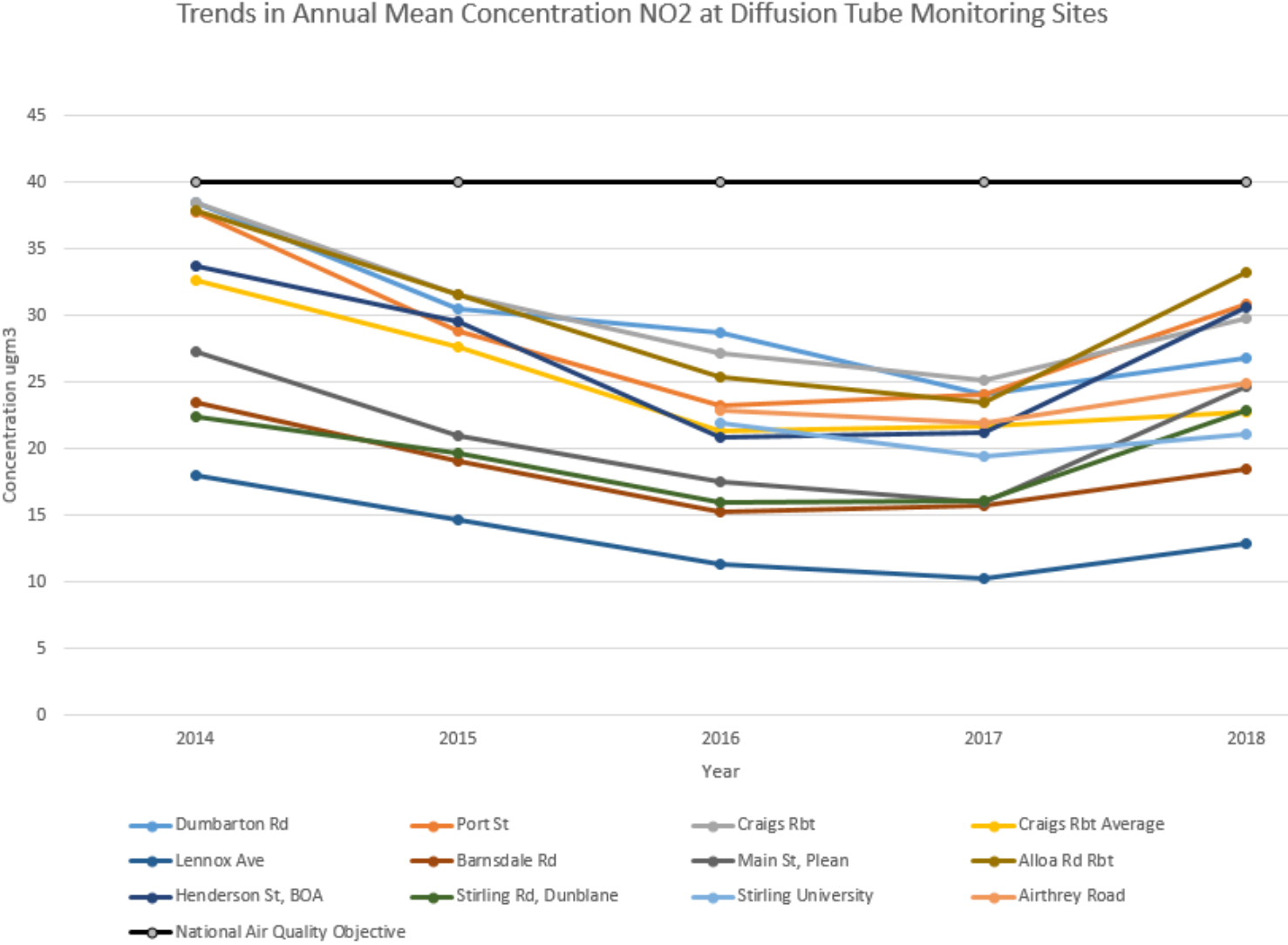
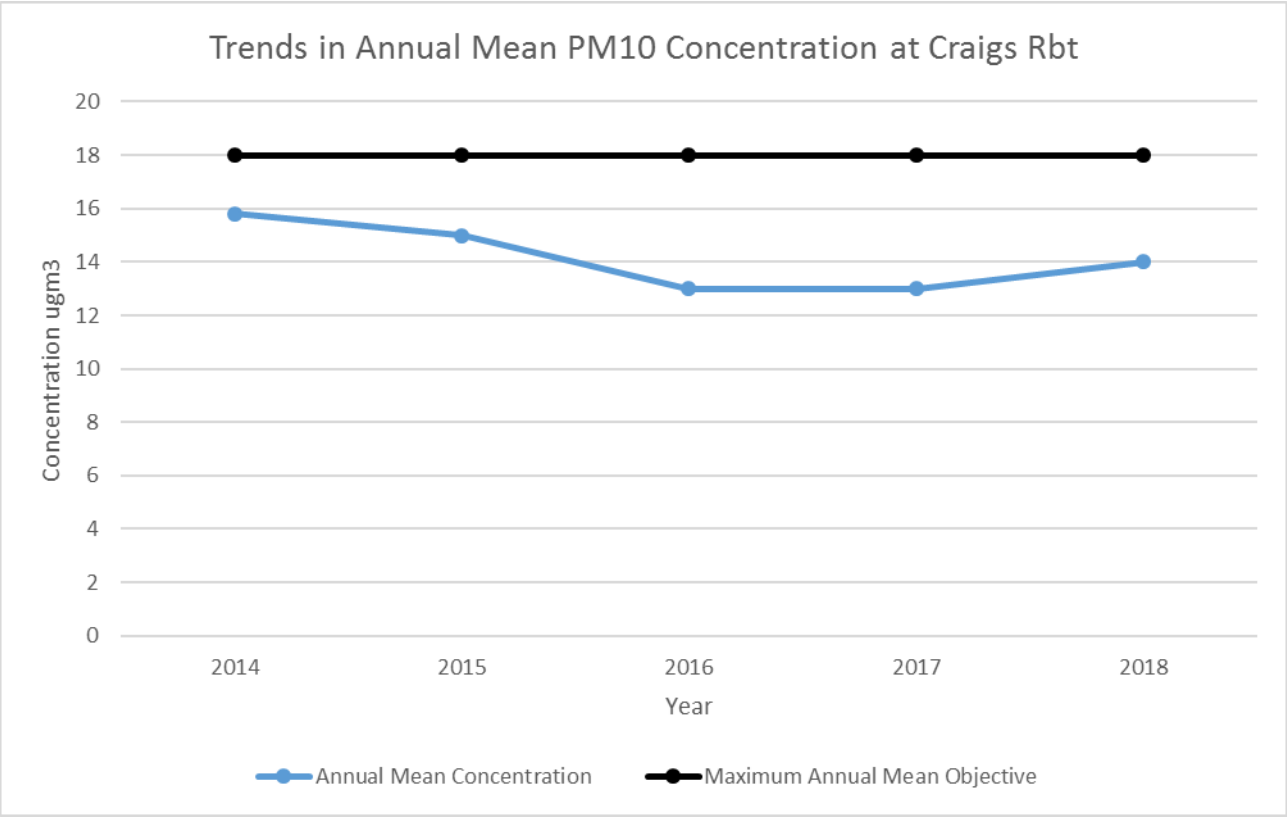


Figure B.1 – Trends in Annual Mean PM<sub>10</sub> Concentration at Craigs Roundabout 2014-2018





## **Appendix C: Supporting Technical Information / Air Quality Monitoring Data QA/QC**

### **C.1 Automatic Site**

Stirling Council operates an automatic monitoring station at Craig's Roundabout. The station houses a chemiluminescence NO<sub>x</sub> automatic analyser and a Tapered Element Oscillating Microbalance (TEOM) analyser for PM<sub>10</sub>. Data recorded by the station is analysed by Ricardo Energy and Environment.

#### **C.1.1 Quality Assurance /Quality Control of automatic monitoring site**

The automatic monitoring equipment is audited every 6 months by AEA Technology and a routine service and breakdown call out service was contracted to EnviroTechnology Services Ltd. Local Site Operator (LSO) calibrations were also performed.

#### **C.1.2 Data Capture Issues**

Following an instrument breakdown at the end of September 2014, the PM<sub>10</sub> monitoring equipment was removed by the equipment maintenance contractor for evaluation and repair. It also became evident that the data had not been received by the Scottish Air Quality website since February 2014 for NO<sub>2</sub>, whilst results obtained from their web logger by Stirling Council revealed anomalous monitoring results. This resulted in the NO<sub>2</sub> monitoring equipment and the web logger also being removed from the site for detailed assessment by the equipment maintenance contractor. It was February/March 2015 before all the equipment (instruments and power supply consumer units) was repaired and re-installed on site, however, it was April 2015 before results from all equipment were being recorded and downloaded to the Scottish Air Quality website.

In August 2015, we were informed, retrospectively, that the NO<sub>2</sub> data indicated a possible problem with 'internal sampling' at the automatic monitor and the data was rejected up to 8 August 2015.

From the 4<sup>th</sup> to 28<sup>th</sup> September 2017 the analyser broke down and no data was collected during this period. The data capture rate for this month was only 22%. In May 2017 there was also a loss of data with the capture rate at 69%.

In May 2018 there was a failure in a part of the NO<sub>x</sub> analyser – this was not resolved until mid-June with a consequent loss of data. This equipment has now been replaced.

## **C.2 Non-Automatic Monitoring Sites**

Non-automatic monitoring is carried out for NO<sub>2</sub> only. There are twelve monitoring sites, seven of which are located within Stirling City Centre. Of these, a set of three tubes are co-located with the automatic analyser at Craig's Roundabout to enable a local bias-adjustment factor to be calculated.

The tubes are provided and analysed by Edinburgh Scientific Services using 50% TEA in Acetone and are changed on a monthly basis by Stirling Council personnel. A map of the diffusion tube locations is shown in Figure A.3 of Appendix A.

### **C.2.1 Data Capture Issues**

No NO<sub>2</sub> data was captured across all 12 of the non-automatic monitoring sites in January and February of 2016. After submission of the NO<sub>2</sub> tubes, it was found that no monitoring data had been captured. Following correspondence with Edinburgh Scientific Services, it was identified that the wrong monitoring tubes had been provided to Stirling Council. This matter was rectified as soon as possible, allowing data to be captured from March onwards.

From this incident onwards, there has been the odd occasion where a tube may go missing but there have been no significant data losses associated with the tubes.

From July to September 2018 monitoring tubes were missing from Henderson Street, Bridge of Allan. The suspected reason was due to hanging baskets being placed in close proximity to the tubes and possibly been knocked off. There were no further issues with the site location.

### **C.2.2 Bias Correction Factor**

#### **C.2.2.1 – 2018**

A bias adjustment factor was applied to the annual mean NO<sub>2</sub> concentrations for 2018. The factor of 0.91 was obtained from the National Diffusion Tube Bias Adjustment Factor Spreadsheet version 03/19 which can be viewed at:

<https://laqm.defra.gov.uk/bias-adjustment-factors/national-bias.html>

The output from the Local Bias Adjustment Spreadsheet is shown in Table C.2.1 below.

Checking Precision and Accuracy of Triplicate Tubes										Automatic Method		Data Quality Check	
Diffusion Tubes Measurements										Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 µgm <sup>-3</sup>	Tube 2 µgm <sup>-3</sup>	Tube 3 µgm <sup>-3</sup>	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean				
1			32.9	31.5	31.4	32	0.8	3	2.1	28	94	Good	Good
2			29.1	30.3	31.9	30	1.4	5	3.5	31	91	Good	Good
3			23.8	19.1	21.9	22	2.4	11	5.9	23	95	Good	Good
4			23.3	22.6	19.8	22	1.9	8	4.6	21	94	Good	Good
5			18.9	21.3	21.2	20	1.4	7	3.4	16	64	Good	or Data Capture
6			16.0	16.6	17.4	17	0.7	4	1.7	12	70	Good	or Data Capture
7			14.6	16.0	15.7	15	0.7	5	1.8	13	96	Good	Good
8			16.8	16.4	16.8	17	0.2	1	0.6	14	96	Good	Good
9			14.7	16.0	16.2	16	0.8	5	2.0	13	95	Good	Good
10			30.3	28.7	13.0	24	9.6	40	23.7	23	96	Poor Precision	Good
11			33.2	34.5	<1	34	0.9	3	8.3	31	86	Good	Good
12			29.9	30.0	25.9	29	2.3	8	5.8	33	95	Good	Good
13												Good	Poor Precision

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

Overall survey --> Precision 11 out of 12 periods have a CV smaller than 20% (Check average CV & DC from Accuracy calculations)

Site Name/ ID: <b>Stirling Craigs Roundabout</b>	Accuracy (with 95% confidence interval) without periods with CV larger than 20% Bias calculated using 9 periods of data Bias factor A Bias B Diffusion Tubes Mean: 24 µgm <sup>-3</sup> Mean CV (Precision): 5 Automatic Mean: 23 µgm <sup>-3</sup> Data Capture for periods used: 94% Adjusted Tubes Mean: µgm <sup>-3</sup>	Accuracy (with 95% confidence interval) WITH ALL DATA Bias calculated using 10 periods of data Bias factor A Bias B Diffusion Tubes Mean: 24 µgm <sup>-3</sup> Mean CV (Precision): 9 Automatic Mean: 23 µgm <sup>-3</sup> Data Capture for periods used: 94% Adjusted Tubes Mean: µgm <sup>-3</sup>
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Jaume Targa, for AEA  
Version 04 - February 2011

**C.2.2.2 – 2017**

A bias adjustment factor was applied to the annual mean NO<sub>2</sub> concentrations for 2017. The factor of 9 was obtained from the National Diffusion Tube Bias Adjustment Factor Spreadsheet version 03/18 which can be viewed at:

<https://laqm.defra.gov.uk/bias-adjustment-factors/national-bias.html>

**C.2.2.3 - 2016**

A bias adjustment factor was applied to the annual mean NO<sub>2</sub> concentrations for 2016. The factor of 0.87 was obtained from the National Diffusion Tube Bias Adjustment Factor Spreadsheet version 06/17 which can be downloaded at:

<https://laqm.defra.gov.uk/bias-adjustment-factors/national-bias.html>

#### **C.2.2.4 - 2015**

Based on the results for 2015 the locally derived bias adjustment factor was calculated using the above tool as 1.04 and the national figure was reported as 0.76.

The data capture for the automatic monitor during 2015 was also limited (34.4%), however, the figure of 1.04 was used as it is more consistent with previous figures and also conservative.

#### **C.2.2.5 - 2014**

A local co-location study was carried out at the automatic monitoring site at Craig's Roundabout, Stirling using triplicate NO<sub>2</sub> diffusion tubes. The calculation was carried out using the local bias adjustment spreadsheet tool: <https://laqm.defra.gov.uk/bias-adjustment-factors/local-bias.html><sup>(5)</sup>. The monthly results from the diffusion tube analysis were compared with the monthly averages calculated from the ratified hourly NO<sub>2</sub> data from the chemiluminescent analyser for matching exposure periods. The locally derived bias adjustment factor for 2014 was found to be 1.22, higher than normal due the limited data capture from the automatic monitor. The National Diffusion Tube Bias Adjustment Factor for the testing laboratory was considerably different at 0.76.

However, due to the limited data capture of the automatic monitor in 2014 the Scottish Environment Protection Agency (SEPA) recommended that the matter was discussed with the LAQM Helpdesk and a surrogate factor generated.

Based on a comparison to the factors used from 2008 to 2013 (respectively, 1.06, 0.92, 1.08, 1.02, 0.9, 1.03) and consideration of the advice presented in LAQM TG16, a factor of 1.1 was considered to be both realistic and conservative. This adjustment was applied to the 2014 diffusion tube data.

### **C.3 –Annualising of Means Monitoring Data**

Where the valid data capture for the full calendar year is less than 75%, the means have been “annualised” as per Box 7.9 and 7.10 of the LAQM TG (16).

Figure C.3.1 – Annualising Continuous Monitoring Data

**Box 7.9 – Example: Annualising Continuous Monitoring Data**

It has only been possible to carry out a monitoring survey at site for six months between July and December 2015. The measured mean concentration **M** for this period is 30.2µg/m3. How can this be used to estimate the annual mean for this location?

□ Identify two to four nearby, long-term, continuous monitoring sites, ideally those forming part of the national network. The data capture for each of these sites should ideally be at least 85%. These sites should be background (Urban Background, Suburban or Rural) sites to avoid any very local effects that may occur at Urban Centre, Roadside or Kerbside sites, and should, wherever possible lie within a radius of about 50 miles. If no background sites are available, and the site to be annualised is itself a Urban Centre, Roadside or Kerbside site, then it is permissible to annualise using roadside or kerbside sites rather than background sites, though this should be clearly stated in the annual report.

- Obtain the annual means, **Am**, for the calendar year for these sites.
- Work out the period means, **Pm**, for the period of interest, in this case July to December 2015.
- Calculate the ratio, **R**, of the annual mean to the period mean (**Am/Pm**) for each of the sites.
- Calculate the average of these ratios, **Ra**. This is then the annualisation factor.
- Multiply the measured period mean concentration **M** by this annualisation factor **Ra** to give the estimate of the annual mean for 2015.

For this example the best estimate of the annual mean for site S in 2015 will be  $M \times Ra = 30.2 \times 0.944 = 28.5\mu\text{g}/\text{m}^3$ .

Background Site	Annual mean 2015 (Am)	Period Mean 2015 (Pm)	Ratio (Am/Pm)
A	28.6	29.7	0.963
B	22.0	22.8	0.965
C	26.9	28.9	0.931
D	23.7	25.9	0.915
<b>Average (Ra)</b>			<b>0.944</b>

If the short-term period covers, for instance, February to June 2016, and the work is being carried out in August 2016, then an annual mean for 2016 will not be available. The calculation can then be carried out using the ratio to the 2015 annual mean, but the result is then an estimate of the 2015 annual mean at the short-term site. The 2016 bias correction factor would also not be available, and so it would be necessary to use the 2015 factor instead.

Figure C.3.2 – Annualising NO<sub>2</sub> Diffusion Tube Monitoring Data**Box 7.10 – Example: Annualising NO<sub>2</sub> Diffusion Tube Monitoring Data**

A diffusion tube site (D1) has 8 months' worth of data and so it is necessary to annualise. A continuous background site (B1) has greater than 85% data capture for the year. The tubes were set out in accordance with the recommended calendar for 2015. If there are many locations to be annualised then it can be quicker to average the background site data to the same calendar as the diffusion tubes. The results are given in the below table. In addition, the results are given for the background site for those months that D1 data are available (Column B1 when D1 is Available).

Start Date	End Date	B1	D1	B1 when D1 is Available
7 January 2015	4 February 2015	15.6	38.4	15.6
4 February 2015	4 March 2015	38.3		
4 March 2015	1 April 2015	22.7	43.1	22.7
1 April 2015	29 April 2015	22.2		
29 April 2015	27 May 2015	24.9	51.3	24.9
27 May 2015	1 July 2015	20.8		
1 July 2015	29 July 2015	18.1	31.3	18.1
29 July 2015	26 August 2015	16.1	26.8	16.1
26 August 2015	30 September 2015	25.5	41.0	25.5
30 September 2015	28 October 2015	21.1		
28 October 2015	2 December 2015	28.1	29.8	28.1
2 December 2015	6 January 2016	32.0	39.8	32.0
<b>Average</b>		<b>23.8</b>	<b>37.7</b>	<b>22.9</b>

The annual mean (**Am**) of B1 is 23.8µg/m<sup>3</sup>. The period mean (**Pm**), of B1 is 22.9µg/m<sup>3</sup>. The ratio **R** of the annual mean to the period mean (**Am/Pm**) is 1.04. This process should be repeated for all continuous background sites. If no continuous monitoring sites are available, then diffusion tube sites from background locations with 12 months' data may be used. In either case, the more background sites that can be identified the better. Calculate the average of these ratios **Ra**. This is then the annualisation factor.

The measured period mean concentration **M** is 37.7µg/m<sup>3</sup>. Multiply by this annualisation factor **Ra** to give the estimate of the annual mean for 2015. Assuming that all other background sites yielded an annualisation factor of 1.04, then **Ra** in this example is 1.04; and the annualised average of **D1 = M × Ra = 37.7 × 1.04 = 39.2µg/m<sup>3</sup>**.

If the periods that the tubes were out varied beyond the 4 to 5 week recommendation, then it may be necessary to do a time weighted average rather than simple average in order to calculate **M**, **Am** and **Pm**.

## 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
LAQM TG16	Local Air Quality Management Technical Guidance 2016
LDP	Local Development Plan
LSO	Local Site Operator
NO	Nitric Oxide
NO <sub>2</sub>	Nitrogen Dioxide
NO <sub>x</sub>	Nitrogen Oxides
O <sub>3</sub>	Ozone

PM <sub>10</sub>	Airborne particulate matter with an aerodynamic diameter of 10µm (micrometres or microns) or less
PM <sub>2.5</sub>	Airborne particulate matter with an aerodynamic diameter of 2.5µm or less
PM <sub>1</sub>	Airborne particulate matter with an aerodynamic diameter of 1 µm or less
QA/QC	Quality Assurance and Quality Control
SO <sub>2</sub>	Sulphur Dioxide



## References

- (1) 2017 Air Quality Annual Progress Report for Stirling Council
- (2) [http://www.scottishairquality.co.uk/latest/site-info?site\\_id=STRL&view=graphing](http://www.scottishairquality.co.uk/latest/site-info?site_id=STRL&view=graphing)
- (3) <https://laqm.defra.gov.uk/review-and-assessment/tools/emissions.html#biomass>
- (4) Defra, Local Air Quality Guidance Management, Technical Guidance (TG16), April 2016
- (5) <https://laqm.defra.gov.uk/bias-adjustment-factors/bias-adjustment.html>
- (6) <http://laqm.defra.gov.uk/bias-adjustment-factors/national-bias.html>
- (7) <http://laqm.defra.gov.uk/review-and-assessment/tools/modelling.html>