# FIFE AIR QUALITY ANNUAL PROGRESS REPORT 2022

## Fife Council

Report for: Fife Council

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

In fulfilment of Part IV of the Environment Act 1995

Local Air Quality Management

August 2022

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# Executive Summary

## AIR QUALITY IN FIFE

Air quality is generally good in most parts of Fife, but there are a few specific areas within town centres where hotspots of pollution have been identified and action is required. The main pollutants of concern in these hotspot areas are nitrogen dioxide ($NO_2$) and fine particulate matter ($PM_{10}$ and $PM_{2.5}$) mainly sourced from road vehicle emissions. This Annual Progress Report has been undertaken to fulfil Fife Council's duty to annually review and assess air quality. The report provides the latest monitoring results and discusses the implications for air quality management in the Fife area.

The Annual Progress Report utilises monitoring data collected throughout 2021. Fife Council carry out monitoring of nitrogen dioxide ($NO_2$) at four automatic stations in Cupar, Dunfermline, Kirkcaldy and Rosyth. Non-automatic monitoring of $NO_2$ was carried out using diffusion tubes at 42 sites (total of 58 tubes). All $NO_2$ concentrations measured during 2021 were below the annual mean objective of 40 µg $m^{-3}$.

$PM_{10}$ and $PM_{2.5}$ is measured at the four automatic sites within Fife at Cupar, Dunfermline, Kirkcaldy and Rosyth. During 2021 all concentrations were below the annual mean objective of 18 µg $m^{-3}$ for $PM_{10}$ and 10 µg $m^{-3}$ for $PM_{2.5}$.

The review of all available data relating to carbon monoxide (CO), sulphur dioxide ($SO_2$) and benzene monitoring during 2021 indicates that it is unlikely that any air quality objectives relating to these pollutants were exceeded during 2021.

The review of all other local developments has not identified any locations where there may be a risk of the air quality objectives being exceeded and so no additional air quality assessment is recommended at this time.

There are currently two Air Quality Management Areas (AQMAs) for $PM_{10}$ located within the Fife Council boundary, these are:

- Bonnygate, Cupar, declared in October 2008.
- Appin Crescent, Dunfermline, declared in August 2012.

During 2021, Fife Council revoked the $NO_2$ element of both AQMAs after recommendations from the Scottish Government and Scottish Environment Protection Agency (SEPA).

The Air Quality Action Plan (AQAP) for the Bonnygate, Cupar AQMA was last updated in 2021. The AQAP has been successful in reducing both $NO_2$ and $PM_{10}$ concentrations within the Bonnygate area for a number of years now. During 2021 all annual mean concentrations were below the objective level of 40 µg $m^{-3}$ for $NO_2$ and 18 µg $m^{-3}$ for $PM_{10}$.

The AQAP for Appin Crescent, Dunfermline was last updated in 2021. The AQAP has been successful in reducing both $NO_2$ and $PM_{10}$ concentrations within the Appin Crescent area for a number of years now. During 2021 all annual mean concentrations were below the objective level of 40 µg $m^{-3}$ for $NO_2$ and 18 µg $m^{-3}$ for $PM_{10}$.

Three AQMesh sensor units were installed in December 2017 to seek to further understand pollutant concentrations and trends in the Appin Crescent, Dunfermline and Bonnygate, Cupar AQMAs. Data is managed and processed by Ricardo Energy and Environment (Ricardo) who carry out the appropriate Quality Assurance/Quality Control (QA/QC) procedures. The data available for 2021 showed no exceedances.

The Air Quality Strategy for Fife (2021–2025) was developed from the guidance of the Scottish Government and aims not only to raise awareness of air quality issues but also to promote some of the existing best practice work that the Council has undertaken within existing AQMAs to other parts of Fife. It recognises that no one single authority or Council service can have all the solutions and consequently a collaborative approach with key partners and stakeholders is considered essential in order to bring about improvements in air quality. An Air Quality Steering Group (including various Council services, SEPA, NHS Fife and representatives of local communities) aims to meet regularly to ensure that the aims and objectives of Fife's Air Quality Strategy and Air Quality Action Plans are being progressed. Progress in implementing the aims and objectives of Fife's Air Quality Strategy was acknowledged at the COSLA excellence awards in 2017 where Fife Council received a bronze award in the category of "Tackling Inequalities and Improving Health". The Air Quality Strategy for Fife was also last updated in 2021.

Following the review of all available data it is recommended that Fife Council carry out the following actions:

- Continue to monitor $NO_2$, $PM_{10}$ and $PM_{2.5}$ concentrations throughout Fife.
- Produce an Annual Progress Report in 2023, reporting concentrations measured during 2022.
- Continue to implement the measures outlined in the action plans for Appin Crescent, Dunfermline and Bonnygate, Cupar.

## ACTIONS TO IMPROVE AIR QUALITY

Measures outlined in the AQAPs for Bonnygate, Cupar and Appin Crescent, Dunfermline have been implemented throughout 2021. This includes the ongoing implementation of the Fife ECO Stars scheme which is a free, voluntary scheme that provides recognition, guidance and advice on operational best practice to operators of goods vehicles, buses and coaches, taxis and private hire vehicles. It is being rolled out in Fife to help fleet operators improve efficiency, reduce fuel consumption and reduce emissions – all helping to improve local air quality and at the same time, make cost savings.

As of June 2022, the Fife Fleet scheme stands at 269 members operating 9,446 vehicles in and around Fife. Recruitment of new members continues to reflect the full spectrum of fleets operating in Fife. The requirement for all school and social work contract operators to become members of ECO Stars has resulted in a continued increase in membership numbers for the ECO Stars Taxi and Private Hire scheme. As of June 2022, the Taxi and Private Hire scheme stands at 150 members operating 622 vehicles.

## LOCAL PRIORITIES AND CHALLENGES

Fife Council has been awarded its grant funding from the Scottish Government for 2022-23. The funding will be used to implement the following air quality initiatives and studies, which aim to work towards and further enhance the measures set out in the action plans for Bonnygate, Cupar and Appin Crescent, Dunfermline:

**Bonnygate, Cupar:**

Fife Council will continue to implement the measures set out in the Bonnygate AQAP during 2022. Fife Council's priorities within the designated AQMA over the forthcoming year include:

- Continue the implementation of Fife Council's travel plan including encouraging walking and cycling infrastructure and associated initiatives;
- Fife ECO Stars schemes for Fleet and Taxis operators will continue to encourage and promote 'clean fleet operations';
- Continue with the interrogation of monitoring data from the AQMesh unit in the Bonnygate to further understand pollutant concentrations and trends within the Bonnygate AQMA.

**Appin Crescent, Dunfermline:**

Fife Council will continue to implement the measures set out in the Appin Crescent AQAP during 2022. Fife Council's priorities within the designated AQMA over the forthcoming year include:

- Continue the implementation of Fife Council's travel plan including encouraging walking and cycling infrastructure and initiatives;
- Fife ECO Stars schemes for Fleet and Taxis operators will continue to encourage and promote 'clean fleet operations';
- Continue with the interrogation of monitoring data from the AQMesh units in Appin Crescent to further understand pollutant concentrations and trends within the Appin Crescent AQMA.

In addition to the above educational events to highlight Clean Air Day are proposed to be delivered at three selected schools in the Dunfermline area as part of Clean Air Day on and around the 16th of June 2022. This follows on from the successful delivery of educational packages as part of Clean Air Day in 2020 and 2021 at other schools in Fife. The 2022 event will include the use of the EnviroTechnology Services 'SmogMobile' to undertake monitoring at/in the vicinity of the three schools. The 'SmogMobile' is a zero emission, mobile air quality monitoring laboratory fitted with next generation, state-of-the-art instruments which can measure

pollutants and greenhouse gases in real time both inside and outside the vehicle whilst it is stationary or on the move. Further information on the vehicle is available at https://www.et.co.uk/products/air-quality-monitoring/vehicles-and-mobile-laboratories/the-smogmobile.

The allocated funding will also be used to undertake an anti-idling engine campaign which will focus mainly on schools and link with other educational based air quality activities such as Clean Air Day and to also build an air quality and climate change co-benefits evidence base in order to evaluate the likely impact and benefits of actions being considered by Fife Council in relation to the 'Climate Emergency Plan'.

## HOW TO GET INVOLVED

Members of the public can find information related to air quality on the Fife Council website. Actions that members of the public can take to help reduce air pollution include:

- Car sharing
- Reducing car journeys by choosing to walk, cycle or take public transport instead
- Maintain and look after your vehicle properly
- Consider switching to an electric vehicle

Further information is available on the dedicated Fife Council air quality web pages at www.fife.gov.uk/airquality.

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# 1. LOCAL AIR QUALITY MANAGEMENT

This report provides an overview of air quality in Fife 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) summarises the work being undertaken by Fife Council to improve air quality and any progress that has been made.

Table 1.1 below summarises the Air Quality Objectives applicable to Scotland.

Table 1.1 Summary of Air Quality Objectives in Scotland

| AQ Objective-Pollutant | Concentration | 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 |
| | 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 |
| | 18 µg $m^{-3}$ | Annual mean | 31.12.2010 |
| Particulate Matter ($PM_{2.5}$) | 10 µg $m^{-3}$ | Annual mean | 31.12.2020 |
| Sulphur Dioxide ($SO_2$) | 350 µg $m^{-3}$, not to be exceeded more than 24 times a year | 1-hour mean | 31.12.2004 |
| | 125 µg $m^{-3}$, not to be exceeded more than 3 times a year | 24-hour mean | 31.12.2004 |
| | 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 |
| Lead | 0.25 µg $m^{-3}$ | Annual Mean | 31.12.2008 |

## 1.1 SUMMARY OF PREVIOUS REVIEW AND ASSESSMENT

### 1.1.1 Previous Review and Assessment Reports

Fife Council have carried out a number of reviews and assessments in relation to air quality since 2007. All reports can be accessed via the Fife Council website[1] and Air Quality in Scotland websites[2].

The 2007 APR and 2008 APR concluded that a detailed assessment should be carried out for Bonnygate, Cupar ($NO_2$), Appin Crescent, Dunfermline ($PM_{10}$) and Admiralty Road, Rosyth ($PM_{10}$). These reports concluded that an AQMA should be declared for $NO_2$ and $PM_{10}$ at Bonnygate, Cupar and increased monitoring should be carried out at Appin Crescent, Dunfermline. This monitoring was increased and an additional assessment in 2010 suggested an AQMA should be declared in Appin Crescent for $NO_2$. A further detailed assessment resulted in the amendment of the Appin Crescent AQMA to include $PM_{10}$. Subsequent AQAPs have been put into place.

The 2013 APR concluded that an AQMA was not required at Admiralty Road, Rosyth at that time.

A traffic management options appraisal was carried out in 2014 at Appin Crescent to assess if changes to the traffic management would have a significant impact. This was not the case. The Cupar Streetscene dispersion model was also carried out in 2014 to assess the traffic management changes proposed for Cupar. Two options were deemed to have a positive impact and were implemented in 2014. The 2014 APR concluded that the traffic management changes in Cupar were a success and concentrations in the Bonnygate AQMA had reduced.

A modelling assessment was carried out in 2015 to determine the effects of the Cupar North Development Zone and Relief Road. The report concluded that the results for each approach were very similar but when considering the cumulative impacts of the development without the relief road it is recommended that mitigation measures are considered to counteract the impact of additional development traffic.

An additional Appin Crescent traffic management appraisal was carried out in 2015 to investigate the potential impact of traffic management scenarios which aimed to improve traffic flow through Appin Crescent. It concluded that two out of the three options assessed did not provide air quality benefits however the third option (removal of a bus stop) did provide improvements.

The 2016 APR indicated exceedances within the current Appin Crescent AQMA at Appin Crescent (2) and Appin Crescent (6 ABC). The Air Quality Action Plan for Appin Crescent presents actions that will be implemented to address these exceedances. No exceedances were measured in the Cupar AQMA.

The 2017 APR highlighted a marginal exceedance within St Andrews as the result of new monitoring deployed within the town centre which commenced in 2016. This monitoring location was however some distance from the nearest receptor. In accordance with TG.16, the result was therefore corrected for $NO_2$ drop off using the LAQM $NO_2$ fall off with distance calculator. This resulted in an annual mean concentration of 33 µg $m^{-3}$ at the nearest receptor which is below the objective. Measured 2016 concentrations of $PM_{10}$ and $PM_{2.5}$ were below the annual mean objectives at all sites. The review of all available data relating to carbon monoxide (CO), sulphur dioxide ($SO_2$) and benzene monitoring during 2016 indicated that it is unlikely that any AQS objectives relating to these pollutants were exceeded during 2016. A review of industrial sources reported that Longannet Power Station ceased operation in March 2016.

The 2018 APR indicated $NO_2$, $PM_{10}$ and $PM_{2.5}$ concentrations were below the annual mean objectives in 2017. The review of all available data relating to CO, $SO_2$ and benzene monitoring during 2017 indicated that it was unlikely that any AQS objectives relating to these pollutants were exceeded.

Fife Council carried out a number of surveys in 2018 including an emissions tracer survey and a mobile air quality survey in St Andrews measuring $NO_2$, $PM_{10}$ and $PM_{2.5}$. The emissions tracer survey sampled a section of the Council vehicle fleet to determine if fleet renewals would yield tangible air quality benefits in the AQMAs and areas of concern. A number of locations with high GPS count points and emissions were established in Kirkcaldy, Methil and Glenrothes, which coincide with the location of Council depot facilities. Fife Council will look to potentially extend the survey to include all fleet vehicles and over a long period of time. This would provide a more accurate estimate of the effect the fleet has on overall emissions levels.

[1] https://www.fife.gov.uk/kb/docs/articles/environment2/environmental-health/air-quality

[2] http://www.scottishairquality.scot/news/reports?view=laqm

The aim of the mobile monitoring was to demonstrate how air pollution concentrations vary within St Andrews and in turn to review the current $NO_2$ diffusion tube monitoring locations. Hotspots were identified along Links Crescent and North Street (A917) and along City Road. Increased concentrations were also measured along South Street and Bell Street for $NO_2$, $PM_{10}$ and $PM_{2.5}$ confirming that the main source of pollution is likely to be road traffic.

An updated air quality impact assessment was carried out in 2018 for the Cupar North Development Zone and Relief Road. Two future 'with development' traffic scenarios were assessed by comparison with future baseline conditions for both annual mean $NO_2$ and $PM_{10}$ concentrations: Phase 1 2024 (when 600 residential units are in use just prior to opening of the relief road) and completed development 2030 (when all residential and mixed use aspects of development are complete, and the Cupar Relief road is operational). No exceedances of the 40 µg $m^{-3}$ $NO_2$ annual mean objective were predicted in 2024 Phase 1. The annual mean $NO_2$ concentrations were not predicted to be in excess of the annual mean objective in the Bonnygate AQMA. $PM_{10}$ exceedances of the 18 µg $m^{-3}$ Scottish annual mean objective were predicted at three 1$^{st}$ floor and two ground floor height receptors where relevant human exposure might be present. The model results indicated that additional emissions from vehicle trips generated by the Cupar North Development would contribute to what could be considered a significant increase in annual mean $PM_{10}$ concentrations within the Bonnygate AQMA in 2024, prior to the relief road becoming operational.

No exceedances of the 40 µg $m^{-3}$ $NO_2$ annual mean objective were predicted in the 2030 completed development scenario. The predicted impact was classified as either beneficial or negligible at all receptors. $PM_{10}$ exceedances of the 18 µg $m^{-3}$ Scottish annual mean objective were predicted at three 1$^{st}$ floor and two ground floor height receptors where relevant human exposure might be present. The model results indicate that the relief road will have a beneficial effect on $PM_{10}$ concentrations within the Bonnygate AQMA; the reduction will not however be sufficient to achieve compliance with the 18 µg $m^{-3}$ Scottish $PM_{10}$ annual mean objective.

Ricardo prepared a regional scale dispersion model on behalf of Fife Council to model emissions from road transport. Concentrations of $NO_2$, $PM_{10}$ and $PM_{2.5}$ were modelled for 2016 at 3 m resolution over the whole of the Council area using a novel modelling framework (RapidAir) developed by Ricardo. The concentrations predicted from RapidAir were validated against roadside measurements made in Fife where emissions data was available. In addition, local validations were carried out for each of the main towns in Fife for $NO_2$ (Cupar, Dunfermline, Kirkcaldy, Rosyth and St Andrews) and the remaining tubes locations in combination.

The 2019 APR indicated $NO_2$, $PM_{10}$ and $PM_{2.5}$ concentrations were below the annual mean objectives in 2018. The review of all available data relating to CO, $SO_2$ and benzene monitoring during 2018 indicated that it was unlikely that any AQS objectives relating to these pollutants were exceeded. Additional indicative monitoring of $NO_2$, $PM_{10}$ and $PM_{2.5}$ was carried out using AQMesh sensor units within the Bonnygate and Appin Crescent AQMAs. No exceedances were measured for any of the pollutants.

The 2020 APR indicated all $NO_2$, $PM_{10}$ and $PM_{2.5}$ concentrations measured during 2019 were below the annual mean objective.

Additional indicative monitoring of $NO_2$, $PM_{10}$ and $PM_{2.5}$ was carried out using AQMesh sensors units within the Bonnygate and Appin Crescent AQMAs. For the Bonnygate monitoring location, the data showed that there were no exceedances of the $NO_2$ objectives, however there were exceedances of $PM_{10}$ (both annual and daily objectives) and $PM_{2.5}$ objectives during 2019. For the two Appin Crescent locations there were no exceedances measured for the $NO_2$, $PM_{10}$ or $PM_{2.5}$ objectives.

The review of all available data relating to CO, $SO_2$ and benzene monitoring during 2019 indicated that it was unlikely that any AQS objectives relating to these pollutants were exceeded.

Further information on any of these reviews and assessments can be found by contacting Fife Council directly at air.quality@fife.gov.uk or looking on the website for a copy www.fife.gov.uk/airquality

### 1.1.2 2021 Annual Progress Report

The 2021 APR utilised monitoring data collected throughout 2020. Fife Council carried out monitoring of $NO_2$ at four automatic stations in Cupar, Dunfermline, Kirkcaldy and Rosyth. Non-automatic monitoring of $NO_2$ was carried out using diffusion tubes at 42 sites (total of 58 tubes). There were no diffusion tube sites which commenced or were decommissioned in 2020. However, Appin Crescent 3 moved location slightly to the east,

due to being located on a piece of street furniture which was removed. All $NO_2$ concentrations measured during 2020 were below the annual mean objective of 40 µg $m^{-3}$.

$PM_{10}$ and $PM_{2.5}$ was measured at the four automatic sites within Fife at Cupar, Dunfermline, Kirkcaldy and Rosyth. During 2020, all concentrations were below the annual mean objective of 18 µg $m^{-3}$ for $PM_{10}$ and 10 µg $m^{-3}$ for $PM_{2.5}$.

Due to COVID-19 restrictions Fife were not able to maintain their diffusion tube monitoring networks (exposure and analysis in-line with the DEFRA calendar) as normal during the 2020 lockdown period. Two tube changeover dates (1st April and 29th April) were missed during the first lockdown. However, diffusion tube monitoring returned to normal in June. Therefore, Fife have data for diffusion tubes that were exposed for 3 months. However, this data has been discounted from the monthly diffusion tube processing in accordance with appropriate technical guidance.

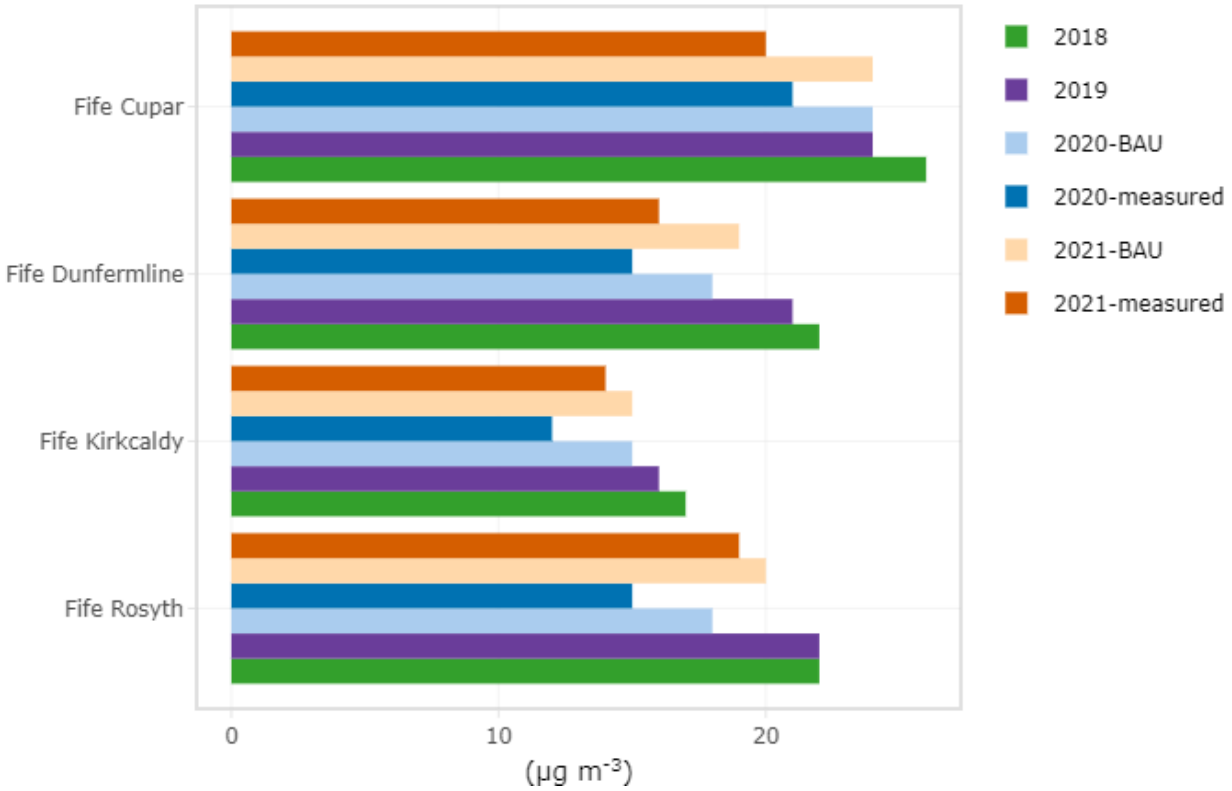
Additional indicative monitoring of $NO_2$, $PM_{10}$ and $PM_{2.5}$ was carried out using AQMesh sensors units within the Bonnygate and Appin Crescent AQMAs. There were no exceedances measured at any of the sensor locations for the $NO_2$, $PM_{10}$ or $PM_{2.5}$ objectives.

The review of all available data relating to CO, $SO_2$ and benzene monitoring during 2020 indicated that it was unlikely that any AQS objectives relating to these pollutants were exceeded.

### 1.1.3 COVID-19 Lockdown Effects of Air Quality Report

A report examining the impact of COVID-19 lockdown measures on evolving ambient air quality was prepared for Fife. The report can be found at: https://www.scottishairquality.scot/sites/default/files/publications/2020-12/Fife_covid_analysis_updated.html. The analysis focuses on NOx and $NO_2$ (and ozone data where measured) from January 2020 through December 2021 and uses proven modelling techniques to discount the influence of weather on ambient pollutant concentrations. $NO_2$ annual average measured concentrations for 2018 to 2021 and annual average business as usual (BAU) concentrations for 2020 and 2021 are shown in Figure 1-1. $NO_2$ concentrations were still not back to levels of 2018/19 or what has been modelled as business as usual for 2021.

Figure 1-1 $NO_2$ Annual Average and Business As Usual Concentrations



# 2. ACTIONS TO IMPROVE AIR QUALITY

## 2.1 AIR QUALITY MANAGEMENT AREAS

A summary of AQMAs declared by Fife Council can be found in Table 2.1. Further information related to declared or revoked AQMAs, including maps of AQMA boundaries are available online http://www.scottishairquality.co.uk/laqm/aqma. The boundaries of the AQMA's declared by Fife Council are shown in Figure 2-1 (Bonnygate, Cupar) and Figure 2-2 (Appin Crescent, Dunfermline). A steering group including key representatives from relevant services of Fife Council was formed to develop the AQAPs for both Bonnygate and Appin Crescent using the findings of the Further Assessment reports and the wide range of potential options for improving air quality. The steering group meet regularly to discuss and review the progress of the action plan measures outlined in the AQAPs.

Following the 2021 Annual Progress Report, Fife Council revoked both AQMA's for $NO_2$. Whilst concentrations of $NO_2$ and $PM_{10}$ have improved significantly and now meet the Scottish air quality objectives for both pollutants, due to the current uncertainty regarding $PM_{10}$ concentrations reported by different analysers and the Particulate Matter concentrations indicated by the Bonnygate AQMesh monitoring in 2020, Fife Council decided not to implement the revocation procedure for the $PM_{10}$ element of the AQMAs at this time.

Fife Council proposes to continue to implement both AQAPs for $PM_{10}$ and monitor $NO_2$ and $PM_{10}$ concentrations within the AQMAs to ensure that the Scottish air quality objectives continue to be achieved, and public health continues to be protected. This will include the continued consideration of monitoring data collected by the AQMesh sensors within Bonnygate and Appin Crescent which allow for concentrations of PM to be measured at locations of concern where previously it was not possible.

Fife Council will review the 2022 monitoring data obtained for both AQMAs in the 2023 APR and will also take guidance from the current Particulate Matter Measurement study that has been commissioned by the Scottish Government before a decision is made regarding the potential revocation of both $PM_{10}$ AQMAs.

Table 2.1 Declared Air Quality Management Areas

| AQMA Name | Pollutants and Air Quality Objectives | City/Town | Description | Action Plan |
|---|---|---|---|---|
| Bonnygate, Cupar | $PM_{10}$ annual mean | Cupar | An area comprising of Bonnygate (A91), Crossgate (A914) and St Catherine Street (A91). There are a number of residential properties within the area close to the road at 1st floor height above commercial properties. | Bonnygate Cupar, AQAP was updated in 2021 |
| Appin Crescent, Dunfermline | $PM_{10}$ annual mean | Dunfermline | An area comprising of Appin Crescent, Dunfermline. There are a number of residential properties within the area close to the road at both ground level and 1st floor height. | Appin Crescent, AQAP was updated in 2021 |

Figure 2-1 Bonnygate, Cupar AQMA Boundary

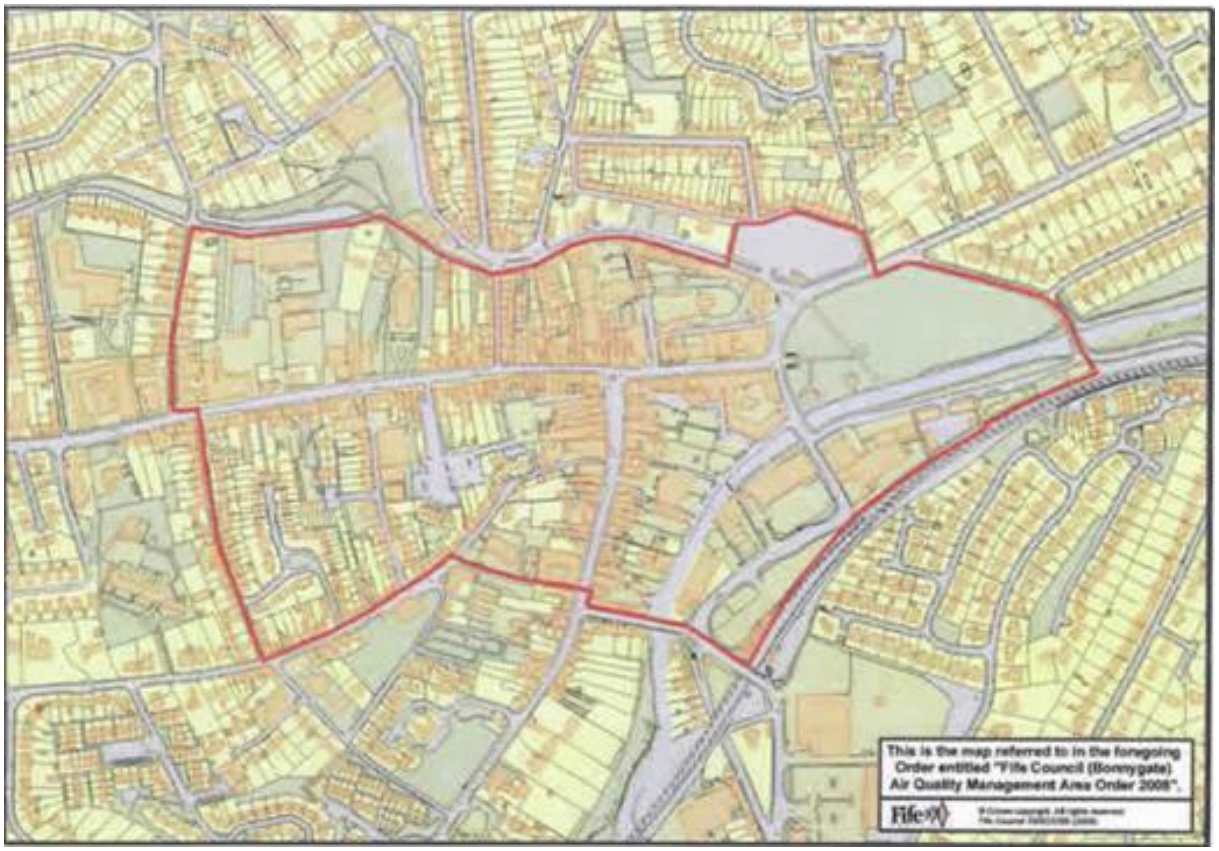
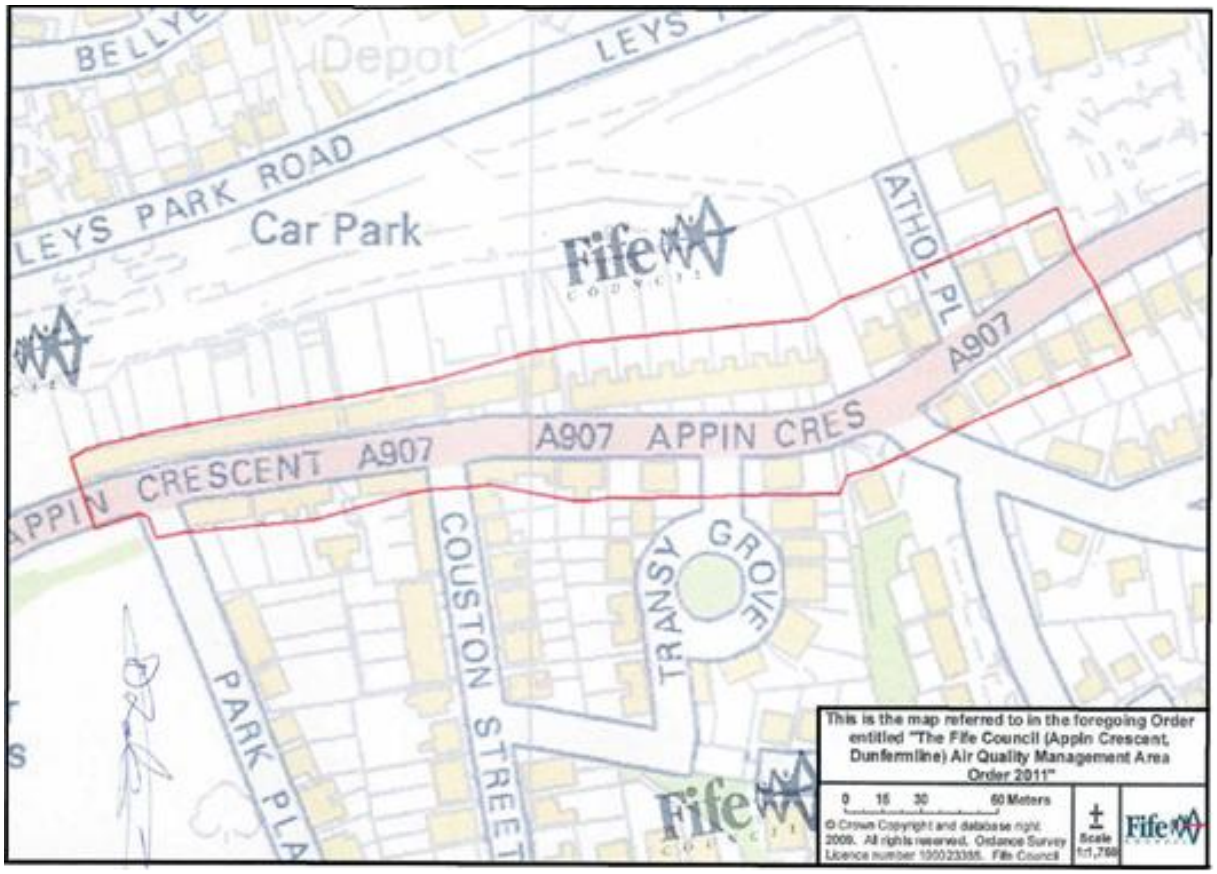



Figure 2-2 Appin Crescent, Dunfermline AQMA Boundary



## 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 Fife 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.

Fife Council has embedded air quality in its Fife Plan, Fife Local Plan, Fife Local Transport Strategy and Joint Health Protection Plan. This has been facilitated through the setting up of a Fife Core Air Quality Steering Group which consists of the relevant teams/organisations/agencies and meets quarterly to assess progress. In its Plan4Fife 2021-2024 (August 2021) specific reference is made to "Improved air quality to meet prescribed standards to reduce preventable ill-health". The Fife Local Plan and Fife Local Transport Plan are currently under review and air quality is to be further embedded into these via consultation with Planning and Transportation colleagues. Comments from the Council's Land and Air Quality Team have already been provided for the latest versions/updates of these Plans.

Fife Council has also in partnership with NHS Fife updated its Joint Health Protection Plan (JHPP) which covers the period 1st April 2020 to 31st March 2022 (new version expected to be finalised in the summer of 2022) and includes specific reference to air quality in terms of the existing AQMAs and Fife Council's Air Quality Strategy and highlights the importance of a collaborative approach to tackling air quality issues. This collaborative approach is demonstrated by membership of NHS Fife on the Fife Core Air Quality Steering Group and, Mossmorran and Braefoot Bay Expert Advisory Group on Air Quality. Fife Council is also exploring with NHS Fife the development and implementation of the MUSTER model (Meeting, Understanding, Surveillance, Toxicology, Evaluation and Reporting) which is a model that proposes a method of investigation at an individual level which addresses physical, and psychosocial concerns including air quality issues. Fife Council will also engage further with NHS Fife on health related promotion activities such as encouraging walking and cycling in preference to the car.

### 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.

Fife Council has undertaken the relevant screening process and determined that there is currently no requirement for any Low Emission Zones (LEZs) in Fife. Fife Council has also provided comments in relation to the proposed Low Emissions Zones (LEZs) being introduced within neighbouring local authorities (Edinburgh and Dundee).

### 2.2.3 Integrated Policy

Fife Council maximises co-benefits between air quality and related policy areas such as climate change, noise, transport, planning and agriculture amongst others to deliver enhanced benefits. Fife Council's Land and Air Quality Team is currently working with colleagues in our Climate and Zero Waste Team on a Climate Change Co-Benefits Evidence Base study. Fife Council would like to combine our understanding of the air quality and climate gas emissions impacts to evaluate the likely impact and benefits of actions being considered by Fife Council in relation to the Climate Emergency Plan. This project will build the air quality evidence base through:

- Collating information on emissions and concentrations of NOx and PM across Fife
- Estimating the impact of the proposed measures being considered by Fife Council in the Climate Emergency Plan on these emissions.

Fife Council are also integrating air quality issues into transport and planning as outlined in the above Placemaking – Plans and Policies section. Further consideration of noise and agriculture will be the subject of future Scottish Government air quality grant submissions to undertake the relevant studies.

Additionally, the Climate Change and Zero Waste team have moved into Fife Council's Planning Service to further strengthen action in this area. This demonstrates how responding to the Climate Emergency is seen as core to the work moving forward in Fife. Fife Council's Land & Air Quality team continues to work closely with the Climate Change and Zero Waste team to ensure air quality is considered.

### 2.2.4 Tackling Non Transport Emissions Sources

Fife Council address emissions from domestic (household) burning and agriculture, going beyond current regulatory and management approaches. We have already undertaken a domestic fuel use survey in our two AQMAs (Bonnygate, Cupar and Appin Crescent, Dunfermline) to further understand the contribution of this source and to assist in the development of best practice guidance. In terms of agricultural sources we intend to submit a Scottish Government air quality grant application next financial year to further investigate this source of emissions in the Fife area.

Fife Council are also actively supporting the SGN Hydrogen 100 (H100) project which aims to give residents in the Levenmouth area the opportunity to be at the leading edge of the low-carbon economy. A world-first hydrogen network in Buckhaven and Methil will bring renewable hydrogen into around 300 homes in 2023 allowing residents to heat their homes and cook their food using 100% zero-carbon hydrogen (produced by a dedicated electrolysis plant, powered by a nearby offshore wind turbine). Participating customers will use hydrogen boilers, heaters and cooking appliances during the 4.5 year initial trial which will run until 2027. The project is the first of its kind to employ a direct supply of clean power to produce hydrogen for domestic heating which will put Fife at the forefront of the clean energy revolution.

Further information on the first-of-a-kind demonstration project that is leading the way in decarbonising home heating is available at https://sgn.co.uk/H100Fife and at https://h100fife.co.uk.

### 2.2.5 Transport – Avoiding unnecessary travel and Active Travel

Fife Council supports a modal shift to active travel and public transport. This will mean, amongst other objectives, providing a transport system that facilitates active travel choices, better public transport provision and constraints upon private vehicle use, especially in urban centres where pollution and congestion are most acute. Fife Council has a number of active travel initiatives in place which are discussed further below.

Fife Council will work with active travel partners to identify funding for permanent active travel infrastructure and behavioural change programmes, through grant funded programmes in line with the National Transport Strategy (NTS) Sustainable Travel Hierarchy and the Sustainable Investment Hierarchy, and where the projects are clearly aligned to the active travel outcomes framework. Relevant examples include:

- Partnership working with Sustrans to develop projects as well as seek grant funding from Sustrans to expand the shared use network across Fife
- Partnership working with SEPA to develop projects and jointly seek funding to implement
- SEStran working with community groups directly to encourage active travel, with grant funding where available

Fife Council will work with delivery partners to make temporary active travel infrastructure, delivered under the Space for People fund during the COVID-19 outbreak, permanent in the medium to longer term. Relevant examples include:

- St Andrews 20mph zone, being considered to be made permanent
- Cupar 20mph zone, being considered to be made permanent

Fife Council will work collaboratively with various partners to deliver our Active Travel vision of enabling walking, cycling and wheeling to be the most popular mode of travel for short, everyday journeys in our towns and cities. Relevant examples include:

- Encourage School Travel Plans to be developed for all schools
- Promote the "Walk Once a Week" initiative in schools to encourage active travel
- Promote Hands Up Scotland surveys in schools

- Promote Bikeability in schools, teach pupils how to cycle and develop road sense
- Undertake marketing and promotion in order to encourage use of public transport
- Community engagement to increase the active travel network across Fife

Specific details on several of the above active travel initiatives which are targeted at primary schools are provided below:

The "Walk Once a Week" Campaign is a partnership between Fife Council and Living Streets Scotland that continues to progress the active travel agenda in Fife Primary schools and increase the uptake of active travel. 2021/22 saw a maximum of 19 school and 4,207 pupils take part. While the total number of pupils and schools engaged was lower than would be hoped for in an ordinary year it is still encouraging to see schools taking part in spite of continued COVID-19 related restrictions.

The Hands Up Scotland survey is a project funded by Transport Scotland and is a joint survey between Sustrans and all 32 local authorities across Scotland whereby each September schools across Scotland complete the survey by asking their pupils 'How do you normally travel to school?' and the results provide a valuable annual snapshot of typical school travel habits. The results for 2021 show that there was a slight decrease in active travel within Fife Primary schools from 59.4% in 2020 (50.1% walking, 4% cycling and 5.3% scooter/skate) to 53.9% in 2021 (46.4% walking, 3.3% cycling and 4.2% scooter/skate). In association with this decrease in active travel there was an increase in pupils being driven to school (from 19% in 2020 to 23.1% in 2021) and those opting to park and stride (from 15.4% in 2020 to 16.5% in 2021).

Cycling is promoted through encouraging active schools and is further promoted within schools via the Bikeability scheme. Over 2021 the number of pupils signed up to take part across Levels 1 and 2 of Bikeability were:

- Level 1 – 1,357 pupils from 31 schools (100% of pupils passed)
- Level 2 – 1,240 pupils from 28 schools (100% of pupils passed)

### 2.2.6 Public Engagement and Behavioural Change

Fife Council carry out a large number of public engagement activities, including the promotion of sustainable travel choices that are aimed towards encouraging changes in behaviour that will contribute to improving local air quality. These activities aim to encourage a shift away from the use of private motor vehicles for travelling to more sustainable forms of transport or reducing the need for travel.

Travel to school is still a necessity and Fife Council actively promote ways to make this a sustainable journey through initiatives such as WOW (Walk Once a Week), The Hands Up Scotland survey and Bikeability which are all discussed in more detail in Section 2.2.5 above.

In recent years Clean Air Day (CAD) has become a successful platform for allowing Fife Council to raise awareness of air quality issues while also encourage sustainable travel options. We have successfully delivered educational initiatives and events around CAD focussing specifically on Fife primary schools and below details of the events undertaken in 2021 are provided.

For Clean Air Day 2021, Fife Council provided two primary schools with an educational package, including materials to carry out their own monitoring studies whereby the participating primary schools were:

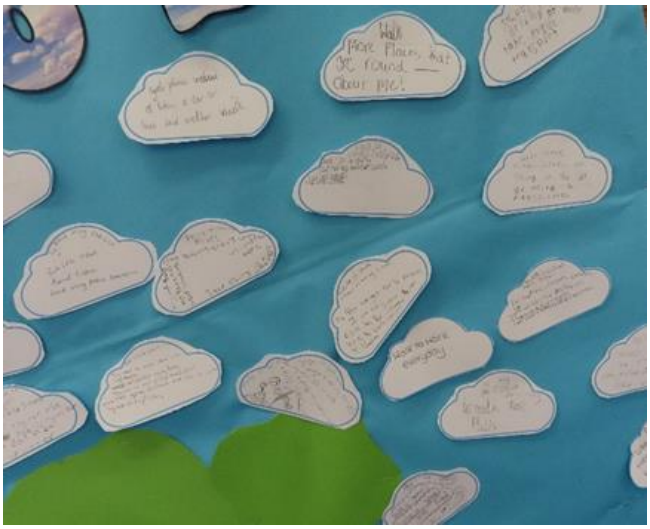
- Southwood Primary School, Glenrothes
- Pupil Support Services, Glenrothes Campus (Rimbleton)

Prior to Clean Air Day, each school was provided with a pack by Ricardo Energy & Environment, on behalf of Fife Council. Pupils used the information from the introductory presentation to determine their own monitoring locations, placing electronic diffusion tubes in key locations they had selected around their school grounds. Additionally, a Plume Lab Flow 2 personal monitor was provided so that mobile measurements could be taken by pupils during breaks and at lunch times. This gave them a chance to see what the air quality was like in real time.

For Clean Air Day on the 17th June 2021, the participating schools joined an online webinar to learn more about the different air pollutants, how they are monitored within Fife Council, and their impacts on the health of people and the environment. A live interactive quiz was also hosted, giving all pupils the chance to answer via school tablets and show their air pollution knowledge. Additionally, at the end of the presentation a Q&A session meant pupils could ask any further questions they had on the subject. To help promote the day branded Clean Air Day items were gifted to pupils by Environmental Protection Scotland (EPS). To encourage active travel, Ricardo Energy & Environment provided pupils with bike bells and hi-visibility snap bands.

Members of staff from the Land & Air Quality Team also attended Southwood Primary, Glenrothes on the 17th June 2021 to speak to the children about Clean Air Day and the importance of sustainable travel options. A lot of the children were proud to be already adopting sustainable travel to and from school with many already walking, scooting and cycling on a regular basis. The children were also proud to show off their Clean Air Day pledges which were presented on a colourful presentation board at the school reception.

After Clean Air Day the schools were sent a presentation which allowed pupils to review what they had learned previously about air pollution and the monitoring results from their studies.

Positive feedback was received from Southwood Primary with the class teacher noting:

*"The resources provided were excellent and the children really enjoyed making pledges, taking part in the quiz and wordsearch. Would highly recommend schools take part in this initiative, our children gained learnt through real life meaningful contexts."*

This is great feedback for Fife Council and shows that the event was a success. Depending on future funding opportunities it is hoped that similar type events could be held in future years.

## 2.3 PROGRESS AND IMPACTS OF MEASURES TO ADDRESS AIR QUALITY IN FIFE COUNCIL

Fife 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 for Bonnygate, Cupar and Table 2.3 for Appin Crescent, Dunfermline. More detail on these measures can be found in the air quality Action Plan relating to each AQMA, these are available on the Council's website at www.fife.gov.uk/airquality.

Key completed measures include:

**Bonnygate**

- The Implementation of new Urban Traffic Management and Control system and changes to pedestrian crossings
    - Complete and monitoring on-going
- Update to the air quality strategy
    - Now covers 2021-2025 and aligns with CAFS2
- Identifying the most polluting vehicles within the AQMA
    - Undertook Real World Driving emissions study, gathered data from over 12,000 vehicles
    - Data will be used to inform decision making and policy changes within AQMA

**Appin Crescent**

- Changes to signage and road markings
    - Complete and monitoring on-going
- Update to the air quality strategy
    - Now covers 2021-2025 and aligns with CAFS2
- Identifying the most polluting vehicles within the AQMA
    - Undertook Real World Driving emissions study, gathered data from nearly 13,000 vehicles
    - Data will be used to inform decision making and policy changes within AQMA

Progress on the following measures has been slower than expected due to COVID-19

- Integrate Air Quality with other Council Strategies

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

- Improving links with local transport strategy/area transport plan – Updates in progress
- Improving Air Quality links with Local Planning and Development Framework, Provision of Information and promotion of travel options and Provision of information relating to Air Quality – A Development Plan Scheme will be published for the Local Development Plan in the summer of 2022 which will set out the timescales for the preparation of plan itself.
- Integrate Air Quality with other Council Strategies – Work with colleagues in our Climate and Zero Waste Team to produce a Climate Change Co-Benefits Evidence Base study

Table 2.2 Progress on Measures to Improve Air Quality in Bonnygate

| 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 | Liaise with Scottish Government to encourage the consideration of national measures | Policy Guidance and Development Control | Increase focus on background concentrations of PM and encourage national action | Fife Council | On-going | 2021 -2025 | Maintain contact with the Scottish Government regarding the adoption of national air quality measures | Low<br>KPI's to be developed in liaison with Scottish Government | Fife Council continues to attend and contribute to air quality seminars, training events and pollution liaison group meetings where national air quality measures are discussed. | 2025 | |
| 2 | Improving links with Local Transport Strategy/ Area Transport Plan | Policy guidance and development control | Measures to ensure the current poor air quality in the AQMA is improved where possible and to avoid future problems are implemented via the Local Transport Strategy | Fife Council | On-going | 2021 -2025 | Reference to Bonnygate AQMA and measures included in Air Quality Action Plan.<br>Integration of plan with Local Transport Strategy | Low | Fife Council Air Quality Steering Group outputs continue to contribute to the development of Fife Council's Local Transport Strategy which is in the process of being updated as of March 2022. Subsequent updates to associated Strategies and Plans may follow.<br>Fife Council will seek to incorporate specific air quality measures into the updated Local Transport Strategy. | 2025 | |
| 3 | Improving Air Quality links with Local Planning and Development Framework | Policy guidance and development control | Local planning considerations aim to mitigate the cumulative negative air quality impacts of new development | Fife Council | On-going | 2021 -2025 | Ensure that development proposals with the potential to exert an impact on the Bonnygate AQMA are assessed for air quality impacts and where necessary, appropriate mitigation measures considered | Medium | The Low Carbon Fife Supplementary Guidance was adopted in January 2019 and now forms a statutory part of the Local Development Plan (FIFEplan). This guidance incorporates the Fife Council Air Quality Developers Guide.<br>A Development Plan Scheme will be published for the Local Development Plan in the summer of 2022 which will set out the timescales for the preparation of the plan itself.<br>In conjunction with this the Fife Council Air Quality Developers Guide has been recently amended as has the associated Fife Council Air Quality Strategy (covering the period 2021 to 2025). | 2025 | |
| 4 | Integrate Air Quality with other Council Strategies | Policy guidance and development control | Encourage opportunity for contributions towards improving local air quality and minimising negative impacts from existing and | Fife Council | On-going | 2021 -2025 | Continue and enhance joint working between Council Services and other Partnership Organisations to encourage potential air | Low | Member of the Council's Climate Change Team invited to attend future Fife Core Air Quality Steering Group meetings.<br>The Plan for Fife, the Fife Partnership Local Outcome Improvement Plan, was in 2020-2021.<br>Fife Council declared a climate emergency in 2019 and the COVID-19 pandemic brought new challenges to address. An updated plan for 2021-2024 sets out the key recovery and renewal priorities.<br>On February 6th 2020 Fife Council's Environment and Protective Services Committee approved the Sustainable | 2025 | To invite one of the Council's Climate Change Team to attend Fife Core Air Quality Steering Group |

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | future Council strategies.<br>Increase awareness of local air quality | | | | quality implications of existing and future Council strategies.<br>Implementation of the relevant AQS objectives | | Energy Climate Action Plan - Climate Fife. Climate Fife includes a practical action plan.<br>https://www.fife.gov.uk/kb/docs/articles/environment2/climate-change,-carbon-and-energy. The Scottish Government 'expect any Scottish local authority which has or is currently developing a Sustainable Energy [Climate] Action Plan to ensure that air quality considerations are covered, (Clean Air for Scotland – The Road to a Healthier Future 2015, P21)'.<br>The Addressing the Climate Emergency (ACE) Board has been set up, with key Climate Fife priorities being taken forward through the ACE Action Plan are:<br>• Climate Ready Buildings<br>• Climate Resilient Communities<br>• Climate Action Communities<br>• Maximising Environmental Capital<br>• Implementing Climate Fife Priorities<br>Links to air quality are considered throughout these action plans, specifically by the Local Transport Strategy and Local Development Plan that have the potential for air quality impacts.<br>Additionally, the Climate Change and Zero Waste team have moved into Fife Council's Planning Service to further strengthen action in this area. This demonstrates how responding to the Climate Emergency is seen as core to the work moving forward in Fife.<br>Fife Council's Land & Air Quality team continues to work closely with the Climate Change and Zero Waste team to ensure air quality is considered. We will work with colleagues in our Climate and Zero Waste Team to produce a Climate Change Co-Benefits Evidence Base study | | meetings in the future. |
| 5 | Implementation of new Urban Traffic Management and Control system and changes to pedestrian crossings | Policy guidance and development control | Improve efficiency of transit through Cupar Town Centre and reduce emissions from road traffic sources within the Bonnygate street canyon | Fife Council | Completed | Completed and monitoring ongoing | Pollutant reduction in AQMA.<br>AQ monitor will continue to confirm the effectiveness of the measures | Decline in $NO_2$ and $PM_{10}$ concentrations within Bonnygate, monitoring to continue until trend has emerged. Pollutant concentrations can vary annually due to meteorological influences | Completed and monitoring ongoing | 2025 | |
| 6 | Travel Plans for large Institutions and Businesses | Promoting travel alternatives | To encourage a shift to more sustainable forms of travel | Fife Council | On-going | 2021 -2025 | Continue the implementation of Fife Council's travel plan | Low | Transportation department continuing to support schools in updating and developing School specific travel plans.<br>Continue to actively promote sustainable travel to school, including initiatives such as Bikeability and WOW (Walk Once a Week). | 2025 | |

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | or reducing the need for travel | | | | Undertake Council travel surveys | | Continue the implementation of Fife Council's Travel Plan. | | |
| 7 | Provision of Information and promotion of travel options | Promoting travel alternatives | Discourage long stay commuter parking as part of the Fife Council's Parking Strategy.<br>To increase awareness of travel choices and encourage changes in behaviour that will contribute to improving local air quality | Fife Council | Annually | 2021 -2025 | To improve integration between cycling, walking and public transport.<br>To continue to liaise with Scottish Government in the production of KPIs for this action plan measure | Low | Grant application for 2021-22 includes 9 new traffic counters with 9 obtained in 2019-20 and in 2020-21 through grant funding also.<br>These traffic counters will aid in tracking changes in vehicle use within existing AQMAs and other parts of Fife.<br>Adopted FIFEplan policy 11 requires new development to encourage and facilitate the use of sustainable transport appropriate to the development, promoting in the following order of priority: walking, cycling, public transport, cars.<br>A Development Plan Scheme will be published for the Local Development Plan in the summer of 2022 which will set out the timescales for the preparation of plan itself.<br>Continue to actively promote sustainable travel to school, including initiatives such as Bikeability and WOW (Walk Once a Week). | 2025 | |
| 8 | Target reduced localised emissions from freight | Freight and delivery management | Improve efficiency of transit through the AQMA and facilitate reduced emissions | Fife Council | On-going | 2021-2025 | Pollution reduction in AQMA | Medium | Continue to engage with HDV Fleet operators through the ongoing roll out of the Fife ECO Stars scheme. | 2025 | |
| 9 | Provision of information relating to Air Quality | Public information | To increase awareness of local air quality issues and encourage changes in behaviour that will contribute to improving local air quality | Fife Council | On-going | 2021 -2025 | Continue to make information relating to local air quality management available through the Council website and Scottish Government "Air Quality in Scotland" Website.<br>Production of booklet – travel pack<br>Publication of LAQM reports | Low | The Low Carbon Fife Supplementary Guidance was adopted in January 2019 and now forms a statutory part of the Local Development Plan (FIFEplan). This guidance incorporates the Fife Council Air Quality Developers Guide.<br>A Development Plan Scheme will be published for the Local Development Plan in the summer of 2022 which will set out the timescales for the preparation of plan itself.<br>In conjunction with this the Fife Council Air Quality Developers Guide has been recently amended as has the associated Fife Council Air Quality Strategy (covering the period 2021 to 2025) with both documents available online at www.fife.gov.uk/airquality | 2025 | |
| 10 | Parking Management and Control | Traffic management | Reduce traffic by discouraging long stay parking and | Fife Council | On-going | 2021 -2025 | Pollutant reduction in AQMA | Low | Continue to evaluate parking management measures within the Bonnygate AQMA. | 2025 | |

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | associated commuting movements. Minimise impacts of commercial deliveries on traffic movement | | | | | | | | |
| 11 | Review and support proposed infrastructure changes that will contribute to delivering improvements in local air quality | Transport planning and infrastructure | Support Council proposals for infrastructure changes that will facilitate improvements in vehicle movements within Cupar. (Confirm that proposals will be subject to suitable environmental assessments) | Fife Council | On-going | 2021 -2025 | Pollutant Reduction in AQMA | High | Continue to support proposed infrastructure changes and provide comments when consulted. Monitoring data from within the AQMA (automatic monitoring data, diffusion tube data, AQMesh data and traffic flow data) available for any associated modelling studies required in association with such infrastructure changes. | 2025 | |
| 12 | Target reductions in emissions from the Council fleet and contract vehicles (including driver training) | Vehicle fleet efficiency | Target reduced emissions from Council fleet vehicles and Council contract fleet vehicles | Fife Council | Annually | 2021 -2025 | Monitor and assess viable options for alternative fuels, technologies, and fuel additives.<br>Fife Council tender specification outlines that all new vehicles must have exhaust trap and filtration systems.<br>Number of vehicles in Council fleet<br>Number of electric and hydrogen powered vehicles in Council fleet | Medium | As of March 2022, Fife Council had 55 full electric vehicles and 19 hybrid vehicles in service (either leased or purchased).<br>As of March 2022, the size of the Fife Council fleet decreased slightly from the 2021 figure of 1,518 vehicles and now stands at 1,506 vehicles.<br>Total diesel use for 2020/21 was 3,118,643 litres (a reduction of 576,534 litres from 2019/20). The notable reduction was primarily a result of the COVID-19 impacts. | 2025 | |

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Annual reduction in Fuel usage | | | | |
| 13 | Target reductions in emissions from buses | Vehicle fleet efficiency | Target reduced emissions from buses operating within the Bonnygate AQMA | Fife Council | On-going | 2021 -2025 | Establish a bus quality partnership<br>Increase in fleet using alternative fuel | Medium | Continue to encourage bus operators to recognise the importance of air quality and climate change issues through the Fife ECO Stars scheme and to explore the potential to set up voluntary bus agreements through interaction with local bus operators.<br>As of March 2022, there are 58 bus operators within the ECO Stars scheme (one operator went out of business), but the number of vehicles covered has increased to 1,345. | 2025 | |
| 14 | Fife ECO Stars | Vehicle fleet efficiency | Encourage operators of buses, coaches, HGVs and LDVs to sign up to voluntary scheme which encourages and promotes 'clean operators' | Fife Council | On-going | 2021 -2025 | Develop and promote Fife ECO Stars, a new green recognition scheme aiming to tackle air pollution from transport | Medium | As of June 2022, the Fife Commercial Fleet Membership grew to 269 members covering 9,446 vehicles operating in Fife and beyond (note this figure includes the number of bus operators and vehicles noted above).<br>As of June 2022, the Taxi & Private Hire Membership has increased to 150 members operating 622 vehicles. The requirement for all Fife Council school and social work contract operators to become members of ECO Stars is a key factor in the continued growth of the Taxi & Private Hire Membership scheme. | 2025 | |
| 15 | Maintenance and utilisation of Air Quality and Planning Toolkit | Policy guidance and development control | Facilitate the consideration of the potential air quality impacts of developments across Fife, but notably near existing AQMAs | Fife Council | Annually | 2021 -2025 | Develop a GIS based dispersion modelling toolkit to assist planners and other local authority officers in the consideration of the air quality issues in the development management process | Low | The Regional RapidAir$^{TM}$ Dispersion Model is in the process of being updated again using the most recent available data. Phase 1 of the update is completed as of March 2022 with Phase 2 anticipated to be completed by March 2023.<br>Council will utilise the updated Model to consider air quality issues in the development management process. | 2025 | |
| 16 | Update Air Quality Strategy for Fife | Policy guidance and development control | Update Strategy so that it meets the current needs of Fife with regards Air Quality and aligns with the Clean Air for Scotland Strategy 2 | Fife Council | To be completed and issued in 2021 | 2021 | Aligning the Strategy with CAFS whilst meeting the specific needs of Fife. Following the latest guidelines with regards the development of Air Quality Strategy and then meets the | Medium | Fife Council Air Quality Strategy was updated and approved in 2021 and now covers the period of 2021-2025.<br>The update aligns with the Clean Air for Scotland Strategy 2 (CAFS2) | 2021 | |

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | approval of the committee | | | | |
| 17 | Promote the continued expansion of the Councils Electric Vehicle Fleet | Promoting Low Emission Transport | Cross department initiative to promote the continued expansion of the Council Vehicle Fleet | Fife Council | On-going | 2021 – 2025 | The Number of electric Vehicle in the Council Fleet | Medium | As of March 2022, Fife Council had 55 full electric vehicles and 19 hybrid vehicles in service (either leased or purchased).<br>The number of electric and hybrid vehicles being added to the Fleet continues to increase every year with new vehicles identified and brought in on trial | 2025 | |
| 18 | Promote the continued development of the Electric Vehicle Infrastructure | Promoting Low Emission Transport | Work with Roads and planning department to further develop EV infrastructure, focusing on the addition of charging points | Fife Council | On-going | 2021 – 2025 | Number of EV Charging points.<br>Number of times EV Charging points are used.<br>Number of EV registered in Fife | Low | As of May 2022, there are 71 charging point locations across Fife including a range of free, fast and rapid chargers as shown on the ChargePlaceScotland site as being available at this time (i.e., the 71 locations do not include any out of commission).<br>In 2021 EV Charging points in Cupar were used by 207 public users (down from 260 public users in 2019) with the reduction likely due to the introduction of charging at Fife Council charge points in November 2020. | 2025 | |
| 19 | Promote Sustainable travel initiatives | Promoting Travel Alternatives | Focus on promotional material in schools and businesses.<br>Identify initiatives to work in tandem with ECO Stars that focus on alternative travel options.<br>Provision of guidance and information | Fife Council | On-going | 2021 – 2025 | Creation of promotional material.<br>Promotion of Air Quality related events.<br>Identification of new Initiatives.<br>Incorporation of new Initiatives. | Low | Fife Council continues to provide information via the air quality pages of the Fife Council website www.fife.gov.uk/airquality and promotional materials for initiatives carried out such as Fife ECO Stars and Clean Air Day | 2025 | |
| 20 | Promote domestic combustion best practice guidance | Policy Guidance and Development Control | Managing the PM concentration contribution from the increased number of small-scale domestic biomass burners | Fife Council | 2021 | 2021 – 2025 | Identification of best practise guidance.<br>Creation of promotional material.<br>Distribution of promotional material | Low | A survey on domestic fuel use within the AQMA was undertaken in March 2022 with around 1/3 of the responses wanting to learn more on the best practice in terms of running and maintaining their appliance. The findings of this fuel use survey will aid in the production of such promotion materials. | 2025 | |
| 21 | Develop alternative travel Infrastructure | Transport Planning and Infrastructure | Continued enhancement and management | Fife Council | On-going | 2021 – 2025 | Development projects carried out on Fife cycle | Low | Fife Council maintains one of the UK's most comprehensive cycle network with 350 miles of signed cycle routes.<br>Fife Council has promoted/developed numerous initiatives such as WOW and Bikeability. | 2025 | |

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | of cycle routes and walking paths and infrastructure in Fife. Making it easier to commute using these alternatives | | | | and walking paths.<br>Events carried out or promoted by Fife Council | | The Fife Travel Plan has been set up since 1999 and continually enhance and developed.<br>Partnerships have been developed such as with Living Streets Scotland. | | |
| 22 | Promote and organise Clean Air Day Events | Public Information | On schools events packages<br>Citizen Science Projects | Fife Council | Annually | 2021 – 2025 | CAD Events carried out or promoted by Fife Council | Low | For the 2021 Clean Air Day, presentations were given to three Primary Schools within Fife with Citizen Science Packs and portable air quality monitors used to provide air quality data.<br>As of March 2022, preparations are underway in terms of 2022 Clean Air Day events which will include the use of the EnviroTechnology Services 'SmogMobile' which is a zero-emission mobile air quality monitoring laboratory. | 2025 | |
| 23 | Identify source apportionment to background PM | Vehicle Fleet Efficiency | The main source of PM for the Bonnygate is background. It would help identify exactly what contributes to this to help identify possible mitigation measures | Fife Council | 2021 - concept | 2021 – 2025 | Source apportionment study for background PM | Medium | A Background Source apportionment study was undertaken in 2021 and provided recommendations for further work focusing on domestic PM sources. A survey on domestic fuel use within the AQMA was undertaken in March 2022 to determine the extent of solid fuel burning in and around the AQMA (specifically from open fires and wood burning stoves). The findings of this exercise will aid in informing future modelling and action planning activities. | 2025 | |
| 24 | Utilise Sensor technology to gain a better understanding of PM concentrations within the AQMA | Traffic Management | Use sensor technology to monitor PM at locations in the AQMA where previously it wasn't possible and where modelling has indicated higher levels. This will inform movement to revoke $PM_{10}$ AQMA | Fife Council | On-going | 2021 – 2025 | Quality controlled Data from AQMesh sensor unit for use in LAQM reporting | Medium | Monitoring has continued in 2021 and the associated data is reported within this APR.<br>Data processed and managed following guidance to ensure data quality. | 2025 | |
| 25 | Identify most polluting vehicles within AQMA | Vehicle Fleet Efficiency | Specific persistent polluters to help inform policy and provide | Fife Council | 2021 | 2021 – 2025 | Emissions study to identify specific polluters<br>Utilisation of data to inform | Medium | A Real-World Driving Emissions Study was undertaken over one week within the AQMA in March 2022 and gathered data from over 12,000 vehicles. The data from the monitoring study which will be used to inform future decision making and policy changes. | 2025 | |

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | evidence to help encourage change. Focusing on business rather than individuals | | | | | | | | |

Table 2.3 Progress on Measures to Improve Air Quality in Appin Crescent

| 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 | Liaise with Scottish Government to encourage the consideration of national measures | Policy guidance and development control | Increase focus on background concentrations of PM and encourage national action | Fife Council | On-going | 2021 -2025 | Maintain contact with the Scottish Government regarding the adoption of national air quality measures | Low<br>KPI's to be developed in liaison with Scottish Government | Fife Council continues to attend and contribute to air quality seminars, training events and pollution liaison group meetings where national air quality measures are discussed. | 2025 | |
| 2 | Improving links with Local Transport Strategy/ Area Transport Plan | Transport planning and infrastructure | Measures to ensure the current poor air quality in the AQMA is improved where possible and to avoid future problems are implemented via the Local Transport Strategy | Fife Council | On-going | 2021 -2025 | Reference to Appin Crescent AQMA and measures included in Air Quality Action Plan.<br>Integration of plan with Local Transport Strategy | Low | Fife Council Air Quality Steering Group outputs continue to contribute to the development of Fife Council's Local Transport Strategy which is in the process of being updated as of March 2022. Subsequent updates to associated Strategies and Plans may follow.<br>Fife Council will seek to incorporate specific air quality measures into the updated Local Transport Strategy | 2025 | |
| 3 | Improving Air Quality links with Local Planning and Development Framework | Policy guidance and development control | Local planning considerations aim to mitigate the cumulative negative air quality impacts of new development | Fife Council | On-going | 2021 -2025 | Integration of Appin Crescent AQAP with future versions of Local Plan.<br>Maintain and make available - air quality guidance notes for developers | Medium | The Low Carbon Fife Supplementary Guidance was adopted in January 2019 and now forms a statutory part of the Local Development Plan (FIFEplan). This guidance incorporates the Fife Council Air Quality Developers Guide.<br>A Development Plan Scheme will be published for the Local Development Plan in the summer of 2022 which will set out the timescales for the preparation of plan itself.<br>In conjunction with this the Fife Council Air Quality Developers Guide has been recently amended as has the associated Fife Council Air Quality Strategy (covering the period 2021 to 2025). | 2025 | |
| 4 | Integrate Air Quality with other Council Strategies | Policy guidance and development control | Encourage opportunity for contributions towards improving local air quality and | Fife Council | On-going | 2021 -2025 | Maintain regular and ongoing communication between members of the Appin Crescent | Low | Member of the Council's Climate Change Team invited to attend future Fife Core Air Quality Steering Group meetings.<br>The Plan for Fife, the Fife Partnership Local Outcome Improvement Plan, was in 2020-2021. | 2025 | To invite one of the Council's Climate Change Team to |

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | minimising negative impacts from existing and future Council strategies.<br>Increase awareness of local air quality | | | | AQAP steering group | | Fife Council declared a climate emergency in 2019 and the COVID-19 pandemic brought new challenges to address. An updated plan for 2021-2024 sets out the key recovery and renewal priorities.<br>On February 6th 2020 Fife Council's Environment and Protective Services Committee approved the Sustainable Energy Climate Action Plan - Climate Fife. Climate Fife includes a practical action plan.<br>https://www.fife.gov.uk/kb/docs/articles/environment2/climate-change,-carbon-and-energy. The Scottish Government 'expect any Scottish local authority which has or is currently developing a Sustainable Energy [Climate] Action Plan to ensure that air quality considerations are covered, (Clean Air for Scotland – The Road to a Healthier Future 2015, P21)'.<br>The Addressing the Climate Emergency (ACE) Board has been set up, with key Climate Fife priorities being taken forward through the ACE Action Plan are:<br>• Climate Ready Buildings<br>• Climate Resilient Communities<br>• Climate Action Communities<br>• Maximising Environmental Capital<br>• Implementing Climate Fife Priorities<br>Links to air quality are considered throughout these action plans, specifically by the Local Transport Strategy and Local Development Plan that have the potential for air quality impacts.<br>Additionally, the Climate Change and Zero Waste team have moved into Fife Council's Planning Service to further strengthen action in this area. This demonstrates how responding to the Climate Emergency is seen as core to the work moving forward in Fife.<br>Fife Council's Land & Air Quality team continues to work closely with the Climate Change and Zero Waste team to ensure air quality is considered. We will work with colleagues in our Climate and Zero Waste Team to produce a Climate Change Co-Benefits Evidence Base study. | | attend Fife Core Air Quality Steering Group meetings in the future. |
| 5 | Travel Plans for large Institutions and Businesses | Transport planning and infrastructure | To encourage a shift to more sustainable forms of travel or reducing the need for travel | Fife Council | On-going | 2021 -2025 | Continue the implementation of Fife Council's travel plan<br>Undertake Council travel surveys | Low | Transportation department continuing to support schools in updating and developing School specific travel plans.<br>Continue to actively promote sustainable travel to school, including initiatives such as Bikeability and WOW (Walk Once a Week).<br>Continue the implementation of Fife Council's Travel Plan. | 2025 | |
| 6 | Provision of Information and promotion of travel options | Promoting travel alternatives | To increase awareness of travel choices and encourage changes in behaviour that will contribute to | Fife Council | Annually | 2021 -2025 | To improve integration between cycling, walking and public transport. | Low | Grant application for 2021-22 includes 9 new traffic counters with 9 obtained in 2019-20 and in 2020-21 through grant funding also.<br>These traffic counters will aid in tracking changes in vehicle use within existing AQMAs and other parts of Fife. | 2025 | |

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | improving local air quality. | | | | Produce Travel Choices facility for Dunfermline.<br>Undertaking Travel Marketing in Dunfermline | | Adopted FIFEplan policy 11 requires new development to encourage and facilitate the use of sustainable transport appropriate to the development, promoting in the following order of priority: walking, cycling, public transport, cars.<br>A Development Plan Scheme will be published for the Local Development Plan in the summer of 2022 which will set out the timescales for the preparation of the plan itself.<br>Continue to actively promote sustainable travel to school, including initiatives such as Bikeability and WOW (Walk Once a Week). | | |
| 7 | Provision of information relating to Air Quality | Public information | To increase awareness of local air quality issues and encourage changes in behaviour that will contribute to improving local air quality | Fife Council | On-going | 2021 -2025 | Continue to make information relating to local air quality management available through the Council website and Scottish Government "Air Quality in Scotland" Website | Low | The Low Carbon Fife Supplementary Guidance was adopted in January 2019 and now forms a statutory part of the Local Development Plan (FIFEplan). This guidance incorporates the Fife Council Air Quality Developers Guide.<br>A Development Plan Scheme will be published for the Local Development Plan in the summer of 2022 which will set out the timescales for the preparation of the plan itself.<br>In conjunction with this the Fife Council Air Quality Developers Guide has been recently amended as has the associated Fife Council Air Quality Strategy (covering the period 2021 to 2025) with both documents available online at www.fife.gov.uk/airquality | 2025 | |
| 8 | Target reductions in emissions from the Council fleet and contract vehicles (including driver training) | Vehicle fleet efficiency | Target reduced emissions from Council fleet vehicles and Council contract fleet vehicles | Fife Council | Annually | 2021 -2025 | Monitor and assess viable options for alternative fuels, technologies, and fuel additives.<br>Fife Council tender specification outlines that all new vehicles must have exhaust trap and filtration systems.<br>Number of vehicles in Council fleet<br>Number of electric and hydrogen powered vehicles in Council fleet | Medium | As of March 2022, Fife Council had 55 full electric vehicles and 19 hybrid vehicles in service (either leased or purchased).<br>As of March 2022, the size of the Fife Council fleet decreased slightly from the 2021 figure of 1,518 vehicles and now stands at 1,506 vehicles.<br>Total diesel use for 2020/21 was 3,118,643 litres (a reduction of 576,534 litres from 2019/20). The notable reduction was primarily a result of the COVID-19 impacts. | 2025 | |

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Annual reduction in Fuel usage | | | | |
| 9 | Investigate the potential for establishing voluntary bus agreement | Promoting travel alternatives | Target reduced emissions from buses operating within the Appin Crescent AQMA | Fife Council | 2021 | 2021 -2025 | Identify most polluting operators within AQMA<br>Liaise with bus operators regarding emissions from the bus fleet and improvements to bus service infrastructure | Medium | Continue to encourage bus operators to recognise the importance of air quality and climate change issues through the Fife ECO Stars scheme and to explore the potential to set up voluntary bus agreements through interaction with local bus operators.<br>As of March 2022, there are 58 bus operators within the ECO Stars scheme (one operator went out of business), but the number of vehicles covered has increased to 1,345. | 2025 | |
| 10 | Fife ECO Stars | Vehicle Fleet Efficiency in HGV and Taxi Fleets | Encouraging more local fleet operators to introduce fleet management systems that improve air quality | Fife Council | On-going | 2021 -2025 | Number of ECO Stars members | Medium | As of June 2022, the Fife Commercial Fleet Membership grew to 269 members covering 9,446 vehicles operating in Fife and beyond (note this figure includes the number of bus operators and vehicles noted above).<br>As of June 2022, the Taxi & Private Hire Membership has increased to 150 members operating 622 vehicles. The requirement for all Fife Council school and social work contract operators to become members of ECO Stars is a key factor in the continued growth of the Taxi & Private Hire Membership scheme | 2025 | |
| 11 | Maintenance and utilisation of Air Quality and Planning Toolkit | Development Control | Ensure future development does not compromise achievement of statutory air quality objectives through use of toolkit to assess planning Development | Fife Council | Annually | 2021 -2025 | Is the Toolkit being utilised by council departments to consider Air Quality issue in Planning developments?<br>Is the Toolkit up to date with latest data? | Low | The Regional RapidAir$^{TM}$ Dispersion Model is in the process of being updated again using the most recent available data. Phase 1 of the update is completed as of March 2022 with Phase 2 anticipated to be completed by March 2023.<br>Council will utilise the updated Model to consider air quality issues in the development management process. | 2025 | |
| 12 | Proposed Air Dispersion modelling study of the potential Dunfermline Northern Link Road | Traffic Management | Estimate the impact of the proposed northern link road and the proposed Dunfermline strategic land allocation (SLA) zones | Fife Council | On-going | 2021 - 2025 | Carry out any future Air Quality dispersion modelling to quantify the impacts of proposed Northern Link or alternatives to the Northern Link Road | Medium | Northern Link Road Dispersion Model updated in March 2022 using the most recent available data showed that no exceedances of the annual mean $NO_2$, $PM_{10}$ or $PM_{2.5}$ Scottish air quality objectives within the Appin Crescent AQMA are predicted for any of the future scenarios assessed.<br>Council will utilise the updated Model to consider air quality issues in and around Dunfermline as part of the planning process.<br>Additional sensor monitoring has continued in areas of concern within the AQMA, and the data was included within the updated Northern Link Road Dispersion Model and will also feed into other future modelling studies where appropriate. | 2025 | |

| 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 |
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| 13 | Update Air Quality Strategy for Fife | Strategy | Update Strategy so that it meets the current needs of Fife with regards to Air Quality and aligns with the Clean Air for Scotland Strategy 2 | Fife Council | To be completed and issued in 2021 | 2021 | Aligning the Strategy with CAFS whilst meeting the specific needs of Fife. Following the latest guidelines with regards the development of Air Quality Strategy and that meets the approval of the Council committee | Medium | Fife Council Air Quality Strategy was updated and approved in 2021 and now covers the period of 2021-2025.<br>The update aligns with the Clean Air for Scotland Strategy 2 (CAFS2) | 2021 | |
| 14 | Promote the continued expansion of the Councils Electric Vehicle Fleet | Promoting Low Emission Transport | Cross department initiative to promote the continued expansion of the Council Vehicle Fleet | Fife Council | On-going | 2021 – 2025 | The Number of electric Vehicles in the Council Fleet | Medium | As of March 2022, Fife Council had 55 full electric vehicles and 19 hybrid vehicles in service (either leased or purchased).<br>The number of electric and hybrid vehicles being added to the Fleet continues to increase every year with new vehicles identified and brought in on trial. | 2025 | |
| 15 | Promote the continued Development of the Electric Vehicle Infrastructure | Promoting Low Emission Transport | Work with Roads and planning department to further develop EV infrastructure, focusing on the addition of charging points | Fife Council | On-going | 2021 – 2025 | Number of EV Charging points.<br>Number of times EV Charging points are used.<br>Number of EV registered in Fife | Low | As of May 2022, there are 71 charging point locations across Fife including a range of free, fast and rapid chargers as shown on the ChargePlaceScotland site as being available at this time (i.e., the 71 locations do not include any out of commission).<br>In 2021 EV Charging points in Cupar were used by 922 public users (down from 1,437 public users in 2019) with the reduction likely due to the introduction of charging at Fife Council charge points in November 2020. | 2025 | |
| 16 | Promote Sustainable travel initiatives | Promoting Travel Alternatives | Focus on promotional material in schools and businesses.<br>Identify initiatives to work in tandem with ECO Stars that focus on alternative travel options.<br>Provision of guidance and information | Fife Council | On-going | 2021 – 2025 | Creation of promotional material.<br>Promotion of Air Quality related events.<br>Identification of new Initiatives.<br>Incorporation of new Initiatives | Low | Fife Council continues to provide information via the air quality pages of the Fife Council website www.fife.gov.uk/airquality and promotional materials for initiatives carried out such as Fife ECO Stars and Clean Air Day | 2025 | |

| 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 |
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| 17 | Promote domestic combustion best practice guidance | Policy Guidance and Development Control | Managing the PM concentration contribution from the increased number of small-scale domestic biomass burners | Fife Council | 2021 | 2021 – 2025 | Identification of best practise guidance.<br>Creation of promotional material.<br>Distribution of promotional material | Low | A survey on domestic fuel use within the AQMA was undertaken in March 2022 with around 1/3 of the responses wanting to learn more on the best practice in terms of running and maintaining their appliance. The findings of this fuel use survey will aid in the production of such promotion materials. | 2025 | |
| 18 | Develop alternative travel Infrastructure | Transport Planning and Infrastructure | Continued enhancement and management of cycle routes and walking paths and infrastructure in Fife. Making it easier to commute using these alternatives | Fife Council | On-going | 2021 – 2025 | Development projects carried out on Fife cycle and walking paths.<br>Events carried out or promoted by Fife Council | Low | Fife Council maintains one of the UK's most comprehensive cycle network with 350 miles of signed cycle routes.<br>Fife Council has promoted/developed numerous initiatives such as WOW and Bikeability.<br>The Fife Travel Plan has been set up since 1999 and continually enhanced and developed.<br>Partnerships have been developed such as with Living Streets Scotland. | 2025 | |
| 19 | Promote and organise Clean Air Day Events | Public Information | On schools events packages<br>Citizen Science Projects | Fife Council | Annually | 2021 – 2025 | CAD Events carried out or promoted by Fife Council | Low | For the 2021 Clean Air Day, presentations were given to three Primary Schools within Fife with Citizen Science Packs and portable air quality monitors used to provide air quality data.<br>As of March 2022, preparations are underway in terms of 2022 Clean Air Day events which will include the use of the EnviroTechnology Services 'SmogMobile' which is a zero-emission mobile air quality monitoring laboratory | 2025 | |
| 20 | Identify source apportionment to background PM | Vehicle Fleet Efficiency | The Main source of PM for the Appin Crescent is background. It would help identify exactly what contributes to this to help identify possible mitigation measures | Fife Council | 2021 - concept | 2021 – 2025 | Source apportionment study for background PM | Medium | A Background Source apportionment study was undertaken in 2021 and provided recommendations for further work focusing on domestic PM sources. A survey on domestic fuel use within the AQMA was undertaken in March 2022 to determine the extent of solid fuel burning in and around the AQMA (specifically from open fires and wood burning stoves). The findings of this exercise will aid in informing future modelling and action planning activities. | 2025 | |
| 21 | Utilise Sensor technology to gain a better understanding of PM concentrations | Traffic Management | Use sensor technology to monitor PM at locations in the AQMA where previously it was not | Fife Council | On-going | 2021 – 2025 | Quality controlled Data from AQMesh sensor units for use in LAQM reporting | Medium | Monitoring has continued in 2021 and the associated data is reported within this APR.<br>Data processed and managed following guidance to ensure data quality. | 2025 | |

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | within the AQMA | | possible and where modelling has indicated higher levels. This will inform movement to revoke $PM_{10}$ AQMA | | | | | | | | |
| 22 | Identify most polluting vehicles within AQMA | Vehicle Fleet Efficiency | Specific persistent polluters to help inform policy and provide evidence to help encourage change. Focusing on business rather than individuals | Fife Council | 2021 | 2021 – 2025 | Emissions study to identify specific polluters<br>Utilisation of data to inform policy | Medium | A Real-World Driving Emissions Study was undertaken over one week within the AQMA in February/March 2022 and gathered data from nearly 13,000 vehicles. The data from the monitoring study which will be used to inform future decision making and policy changes | 2025 | |

### 2.3.1 Progress in Bonnygate AQMA

Automatic monitoring annual mean concentrations going back to 2007 for $NO_2$ and $PM_{10}$ are shown in Figure 2-3 and Figure 2-4 respectively. $NO_2$ concentrations at the automatic monitor within Bonnygate, Cupar have reduced by 61.5% from 52 µg $m^{-3}$ to 20 µg $m^{-3}$ and remain well within the $NO_2$ annual mean objective. The $NO_2$ element of the AQMA was officially revoked in September 2021. However, Fife will continue to monitor $NO_2$ within the existing AQMA.

Since measurements started in 2007 $PM_{10}$ concentrations have reduced by 43.5% from 23 µg $m^{-3}$ to 13 µg $m^{-3}$. Concentrations began to increase slightly from 2017 but remained below the objective. Concentrations dropped sharply in 2020, however this is likely due to the COVID-19 lockdown restrictions. Concentrations then increased slightly in 2021 following the easing of the COVID-19 lockdown restrictions.

Figure 2-3 $NO_2$ Automatic Monitoring Results 2007-2021 – Bonnygate, Cupar

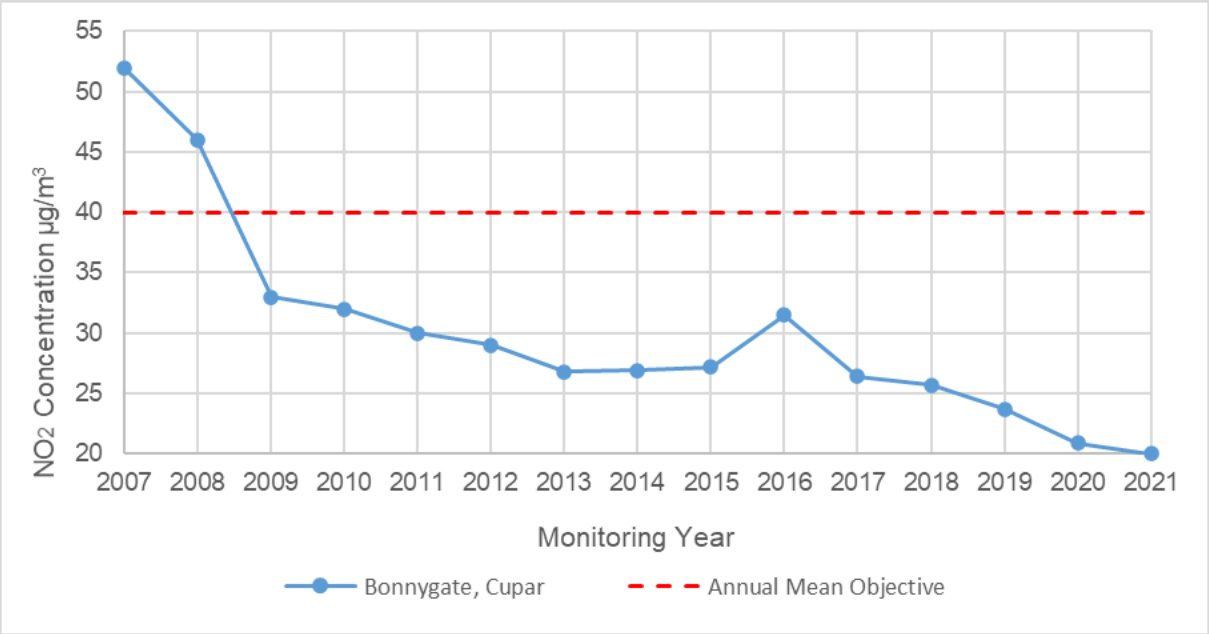
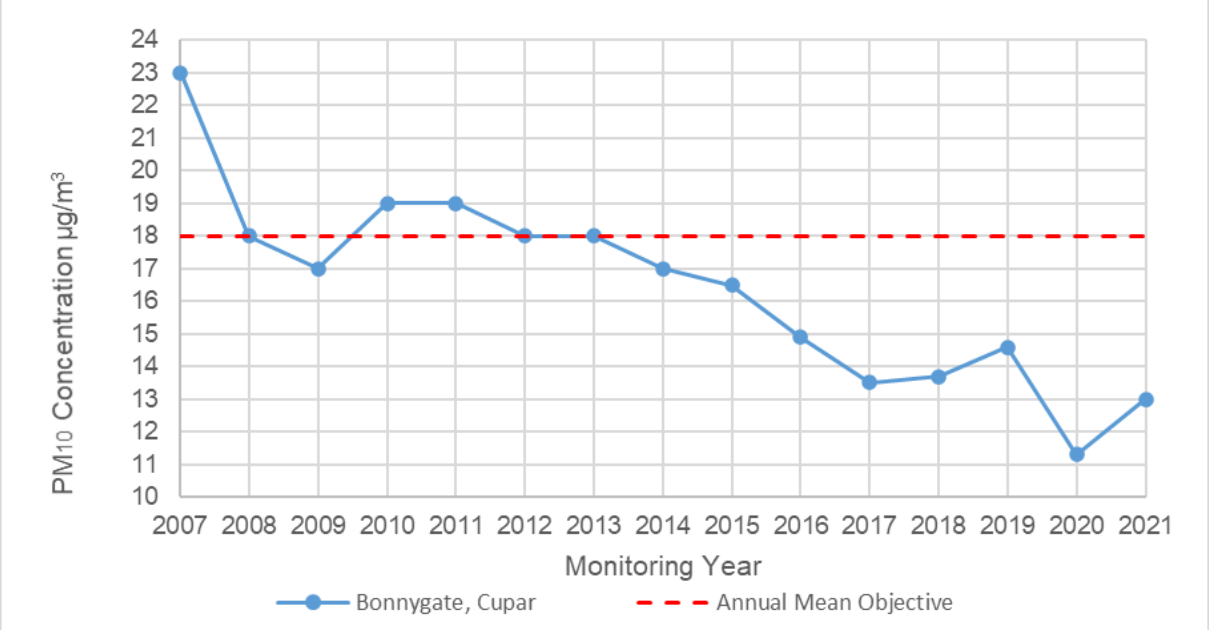



Figure 2-4 $PM_{10}$ Automatic Monitoring Results 2007-2021 – Bonnygate, Cupar



### 2.3.2 Progress in Appin Crescent AQMA

Automatic monitoring annual mean concentrations going back to 2007 for $NO_2$ and $PM_{10}$ are shown in Figure 2-5 and Figure 2-6 respectively. Since 2007, $NO_2$ concentrations have reduced by 48.4% from 31 µg $m^{-3}$ to 16 µg $m^{-3}$ and remain well within the $NO_2$ annual mean objective. $NO_2$ concentrations have decreased steadily from 2015 until 2019 likely as a result of the Action Plan measures being implemented. Concentrations dropped sharply in 2020 however this sharp decrease is likely due to the COVID-19 lockdown restrictions. Concentrations then increased slightly in 2021 following the easing of the COVID-19 lockdown and restrictions. The $NO_2$ element of the AQMA was officially revoked in September 2021. However, Fife continue to monitor $NO_2$ within the existing AQMA.

$PM_{10}$ monitoring started in 2011 and since then concentrations have reduced by 33.3% from 16 µg $m^{-3}$ to 10 µg $m^{-3}$. Since 2017 $PM_{10}$ concentrations have increased slightly however staying well below the annual mean objective. Concentrations dropped sharply again in 2020, however this is likely due to the COVID-19 lockdown restrictions. Concentrations then increased slightly in 2021 following the easing of the COVID-19 lockdown and restrictions. Concentrations have remained below the annual mean objective since 2010.

Figure 2-5 $NO_2$ Automatic Monitoring Results 2007-2021 – Appin Crescent, Dunfermline

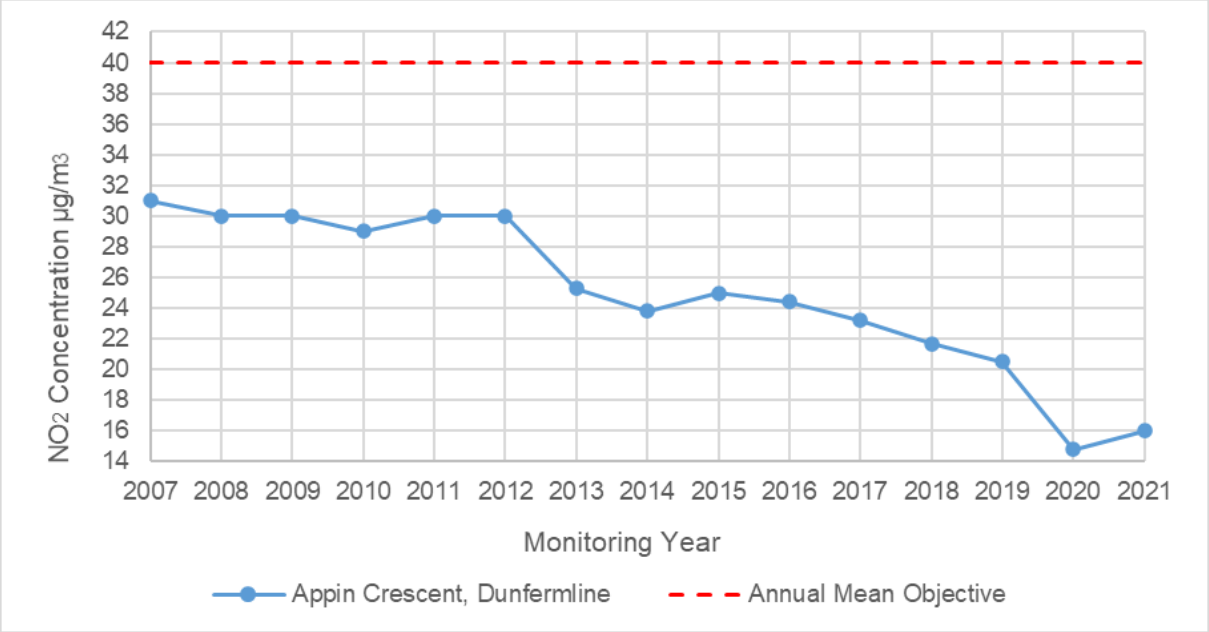
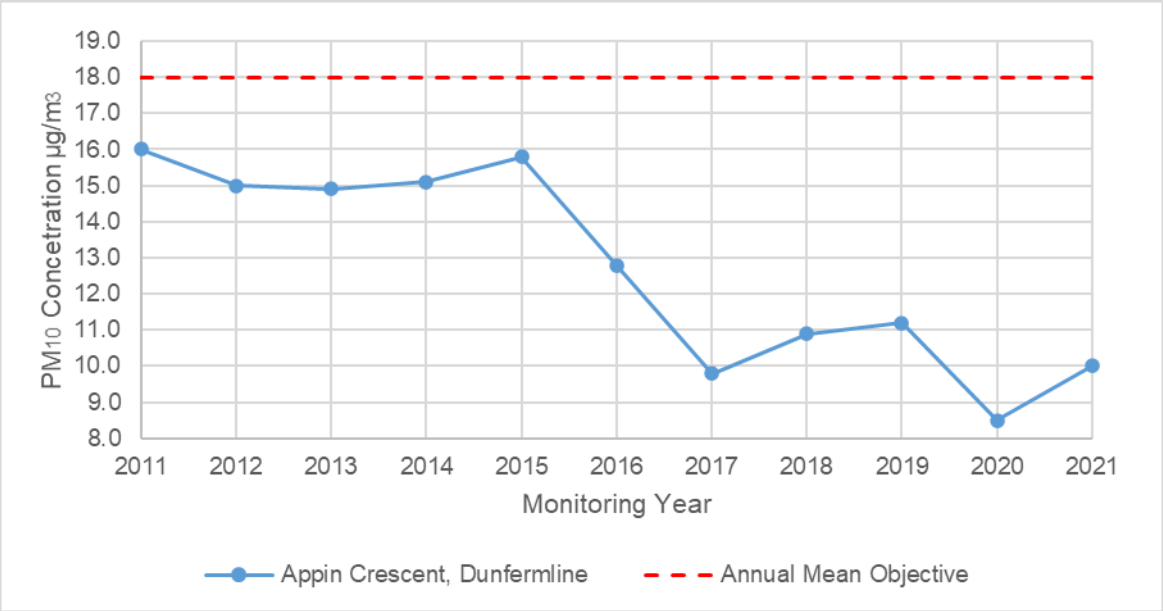


Figure 2-6 $PM_{10}$ Automatic Monitoring Results 2011-2021 – Appin Crescent, Dunfermline




### 2.3.3 Fife ECO Stars Scheme

Fife's ECO Stars Fleet Recognition scheme and parallel ECO Stars Taxi and Private Hire scheme has continued to grow and expand membership during 2021 despite the continued disruption of COVID-19 which has continued to affect the operations of many Fife businesses as well as the ECO Stars recruitment and membership protocols.

Since the Fife Fleet scheme was initiated in 2014, membership has steadily increased year on year. As of June 2022, the Fife Fleet scheme stands at 269 members (up from 254 members in May of 2021) made up of operators in the freight, bus and coach sectors, as well as many van fleets. Fife Fleet Recognition scheme members now operate a total of 9,446 vehicles (up from 9,127 vehicles in May 2021). Several new scheme members over 2021 have sizeable fleets sizes of over 50 vehicles with one noted to have 90 vehicles (hence the notable increase in vehicle numbers compared with the relatively small members increase noted above).

Alongside continued recruitment, there is an ongoing focus on supporting existing members by means of regularly re-engaging with individual members to hear their progress and re-assessing fleets when asked by existing members. Maintaining an ongoing relationship with members is essential in guiding their progress towards maximising fuel efficiency.

The requirement for all school and social work contract operators to become members of ECO Stars has resulted in a continued increase in membership numbers for the ECO Stars Taxi and Private Hire scheme. As of June 2022, the Taxi and Private Hire scheme stands at 150 members (up from 141 members in May 2021), operating 622 vehicles (up from 575 vehicles in May 2021). This sector in particular has been keen to utilise the ECO Stars team's expertise in current and emerging low emission and low carbon vehicles. This is reflected in that 127 of the vehicles operated by this sector (as of March 2022) are rated under ECO Stars assessments as "5 Star Gold" or "5 Star Zero Emission Vehicle" (this is up from 112 vehicles in May 2021).

ECO Stars continues to be supported by the Scottish Government as part of its Clean Air Strategy.

### 2.3.4 Targeting emissions from Council Fleet

Fife Council continues to make good progress towards increasing the number of electric and hybrid vehicles within its Fleet and the installation of publicly available charging points. These actions have direct impacts on both the Bonnygate and Appin Crescent AQMAs and work towards reducing transport emissions as detailed in the AQAPs for both areas. By the end of January 2022 Fife Council's Fleet Operations had 55 full electric vehicles and 19 hybrid vehicles in service including another adapted Nissan ENV200 which was obtained through Scottish Government funding and will be used for the Meals on Wheels (MoW) service and replaces an existing diesel vehicle previously used for the delivery and collection of meals for older and vulnerable

members of society. As of January 2022, 13 of the MoW vehicles within the Fleet are electric with 14 diesel vehicles being phased out over time with the view towards having all the MoW Fleet being electric.

Fife Council Fleet have been working to improve emissions/efficiency of Council refuse collection vehicles (RCVs) through the installation/upgrade of FuelSense 2.00 software within the transmissions of the Fleet of Mercedes Bens RCVs. The initial trial on two vehicles over a six-month period showed an average 8.85% fuel saving and 30 of the RCVs currently have the upgraded software installed. The remaining 13 RCVs in the Fleet will be replaced later in 2022 with new vehicles that will also have the FuelSense 2.00 software installed. It is anticipated that this will bring about substantial savings in terms of fuel costs whilst also reducing emissions. The project has been recognised with a Silver Award in the APSE Striving for Excellence Awards and will be competing for a Gold Award at the official awards ceremony in May 2022.

Fife Council Fleet have also been successful in obtaining funding for the installation of a 150 kW charger at its main depot in Glenrothes in anticipation of trialling the fully electric Mercedes-Benz RCV when it is available in Scotland.

The extent of the charging infrastruture within Fife is best viewed using the ChargePlace Scotland website (http://chargeplacescotland.org). The live map functionality on this site can allow the user to search for the location, type, status and availability of chargers within the Fife Council area. An example of what can be viewed using the live map functionality is shown in Figure 2-7. This shows the extent of available charging points (71 in total) at this time and does not include sites which were out of commission. An example of a rapid charger in Fife can be seen in Figure 2-8. Charging was free within Fife until charging was introduced by Fife Council on 16th November 2020 (charging is a £1.60 connection charge and 15p/kwh).

Figure 2-7 Extent of charging points across Fife as of April 2022

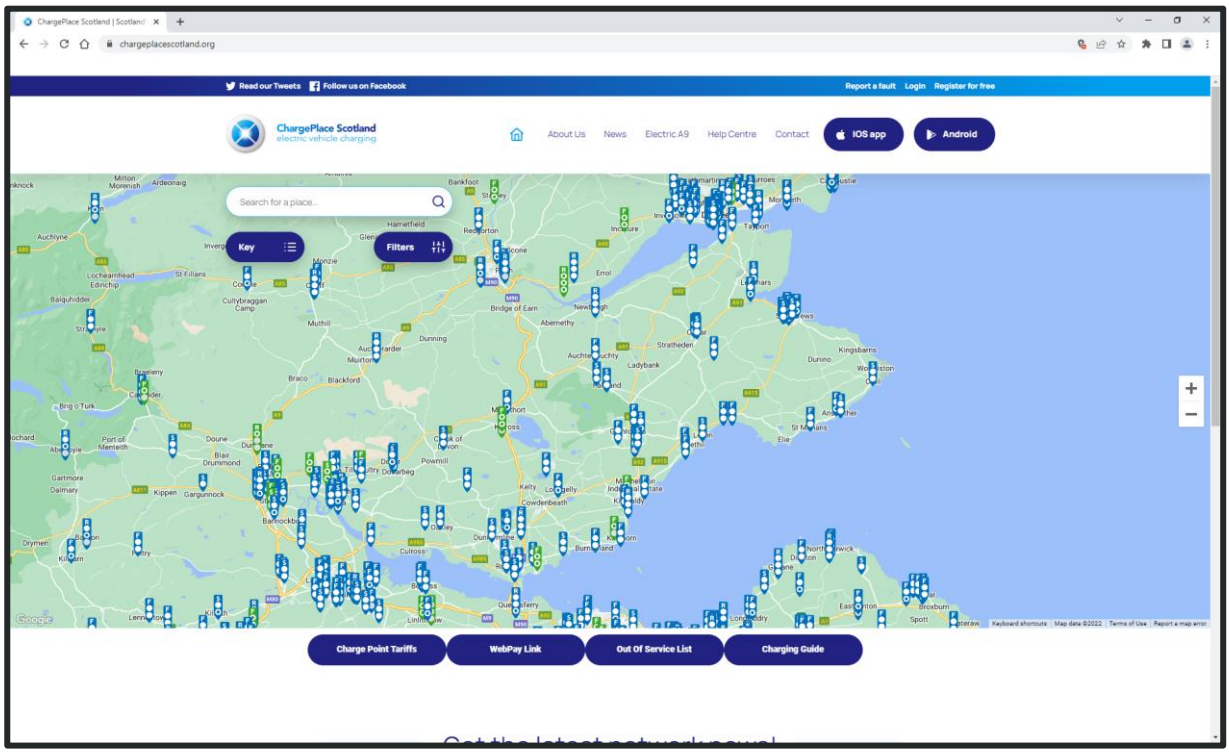


Figure 2-8 Rapid charger in Fife


With specific reference to Cupar there were 207 public charge point users in 2021, down from 260 in 2020. These 207 public charge point users in 2021 accounted for a total of 580 charging sessions using 7,772 kW of electricity in total, down on 2020 when there were 1,518 charging sessions using 13,021 kW of electricity. The noticeable reduction is likely due to a combination of the continued impacts of COVID-19 and the charging introduced by Fife Council in November 2020.

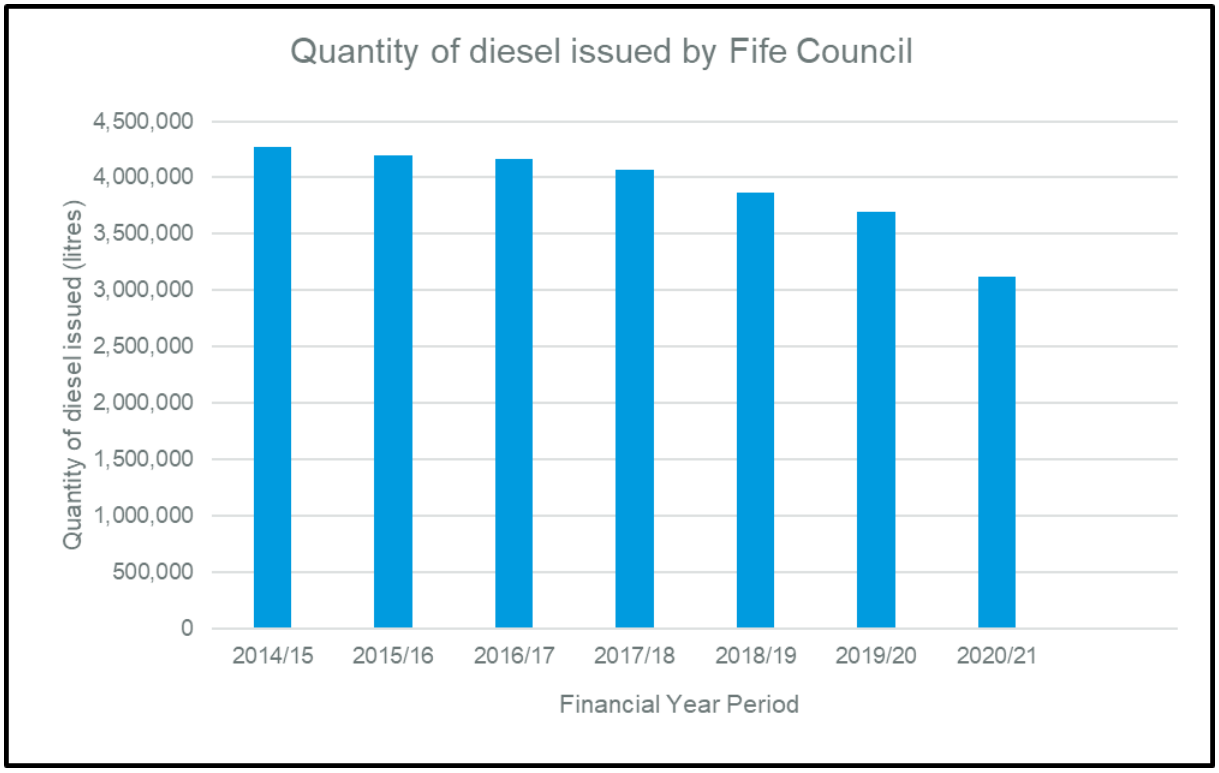
There was also a noticeable reduction in the number of Fife Council vehicle charging sessions in Cupar down from 718 sessions in 2020 (6,054 kW used) to 124 charging sessions in 2021 (1,084 kW used) likely due to the continued impacts of COVID-19.

With specific reference to Dunfermline there were 922 public charge point users in 2021, down from 1,437 in 2020. These 922 public charge point users accounted for a total of 5,737 charging sessions using 61,296 kW of electricity in total, down on 2020 when there were 7,448 charging sessions using 121,048 kW of electricity. The noticeable reduction is likely due to a combination of the continued impacts of COVID-19 and the charging introduced by Fife Council in November 2020.

There was also a noticeable reduction in the number of Fife Council vehicle charging sessions in Dunfermline down from 1,437 sessions in 2020 (25,105 kW used) to 922 charging sessions in 2021 (12,102kW used) likely due to the continued impacts of COVID-19.

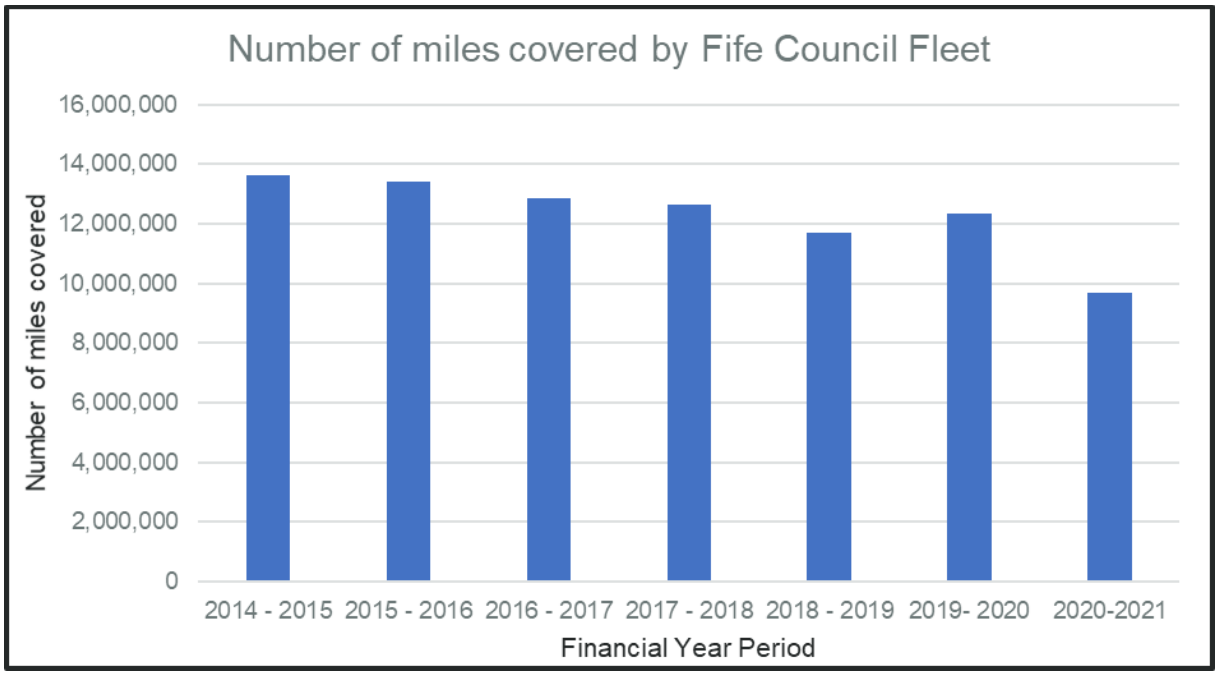
Associated with the increased uptake of electric and hybrid vehicles within the Council Fleet is an overall reduction in the size of the Council Fleet and a reduction in the quantity of diesel being used. Since 2011/12 the Fleet Demand Challenge Approach has reduced the Fleet size by 376 vehicles (up to the 2020/21 period). The amount of diesel used by the Council Fleet reduced significantly to 3,118,643 in 2020/21 (Figure 2-9) due to the impact of COVID-19.

Figure 2-9 Quantity of diesel issued by Fife Council




Along with the reduced diesel usage the mileage covered by the Council Fleet has also decreased over the 2021/21 period due to the impact of COVID-19. Figure 2-10 shows that the mileage covered by the Council Fleet decreased from 12,352,481 in 2019/20 to 9,674,759 in 2020/21.

Figure 2-10 Number of miles covered by Fife Council Fleet



# 3. AIR QUALITY MONITORING DATA AND COMPARISON WITH AIR QUALITY OBJECTIVES

## 3.1 SUMMARY OF MONITORING UNDERTAKEN

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

### 3.1.1 Automatic Monitoring Sites

Fife Council undertook automatic (continuous) monitoring at four sites during 2021, which measure $NO_2$, $PM_{10}$, and $PM_{2.5}$ concentrations. These automatic monitors are located at Cupar, Dunfermline, Kirkcaldy, and Rosyth. Table A.1 in Appendix A provides the site details for all automatic monitoring locations. National monitoring results are also available at: http://www.scottishairquality.scot/data/data-selector.

All $PM_{10}$ analysers were upgraded to FIDAS during 2016 and included monitoring of $PM_{2.5}$, $PM_1$ and total suspended particles (TSP). However, only $PM_{10}$ and $PM_{2.5}$ are considered within LAQM, and it is only these that are reported within this APR.

Maps showing the location of the monitoring sites are provided in Figure 3-1 to Figure 3-5. Further details on how the monitors are calibrated and how the data has been adjusted are included in Appendix C.

Short-period CO monitoring has also been undertaken by Fife Council's Transportation Department.

Concentrations of 1,3 butadiene, benzene, nitrogen dioxide and sulphur dioxide measured independently in 2021 have been summarised in the INEOS Grangemouth Oil Refinery Annual Community Air Quality Monitoring Report[3].

### 3.1.2 Non-Automatic Monitoring Sites

Fife Council undertook non-automatic (passive) monitoring of $NO_2$ at 42 sites during 2021, using 58 diffusion tubes in total. Of these, seven sites are triplicate sites, with four of these triplicate sites being co-located with the automatic analysers at Cupar, Dunfermline, Kirkcaldy and Rosyth. There were no diffusion tube sites which commenced or were decommissioned in 2021.Table A.2 in Appendix A shows the details of the diffusion tube sites.

Maps showing the location of the monitoring sites are provided in Figure 3-1 to Figure 3-5. These focus on the main monitoring areas of Cupar, Dunfermline, Kirkcaldy, Rosyth and St Andrews. Further details on Quality Assurance/Quality Control (QA/QC) and bias adjustment for the diffusion tubes are included in Appendix C.

[3] Community Air Quality Monitoring Report, Ambient Atmospheric Survey in the vicinity of Grangemouth – 2021, INEOS April 2022

Figure 3-1 Location of automatic monitor and nitrogen dioxide diffusion tubes – Bonnygate, Cupar AQMA

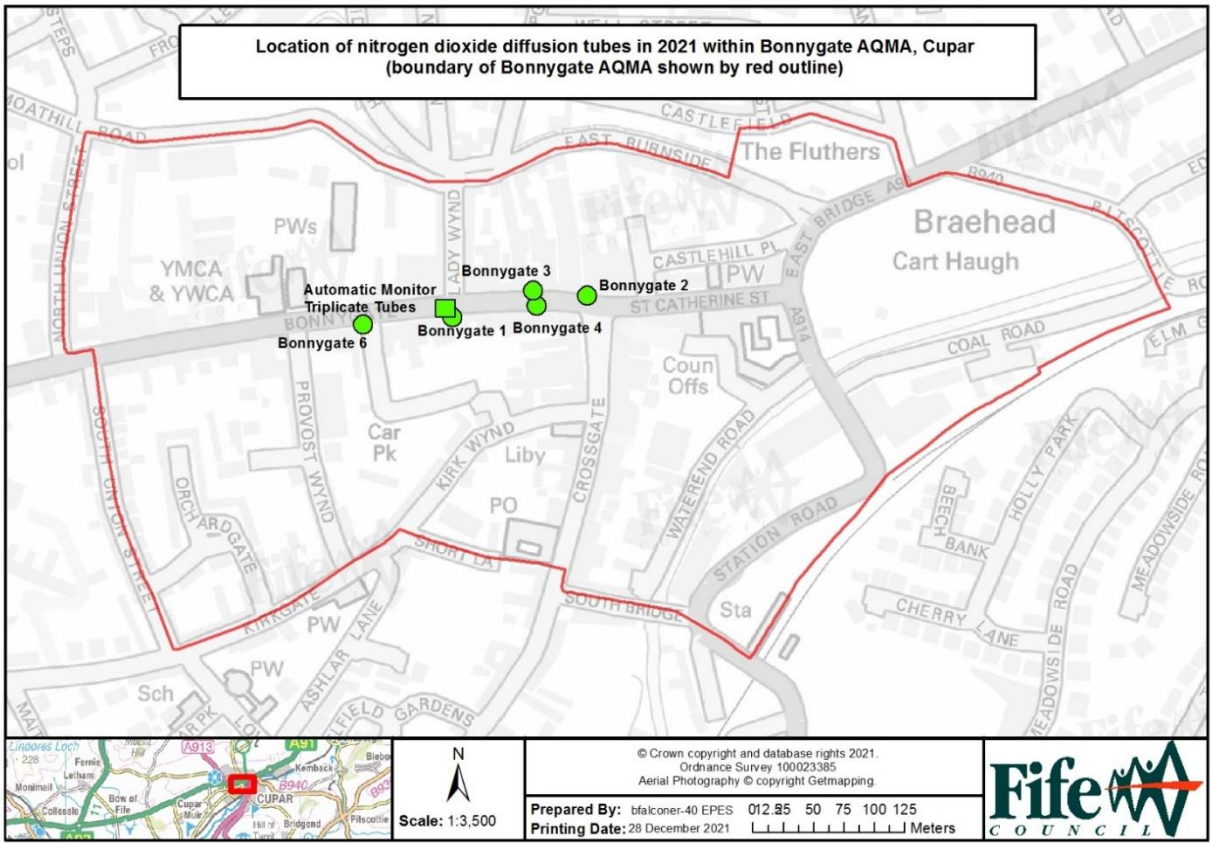



Figure 3-2 Location of automatic monitor and nitrogen dioxide diffusion tubes - Appin Crescent, Dunfermline AQMA

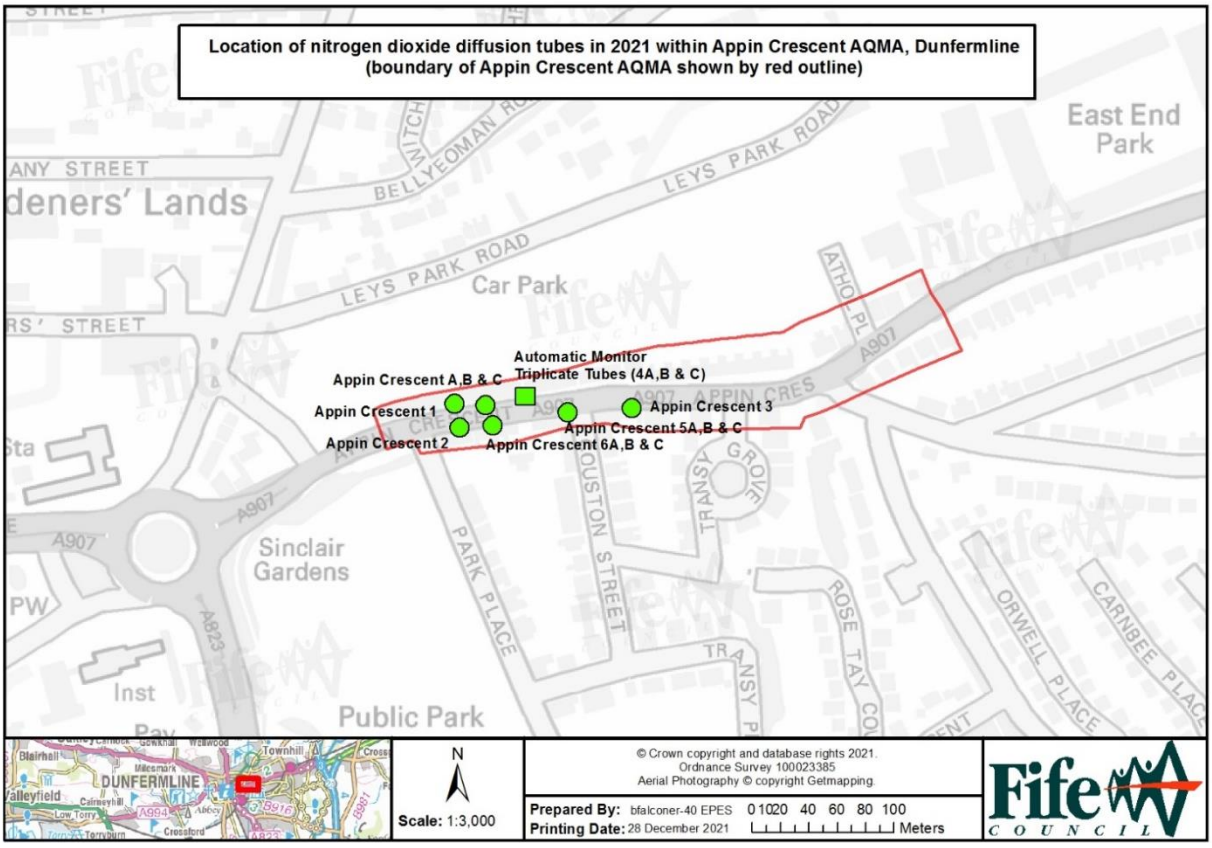


Figure 3-3 Location of automatic monitor and nitrogen dioxide diffusion tubes – St Clair Street, Kirkcaldy

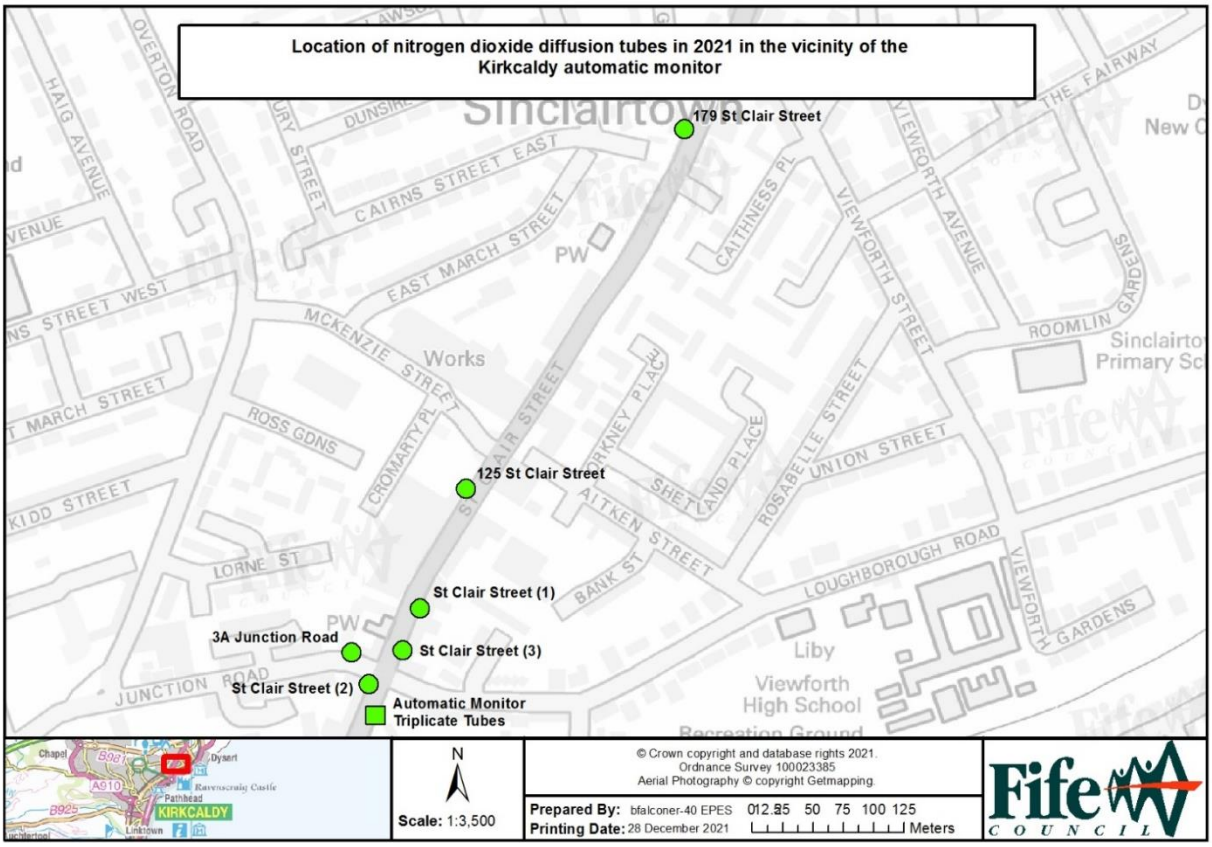



Figure 3-4 Location of automatic monitor and nitrogen dioxide diffusion tubes – Admiralty Road, Rosyth

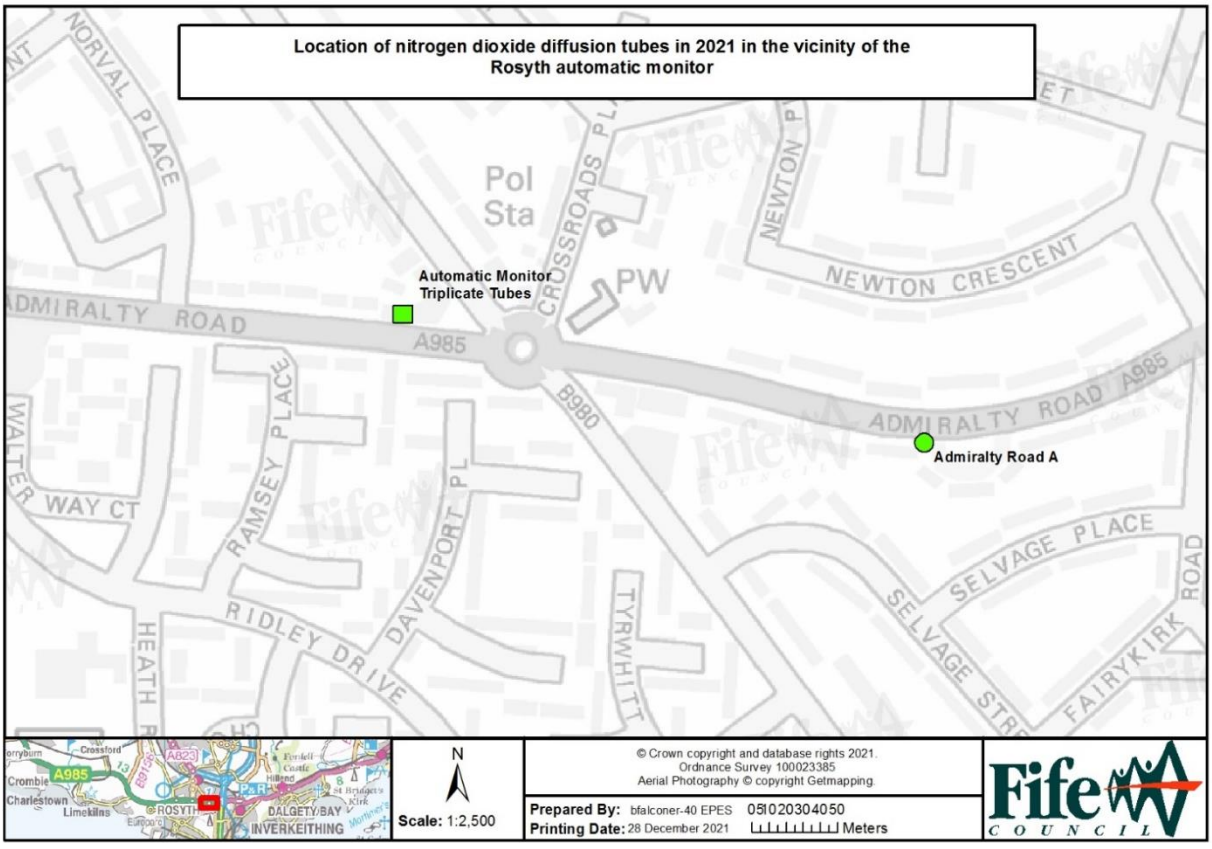
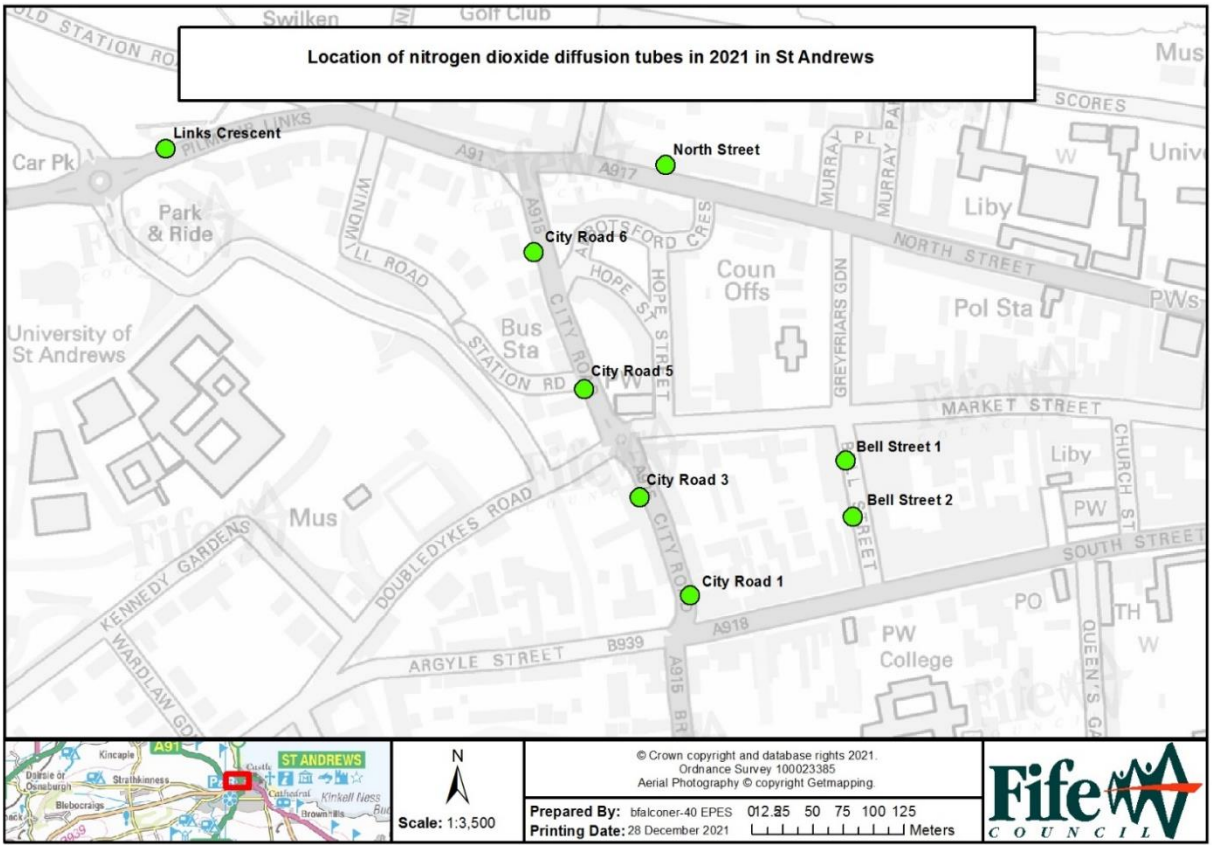


Figure 3-5 Nitrogen dioxide diffusion tube locations – St Andrews




### 3.1.3 Other Monitoring Activities

Fife Council undertook AQMesh monitoring of $NO_2$, $PM_{10}$ and $PM_{2.5}$ at three sites during 2021. Two pods (serial number 1892150 & 1894150) were installed in the Appin Crescent AQMA, and one pod (serial number 1893150) was installed in the Bonnygate AQMA. The two pods at Appin Crescent AQMA were collocated with diffusion tubes Appin Crescent 5A,B,C and Appin Crescent 6A,B,C. The Cupar AQMesh was collocated with diffusion tube Bonnygate 4

## 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.

A dynamic style report containing embedded statistical data for Fife can be found here: https://www.scottishairquality.scot/assets/reports/372/Fife_annual_2021.html. The key areas have been extracted and included below however further detail can be found online. The embedded data allows the reader a level of interaction with some of the report findings, providing additional insight. This approach enables a more easily navigated and streamlined report providing an engaging and intuitive reader experience. The analysis has been carried out for the pollutants $NO_2$, $PM_{10}$ and $PM_{2.5}$ using the Openair analysis tool. Further figures are provided in Appendix H. This type of analysis helps the Council inform future policy making.

Openair is an innovative tool to analyse, interpret and understand air pollution data using "R". R is a free and open-source programming language designed for the analysis of data. The Openair tool can perform complex and innovative analysis of current and archived air pollutant data allowing powerful data visualisation and interrogation. For this report Fife Council has utilised the following analysis tools:

- **Time variation** - This tool produces four separate panes combined into a single plot: The plotted output shows the average variation by day of the week and hour of the day combined (the top-most pane), hour of the day (diurnal variation, shown in the lower left pane), month of the year (seasonal variation in the lower middle pane) and day of week (lower right pane) of one or more variables or at one or multiple sites over a user selected time range. The plots have been created for all four automatic monitoring sites in Fife for the period 1st January – 31st December 2021. The variation of a pollutant by time of day and day of week can reveal useful information concerning the likely sources at a particular site.
- **Polar Plots** – This tool produces polar plots of pollutant concentrations by wind speed and wind direction. Polar plots are useful to gain a quick graphical representation of the relationship between pollutant concentrations and the meteorological conditions. This can be useful in identifying potential sources of pollution affecting the location, for example particle suspension is increased at higher wind speeds come from a specific direction.
- **Calendar Plots** – This tool provides a way of visualising trends in daily pollutant concentrations across a year in the familiar form of a calendar. Concentrations are represented with a colour scale and the meteorological conditions can be represented using arrows giving the vector averaged wind direction, scaled according to the wind speed based on modelled wind speed and direction from data from the UK air quality forecast. In this way pollution episodes can be identified by date and sources potentially indicated by the combination of pollutant and meteorological conditions.
- **Back trajectory Analysis Plots –** The back trajectory plots show data from the HYSPLIT model (NOAA HYSPLIT[4]) run in the analysis mode. This shows the air mass back trajectories for the period cover by this report. Two different kinds of plot are shown. One statistically groups the trajectories into similar clusters and shows the proportion of time during the report period that each represents. This is useful to get an overview of air mass origins during the report period. Plots in Trajectories associated with top ten most polluted days provide information on the trajectory direction associated with the top 10 measured concentrations.

### 3.2.1 Nitrogen Dioxide ($NO_2$)

#### *3.2.1.1 Automatic Monitoring Data*

Table A.3 in Appendix A compares the ratified and adjusted monitored $NO_2$ annual mean concentrations for the past five years with the air quality objective of 40 µg $m^{-3}$.

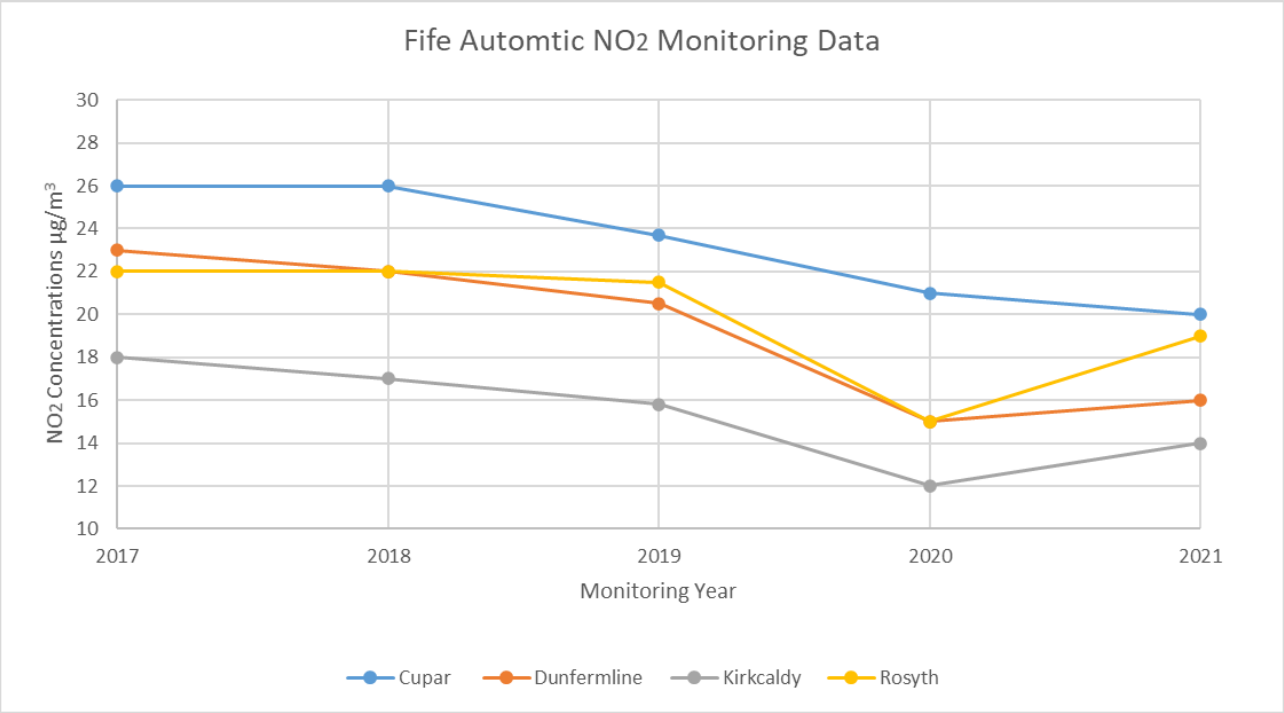
For diffusion tubes, the full 2021 dataset of monthly mean values is provided in Appendix B.

Table A.4 in Appendix A compares the ratified continuous monitored $NO_2$ hourly mean concentrations for the past five years with the air quality objective of 200 µg $m^{-3}$, not to be exceeded more than 18 times per year.

Figure 3-6 provides the monitoring results for 2021 and the previous five years. All four automatic monitoring sites did not record any exceedances of the AQS $NO_2$ annual or 1-hour mean objectives during 2021 and have been consistently well below the objectives for the past five years.

[4] https://www.arl.noaa.gov/hysplit/hysplit

Figure 3-6 Fife automatic monitoring sites $NO_2$ annual mean concentrations (µg $m^{-3}$)




Over the last five years $NO_2$ concentrations have been declining steadily since 2017 with the exception of Rosyth which has been more consistent. In 2020 a sharp drop in concentrations is likely due to the COVID-19 lockdown and restrictions resulting in less vehicles and a reduction in concentrations. In 2021 concentrations increased again as the COVID-19 lockdown and restrictions eased. However, concentrations remain lower than in 2019. Longer $NO_2$ trends at the two AQMAs can be seen in Figure 2-3 and Figure 2-5 above. The trend of decreasing concentrations seen at Cupar and Dunfermline suggest that the Action Plan measures introduced have had a positive impact. Following this the $NO_2$ element of the AQMA was revoked in 2021.

Three AQMesh units have been monitoring since December 2017 to seek to further understand the pollutant concentrations and trends in the Appin Crescent, Dunfermline AQMA and Bonnygate, Cupar AQMA. Data is managed and processed by Ricardo who carry out appropriate QA/QC. The data showed that no $NO_2$ exceedances were measured during 2021. Analysis of the monitoring data from these units is provided in Appendix E.

#### *3.2.1.2 Diffusion Tube Monitoring Data*

Table A.3 in Appendix A compares the ratified and adjusted monitored $NO_2$ annual mean concentrations for the past five years with the air quality objective of 40 µg $m^{-3}$.

The data has been bias corrected using the local bias adjustment factor, or a combined factor for areas out with the areas covered by automatic monitors. The following local bias adjustments were calculated – further details are provided in Appendix C:

- Cupar = 0.79
- Dunfermline = 0.74
- Kirkcaldy = 0.66
- Rosyth = 0.83
- Average of Local = 0.75

The local bias adjustment factor was applied to all diffusion tubes within the areas covered by the automatic monitors while the average of the local bias adjustment factors was used for all other sites for consistency.

For diffusion tubes, the full 2021 dataset of monthly mean values is provided in Appendix B.

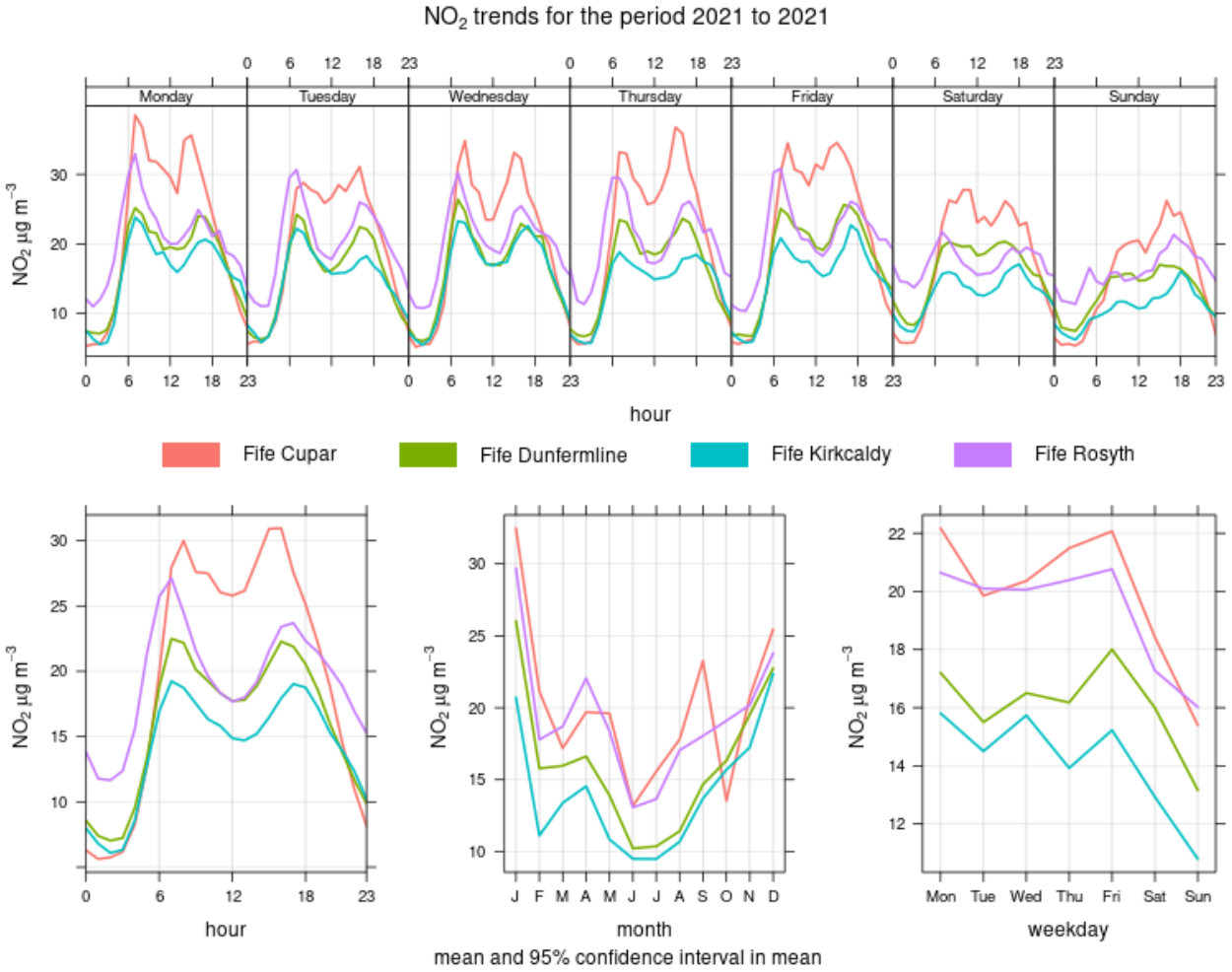
Details of the diffusion tube bias adjustment are found within Appendix C of this report. Diffusion tube results from 2017 to 2021 are presented in Appendix A, Table A.3. Diffusion tube trend graphs are provided for the different areas of interest within Fife, these are presented in Appendix A, Figure A.1 to Figure A.7. The 2021

diffusion tube results indicate that there were no exceedances of the annual mean objective at any monitoring locations, including locations within Dunfermline and Cupar which have exceeded in previous years. The highest annual mean concentration measured in Appin Crescent, Dunfermline during 2021 was 26 µg $m^{-3}$ at Appin Crescent 2, Appin Crescent 3 and Appin Crescent 6 ABC. The highest annual mean measured at Bonnygate, Cupar during 2021 was 27 µg $m^{-3}$ at Bonnygate B3 and Bonnygate B4.

#### *3.2.1.3 $NO_2$ Trends Analysis 2021*

Figure 3-7 compares the time variation plots for $NO_2$ in 2021 at each of the automatic monitoring stations; Cupar, Dunfermline, Kirkcaldy and Rosyth. All four sites have very similar time variations on data throughout the year, with Cupar being the highest. However, it should be noted that Cupar is located at kerbside (less than 0.5 metres from the kerb) rather than roadside (between 0.5 and 5 metres from the kerb) like the three other sites. This proximity to the source will contribute to the higher concentrations as $NO_2$ drops off significantly the further you are from the source. The highest concentrations are measured between Monday to Friday with rush hour periods (approximately 8am and 5pm) showing highest concentrations. This indicates traffic to be the main source of $NO_2$ for all sites. Concentrations at all four sites significantly drop at the weekend. There is a strong seasonal variation at all sites with winter months seeing significantly higher concentrations than in summer months. This is likely due to a decrease in traffic during summer months and winter conditions providing poor pollution dispersion conditions.

Figure 3-7 $NO_2$ Time Variation for Fife



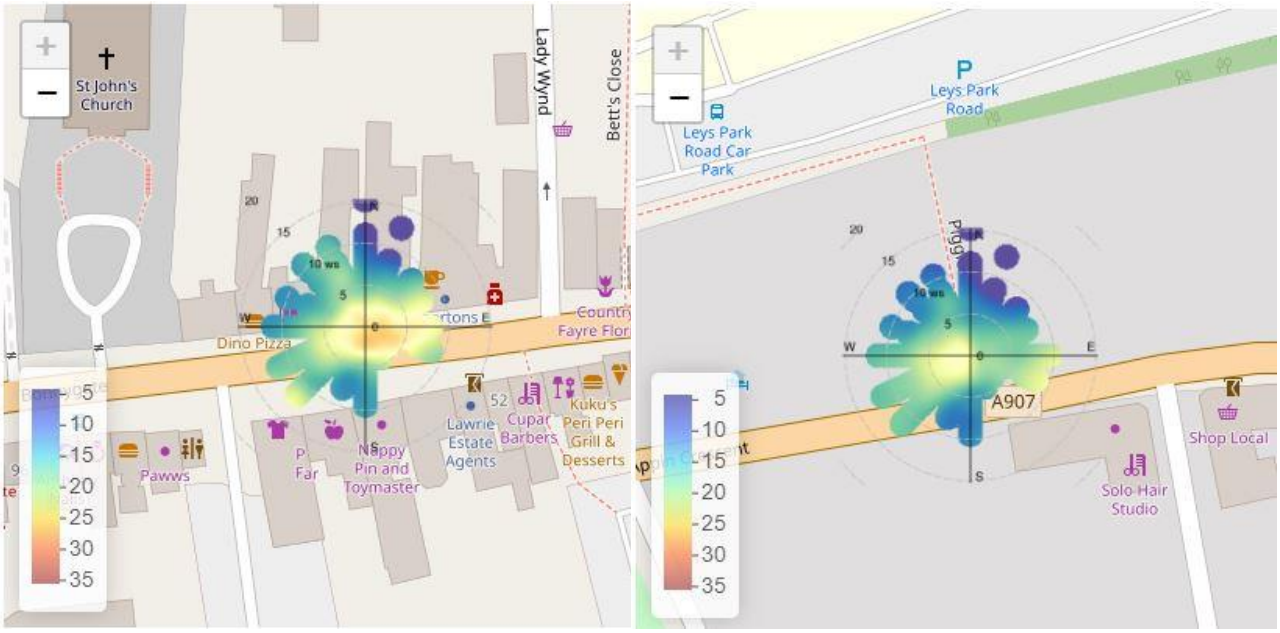

Figures F.1-4 in Appendix F show the $NO_2$ time series plots for each monitoring site independently.

Figures F.13-16 show $NO_2$ calendar plots of the date and wind speed for each of the monitoring stations across Fife. Calendar plots show elevated concentrations. As with the time variation figures it can be seen that the lowest concentrations are in summer with higher concentrations throughout the winter months specifically January and February for all sites.

Figures F.25-28 show $NO_2$ polar plots at each of the monitoring stations. This report will focus on the Polar plots analysis for the AQMAs at Cupar (left) and Dunfermline (right) shown in Figure 3-8. Both plots indicate a broadly east-west signal which is consistent with parallel winds through the street canyon. It also shows that concentrations are highest when wind speeds are low.

It should be noted that the meteorological conditions in the Openair tool on the Scottish Government website are modelled, so there may be some bias in the data and subsequent analysis. However, these polar plots are very similar to last year's plots.

Figure 3-8 Polar plots of $NO_2$ concentrations by wind speed and direction



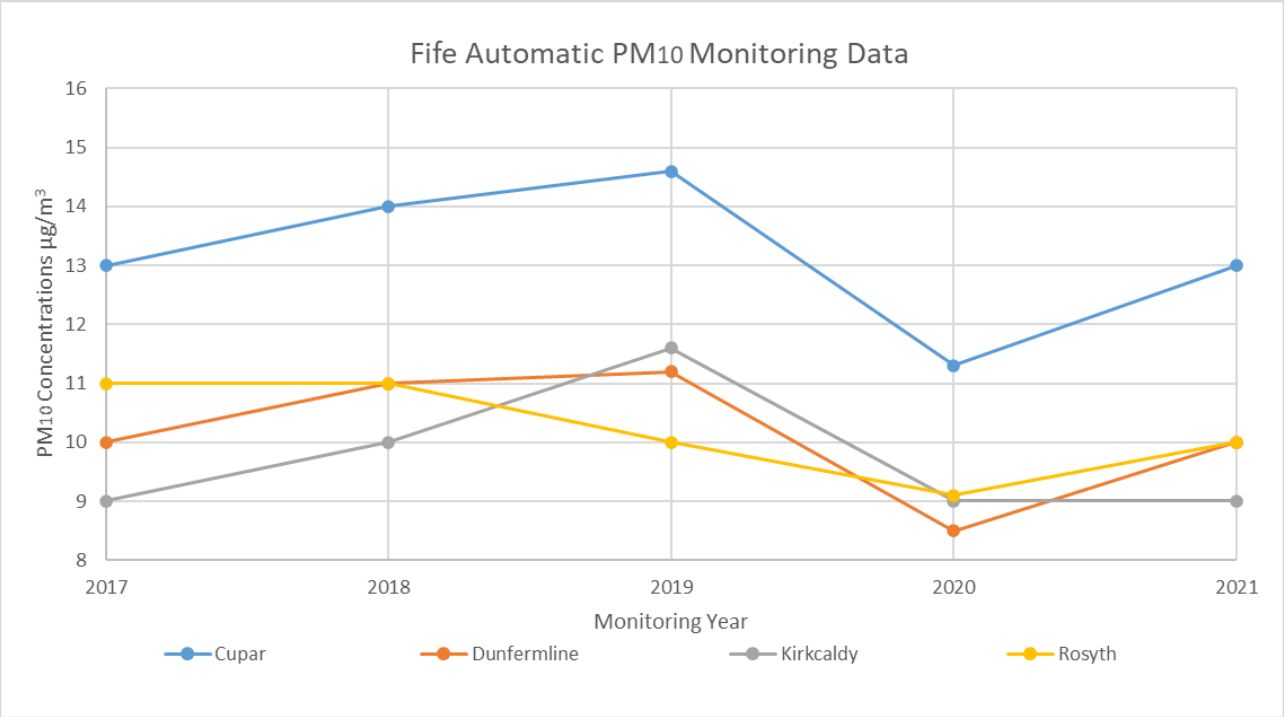

### 3.2.2 Particulate Matter ($PM_{10}$)

Table A.5 in Appendix A compares the ratified and adjusted monitored $PM_{10}$ annual mean concentrations for the past five years with the air quality objective of 18 µg $m^{-3}$.

Table A.6 in Appendix A compares the ratified continuous monitored $PM_{10}$ daily mean concentrations for the past five years with the air quality objective of 50 µg $m^{-3}$, not to be exceeded more than seven times per year.

Figure 3-9 provides the $PM_{10}$ monitoring results for 2021 and the previous five years. All four automatic monitoring sites did not record an exceedance of the $PM_{10}$ annual or 24-hour mean statutory objectives during 2021 and have been consistently below the objectives for the past five years.

Figure 3-9 Fife automatic monitoring sites $PM_{10}$ annual mean concentrations (µg $m^{-3}$)



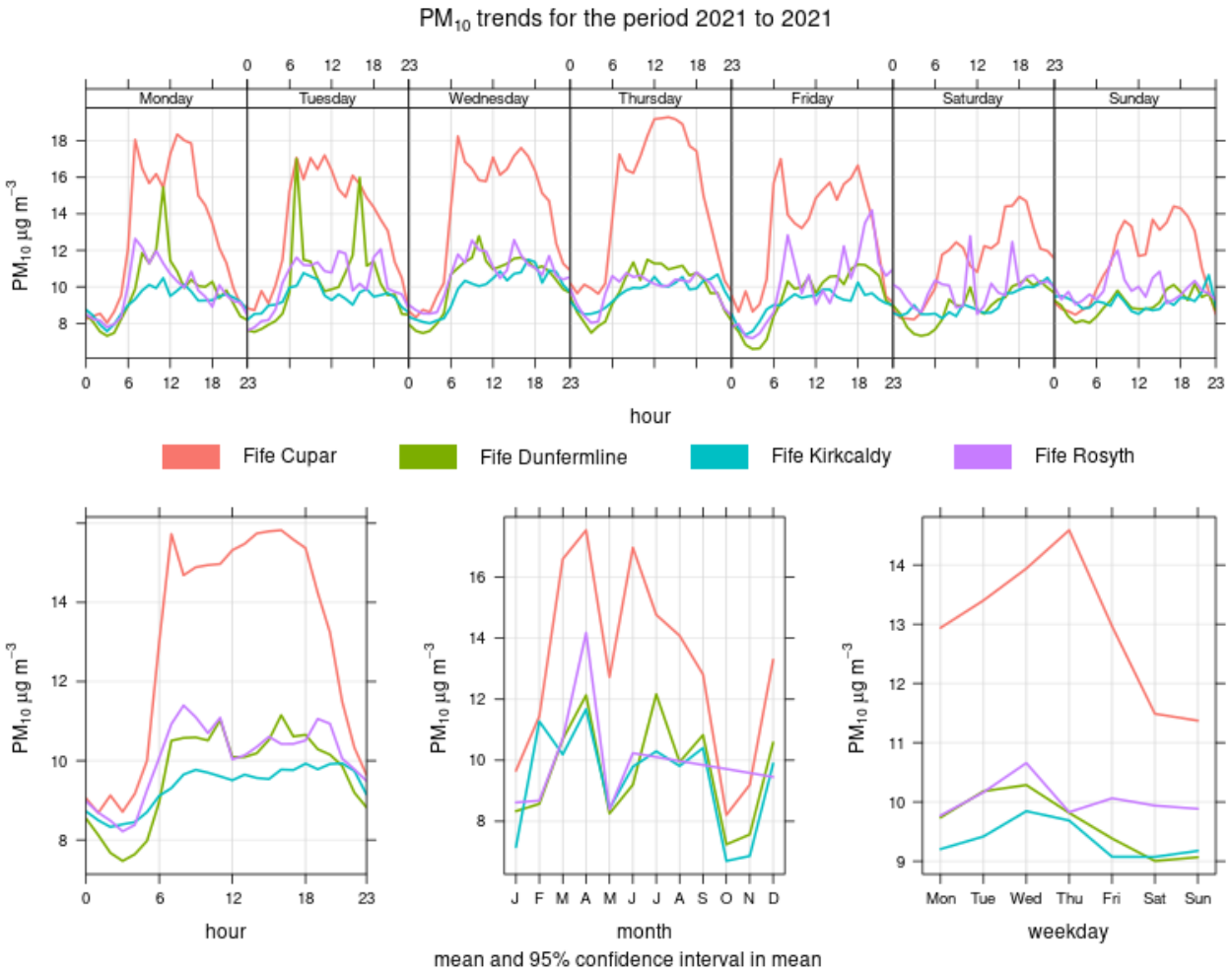

$PM_{10}$ concentrations increased slightly between 2017 and 2019 with the exception of Rosyth which remained constant in 2018 before declining in 2019. Concentrations dropped at all sites in 2020 although this is likely due to the COVID-19 lockdown and restrictions. In 2021 concentrations increased slightly as a result of COVID-19 lockdown and restrictions easing. Longer $PM_{10}$ trends at the two AQMAs can be seen in Figure 2-4 and Figure 2-6 above. Over the past few years with the exception of 2020 concentrations at all sites have stayed effectively stable within 1 or 2 µg $m^{-3}$ before dropping in 2020 due to the COVID-19 lockdown.

Three AQMesh units have been monitoring since December 2017 to further understand pollutant concentrations and trends in the two AQMAs. The 2021 $PM_{10}$ data showed that no exceedances were measured during 2021. Analysis of the monitoring data from these units is provided in Appendix E.

#### *3.2.2.1 $PM_{10}$ Trends Anlysis 2021*

Figure 3-10 compares the time variation plots for $PM_{10}$ in 2021 at each of the automatic monitoring stations. All four sites have very similar time variations in data throughout the year, with Cupar being the highest. The highest concentrations at all sites are measured between Monday to Friday (similar to $NO_2$ concentrations). The analysis suggests that traffic at Cupar has a greater effect on concentrations than the other locations however, this may be due to the location of the site (kerbside rather than roadside). It does however show the contribution traffic has to $PM_{10}$ at kerbside.

Figure 3-10 $PM_{10}$ Time Variation for Fife

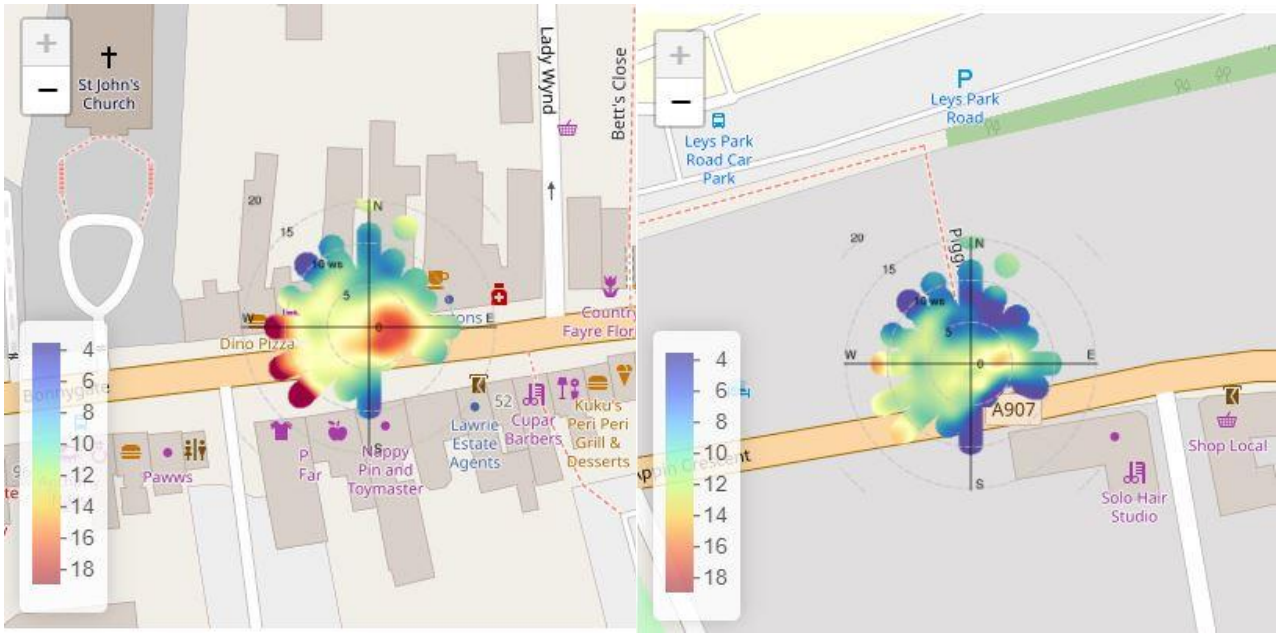



Figures F.5-8 in Appendix F show the $PM_{10}$ time series plots for each monitoring site individually.

Figures F.17-20 show $PM_{10}$ calendar plots of the date and the wind speed for each of the monitoring stations across Fife. Calendar plots show elevated concentrations. Concentrations are relatively low throughout the year at all sites, with the exception of Cupar in March and April which is higher.

Figures F.29-32 show $PM_{10}$ polar plots at each of the monitoring stations. Polar plots analysis for the AQMAs at Cupar (left) and Dunfermline (right) shown in Figure 3-11. All plots indicate that concentrations are highest with high wind speeds coming from the southwest. This can suggest that Particulate Matter concentrations in Fife are influenced by transboundary pollution. The signal seen with lower wind speed from the east indicate more local emission sources.

Figure 3-11 Polar plots of $PM_{10}$ concentrations by wind speed and direction

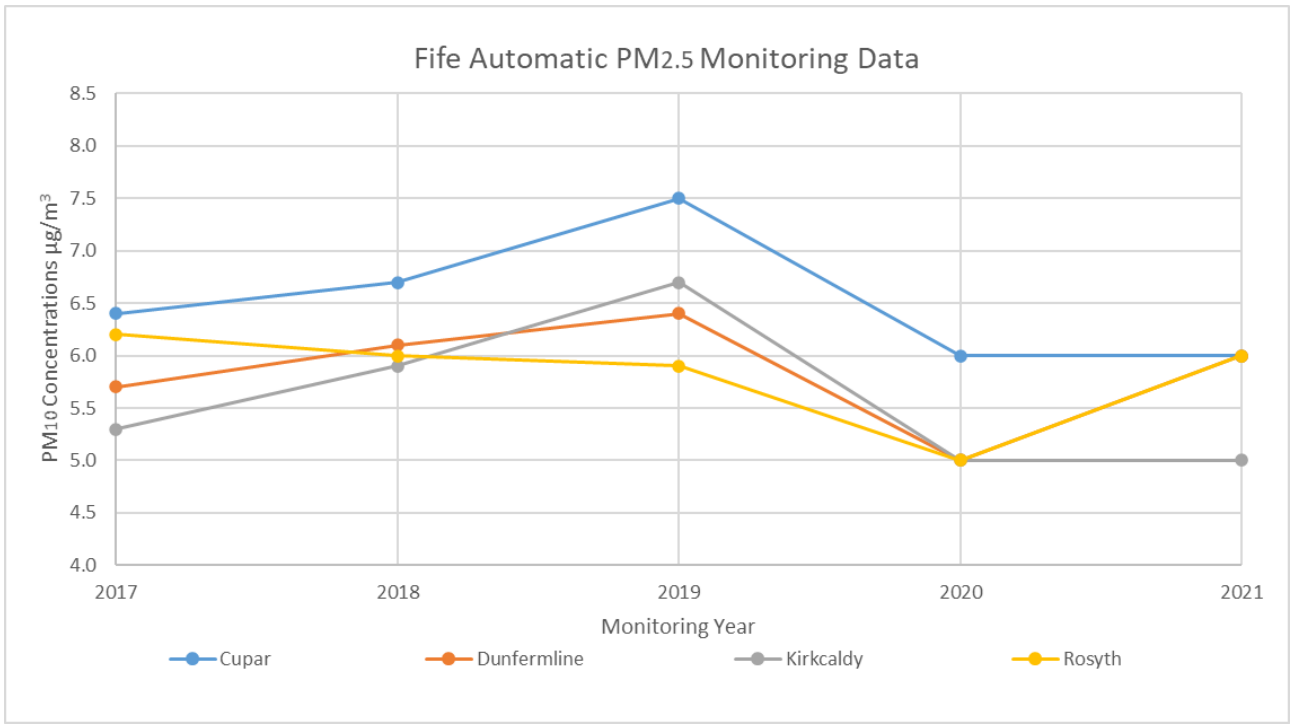



### 3.2.3 Particulate Matter ($PM_{2.5}$)

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 10 µg $m^{-3}$.

Figure 3-12 provides the $PM_{2.5}$ monitoring results for 2021 and the previous five years. All four automatic monitoring sites did not record an exceedance of $PM_{2.5}$ annual mean objective during 2021 and have been consistently below the objectives for the past five years.

Figure 3-12 Fife automatic monitoring sites $PM_{2.5}$ annual mean concentrations 2017-2021 (µg $m^{-3}$)




Overall $PM_{2.5}$ concentrations have remained unchanged since monitoring commenced. The concentrations declined between 2019 and 2020 however this is likely due to the COVID-19 lockdown restrictions.

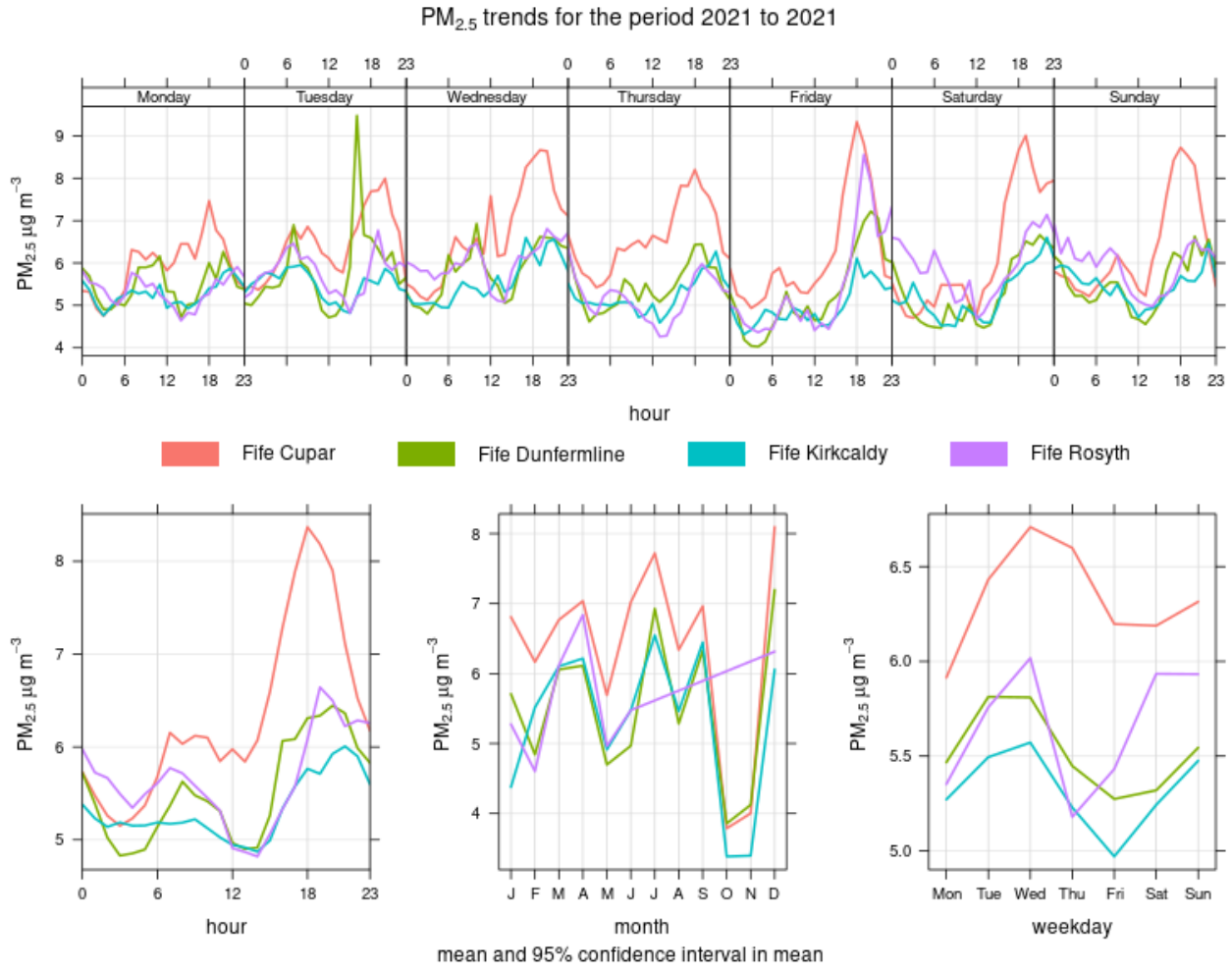
Concentrations remained consistent or increased slightly in 2021 following the easing of the COVID-19 lockdown and restrictions.

Three AQMesh units have been monitoring since December 2017 to further understand pollutant concentrations and trends in the two AQMAs. The 2021 $PM_{2.5}$ data showed that no exceedances were measured during 2021. Analysis of the monitoring data from these units is provided in Appendix E.

#### *3.2.3.1 $PM_{2.5}$ Trends Analysis 2021*

Figure 3-13 compares the time variation plots for $PM_{2.5}$ in 2021 at each of the automatic monitoring stations. All four sites have very similar time variations in data throughout the year. Concentrations are relatively consistent across the full week. Diurnal variations show that concentrations at all sites appear to increase during the night, especially at Cupar. This along with the diurnal plot suggests that traffic is not the only source of $PM_{2.5}$, with domestic fuel burning also being a potential source.

Figure 3-13 $PM_{2.5}$ Time Variation for Fife

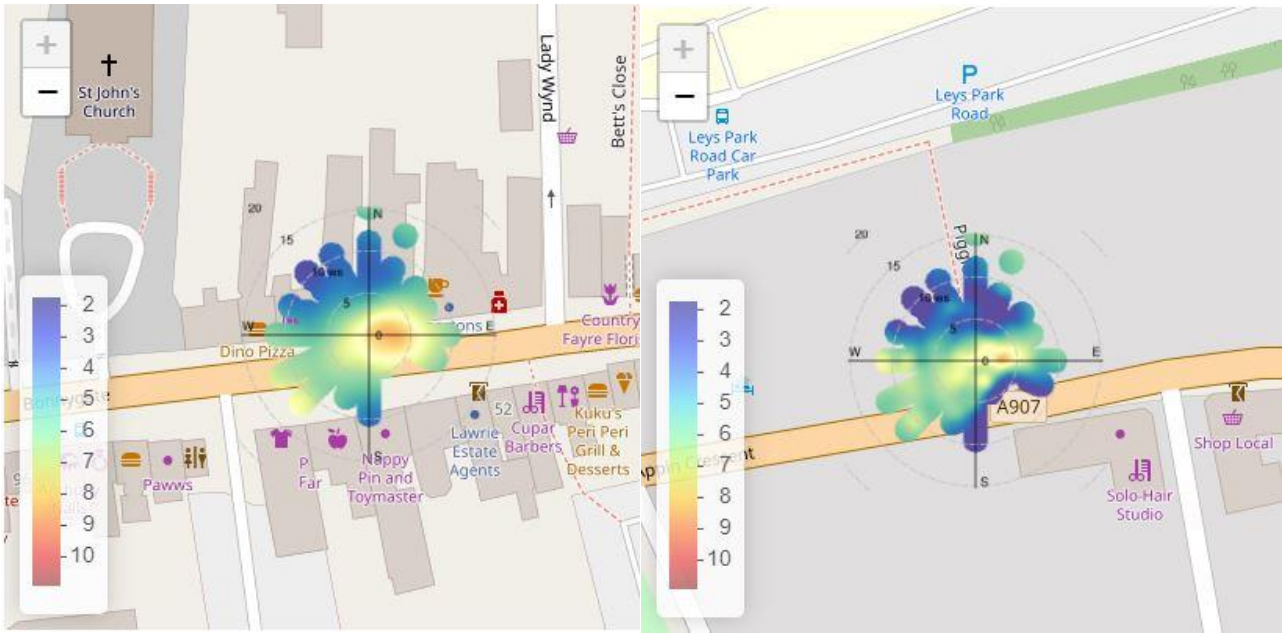



Figures F.9-12 in Appendix F show the $PM_{2.5}$ time series plots for each monitoring site individually.

Figures F.21-24 show $PM_{2.5}$ calendar plots of the date and the wind speed for each of the monitoring stations across Fife. Calendar plots show elevated concentrations. Concentrations are relatively low throughout the year at all sites.

Figures F.33-36 show $PM_{2.5}$ polar plots at each of the monitoring stations. Polar plots analysis for the AQMAs at Cupar (left) and Dunfermline (right) shown in Figure 3-14. As with $PM_{10}$, the plots indicate a transboundary component with a signal seen with strong winds from the southwest. The $PM_{2.5}$ polar plots however also suggest that higher concentrations are experience at lower wind speeds from the east suggesting a more local source.

Figure 3-14 Polar plots of $PM_{2.5}$ concentrations by wind speed and direction




### 3.2.4 Sulphur Dioxide ($SO_2$)

Fife Council does not undertake any $SO_2$ monitoring as previous review and assessment has not identified the need for this.

### 3.2.5 Carbon Monoxide, Lead and 1,3-Butadiene

As in previous years, short periods of CO monitoring have been undertaken by Fife Council's Transportation Services at a number of roadside locations. Measurements were undertaken with Marksman 660 street monitors. The results are summarised in Table 3.1.

Whilst none of these monitoring periods are sufficiently long to permit full assessment of CO concentrations over a full annual period for 2021, they all indicate that concentrations are likely to be below the AQS objective of 10 mg $m^{-3}$ for the running 8-hour mean concentration.

Table 3.1 CO Monitoring Fife Transportation Services

| Site Number/Location | Monitoring Period | Max 8-Hour Concentration (ppm) |
|---|---|---|
| Site 3: Dunfermline, Bothwell Gardens | 17/04/21 to 23/04/21 | 0.38 |
| | 13/07/21 to 19/07/21 | 0.46 |
| | 06/10/21 to 12/10/21 | 0.24 |
| Site 7: Leven, Glenlyon Road/Windygates Road | 06/05/21 to 12/05/21 | 0.55 |
| | 10/08/21 to 16/08/21 | 0.68 |
| | 08/02/22 to 14/02/22 | 1.66 |
| Site 13: Dunfermline, Carnegie Drive/Pilmuir Street | 17/04/21 to 23/04/21 | 0.71 |
| | 13/07/21 to 19/07/21 | 0.85 |
| | 06/10/21 to 12/10/21 | 2.84 |
| Site 16: Kirkcaldy, Dunnikier Road/Victoria Road | 01/06/21 to 07/06/21 | 0.66 |
| | 01/09/21 to 07/09/21 | 0.63 |
| | 08/03/22 to 14/03/22 | 0.60 |

| Site Number/Location | Monitoring Period | Max 8-Hour Concentration (ppm) |
|---|---|---|
| Site 24: Rosyth, Admiralty Road/Queensferry Road | 10/06/21 to 16/06/21 | 0.49 |
| | 24/09/21 to 30/09/21 | 0.59 |
| | 22/03/22 to 28/03/22 | 0.53 |
| Site 34: Cupar, Bonnygate | 06/05/21 to 12/05/21 | 1.59 |
| | 10/08/21 to 16/08/21 | 0.45 |
| | 05/02/22 to 11/02/22 | 2.73 |
| Site 35: Dunfermline, Appin Crescent | 17/04/21 to 23/04/21 | 1.11 |
| | 27/07/21 to 02/08/21 | 0.25 |
| | 21/10/21 to 27/10/21 | 0.33 |
| Site 36: Kirkcaldy, St Clair Street/Junction Road | 01/06/21 to 07/06/21 | 0.94 |
| | 01/09/21 to 07/09/21 | 0.30 |
| | 08/03/22 to 14/03/22 | 0.38 |
| Site 37: A909 Mossmorran | 08/04/21 to 14/04/21 | 0.11 |
| | 27/07/21 to 02/08/21 | 0.63 |
| | 21/10/21 to 27/10/21 | 0.49 |
| Site 39: St Andrews, Bell Street | 20/05/21 to 26/05/21 | 0.60 |
| | 20/08/21 to 26/08/21 | 0.44 |
| | 23/02/22 to 01/03/22 | 2.2 |
| Site 40: St Andrews, City Road | 20/05/21 to 26/05/21 | 0.50 |
| | 20/08/21 to 26/08/21 | 0.50 |
| | 23/02/22 to 01/03/22 | 3.05 |

**Other hydrocarbons:**

Monitored concentrations of propane, n-butane, iso-butane, n-pentane, hexane, heptane, octane, nonane, decane, propylene, toluene, o-xylene, m & p-xylene, styrene and total C4 to C10 hydrocarbons are measured by INEOS as part of their annual reporting requirements at Grangemouth and Houndpoint. Annual average concentrations are lower than the set air quality limit for these substances. The INEOS Grangemouth[3] annual community air monitoring report for 2021 states that there were no significant changes in the annual average concentrations for all hydrocarbon components across all locations, when compared with historical data. The results associated with INEOS Houndpoint are discussed below in the Benzene section.

At the time of writing, The Mossmorran and Braefoot Bay Independent Air Quality Monitoring Review Annual Report 2021 has not yet been published. This has been due to COVID-19 and the setting up of three Expert Advisory Groups (Air Quality; Communications and Noise, Vibration & Light) and it is anticipated that this will be produced later this year and the findings incorporated into a revised version of this Annual Progress Report.

### 3.2.6 Benzene

There are currently two benzene monitoring programmes carried out within the Fife Council boundary:

- Monitoring in the area of the Grangemouth oil refinery on behalf of INEOS,
- Monitoring along the Fife coastline on behalf of INEOS (associated with Houndpoint).

**INEOS Grangemouth Benzene Monitoring**

Benzene monitoring is presented for INOES Grangemouth oil refinery in their annual monitoring report for 2021[5]. This report concludes that the annual average concentrations of Benzene are below the Air Quality (Scotland) Regulations 2000 air quality objective of 3.25 µg $m^{-3}$ (1ppb).

**INEOS Houndpoint Benzene Monitoring**

INEOS FPS Ltd. commissioned National Physical Laboratory (NPL) to monitor the ambient air hydrocarbon levels at 12 locations on the Forth Estuary coastline during 2021 (1st January 2021 to 31st December 2021). Nine locations on the Estuary North shore between North Queensferry and West Wemyss (including four locations between Dalgety Bay and Burntisland) were used, and three locations on the Estuary South shore between South Queensferry and Whitehouse Point were used.

The ambient air samples were collected over two week periods using passive diffusive tubes. These samples were analysed for iso-butane, n-butane, iso-pentane, n-pentane, n-hexane, n-heptane, benzene, toluene, xylene and total hydrocarbons (C4-C10). These hydrocarbons may be emitted from a variety of sources around the Forth Estuary including INEOS operations at Hound Point Terminal, road traffic, and other industrial sites such as the operations of ExxonMobil and Shell at Braefoot Bay and Mossmorran.

The results of this monitoring indicate that the average concentrations of benzene over the 12-month period were low with the annual means at each location ranging from 0.1 to 0.4 parts per billion volume to volume (ppb v/v). This is below the current annual Air Quality (Scotland) Strategy objective of 1 ppb v/v.

- The concentrations of other hydrocarbons were also low, but there are no Air Quality (Scotland) Strategy objectives for these substances.
- The substance present in the greatest concentrations at all locations was n-butane for which annual mean concentrations ranged from 1.3 to 9.3 ppb v/v.
- Concentrations of n-heptane, toluene and xylene were all below the limit of detection (LOD) of <0.3 ppb v/v at all locations.
- The annual mean concentrations of other individual substances ranged from <0.3 (LOD) to 3.6 ppb v/v.
- The annual mean concentrations of total hydrocarbons (C4 to C10) at different locations ranged from <5 (LOD) to 20 ppb v/v.

INEOS FPS Ltd., and the previous Hound Point Terminal operator, have commissioned monitoring along the Forth Estuary coastline for many years and there has been an overall reduction in the levels of hydrocarbons, including benzene, present in the ambient air over the last decade. The concentrations at any one locality are highly dependent on the weather. The measurements made in 2021 indicate that concentrations of the lower molecular weight monitored substances have reduced when compared to those measured in 2020 at most of the locations.

### 3.2.7 Summary of Compliance with AQS Objectives

Monitoring data measured in 2021 identified no exceedances of the AQS annual mean objective for $NO_2$ at any of the automatic or non-automatic monitoring locations in Fife. The highest annual mean concentration measured in Appin Crescent, Dunfermline during 2021 was 26 µg $m^{-3}$ at Appin Crescent 2, Appin Crescent 3 and Appin Crescent 6 ABC. The highest annual mean concentration measured in Bonnygate, Cupar during 2021 was 27 µg $m^{-3}$ at Bonnygate B3 and Bonnygate B4.

All the automatic monitoring sites in Fife measured $PM_{10}$ concentrations below the annual and daily mean objectives during 2021. Bonnygate, Cupar and Appin Crescent, Dunfermline have both been declared AQMAs for $PM_{10}$. $PM_{10}$ concentrations within these locations have remained below the annual mean objective consistently since 2014.

Fife Council has examined the results from monitoring in the Fife Council area. Concentrations within the Appin Crescent, Dunfermline AQMA and Bonnygate Cupar AQMA are within the air quality objectives.

In light of the 2021 monitoring results, Fife Council should continue to monitor at locations throughout Fife. Following a review of concentrations Fife Council intend to amend non-automatic monitoring locations as

[5] Community Air Quality Monitoring Report, Ambient Atmospheric Survey in the Vicinity of Grangemouth – 2021, INEOS January 2022

appropriate. The monitoring data for 2022 will be reported in the next Annual Progress Report (2023) which will evaluate the most recent monitoring data.

## 3.3 ADDITIONAL AQMESH SENSOR MONITORING STUDY

The full data analysis of Fife Council's three AQMesh air quality monitoring sensor sites from 1st January – 31st December 2021, measuring particulate matter ($PM_{10}$ and $PM_{2.5}$) and nitrogen dioxide ($NO_2$) are provided in Appendix E.

In 2021, none of Fife's AQMesh sensor sites measured exceedances for any of the Scottish AQ objectives for pollutants $NO_2$, $PM_{10}$ and $PM_{2.5}$.

When comparing the Appin Crescent East and West AQMesh sensors with the nearby automatic site in the Dunfermline AQMA, the statistics show that:

- $NO_2$ annual mean concentrations for both Appin Crescent AQMesh pods have consistently been above that measured at the automatic site since monitoring began in 2018.
- $PM_{10}$ and $PM_{2.5}$ concentrations were higher in 2018 and 2019 at both Appin Crescent AQMesh pods than at the automatic site, but since 2020 concentrations have been below the automatic site.

When comparing the Bonnygate AQMesh sensor with the nearby automatic site in the Cupar AQMA, the statistics show that:

- Bonnygate AQMesh $NO_2$ annual mean concentrations have been higher than the Cupar automatic site annual mean concentrations since monitoring began in 2018, except for 2020 when the annual mean concentrations were the same.
- $PM_{10}$ and $PM_{2.5}$ concentrations for the AQMesh pod in Bonnygate have been very similar since monitoring began in 2018, except for 2019, when both $PM_{10}$ and $PM_{2.5}$ were higher at the AQMesh pod than the automatic site.

For both Bonnygate and Appin Crescent locations the co-located diffusion tubes measured higher $NO_2$ concentrations than the AQMesh sensors.

Diurnal variation analysis indicates:

- Bonnygate AQMesh site is more affected by traffic $NO_2$ emissions than the Cupar automatic site. Comparing 2020 with 2021 diurnals also indicates that traffic emissions are returning back to pre-Covid-19 patterns however concentrations are still lower than 2019 levels.
- In 2020, both Appin Crescent AQMesh sites measured higher $NO_2$ concentrations than the Dunfermline automatic site throughout the day. The Appin Crescent East AQMesh site is more affected by traffic $NO_2$ emissions than both the Appin Crescent West and the Dunfermline automatic sites.
- The only distinguishable diurnal variation for $PM_{10}$ is at the Cupar automatic site. This could suggest that traffic contributes more to $PM_{10}$ concentrations at the Cupar automatic site location than at the Bonnygate AQMesh location.
- Diurnal analysis suggests that traffic has little contributing factor to $PM_{10}$ concentrations at Appin Crescent locations.
- There is no obvious variation in $PM_{2.5}$ for all years at both Appin Crescent and Bonnygate which indicates that traffic contributes little to $PM_{2.5}$ concentration in both areas.

## 3.4 ADDITIONAL STUDIES

Three additional studies were carried out by Ricardo Energy & Environment on behalf of Fife Council. These include the Northern Link Road dispersion model, a real-world driving emission study and the domestic fuel use survey.

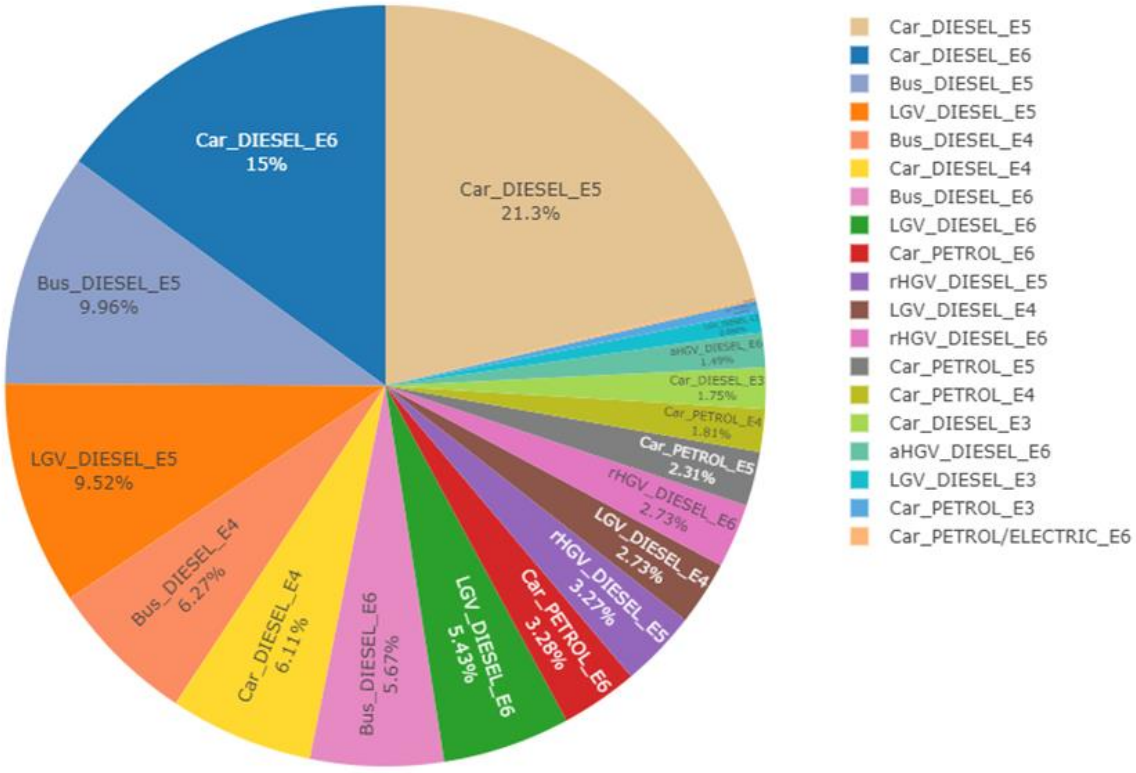
### 3.4.1 Northern Link Road

The Northern Link Road dispersion model was updated in March 2022 using the most recent available data. These results show that no exceedances of the annual mean $NO_2$, $PM_{10}$ and $PM_{2.5}$ Scottish air quality objectives within the Appin Crescent AQMA are predicted for any of the future scenarios assessed. Fife Council will utilise the updated model to consider air quality issues in and around Dunfermline as part of the planning process.

### 3.4.2 Real World Driving Emissions Study

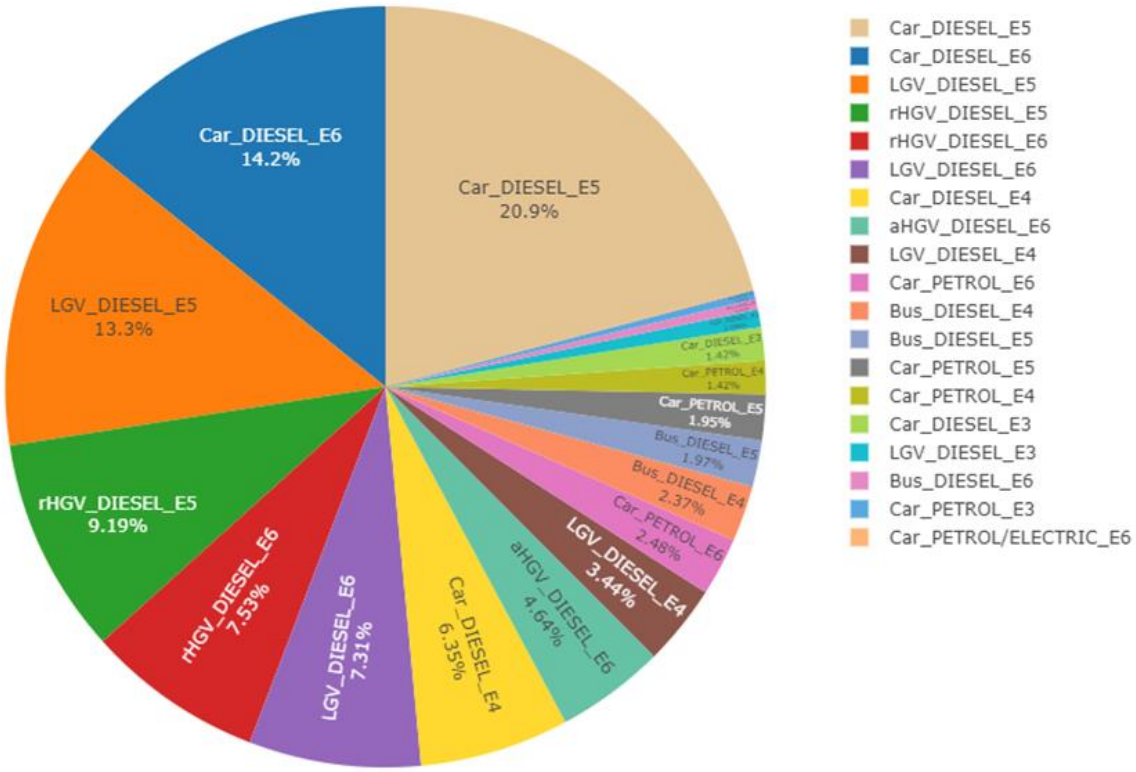
A Real-World Driving Emissions Study was undertaken over one week within the Appin Crescent AQMA in February/March 2022 and gathered data from nearly 13,000 vehicles. The data from the monitoring study will be used to inform future decision making and policy changes within Appin Crescent. An apportionment of emissions by vehicle type, fuel and euro standard can be seen in Figure 3-15.

Figure 3-15 Apportionment of emissions to vehicles by fuel type and Euro standard based on real-world emission factors and fleet composition at Dunfermline measured during the vehicle emissions remote sensing field campaign




A Real-World Driving Emissions Study was undertaken over one week within the Bonnygate AQMA in March 2022 and gathered data from over 12,000 vehicles. The data from the monitoring study will be used to inform future decision making and policy changes within the Bonnygate. An apportionment of emissions by vehicle type, fuel and euro standard can be seen in Figure 3-16.

Figure 3-16 Apportionment of emissions to vehicles by fuel type and Euro standard based on real-world emission factors and fleet composition at Bonnygate measured during the vehicle emissions remote sensing field campaign




### 3.4.3 Domestic Fuel Use Survey

A survey on domestic fuel use within both AQMAs was undertaken in March 2022. This fuel use survey looked specifically at identifying the extent of solid fuel burning in and around the AQMAs, in particular whether open fireplaces, solid-fuel stoves and biomass boilers are used as a source of heat by householders and businesses.

Of the 2,020 surveys sent out a total of 556 responses were received, 339 from the Bonnygate area and 217 from the Appin Crescent area. This was an overall response rate of 28%. Considering each location individually Bonnygate had a 24% response rate compared to 37% at Appin Crescent. Out of the 339 responses from Bonnygate, 12% (42) responded yes to using solid fuel burning as a heating source. In Appin Crescent 17% (36) out of the 217 responded yes to using solid fuel burning as a heating source.

Around a third of survey respondents want to learn more on the best practice in terms of running and maintaining their appliance. The findings of this fuel use survey will aid in the production of such promotional materials.

# 4. NEW LOCAL DEVELOPMENTS

## 4.1 ROAD TRAFFIC SOURCES

There have been several changes/additions to the existing local and trunk road network in Fife during 2021/22. Completed changes include the signalisation of Pitreavie Roundabout, Dunfermline and the provision of an additional lane on its southbound approach (A823), the signalisation of High Street/Foulford Road/Perth Road, Cowdenbeath and Phase 1 of the St Andrews West Link Road. Changes which have started include the upgrade and signalisation of Redhouse Roundabout, Kirkcaldy by Kingdom Park Limited (associated with the on-going Kingdom Park development works) however there is no anticipated completion date as yet. There have also been several new residential streets adopted by Fife Council during 2021/22.

## 4.2 OTHER TRANSPORT SOURCES

Fife Council confirms that there are no new roads, junctions, bus stations or railway sources that have been identified that meet the associated criteria for further consideration.

## 4.3 INDUSTRIAL SOURCES

Due to the impact of the cyber-attack experienced by SEPA, Fife Council have been unable to source any supporting information for the 2021 period.

## 4.4 COMMERCIAL AND DOMESTIC SOURCES

Due to the impact of the cyber-attack experienced by SEPA, Fife Council have been unable to source any supporting information for the 2021 period

## 4.5 NEW DEVELOPMENTS WITH FUGITIVE OR UNCONTROLLED SOURCES

Due to the impact of the cyber-attack experienced by SEPA, Fife Council have been unable to source any supporting information for the 2021 period

# 5. PLANNING APPLICATIONS

## 5.1 APPLICATIONS

The relevant planning guidance controls how Fife Council will manage potential air quality impacts from proposed developments. During 2021 the Land & Air Quality Team commented on numerous planning applications in relation to air quality matters with these ranging from proposed installation of domestic wood burning stoves and commercial biomass boilers to large scale residential developments where an Air Quality Impact Assessment (AQIA) was recommended/required in support of the application. The types of comments made by the team are summarised in Table 5.1:

Table 5.1 Summarised air quality related planning application comments

| Comment | Number of planning applications |
|---|---|
| AQIA advised and/or submitted for applications located out with AQMA's | 43 |
| AQIA advised and/or submitted for applications located within AQMA's | 1 |
| Biomass boiler/wood burning Stove questionnaire requested and/or submitted | 18 |
| General information provided (e.g., agreeing scope of AQIA, further info required, retain air quality condition(s) etc) | 16 |

**Applications of note include the following:**

**21/00056/FULL - Erection of 23 affordable housing units and 1 retail unit and associated infrastructure works at Bonnygate Car Park, Bonnygate, Cupar, Fife, KY15 4LB**

Airshed Air Quality Assessment submitted in support of the application which considered the impact on the Bonnygate AQMA from the development of the Bonnygate gap site whereby it was concluded that the effect on air quality within the Bonnygate AQMA would be negligible. We therefore have no further comment to make in relation to air quality at this time. Application approved 3rd June 2021.

**21/00954/PPP - Planning permission in principle for residential development (approximately 140 units) including affordable housing, access, landscaping, open space and associated engineering works at Mid Mire, Kinghorn, Fife**

EnviroCentre Air Quality Assessment submitted in support of the application and determined that no significant impact is predicted on existing or future residents as a result of the proposed development. We therefore have no further comment to make in relation to air quality at this time. Application refused on 1st October 2021 and now subject of appeal (as of March 2022).

**21/03264/PPP - Planning permission in principle for residential development (approximately 350 units) with commercial use, formation of accesses, landscaping, open space, SuDS and associated works at land to west of Rosemount Road, Glenrothes**

ITPEnergised Air Quality Impact Assessment submitted in support of the application and site assessed as being suitable for future residential use with regard to air quality with the significance of effect of operational phase emissions upon local air quality considered to not be significant. We therefore have no further comment to make regarding air quality at this time. Application not yet decided (as of March 2022).

**20/02284/FULL - Installation of flue associated with biomass plant at Fife Council Environmental Services, Lochhead Landfill Site, North of Wellwood, Dunfermline**

The information provided consisted of a semi-quantitative screening assessment based on the results of the air quality impact assessment of the original biomass plant, scaled to account for two units. While no additional modelling has been undertaken it was noted that WSP concluded that the operation of the second biomass boiler (whether operating alone or in conjunction with the existing plant) will have an insignificant impact on local air quality. We therefore have no further comment to make. Application approved 18th March 2021.

**20/03227/ARC - Application for approval of matters specified by condition 1 of 17/02330/PPP for erection of 581 residential units, retail units and associated access, open space, landscaping and infrastructure at Land to South of Riverside Terrace, Kincardine**

EnviroCentre Air Quality Assessment submitted in support of the application and determined that no significant air quality impact is predicted as a result of the proposed development. We therefore have no further comment to make in relation to air quality at this time. Application not yet decided (as of March 2022).

**21/00704/PREAPP - Pre-application for development of up to 115 No. affordable houses with associated infrastructure and landscaping at Land to South of Lochgelly Road, Cowdenbeath**

Given the nature and scale of the proposed development, it is advised that a suitable air quality impact assessment should be undertaken and submitted in support of any subsequent planning applications for the subject site. Application approved 29th April 2021 and requirement for AQIA to be included with future applications specified within PREAPP response from Planning Department.

**21/01842/PPP - Redevelopment of former Prestonhill Quarry, Inverkeithing to create a mixed-use development including approximately 180 residential units (including affordable housing), holiday lodges, café/bistro, associated access, open space, landscaping, SUDS and other infrastructure at Prestonhill Quarry, Preston Crescent, Inverkeithing**

Airshed Air Quality Impact Assessment submitted in support of the application. It was noted that a full assessment could not be completed due to COVID-19 restrictions at the time of writing and Airshed advise that impacts associated with the proposed development will be assessed in detail once the masterplan has been finalised and the baseline road traffic survey has been completed. The updated air quality assessment should then be submitted for comment/approval. Application refused 22nd February 2022 (unclear if site will be subject to an appeal).

**21/00791/PPP - A major residential development of residential units, associated car parking, open space, landscaping, drainage and formation of new accesses onto The Avenue, Lochgelly at Land to South of The Piggery, The Avenue, Lochgelly, Fife**

EnviroCentre Air Quality Assessment submitted in support of the application and determined that no significant impact is predicted on existing or future residents as a result of the proposed development. We therefore have no further comment to make in relation to air quality at this time. Application undecided as of March 2022.

**21/02021/PREAPP - Pre-application for the development of the Royal and Ancient Operations Centre comprising accommodation for staff and collaborative partners at St Andrews Bay Golf Resort and Spa, Kingask, St Andrews, Fife, KY16 8PN**

Given the potential scale of the development an air quality impact assessment should be submitted in support of subsequent planning applications for the subject site. Application approved 20th September 2021 and requirement for AQIA to be included with future applications specified within PREAPP response from Planning Department.

# 6. CONCLUSIONS AND PROPOSED ACTIONS

## 6.1 CONCLUSIONS FROM NEW MONITORING DATA

**Nitrogen Dioxide**

The 2022 APR has considered the available monitoring data measured during 2021. During 2021 non-automatic, diffusion tube monitoring was undertaken at 42 locations within Fife (covering 58 diffusion tubes in total). $NO_2$ is also measured at four sites using automatic monitors, Cupar, Dunfermline, Kirkcaldy and Rosyth. There were no exceedances of the $NO_2$ annual mean objective at any automatic or non-automatic monitoring locations during 2021. The highest annual mean concentration measured in Appin Crescent, Dunfermline during 2021 was 26 µg $m^{-3}$ at Appin Crescent 2, Appin Crescent 3 and Appin Crescent 6 ABC. The highest annual mean concentration measured in Bonnygate, Cupar during 2021 was 27 µg $m^{-3}$ at Bonnygate B3 and Bonnygate B4. No diffusion tubes were commissioned or decommissioned during 2021.

Three AQMesh sensors were installed in December 2017 to seek to further understand pollutant concentrations and trends in the Appin Crescent, Dunfermline AQMA (two monitoring locations) and Bonnygate, Cupar AQMA (one monitoring location). Data is managed and processed by Ricardo who carry out appropriate QA/QC. The data from all three sites showed that no exceedances were measured during 2021 for $NO_2$.

Concentrations measured in 2021 have increased compared to 2020 although this is to be expected as the 2020 concentrations were attributed to the COVID-19 pandemic lockdown restrictions and consequent reductions in traffic levels. Road traffic is the major source of $NO_2$ at monitoring locations in Fife.

**Particulate Matter**

$PM_{10}$ concentrations are measured at four locations in Fife at Cupar, Dunfermline, Kirkcaldy and Rosyth. Measured 2021 concentrations were below the $PM_{10}$ annual mean objective with no exceedances of the annual or daily mean objective at all sites.

During 2021, $PM_{2.5}$ was measured at four automatic monitoring sites in Cupar; Dunfermline, Kirkcaldy and Rosyth. Measured 2021 concentrations were below the $PM_{2.5}$ annual mean objective at all sites.

AQMesh Sensors located at two monitoring locations within Appin Crescent, Dunfermline measured no exceedances of the annual or daily mean objectives for both $PM_{10}$ and $PM_{2.5}$.

The AQMesh Sensor monitoring location within Bonnygate Cupar measured no exceedances of the annual or daily mean objectives for both $PM_{10}$ and $PM_{2.5}$.

Concentrations measured in 2021 have increased compared to 2020 although this is to be expected as the 2020 concentrations were attributed to the COVID-19 pandemic lockdown restrictions and consequent reductions in traffic levels. Decreases in concentrations of PM were lower than that seen for $NO_2$ due to traffic not being the predominant source.

**Sulphur Dioxide**

No $SO_2$ concentrations were measured in Fife during 2021. Historical $SO_2$ monitoring data from the Longannet power station site is available in previous year's APR report for Fife Council.

**Carbon Monoxide**

Short-term monitoring undertaken by Fife Council's Transportation Services department during 2021 indicates that the AQS objective for CO is unlikely to have been exceeded during 2021.

**Benzene and 1,3 Butadiene**

Benzene and 1,3 Butadiene monitoring carried out in the area of the INEOS Grangemouth refinery show that it is unlikely that the AQS objective for these pollutants have been exceeded within the Fife Council boundary.

A summary of the monitoring data from INEOS Houndpoint states that concentrations of the monitored substances have reduced when compared to those measured in 2020 at most of the locations.

At the time of writing, The Mossmorran and Braefoot Bay Independent Air Quality Monitoring Review Annual Report 2021 has not yet been published as this has been delayed. A summary will be added to this report once it is available.

## 6.2 CONCLUSIONS RELATING TO NEW LOCAL DEVELOPMENTS

Fife Council have not identified any New Local Developments out with the applications previously considered and assessed by Fife Council where there may be a risk of the air quality objectives being exceeded. Therefore, no additional air quality assessment is recommended at this time.

## 6.3 PROPOSED ACTIONS

Following the review of all available data it is recommended that Fife Council carry out the following actions:

1. Submit the next Air Quality Progress Report in June 2023.
2. Review the current $NO_2$ diffusion tube monitoring programme and seek to relocate any tubes where deemed appropriate (i.e., where continuously low readings have been recorded).
3. Continue to implement the measures outlined in the action plans for Bonnygate, Cupar and Appin Crescent, Dunfermline.
4. Continue to measure pollution in both AQMAs using AQMesh Sensor units to obtain a better understanding of concentrations in locations previously not monitored. Also use two AQMesh Sensor units at City Road, St Andrews and St Clair Street, Kirkcaldy to further evaluate pollutant concentrations at these locations.
5. Await the outcomes of the Particulate Matter Measurement Study recently commissioned by the Scottish Government due to the current uncertainty regarding $PM_{10}$ concentrations reported by different analyser types. The outcomes of this exercise will help guide future decision making regarding the possible revocation of the current $PM_{10}$ AQMAs.

Fife Council have confirmed they will undertake these recommended actions.

## 6.4 GRANTS AWARDED

In March of each year Fife Council apply for grant funding from the Scottish Government to carry out local air quality management and AQAP related projects. For the financial year April 2022 to March 2023, Fife Council have been awarded funding for the following:

- Fleet – Nissan ENV200 electric van (to be used as a MoW vehicle replacing an existing diesel van within the Fleet)
- TRL – Continuation of Fleet and Taxi EcoStars schemes within Fife
- Ricardo – AQMesh data management and reporting over 2022 for existing AQMA pods
- Ricardo – Citizen Science Packs for CAD 2022 activities at three schools
- EnviroTechnology Services – Hire of ‘SmogMobile’ for CAD 2022 activities at three schools
- Ricardo – Building of an air quality and climate change co-benefits evidence base in order to evaluate the likely impact and benefits of actions being considered by Fife Council in relation to the ‘Climate Emergency Plan’.
- Ricardo – Undertake an anti-idling engine campaign which will focus mainly on schools and link with other educational based air quality activities such as Clean Air Day.

# APPENDICES

Appendix A: Monitoring Results

Appendix B: Full Monthly Diffusion Tube Results for 2021

Appendix C: Air Quality Monitoring Data QA/QC

Appendix D: Technical Specification of Automatic Monitoring Equipment

Appendix E: Calculated Sensitivities and Example Co-location Data Orthogonal Regression Analysis

Appendix F: Dynamic Report

# 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? Which AQMA? | Monitoring Technique | Distance to Relevant Exposure (m) (1) | Distance to kerb of nearest road (m) (2) | Inlet Height (m) |
|---|---|---|---|---|---|---|---|---|---|
| Cupar | Kerbside | 337403 | 714571 | $NO_2$, $PM_{10}$, $PM_{2.5}$ | YES Bonnygate | $NO_x$ Analyser (Chemiluminescence), FIDAS (since December 2016) | N (1m) | <0.5m | 1.9m |
| Dunfermline | Roadside | 309926 | 687722 | $NO_2$, $PM_{10}$, $PM_{2.5}$ | YES Appin Crescent | $NO_x$ Analyser (Chemiluminescence), FIDAS (since September 2016) | Y (1m) | 4m | 2m |
| Kirkcaldy | Roadside | 329143 | 692986 | $NO_2$, $PM_{10}$ $PM_{2.5}$ | N | $NO_x$ Analyser (Chemiluminescence), FIDAS (since April 2016) | N (10m) | 5m | 2m |
| Rosyth | Roadside | 311755 | 683503 | $NO_2$, $PM_{10}$ $PM_{2.5}$ | N | $NO_x$ Analyser (Chemiluminescence) FIDAS (since July 2015) | Y (1.5m) | 6m | 2.1m |

**Notes:**

(1) 0 m 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 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) |
|---|---|---|---|---|---|---|---|---|---|
| Central Area | | | | | | | | | |
| Glenlyon, Leven | Kerbside | 337357 | 701318 | $NO_2$ | No | No (26.8) | 1 | No | 2.2-2.5 |
| ASDA Roundabout, Kirkcaldy | Kerbside | 328742 | 694045 | $NO_2$ | No | No (28.0) | 1 | No | 2.2-2.5 |
| Victoria Road, Kirkcaldy | Roadside (Façade) | 328144 | 692315 | $NO_2$ | No | Yes | 2.5 | No | 2.2-2.5 |
| Dunnikier Road, Kirkcaldy | Roadside (Façade) | 328152 | 692352 | $NO_2$ | No | Yes | 3.4 | No | 2.2-2.5 |
| St Clair Street 1, Kirkcaldy | Roadside | 329157 | 693030 | $NO_2$ | No | No (2.0) | 1.3 | No | 2.2-2.5 |
| St Clair Street 2, Kirkcaldy | Roadside | 329131 | 693008 | $NO_2$ | No | No (2.0) | 1.8 | No | 2.2-2.5 |
| St Clair Street 3 (MS), Kirkcaldy | Roadside (Façade) | 329174 | 693069 | $NO_2$ | No | Yes | 2 | No | 2.2-2.5 |
| 125 St Clair Street, Kirkcaldy | Roadside (Façade) | 329208 | 693163 | $NO_2$ | No | Yes | 1.5 | No | 2.2-2.5 |
| 179A St Clair Street, Kirkcaldy | Roadside (Façade) | 329310 | 693326 | $NO_2$ | No | Yes | 1.5 | No | 2.2-2.5 |
| St Clair Street Romon A, B, C Kirkcaldy* | Roadside | 329143 | 692986 | $NO_2$ | No | No (10.0) | 5 | Yes | 2.2-2.5 |
| 3A Junction Road, Kirkcaldy | Roadside (Façade) | 329123 | 693029 | $NO_2$ | No | Yes | 1.5 | No | 2.2-2.5 |
| Henry Road, Kirkcaldy | Roadside | 327437 | 692270 | $NO_2$ | No | No (16.0) | 1.7 | No | 2.2-2.5 |
| East Area | | | | | | | | | |
| Bell Street 1, St Andrews | Roadside (Façade) | 350712 | 716691 | $NO_2$ | No | Yes | 1.6 | No | 2.2-2.5 |

| 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) |
|---|---|---|---|---|---|---|---|---|---|
| Bell Street 2, St Andrews | Roadside (Façade) | 350721 | 716646 | $NO_2$ | No | Yes | 2.1 | No | 2.2-2.5 |
| City Road 1, St Andrews | Roadside | 350590 | 716570 | $NO_2$ | No | No (1.0) | 1.5 | Yes | 2.2-2.5 |
| City Road 3, St Andrews | Roadside | 350538 | 716682 | $NO_2$ | No | No (14.0) | 1.5 | No | 2.2-2.5 |
| City Road 5, St Andrews | Roadside | 350499 | 716748 | $NO_2$ | No | No (5.0) | 1.9 | No | 2.2-2.5 |
| City Road 6, St Andrews | Roadside | 350470 | 716826 | $NO_2$ | No | No (5.0) | 2.2 | No | 2.2-2.5 |
| Links Crescent, St Andrews | Roadside (Façade) | 350156 | 716947 | $NO_2$ | No | Yes | 3 | No | 2.2-2.5 |
| North Street, St Andrews | Roadside | 350519 | 716935 | $NO_2$ | No | No (3.0) | 2.2 | No | 2.2-2.5 |
| Bonnygate B1, Cupar | Roadside (Façade) | 337409 | 714570 | $NO_2$ | Yes, Bonnygate | Yes | 5.3 | No | 2.2-2.5 |
| Bonnygate B2, Cupar | Roadside (Façade) | 337507 | 714584 | $NO_2$ | Yes, Bonnygate | Yes | 1.7 | No | 2.2-2.5 |
| Bonnygate B3, Cupar | Roadside (Façade) | 337480 | 714586 | $NO_2$ | Yes, Bonnygate | Yes | 1.6 | Yes | 2.2-2.5 |
| Bonnygate B4, Cupar | Roadside (Façade) | 337467 | 714576 | $NO_2$ | Yes, Bonnygate | Yes | 1.9 | No | 2.2-2.5 |
| Bonnygate West B6, Cupar | Roadside | 337333 | 714559 | $NO_2$ | Yes, Bonnygate | No (4.0) | 3 | No | 2.2-2.5 |
| Bonnygate Monitor A, B, C, Cupar* | Kerbside | 337403 | 714571 | $NO_2$ | Yes, Bonnygate | No (4.8) | 0.6 | Yes | 2.2-2.5 |

| 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) |
|---|---|---|---|---|---|---|---|---|---|
| West Area | | | | | | | | | |
| High Street, Cowdenbeath | Kerbside | 316527 | 691742 | $NO_2$ | No | No (3.5) | 0.5 | No | 2.2-2.5 |
| Admiralty Road A, Rosyth | Roadside (Façade) | 312069 | 683431 | $NO_2$ | No | Yes | 9 | No | 2.2-2.5 |
| Admiralty Road ROMAN A, B, C, Rosyth* | Roadside (Façade) | 311755 | 683503 | $NO_2$ | No | Yes | 6.5 | Yes | 2.2-2.5 |
| Appin Crescent 1, Dunfermline | Roadside (Façade) | 309888 | 687719 | $NO_2$ | Yes, Appin Crescent | Yes | 6.5 | No | 2.2-2.5 |
| Appin Crescent 2, Dunfermline | Roadside (Façade) | 309883 | 687701 | $NO_2$ | Yes, Appin Crescent | Yes | 1.5 | No | 2.2-2.5 |
| Appin Crescent 3, Dunfermline | Roadside (Façade) | 309975 | 687716 | $NO_2$ | Yes, Appin Crescent | Yes | 1.8 | No | 2.2-2.5 |
| Appin Crescent 4A,B,C, Dunfermline* | Roadside (Façade) | 309926 | 687722 | $NO_2$ | Yes, Appin Crescent | Yes | 3.9 | Yes | 2.2-2.5 |
| Appin Crescent 5A,B,C, Dunfermline* | Roadside (Façade) | 309957 | 687714 | $NO_2$ | Yes, Appin Crescent | Yes | 1.5 | No | 2.2-2.5 |
| Appin Crescent 6A, 6B, 6C Dunfermline* | Roadside (Façade) | 309904 | 687704 | $NO_2$ | Yes, Appin Crescent | Yes | 1.5 | No | 2.2-2.5 |
| Appin Crescent A, B, C Dunfermline* | Roadside | 309900 | 687716 | $NO_2$ | No | No (5.1) | 1.6 | No | 2.2-2.5 |
| Carnegie Drive A, B, C Dunfermline* | Roadside (Façade) | 309023 | 687632 | $NO_2$ | No | Yes | 2.3 | No | 2.2-2.5 |
| 11 Halbeath Road, Dunfermline | Roadside (Façade) | 310245 | 687784 | $NO_2$ | No | Yes | 14 | No | 2.2-2.5 |

| 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) |
|---|---|---|---|---|---|---|---|---|---|
| Pilmuir Street, Dunfermline | Roadside | 309143 | 687774 | $NO_2$ | No | Yes | 2 | No | 2.2-2.5 |
| Mill Street, Dunfermline | Roadside | 308888 | 687968 | $NO_2$ | No | Yes | 2 | No | 2.2-2.5 |
| Rumblingwell, Dunfermline | Roadside | 307898 | 688224 | $NO_2$ | No | No (6.3) | 1.7 | No | 2.2-2.5 |
| 102 Baldridgeburn, Dunfermline | Kerbside | 308447 | 688068 | $NO_2$ | No | No (3.0) | 0.5 | No | 2.2-2.5 |

**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.

* Triplicate sites

K = Kerbside, 0-1, from the kerb of a busy road. R = Roadside,1-5m from the kerb. R (F) = Façade of buildings on street.

Table A.3 – Annual Mean $NO_2$ Monitoring Results (µg $m^{-3}$)

| Site ID | Site Type | Monitoring Type | Valid Data Capture for Monitoring Period (%) (1) | Valid Data Capture 2021 (%) (2) | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|---|---|---|---|
| Cupar | Kerbside | Automatic | 100 | 92 | 26.4 | 25.7 | 23.6 | 20.9 | 20.0 |
| Dunfermline | Roadside | Automatic | 100 | 95 | 23.2 | 21.7 | 20.5 | 15.2 | 16.1 |
| Kirkcaldy | Roadside | Automatic | 100 | 100 | 18.2 | 16.9 | 15.8 | 12.2 | 14.1 |
| Rosyth | Roadside | Automatic | 100 | 98 | 22.1 | 21.5 | 21.5 | 15.4 | 19.3 |
| Central Area | | | | | | | | | |
| Glenlyon, Leven | Kerbside | Diffusion Tube | 100 | 100 | 24 | 24 | 23 | 16 | 20 |
| ASDA Roundabout, Kirkcaldy | Kerbside | Diffusion Tube | 100 | 100 | 24 | 27 | 22 | 16 | 19 |
| Victoria Road, Kirkcaldy | Roadside (Façade) | Diffusion Tube | 100 | 100 | 23 | 25 | 23 | 16 | 22 |
| Dunnikier Road, Kirkcaldy | Roadside (Façade) | Diffusion Tube | 100 | 100 | 21 | 23 | 22 | 16 | 18 |
| St Clair Street 1, Kirkcaldy | Roadside | Diffusion Tube | 100 | 100 | 33 | 30 | 25 | 18 | 21 |
| St Clair Street 2, Kirkcaldy | Roadside | Diffusion Tube | 100 | 100 | 34 | 33 | 29 | 23 | 23 |
| St Clair Street 3 (MS), Kirkcaldy | Roadside (Façade) | Diffusion Tube | 100 | 83.33 | 25 | 26 | 23 | 16 | 19 |
| 125 St Clair Street, Kirkcaldy | Roadside (Façade) | Diffusion Tube | 100 | 100 | 29 | 28 | 23 | 18 | 20 |
| 179A St Clair Street, Kirkcaldy | Roadside (Façade) | Diffusion Tube | 100 | 100 | 26 | 25 | 22 | 18 | 18 |
| St Clair Street Romon A, B, C Kirkcaldy* | Roadside | Diffusion Tube | 100 | 100 | 19 | 17 | 16 | 13 | 14 |
| 3A Junction Road, Kirkcaldy | Roadside (Façade) | Diffusion Tube | 100 | 100 | 22 | 23 | 19 | 15 | 17 |
| Henry Road, Kirkcaldy | Roadside | Diffusion Tube | 100 | 100 | 26 | 24 | 21 | 16 | 19 |

| Site ID | Site Type | Monitoring Type | Valid Data Capture for Monitoring Period (%) [1] | Valid Data Capture 2021 (%) [2] | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|---|---|---|---|
| East Area | | | | | | | | | |
| Bell Street 1, St Andrews | Roadside (Façade) | Diffusion Tube | 100 | 100 | 27 | 28 | 27 | 14 | 15 |
| Bell Street 2, St Andrews | Roadside (Façade) | Diffusion Tube | 100 | 100 | 24 | 23 | 22 | 13 | 14 |
| City Road 1, St Andrews | Roadside | Diffusion Tube | 100 | 83.33 | 20 | 22 | 22 | 13 | 16 |
| City Road 3, St Andrews | Roadside | Diffusion Tube | 100 | 100 | 22 | 23 | 22 | 16 | 17 |
| City Road 5, St Andrews | Roadside | Diffusion Tube | 100 | 100 | 23 | 22 | 18 | 13 | 15 |
| City Road 6, St Andrews | Roadside | Diffusion Tube | 100 | 100 | 31 | 31 | 27 | 21 | 24 |
| Links Crescent, St Andrews | Roadside (Façade) | Diffusion Tube | 100 | 100 | 19 | 21 | 19 | 14 | 16 |
| North Street, St Andrews | Roadside | Diffusion Tube | 100 | 100 | - | - | 21 | 13 | 17 |
| Bonnygate B1, Cupar | Roadside (Façade) | Diffusion Tube | 100 | 100 | 24 | 25 | 24 | 18 | 21 |
| Bonnygate B2, Cupar | Roadside (Façade) | Diffusion Tube | 100 | 100 | - | - | 23 | 21 | 23 |
| Bonnygate B3, Cupar | Roadside (Façade) | Diffusion Tube | 100 | 100 | 31 | 31 | 32 | 20 | 27 |
| Bonnygate B4, Cupar | Roadside (Façade) | Diffusion Tube | 100 | 100 | 33 | 34 | 32 | 22 | 27 |
| Bonnygate West B6, Cupar | Roadside | Diffusion Tube | 100 | 100 | 20 | 18 | 18 | 13 | 14 |

| Site ID | Site Type | Monitoring Type | Valid Data Capture for Monitoring Period (%) [1] | Valid Data Capture 2021 (%) [2] | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|---|---|---|---|
| Bonnygate Monitor A, B, C, Cupar* | Kerbside | Diffusion Tube | 100 | 100 | 26 | 27 | 23 | 16 | 19 |
| West Area | | | | | | | | | |
| High Street, Cowdenbeath | Kerbside | Diffusion Tube | 100 | 100 | 18 | 20 | 19 | 14 | 16 |
| Admiralty Road A, Rosyth | Roadside (Façade) | Diffusion Tube | 100 | 100 | 26 | 25 | 27 | 20 | 23 |
| Admiralty Road ROMAN A, B, C, Rosyth* | Roadside (Façade) | Diffusion Tube | 100 | 100 | 22 | 22 | 22 | 17 | 19 |
| Appin Crescent 1, Dunfermline | Roadside (Façade) | Diffusion Tube | 100 | 100 | 25 | 25 | 26 | 19 | 21 |
| Appin Crescent 2, Dunfermline | Roadside (Façade) | Diffusion Tube | 100 | 100 | 34 | 34 | 31 | 24 | 26 |
| Appin Crescent 3, Dunfermline | Roadside (Façade) | Diffusion Tube | 100 | 100 | 29 | 28 | 28 | 21 | 26 |
| Appin Crescent 4A,B,C, Dunfermline* | Roadside (Façade) | Diffusion Tube | 100 | 100 | 23 | 21 | 21 | 15 | 16 |
| Appin Crescent 5A,B,C, Dunfermline* | Roadside (Façade) | Diffusion Tube | 100 | 100 | 35 | 31 | 30 | 23 | 24 |
| Appin Crescent 6A, 6B, 6C Dunfermline* | Roadside (Façade) | Diffusion Tube | 100 | 100 | 37 | 35 | 34 | 24 | 26 |
| Appin Crescent A, B, C Dunfermline* | Roadside | Diffusion Tube | 100 | 91.67 | 29 | 27 | 27 | 20 | 21 |

| Site ID | Site Type | Monitoring Type | Valid Data Capture for Monitoring Period (%) (1) | Valid Data Capture 2021 (%) (2) | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|---|---|---|---|
| Carnegie Drive A, B, C Dunfermline* | Roadside (Façade) | Diffusion Tube | 100 | 100 | 26 | 27 | 26 | 18 | 22 |
| 11 Halbeath Road, Dunfermline | Roadside (Façade) | Diffusion Tube | 100 | 100 | 16 | 15 | 15 | 12 | 12 |
| Pilmuir Street, Dunfermline | Roadside | Diffusion Tube | 100 | 100 | 23 | 24 | 23 | 17 | 17 |
| Mill Street, Dunfermline | Roadside | Diffusion Tube | 100 | 100 | 30 | 30 | 30 | 22 | 25 |
| Rumblingwell, Dunfermline | Roadside | Diffusion Tube | 100 | 100 | 22 | 21 | 21 | 15 | 16 |
| 102 Baldridgeburn, Dunfermline | Kerbside | Diffusion Tube | 100 | 100 | - | - | 33 | 16 | 17 |

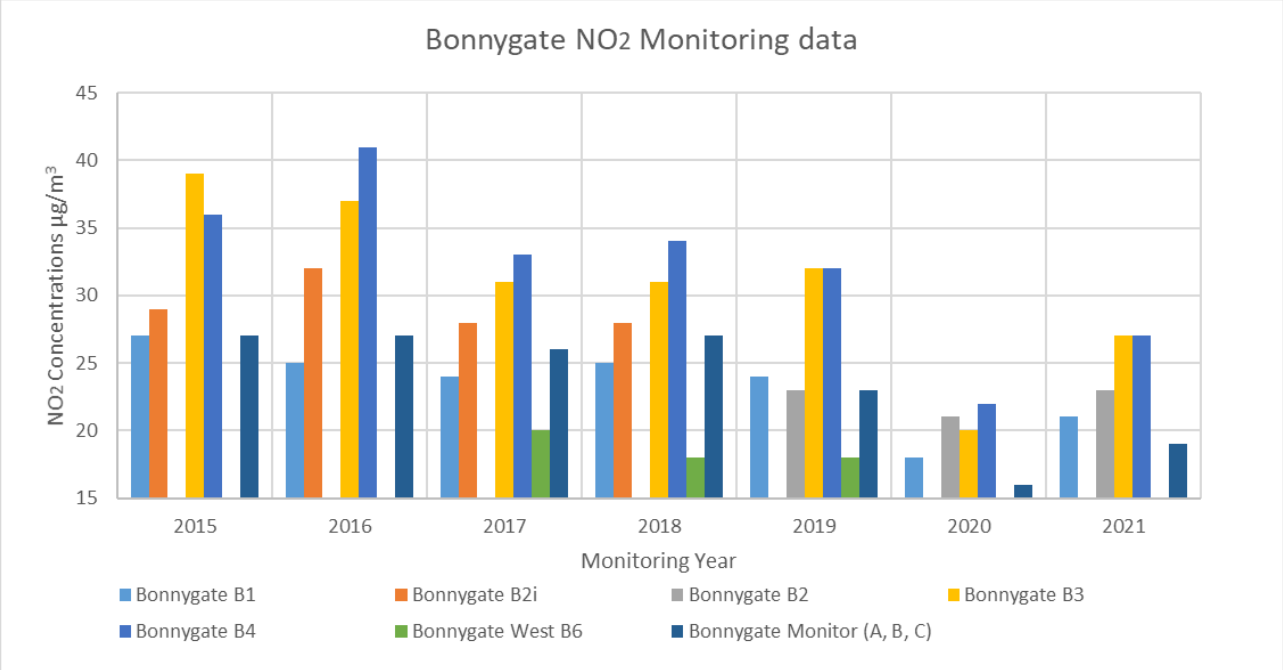
**Notes:**

Means for diffusion tubes have been corrected for bias. 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.

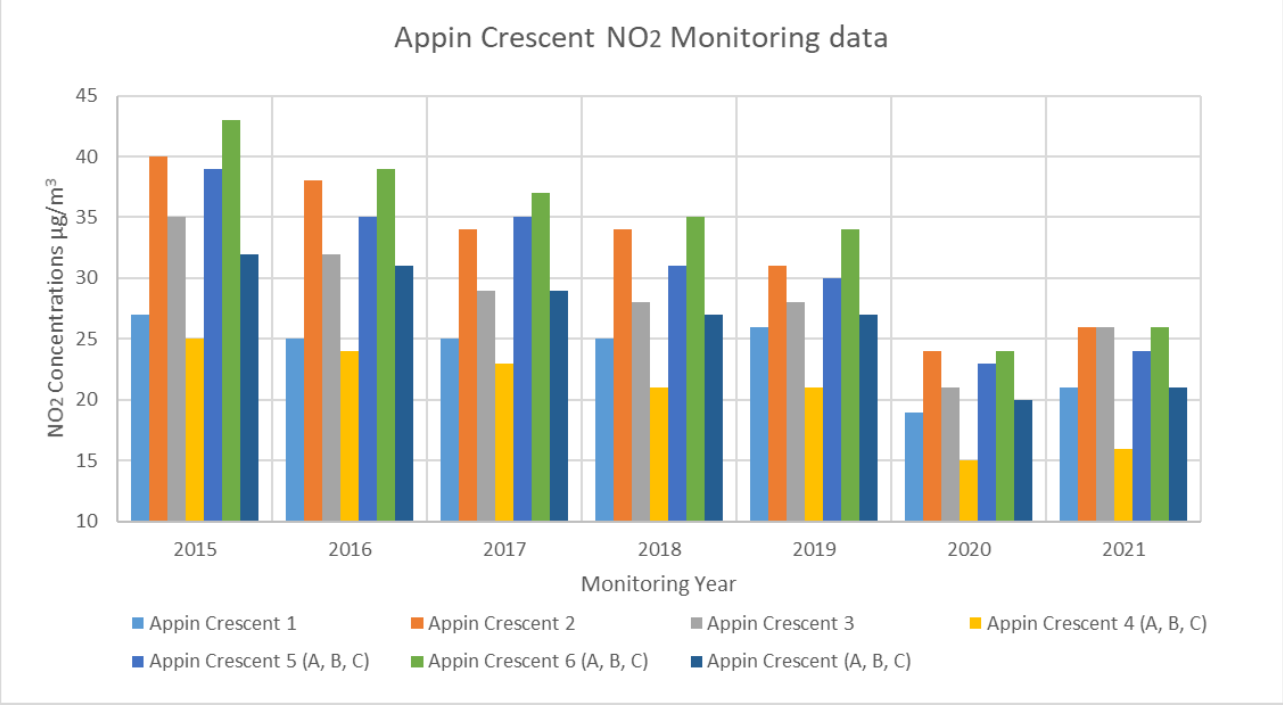
(2) Data capture for the full calendar year (e.g. if monitoring was carried out for 6 months, the maximum data capture for the full calendar year is 50%).

Figure A-1 Bonnygate Diffusion Tube Annual Mean Concentrations 2015-2021 (µg $m^{-3}$)



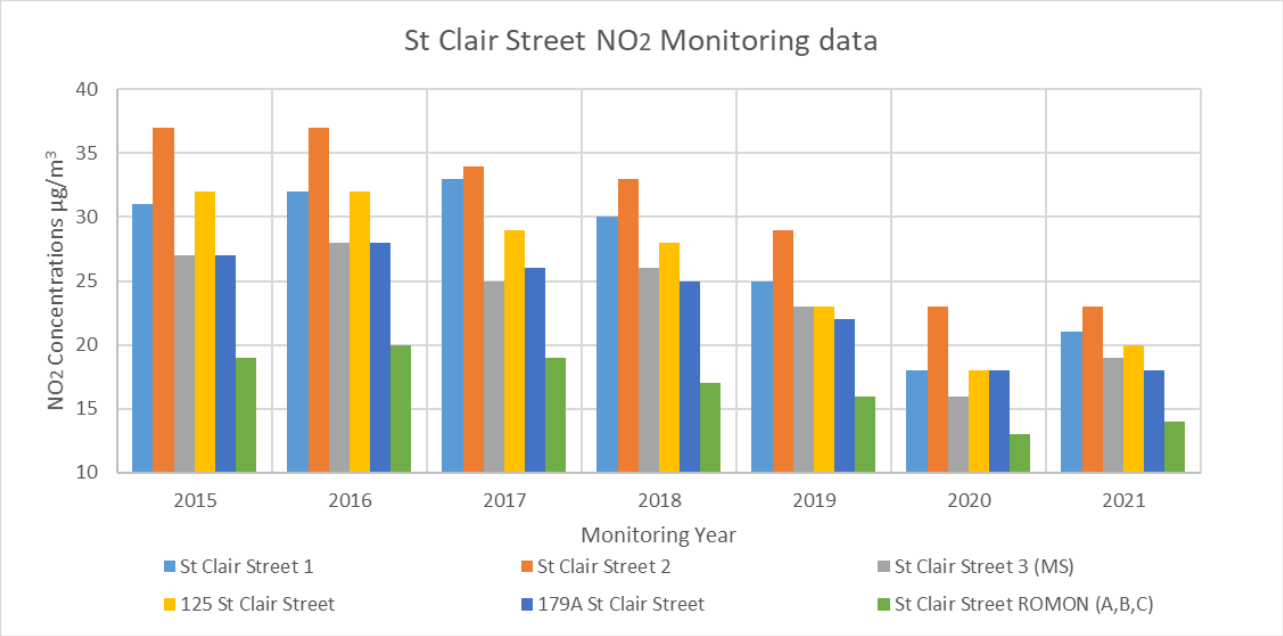

$NO_2$ annual mean concentrations for the Bonnygate area are presented in Figure A-1. Concentrations increased at all sites between 2015 and 2016 before decreasing slightly from 2016 to 2020. Concentrations increased in 2021, likely due to COVID-19 lockdown and restrictions easing, however they still remain below 2019.

Figure A-2 Appin Crescent Diffusion Tube Annual Mean Concentrations 2015-2021 (µg $m^{-3}$)



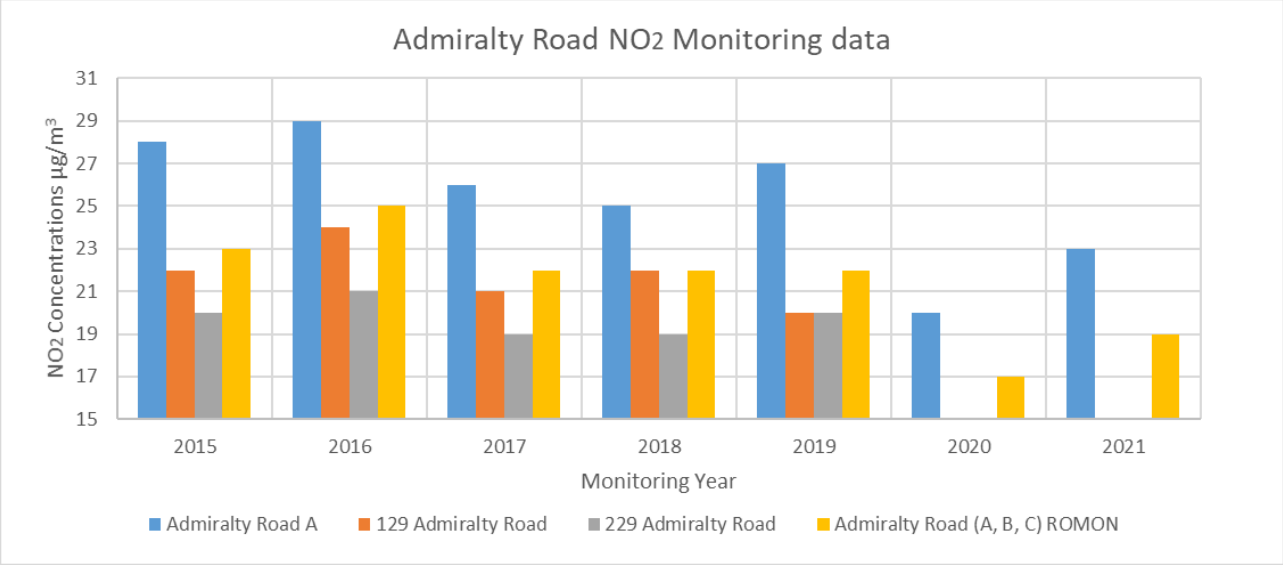

$NO_2$ annual mean concentrations for the Appin Crescent area are presented in Figure A-2. Since 2015 concentrations have declined steadily at all sites. Concentrations increased in 2021 compared to 2020, likely due to COVID-19 lockdown and restrictions easing, however they still remain below 2019.

Figure A-3 St Clair Street Diffusion Tube Annual Mean Concentrations 2015-2021 (µg $m^{-3}$)



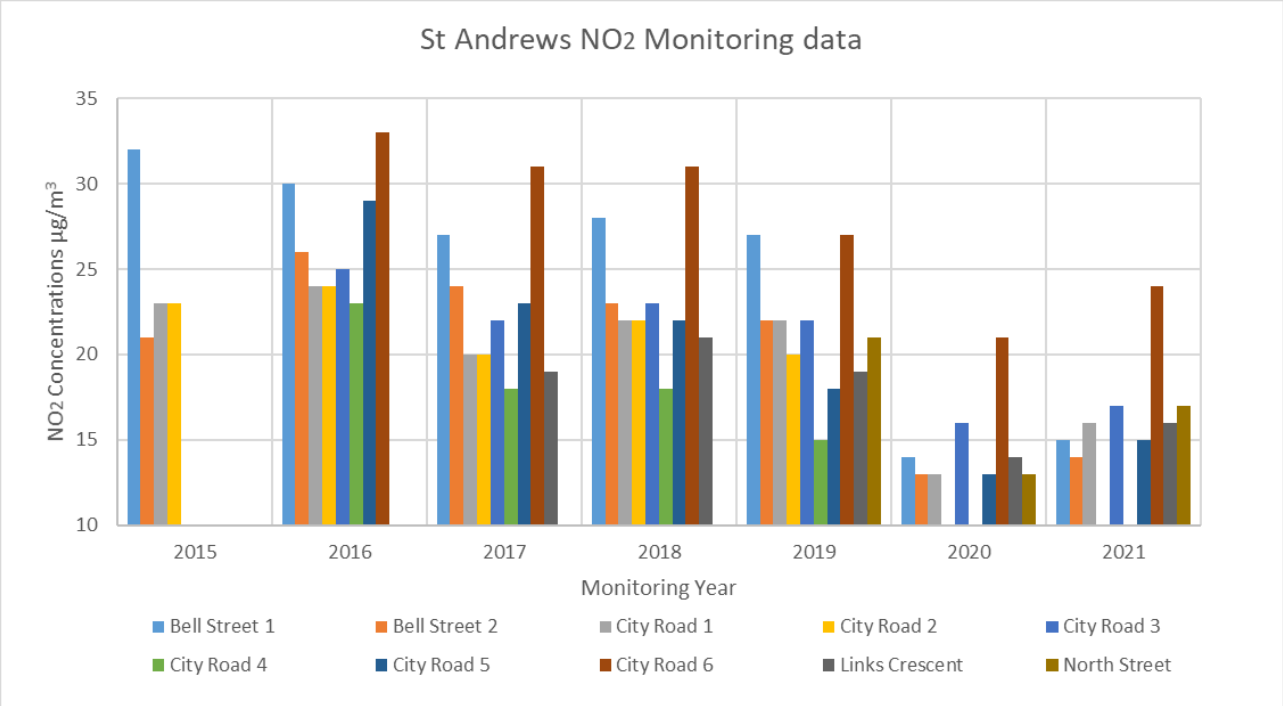

$NO_2$ annual mean concentrations for the St Clair Street area are presented in Figure A-3. Concentrations stayed fairly consistent between 2015 and 2016, then started to decline steadily from 2016 to 2020. Following the easing of COVID-19 lockdown and restrictions concentrations increased slightly in 2021.

Figure A-4 Admiralty Road Diffusion Tube Annual Mean Concentrations 2015-2021 (µg $m^{-3}$)



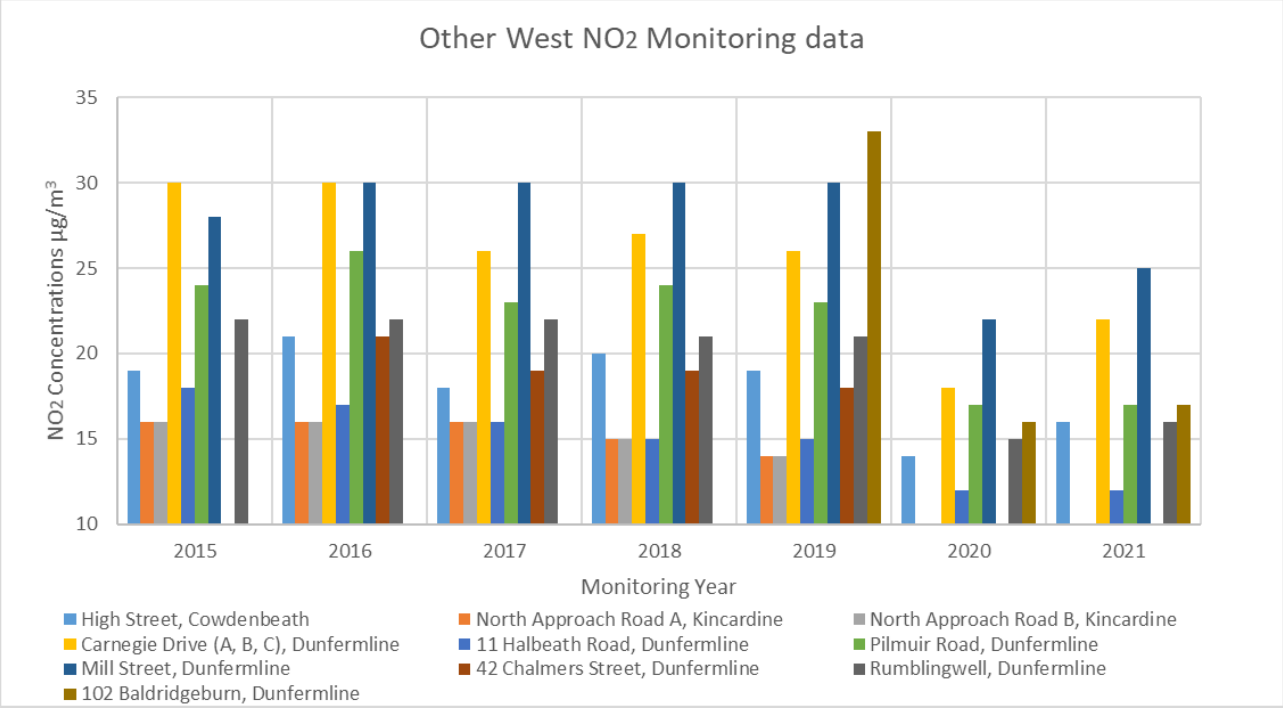

$NO_2$ annual mean concentrations for the Admiralty Road area are presented in Figure A-4. Concentrations increased slightly in 2016, then gradually declined between 2016 and 2020, with the exception of Admiralty Road A increasing slightly in 2019. Concentrations then increased in 2021 following the easing of COVID-19 lockdown and restrictions. 129 Admiralty Road and 229 Admiralty Road were removed after 2019.

Figure A-5 St Andrews Diffusion Tube Annual Mean Concentrations 2015-2021 (µg $m^{-3}$)



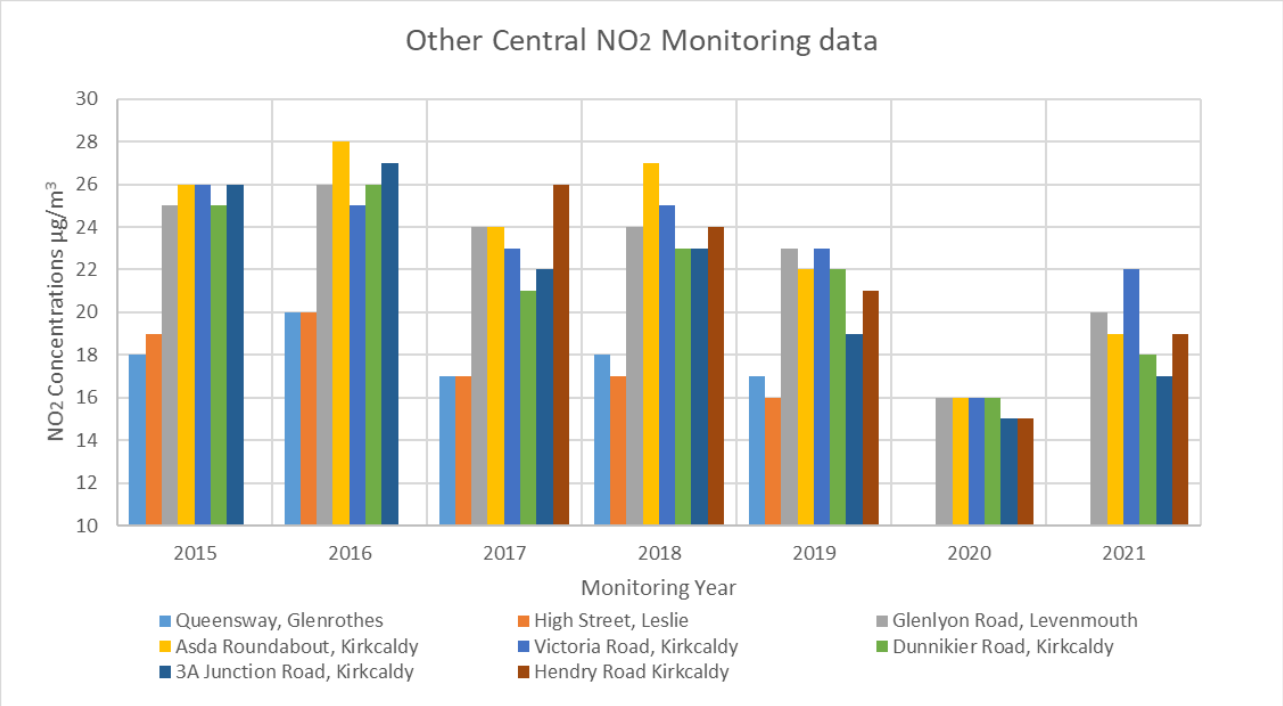

$NO_2$ annual mean concentrations for the St Andrews area are presented in Figure A-5. Between 2015 and 2020 concentrations declined. An additional four monitoring sites were introduced in 2016. Concentrations decreased at all sites with the exception of Bell Street 1 which increased slightly in 2018 before declining again in 2019. Concentrations increased in 2021 compared to 2020 following the easing of COVID-19 lockdown and restrictions, although they still remain below 2019 levels.

Figure A-6 Other West Diffusion Tube Annual Mean Concentrations 2015-2021 (µg $m^{-3}$)




$NO_2$ annual mean concentrations for the other west areas in Fife are presented in Figure A-6. Concentrations increased slightly in 2016 before steadily declining until 2020. 102 Baldridgeburn was added in 2019. All sites increased slightly in 2021 following COVID-19 lockdown and restrictions easing.

Figure A-7 Other Central Diffusion Tube Annual Mean Concentrations 2015-2021 (µg $m^{-3}$)




$NO_2$ annual mean concentrations for the other central areas in Fife are presented in Figure A-7. Concentrations have jumped around across the central Fife area increasing in 2016 before declining again in 2017. There were slight increases again in 2018 before a more significant decline in 2019 and 2020 at all monitoring sites. Concentrations increased in 2021 compared to 2020 following the easing of COVID-19 lockdown and restrictions, although they still remain below 2019 levels.

Table A.4 – 1-Hour Mean $NO_2$ Monitoring Results, Number of 1-Hour Means > 200 µg $m^{-3}$

| Site ID | Site Type | Monitoring Type | Valid Data Capture for Monitoring Period (%) (1) | Valid Data Capture 2021 (%) (2) | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|---|---|---|---|
| Cupar | Kerbside | Automatic | 100 | 92 | 0 | 0 | 0 | 0 | 0 |
| Dunfermline | Roadside | Automatic | 100 | 95 | 0 | 0 | 0 | 0 | 0 |
| Kirkcaldy | Roadside | Automatic | 100 | 100 | 0 | 0 | 0 | 0 | 0 |
| Rosyth | Roadside | Automatic | 100 | 98 | 0 | 0 | 0 | 0 | 0 |

**Notes:**

Exceedances of the $NO_2$ 1-hour mean objective (200 µg $m^{-3}$ not to be exceeded more than 18 times/year) are shown in bold.

If the period of valid data is less than 85%, the 99.8$^{th}$ 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 $PM_{10}$ Monitoring Results (µg $m^{-3}$)

| Site ID | Site Type | Valid Data Capture for Monitoring Period (%) (1) | Valid Data Capture 2021 (%) (2) | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|---|---|---|
| Cupar | Kerbside | 100 | 96 | 13.5 | 13.7 | 14.6 | 11.3 | 13.0 |
| Dunfermline | Roadside | 100 | 97 | 9.8 | 10.9 | 11.2 | 8.5 | 9.6 |
| Kirkcaldy | Roadside | 100 | 100 | 9.2 | 10.3 | 11.6 | 9.0 | 9.4 |
| Rosyth | Roadside | 100 | 54 | 10.6 | 10.5 | 10.0 | 9.1 | 9.9* |

**Notes:**

Exceedances of the $PM_{10}$ annual mean objective of 18 µg $m^{-3}$ 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 $PM_{10}$ Monitoring Results, Number of $PM_{10}$ 24-Hour Means > 50 µg $m^{-3}$

| Site ID | Site Type | Valid Data Capture for Monitoring Period (%) (1) | Valid Data Capture 2021 (%) (2) | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|---|---|---|
| Cupar | Kerbside | 100 | 96 | 1 | 1 | 0 | 0 | 0 |
| Dunfermline | Roadside | 100 | 97 | 0 | 0 | 0 | 0 | 0 |
| Kirkcaldy | Roadside | 100 | 100 | 0 | 0 | 0 | 0 | 0 |
| Rosyth | Roadside | 100 | 54 | 1 | 0 | 0 | 0 | 0 |

**Notes:**

Exceedances of the $PM_{10}$ 24-hour mean objective (50 µg $m^{-3}$ 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 $m^{-3}$)

| Site ID | Site Type | Valid Data Capture for Monitoring Period (%) (1) | Valid Data Capture 2021 (%) (2) | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|---|---|---|
| Cupar | Kerbside | 100 | 96 | 6.4 | 6.7 | 7.5 | 5.6 | 6.3 |
| Dunfermline | Roadside | 100 | 97 | 5.7 | 6.1 | 6.4 | 4.8 | 5.5 |
| Kirkcaldy | Roadside | 100 | 100 | 5.3 | 5.9 | 6.7 | 5.0 | 5.3 |
| Rosyth | Roadside | 100 | 55 | 6.2 | 6.0 | 5.9 | 5.1 | 5.5* |

**Notes:**

Exceedances of the $PM_{2.5}$ annual mean objective of 10 µg $m^{-3}$ 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 – $NO_2$ 2021 Monthly Diffusion Tube Results (µg $m^{-3}$)

| Site ID | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual Mean: Raw Data | Annual Mean: Bias Adjusted (1) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Central | | | | | | | | | | | | | | |
| Glenlyon, Leven | 35.2 | 20 | 23.6 | 26.7 | 25.6 | 19.3 | 20.7 | 24 | 26.7 | 26.8 | 38.4 | 32.1 | 26.6 | 20 |
| ASDA Roundabout, Kirkcaldy | 33.2 | 28.9 | 22.3 | 27.6 | 25.8 | 22.6 | 23.3 | 27.9 | 31.7 | 31.7 | 31.6 | 30.9 | 28.1 | 19 |
| Victoria Road, Kirkcaldy | 36.3 | 26.7 | 26.7 | 32.3 | 31.3 | 24.6 | 29.2 | 32.2 | 34.8 | 32.7 | 57.6 | 33.2 | 33.1 | 22 |
| Dunnikier Road, Kirkcaldy | 32.4 | 23.2 | 23.1 | 27.9 | 26 | 21.2 | 25.5 | 26 | 27.9 | 30.2 | 26.5 | 31.1 | 26.8 | 18 |
| St Clair Street 1, Kirkcaldy | 35.4 | 25.9 | 26.3 | 35.6 | 34.9 | 27.6 | 30.4 | 28.5 | 34.2 | 33.7 | 29.4 | 33.8 | 31.3 | 21 |
| St Clair Street 2, Kirkcaldy | 41.1 | 29 | 38.5 | 32 | 31.3 | 30.5 | 21.2 | 28.9 | 33.3 | 43.7 | 44.5 | 40.1 | 34.5 | 23 |
| St Clair Street 3 (MS), Kirkcaldy | 32.5 | 27.1 | 25.4 | 29.8 | 32.6 | No return | No return | 23.4 | 28.1 | 31.7 | 26.9 | 27.6 | 28.5 | 19 |
| 125 St Clair Street, Kirkcaldy | 39.9 | 26 | 32.7 | 26.3 | 21.8 | 22.7 | 20 | 25.8 | 30.7 | 36.8 | 45.1 | 40.1 | 30.7 | 20 |
| 179A St Clair Street, Kirkcaldy | 40 | 22.7 | 30.1 | 26.2 | 18.4 | 20.6 | 17.7 | 21.8 | 28.3 | 32.3 | 34.8 | 35.8 | 27.4 | 18 |
| St Clair Street Romon A, Kirkcaldy | 31.1 | 18.3 | 23.3 | 19.8 | 14.7 | 13.2 | 12.8 | 15.3 | 20.6 | 24.3 | 28.9 | 25.9 | 20.9 | 14 |
| St Clair Street Romon B, Kirkcaldy | 30 | 19.3 | 22 | 17.3 | 14.8 | 15.4 | 13.8 | 17.9 | 21.4 | 27.3 | 27.7 | 27.6 | | |
| St Clair Street Romon C, Kirkcaldy | 32.4 | 19.2 | 23.1 | 16.6 | 14.7 | 13.4 | 12.8 | 16.6 | 20.1 | 23.8 | 27.2 | 30 | | |

| Site ID | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual Mean: Raw Data | Annual Mean: Bias Adjusted (1) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3A Junction Road, Kirkcaldy | 31.3 | 23.2 | 22.2 | 27 | 24.5 | 18.6 | 22.3 | 25.2 | 26.8 | 25.7 | 28.7 | 29 | 25.4 | 17 |
| Henry Road, Kirkcaldy | 30 | 25.4 | 31 | 23.8 | 25.4 | 22.8 | 18.7 | 26 | 27 | 33.4 | 39.4 | 35 | 28.2 | 19 |
| East | | | | | | | | | | | | | | |
| Bell Street 1, St Andrews | 21.9 | 16 | 15.5 | 17 | 18 | 12.6 | 14.3 | 14.8 | 26.4 | 25.8 | 28.1 | 27 | 19.8 | 15 |
| Bell Street 2, St Andrews | 20.9 | 14.8 | 17.3 | 17.5 | 17.5 | 14.4 | 13.3 | 13.4 | 20.8 | 23.3 | 24.8 | 22.6 | 18.4 | 14 |
| City Road 1, St Andrews | 24.1 | 19 | 15.9 | No return | No return | 16.3 | 21.6 | 25.7 | 23.5 | 22.7 | 20.9 | 22.6 | 21.2 | 16 |
| City Road 3, St Andrews | 27.6 | 21.1 | 24.2 | 23.3 | 19 | 17.2 | 15.9 | 18.8 | 23.1 | 26.5 | 27.8 | 27.4 | 22.7 | 17 |
| City Road 5, St Andrews | 21.4 | 20 | 19.8 | 18.4 | 20.8 | 17.6 | 14.8 | 15.7 | 21.5 | 24.1 | 27.6 | 21.5 | 20.3 | 15 |
| City Road 6, St Andrews | 19.6 | 24.2 | 30.8 | 27.9 | 37 | 29.7 | 31.7 | 34 | 36.2 | 34.5 | 50.1 | 29.6 | 32.1 | 24 |
| Links Crescent, St Andrews | 22 | 18 | 24.9 | 21.1 | 21.9 | 16.2 | 18.1 | 19.7 | 24 | 22.6 | 22.5 | 21.1 | 21 | 16 |
| North Street, St Andrews | 22.7 | 16.2 | 17.5 | 21.6 | 22 | 21.3 | 16.7 | 19.5 | 24.4 | 25.4 | 34.1 | 34.3 | 23 | 17 |
| Bonnygate B1, Cupar | 38.5 | 28.5 | 23.2 | 23.6 | 28.4 | 18.5 | 22.9 | 25.6 | 27.7 | 26.5 | 27.5 | 30.4 | 26.8 | 21 |
| Bonnygate B2, Cupar | 41.2 | 23.8 | 28.9 | 29.3 | 29.9 | 18.6 | 18.4 | 20.3 | 31.5 | 30.1 | 35.9 | 36.3 | 28.7 | 23 |
| Bonnygate B3, Cupar | 40.4 | 32.2 | 29.6 | 39.6 | 39.5 | 26 | 28.6 | 29.5 | 34.5 | 33.6 | 36.1 | 36.8 | 33.9 | 27 |
| Bonnygate B4, Cupar | 42 | 30.5 | 34.7 | 35.4 | 34.8 | 28.8 | 30.3 | 31 | 36.8 | 38.4 | 39.6 | 34.9 | 34.8 | 27 |

| Site ID | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual Mean: Raw Data | Annual Mean: Bias Adjusted (1) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bonnygate West B6, Cupar | 27.8 | 20.1 | 17.8 | 15.5 | 11.9 | 13.4 | 11.3 | 12.5 | 18.8 | 21.8 | 24.2 | 22 | 18.1 | 14 |
| Bonnygate Monitor A, Cupar | 34.1 | 25.8 | 22.9 | 23.7 | 25.5 | 16.2 | 20.8 | 22.8 | 24.9 | 23 | 26.1 | 30.4 | 24.6 | 19 |
| Bonnygate Monitor B, Cupar | 33 | 26.1 | 21 | 23.2 | 24.9 | 15.5 | 20.3 | 14.9 | 26.3 | 26.5 | 30.1 | 27.9 | | |
| Bonnygate Monitor C, Cupar | 35.9 | 23.5 | 22.3 | 23.7 | 22.9 | 16.8 | 20 | 23.2 | 26.3 | 26 | 27.6 | 29.7 | | |
| West | | | | | | | | | | | | | | |
| High Street, Cowdenbeath | 28.5 | 21.2 | 16.8 | 21.8 | 22.1 | 14.6 | 17.3 | 19 | 22.3 | 21.5 | 24.1 | 24 | 21.1 | 16 |
| Admiralty Road A, Rosyth | 39.2 | 26.6 | 28.7 | 27.9 | 24.9 | 16.6 | 20.3 | 25.2 | 26.2 | 28.4 | 34 | 35.6 | 27.8 | 23 |
| Admiralty Road ROMAN A, Rosyth | 32.9 | 21.5 | 21.7 | 23 | 22 | 15.6 | 18.3 | 19.1 | 22.4 | 21.5 | 27.1 | 27.9 | 23.1 | 19 |
| Admiralty Road ROMAN B, Rosyth | 33.7 | 20.9 | 22.6 | 24.6 | 20.5 | 15.9 | 16.5 | 19 | 22 | 25.4 | 32.3 | 28 | | |
| Admiralty Road ROMAN C, Rosyth | 33.6 | 20.2 | 23.4 | 23.6 | 21.1 | 16.6 | 17.6 | 20.5 | 22.2 | 26.4 | 25.2 | 28.1 | | |
| Appin Crescent 1, Dunfermline | 40.9 | 27.4 | 30 | 26.5 | 22.9 | 17.9 | 18.3 | 20.3 | 28.6 | 33.5 | 40.8 | 35 | 28.5 | 21 |
| Appin Crescent 2, Dunfermline | 40.9 | 32.6 | 32.1 | 26 | 29.9 | 24.4 | 27.5 | 24.8 | 38.9 | 39.3 | 59.5 | 39.5 | 34.6 | 26 |
| Appin Crescent 3, Dunfermline | 44.5 | 31.7 | 35.2 | 31 | 30.8 | 24.4 | 25.4 | 27.1 | 42.3 | 37.6 | 45.5 | 43 | 34.9 | 26 |
| Appin Crescent 4A, Dunfermline | 31.6 | 23.5 | 23.3 | 19.2 | 17.7 | 13.5 | 14.2 | 16.2 | 21.9 | 25.8 | 31.5 | 28.9 | 22.2 | 16 |

| Site ID | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual Mean: Raw Data | Annual Mean: Bias Adjusted (1) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Appin Crescent 4B, Dunfermline | 34.8 | 21 | 23 | 20.3 | 17.7 | 13.7 | 14 | 15.9 | 21.3 | 25.3 | 30 | 28.7 | | |
| Appin Crescent 4C, Dunfermline | 37 | 22.4 | 20.8 | 19.7 | 17.9 | 12.8 | 15.4 | 16.6 | 21 | 31 | 30.9 | 21.4 | | |
| Appin Crescent 5A, Dunfermline | 42.9 | 30.1 | 36.6 | 29.6 | 25.3 | 22.9 | 23.2 | 25.9 | 34 | 42.4 | 44.2 | 40.6 | 32.6 | 24 |
| Appin Crescent 5B, Dunfermline | 42.2 | 30.1 | 34.9 | 30.7 | 28 | 23.8 | 23.8 | 25.1 | 33.9 | 35.8 | 42.1 | 41.3 | | |
| Appin Crescent 5C, Dunfermline | 43.8 | 29.9 | 36.8 | 29.3 | 25.9 | 20.8 | 25 | 24.7 | 33.4 | 32 | 42.1 | 41 | | |
| Appin Crescent 6A Dunfermline | 43.4 | 31.4 | 34.1 | 30 | 29.2 | 25.1 | 26.9 | 29.9 | 38.6 | 38.1 | 43.4 | 37.5 | 35.2 | 26 |
| Appin Crescent 6B Dunfermline | 41.5 | 34.9 | 35.1 | 31.3 | 31 | 27.8 | 26.7 | 31.4 | 40.9 | 44.7 | 44.5 | 38.4 | | |
| Appin Crescent 6C Dunfermline | 46.7 | 36.6 | 38.1 | 30.2 | 30.2 | 25 | 26.7 | 30.4 | 41.1 | 41.6 | 43.1 | 42.6 | | |
| Appin Crescent A Dunfermline | 25.7 | 26.4 | 26.8 | 24.5 | 23.7 | 16.8 | 17.7 | 17.8 | 26 | 35.1 | 38.3 | 36.3 | 27.9 | 21 |
| Appin Crescent B Dunfermline | 38.8 | 28.5 | 29.5 | 28.5 | 24.9 | 18.2 | 21.3 | 20.8 | 30.6 | 35.3 | 37.5 | 38.1 | | |
| Appin Crescent C Dunfermline | 40.7 | No return | 26.9 | 26.8 | 24.3 | 17.5 | 20.5 | 20.7 | 29 | 24.1 | 42 | 38 | | |
| Carnegie Drive A Dunfermline | 34.4 | 29.4 | 23 | 28.8 | 30 | 21.1 | 27.9 | 26.7 | 31.4 | 29.9 | 27.6 | 29.6 | 29.1 | 22 |
| Carnegie Drive B Dunfermline | 30.2 | 31.9 | 25 | 29.7 | 30 | 22.3 | 28.4 | 29.1 | 33.9 | 30.8 | 33.9 | 29.8 | | |
| Carnegie Drive C Dunfermline | 32 | 30 | 26.7 | 27.5 | 29.7 | 22.2 | 23.4 | 30.1 | 34.6 | 32.6 | 34.9 | 27.5 | | |

| Site ID | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual Mean: Raw Data | Annual Mean: Bias Adjusted (1) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11 Halbeath Road, Dunfermline | 25.6 | 15.6 | 16 | 14.9 | 13 | 10.8 | 11.1 | 10.9 | 14.6 | 17.2 | 21.2 | 23 | 16.2 | 12 |
| Pilmuir Street, Dunfermline | 24.9 | 21.4 | 24.3 | 20.6 | 22.1 | 15.9 | 18.5 | 17 | 26 | 25.1 | 27.5 | 27 | 22.5 | 17 |
| Mill Street, Dunfermline | 49.9 | 29 | 30.6 | 33.2 | 30.4 | 22.8 | 28.6 | 24.8 | 35.8 | 37 | 38.6 | 41.9 | 33.6 | 25 |
| Rumblingwell, Dunfermline | 31.5 | 19.3 | 21.1 | 20.5 | 19.2 | 16 | 18.2 | 14.3 | 23.8 | 25.9 | 27.4 | 17.6 | 21.2 | 16 |
| 102 Baldridgeburn, Dunfermline | 31 | 20 | 21.1 | 23.5 | 19.4 | 14.4 | 16.7 | 13.1 | 22.7 | 22.7 | 34.4 | 30.1 | 22.4 | 17 |

**Notes:**

(1) See Appendix C for details on bias adjustment

# Appendix C Air Quality Monitoring Data QA/QC

## QA/QC of Automatic Monitoring

The QA/QC procedures follow the requirements of the Technical Guidance (TG.16) and are equivalent to those used at UK levels for the National Network (AURN) monitoring sites. This gives a high degree of confidence in the data obtained, both for measured concentrations at the automatic sites and for establishing robust bias correction factors for diffusion tubes.

In order to satisfy the requirement in the Technical Guidance (TG.16), the following QA/QC procedures were implemented:

- 3-weekly calibrations of the NOx analyser;
- 6-monthly audits and servicing of the monitoring site;
- Data ratification.

Calibrations of the NOx analyser were carried out using certified compressed gas standards (ISO17025). This ensured that the calibration gas was traceable to national and international standards. FIDAS diagnostics were recorded and cal dust performed.

Audits of the monitoring sites consisted of a number of performance checks to identify any faults with the equipment. The calibration cylinder was also checked against another gas standard in order to confirm the gas concentration. Any identified faults during the audit were forwarded on to the service unit for repair.

The final stage of the QA/QC process was to ratify the data. During ratification, all calibration, audit and service data are collected, and the data are scaled appropriately. Any suspect data identified are deleted therefore ensuring that the data are of a high quality.

## Diffusion Tube QA/QC Process

Diffusion tubes used by Fife Council are now supplied and analysed by SOCOTEC. The tube preparation method is 20% TEA in water. SOCOTEC is a participant in the centralised QA/QC services provided by Defra and the devolved administrations. These services compromise of:

- Promotion of the independent AIR-PT scheme, operated by LGC Standards and supported by the health and Safety Laboratory, with yearly assessment against agreed performance criteria. AIR-PT combines two long running PT schemes: LGC Standards STACKS PT scheme and HSL Workplace Analysis Scheme for Proficiency (WASP) PT scheme.
- Provision of quality control standard solutions, free of charge to laboratories that prepare and analyse $NO_2$ diffusion tubes used by Local Authorities for LAQM purposes.

## Bias Correction for Diffusion Tubes

Diffusion tube samplers are a simple and cost effective method of measuring $NO_2$. However, they are classed as an indicative method and are known to have a systematic bias compared to more accurate results obtained from calibrated automatic analysers. The local bias factor is calculated using sites where a triplicate set of diffusion tubes are co-located with a chemiluminescence analyser. The national bias adjustment factor is derived using the national database co-location studies.

Fife Council has four co-location sites that have been used to calculate the local bias adjustment factor. The local bias adjustment factor for each individual location was calculated using the “LAQM Tool” described in LAQM TG(16). The results are shown in Table C.1 below. The average of the local bias adjustment factors is 0.75.

The local bias adjustment was applied to all diffusion tubes within each area. The average of the local was also used for all other sites for consistency. Figures C1-C4 show the locally derived adjustment factors.

## Table C.1 Local Bias Adjustment Summary

| Source | Bias Adjustment Factors 2021 |
|---|---|
| Cupar | 0.79 |
| Dunfermline | 0.74 |
| Kirkcaldy | 0.66 |
| Rosyth | 0.83 |
| Average Local Bias factor | **0.75** |

## Figure C-1 Local bias adjustment spreadsheet - Cupar

**Checking Precision and Accuracy of Triplicate Tubes**

AEA Energy & Environment
From the AEA group

**Diffusion Tubes Measurements**

| Period | Start Date | End Date | Tube 1 | Tube 2 | Tube 3 | Triplicate Mean | Standard Deviati | Coefficient of Variation | 95% CI of mean | Period Mean | Data Capture (% DC) | Tubes Precision Check | Automatic Monitor |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | dd/mm/yyy | dd/mm/yy | µgm⁻³ | µgm⁻³ | µgm⁻³ | | | | | | | | |
| 1 | 08/01/2021 | 02/02/2021 | 34.1 | 33.0 | 35.9 | 34 | 1.5 | 4 | 3.6 | 33.83 | 97 | Good | Good |
| 2 | 02/02/2021 | 01/03/2021 | 25.8 | 26.1 | 23.5 | 25 | 1.4 | 6 | 3.5 | 20.07 | 95 | Good | Good |
| 3 | 01/03/2021 | 30/03/2021 | 22.9 | 21.0 | 22.3 | 22 | 1.0 | 4 | 2.4 | 16.98 | 95 | Good | Good |
| 4 | 30/03/2021 | 05/05/2021 | 23.7 | 23.2 | 23.7 | 24 | 0.3 | 1 | 0.7 | 19.47 | 97 | Good | Good |
| 5 | 05/05/2021 | 02/06/2021 | 25.5 | 24.9 | 22.9 | 24 | 1.4 | 6 | 3.4 | 20 | 98 | Good | Good |
| 6 | 02/06/2021 | 29/06/2021 | 16.2 | 15.5 | 16.8 | 16 | 0.7 | 4 | 1.6 | 13 | 97 | Good | Good |
| 7 | 29/06/2021 | 04/08/2021 | 20.8 | 20.3 | 20.0 | 20 | 0.4 | 2 | 1.0 | 16 | 93 | Good | Good |
| 8 | 04/08/2021 | 31/08/2021 | 22.8 | 14.9 | 23.2 | 20 | 4.7 | 23 | 11.6 | 18 | 98 | Poor Precisio | Good |
| 9 | 31/08/2021 | 28/09/2021 | 24.9 | 26.3 | 26.3 | 26 | 0.8 | 3 | 2.0 | 23 | 60 | Good | r Data Capture |
| 10 | 28/09/2021 | 03/11/2021 | 23.0 | 26.5 | 26.0 | 25 | 1.9 | 8 | 4.7 | 13 | 77 | Good | Good |
| 11 | 03/11/2021 | 29/11/2021 | 26.1 | 30.1 | 27.6 | 28 | 2.0 | 7 | 5.0 | 20.97 | 98 | Good | Good |
| 12 | 29/11/2021 | 05/01/2022 | 30.4 | 27.9 | 29.7 | 29 | 1.3 | 4 | 3.2 | 23.64 | 98 | Good | Good |
| 13 | | | | | | | | | | | | | |
| | | | | | | | | | | | | Good | Good |

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

Overall survey -->

Site Name/ ID: Cupar - Bonnygate

Precision: 11 out of 12 periods have a CV smaller than 20%

(Check average CV & DC from Accuracy calculations)

Accuracy with 95% confidence interval) without periods with CV larger than 20%
Bias calculated using 10 periods of data
Bias factor A 0.79 (0.7 - 0.91)
Bias B 27% (10% - 43%)
Diffusion Tubes Mean: 25 µgm⁻³
Mean CV (Precision): 5
Automatic Mean: 20 µgm⁻³
Data Capture for periods used: 95%
Adjusted Tubes Mean: 20 (17 - 23) µgm⁻³

Accuracy (with 95% confidence interval) WITH ALL DATA
Bias calculated using 11 periods of data
Bias factor A 0.8 (0.71 - 0.91)
Bias B 25% (10% - 41%)
Diffusion Tubes Mean: 24 µgm⁻³
Mean CV (Precision): 6
Automatic Mean: 19 µgm⁻³
Data Capture for periods used: 95%
Adjusted Tubes Mean: 20 (17 - 22) µgm⁻³

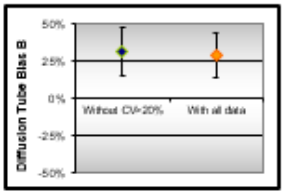



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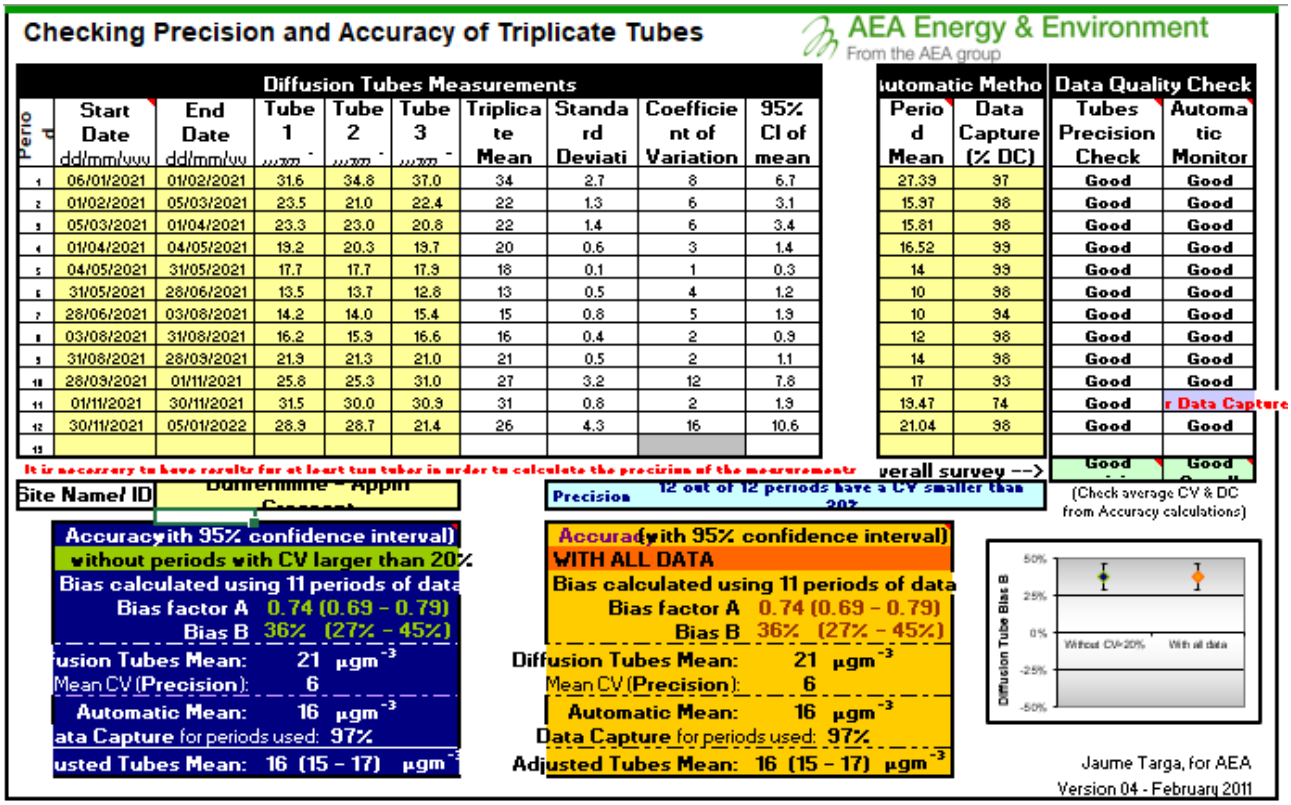
Figure C-2 Local bias adjustment spreadsheet - Dunfermline



Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

Diffusion Tubes Measurements

| Period | Start Date dd/mm/yyyy | End Date dd/mm/yyyy | Tube 1 µg/m³ | Tube 2 µg/m³ | Tube 3 µg/m³ | Triplicate Mean | Standard Deviation | Coefficient of Variation | 95% CI of mean |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 06/01/2021 | 01/02/2021 | 31.6 | 34.8 | 37.0 | 34 | 2.7 | 8 | 6.7 |
| 2 | 01/02/2021 | 05/03/2021 | 23.5 | 21.0 | 22.4 | 22 | 1.3 | 6 | 3.1 |
| 3 | 05/03/2021 | 01/04/2021 | 23.3 | 23.0 | 20.8 | 22 | 1.4 | 6 | 3.4 |
| 4 | 01/04/2021 | 04/05/2021 | 19.2 | 20.3 | 19.7 | 20 | 0.6 | 3 | 1.4 |
| 5 | 04/05/2021 | 31/05/2021 | 17.7 | 17.7 | 17.9 | 18 | 0.1 | 1 | 0.3 |
| 6 | 31/05/2021 | 28/06/2021 | 13.5 | 13.7 | 12.8 | 13 | 0.5 | 4 | 1.2 |
| 7 | 28/06/2021 | 03/08/2021 | 14.2 | 14.0 | 15.4 | 15 | 0.8 | 5 | 1.9 |
| 8 | 03/08/2021 | 31/08/2021 | 16.2 | 15.9 | 16.6 | 16 | 0.4 | 2 | 0.9 |
| 9 | 31/08/2021 | 28/09/2021 | 21.9 | 21.3 | 21.0 | 21 | 0.5 | 2 | 1.1 |
| 10 | 28/09/2021 | 01/11/2021 | 25.8 | 25.3 | 31.0 | 27 | 3.2 | 12 | 7.8 |
| 11 | 01/11/2021 | 30/11/2021 | 31.5 | 30.0 | 30.9 | 31 | 0.8 | 2 | 1.9 |
| 12 | 30/11/2021 | 05/01/2022 | 28.9 | 28.7 | 21.4 | 26 | 4.3 | 16 | 10.6 |
| 13 | | | | | | | | | |

Automatic Metho / Data Quality Check

| Period Mean | Data Capture (% DC) | Tubes Precision Check | Automatic Monitor |
|---|---|---|---|
| 27.39 | 97 | Good | Good |
| 15.97 | 98 | Good | Good |
| 15.81 | 98 | Good | Good |
| 16.52 | 99 | Good | Good |
| 14 | 99 | Good | Good |
| 10 | 98 | Good | Good |
| 10 | 94 | Good | Good |
| 12 | 98 | Good | Good |
| 14 | 98 | Good | Good |
| 17 | 93 | Good | Good |
| 19.47 | 74 | Good | r Data Capture |
| 21.04 | 98 | Good | Good |
| | | | |
| | | Good | Good |

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

verall survey -->

Site Name/ ID: Dunfermline - Appin Crescent

Precision: 12 out of 12 periods have a CV smaller than 20%

(Check average CV & DC from Accuracy calculations)

Accuracy with 95% confidence interval) without periods with CV larger than 20%
Bias calculated using 11 periods of data
Bias factor A 0.74 (0.69 - 0.79)
Bias B 36% (27% - 45%)
usion Tubes Mean: 21 µgm⁻³
Mean CV (Precision): 6
Automatic Mean: 16 µgm⁻³
ata Capture for periods used: 97%
usted Tubes Mean: 16 (15 - 17) µgm⁻³

Accuracy with 95% confidence interval) WITH ALL DATA
Bias calculated using 11 periods of data
Bias factor A 0.74 (0.69 - 0.79)
Bias B 36% (27% - 45%)
Diffusion Tubes Mean: 21 µgm⁻³
Mean CV (Precision): 6
Automatic Mean: 16 µgm⁻³
Data Capture for periods used: 97%
Adjusted Tubes Mean: 16 (15 - 17) µgm⁻³




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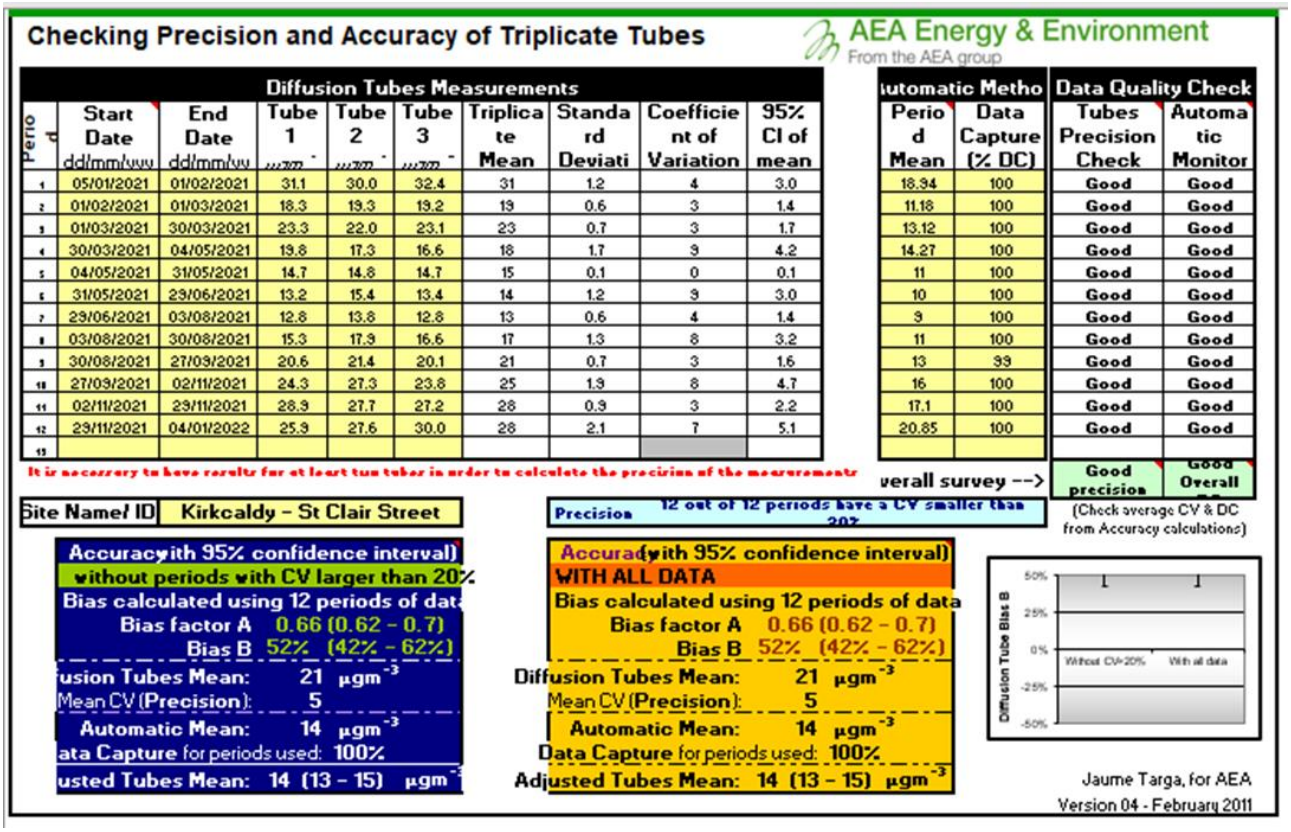
Figure C-3 Local bias adjustment spreadsheet - Kirkcaldy



Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

Diffusion Tubes Measurements

| Period | Start Date dd/mm/yyyy | End Date dd/mm/yyyy | Tube 1 µg/m³ | Tube 2 µg/m³ | Tube 3 µg/m³ | Triplicate Mean | Standard Deviation | Coefficient of Variation | 95% CI of mean |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 05/01/2021 | 01/02/2021 | 31.1 | 30.0 | 32.4 | 31 | 1.2 | 4 | 3.0 |
| 2 | 01/02/2021 | 01/03/2021 | 18.3 | 19.3 | 19.2 | 19 | 0.6 | 3 | 1.4 |
| 3 | 01/03/2021 | 30/03/2021 | 23.3 | 22.0 | 23.1 | 23 | 0.7 | 3 | 1.7 |
| 4 | 30/03/2021 | 04/05/2021 | 19.8 | 17.3 | 16.6 | 18 | 1.7 | 9 | 4.2 |
| 5 | 04/05/2021 | 31/05/2021 | 14.7 | 14.8 | 14.7 | 15 | 0.1 | 0 | 0.1 |
| 6 | 31/05/2021 | 23/06/2021 | 13.2 | 15.4 | 13.4 | 14 | 1.2 | 9 | 3.0 |
| 7 | 23/06/2021 | 03/08/2021 | 12.8 | 13.8 | 12.8 | 13 | 0.6 | 4 | 1.4 |
| 8 | 03/08/2021 | 30/08/2021 | 15.3 | 17.9 | 16.6 | 17 | 1.3 | 8 | 3.2 |
| 9 | 30/08/2021 | 27/09/2021 | 20.6 | 21.4 | 20.1 | 21 | 0.7 | 3 | 1.6 |
| 10 | 27/09/2021 | 02/11/2021 | 24.3 | 27.3 | 23.8 | 25 | 1.9 | 8 | 4.7 |
| 11 | 02/11/2021 | 23/11/2021 | 28.9 | 27.7 | 27.2 | 28 | 0.9 | 3 | 2.2 |
| 12 | 23/11/2021 | 04/01/2022 | 25.9 | 27.6 | 30.0 | 28 | 2.1 | 7 | 5.1 |
| 13 | | | | | | | | | |

Automatic Metho / Data Quality Check

| Period Mean | Data Capture (% DC) | Tubes Precision Check | Automatic Monitor |
|---|---|---|---|
| 18.94 | 100 | Good | Good |
| 11.18 | 100 | Good | Good |
| 13.12 | 100 | Good | Good |
| 14.27 | 100 | Good | Good |
| 11 | 100 | Good | Good |
| 10 | 100 | Good | Good |
| 9 | 100 | Good | Good |
| 11 | 100 | Good | Good |
| 13 | 99 | Good | Good |
| 16 | 100 | Good | Good |
| 17.1 | 100 | Good | Good |
| 20.85 | 100 | Good | Good |
| | | | |
| | | Good precision | Good Overall |

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

verall survey -->

Site Name/ ID: Kirkcaldy - St Clair Street

Precision: 12 out of 12 periods have a CV smaller than 20%

(Check average CV & DC from Accuracy calculations)

Accuracy with 95% confidence interval) without periods with CV larger than 20%
Bias calculated using 12 periods of data
Bias factor A 0.66 (0.62 - 0.7)
Bias B 52% (42% - 62%)
usion Tubes Mean: 21 µgm⁻³
Mean CV (Precision): 5
Automatic Mean: 14 µgm⁻³
ata Capture for periods used: 100%
usted Tubes Mean: 14 (13 - 15) µgm⁻³

Accuracy with 95% confidence interval) WITH ALL DATA
Bias calculated using 12 periods of data
Bias factor A 0.66 (0.62 - 0.7)
Bias B 52% (42% - 62%)
Diffusion Tubes Mean: 21 µgm⁻³
Mean CV (Precision): 5
Automatic Mean: 14 µgm⁻³
Data Capture for periods used: 100%
Adjusted Tubes Mean: 14 (13 - 15) µgm⁻³

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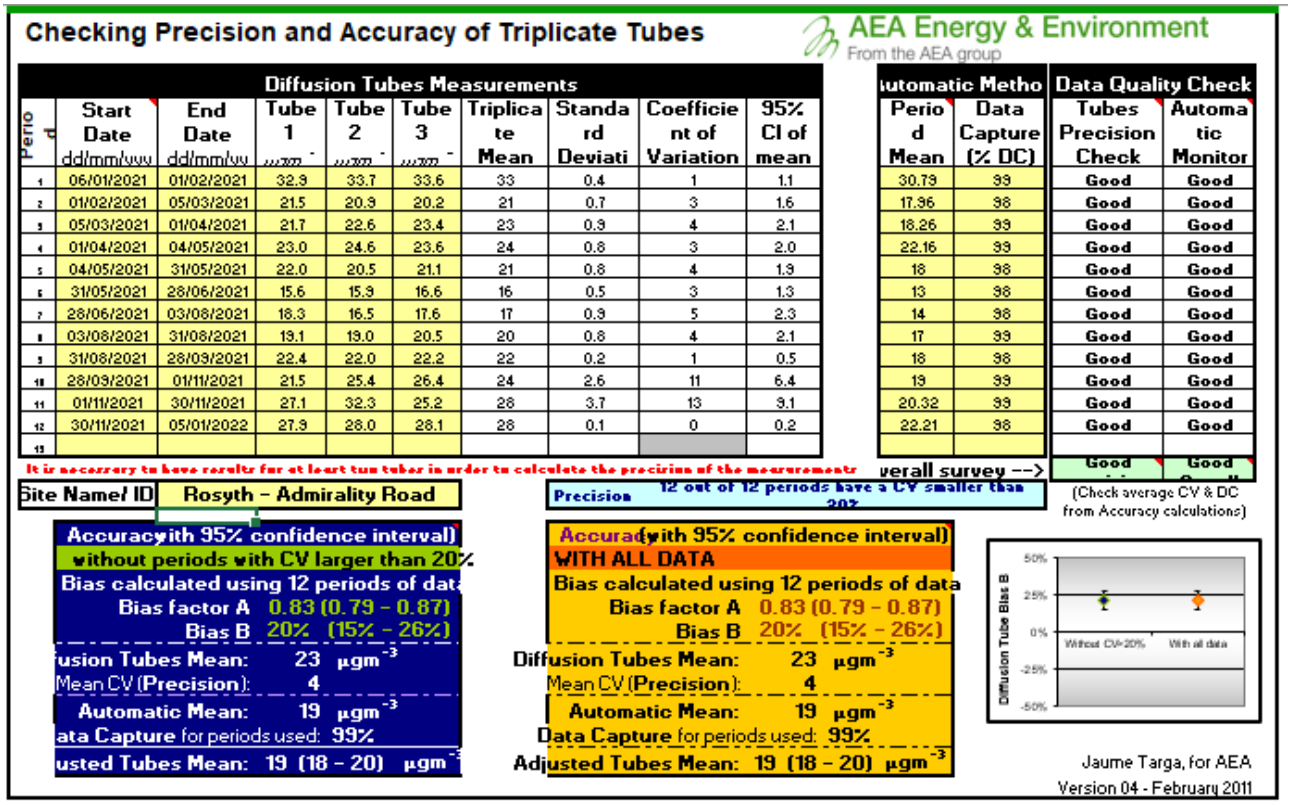
Version 04 - February 2011

Figure C-4 Local bias adjustment spreadsheet - Rosyth




# Automatic Monitoring Annualisation

Annualisation was required for the Rosyth site for $PM_{10}$ and $PM_{2.5}$ as the data capture was less than 75%. This was annualised following Box 7.9 of LAQM.TG(16). Details of the annualisation can be seen in Table C.2.

Table C.2 Annualisation Summary (concentrations presented in µg/m$^3$)

| Site | Annualisation Factor Edinburgh St Leonards | Annualisation Factor Falkirk Grangemouth MC | Annualisation Factor Perth Muirton | Average Annualisation Factor | Annual Mean | Annualised Annual Mean |
|---|---|---|---|---|---|---|
| Rosyth $PM_{10}$ | 0.97 | 0.98 | 1.01 | 0.99 | 10.0 | 9.9 |
| Rosyth $PM_{2.5}$ | 0.98 | 0.97 | 0.94 | 0.96 | 5.7 | 5.5 |

# Appendix D Technical Specification of Automatic Monitoring Equipment

Figure D.1 Bonnygate, Cupar


| | |
|---|---|
| Station Name: | Bonnygate, Cupar |
| Easting: | 337403 |
| Northing: | 714571 |
| Site Classification: | Kerbside (<1m from Kerb) |
| Distance to kerb and road name/number | 0.5m to Bonnygate (A91) |
| Distance to nearest junction and joining road name/number | Opposite the junction with Ladywynd |
| Start date of monitoring | 19 December 2005 |
| Manifold type and height: | Single Teflon tube, Inlet height 1.9m |
| Network affiliation: | Scottish Air Quality Database |
| Quality control procedures: | Manual certified calibration by EnviroTechnology Services with 6-monthly audits by Ricardo |
| Pollutants measured on site: | $PM_{10}$, $PM_{2.5}$, $PM_1$, TSP, NOx, NO, $NO_2$ |
| Instrument manufacturer: | FIDAS 200<br>Thermo i-series |
| Calibration procedure and frequency: | 3-weekly manual calibration by EnviroTechnology Services |
| Site service arrangements: | 6-monthly detailed service by EnviroTechnology Services |
| Co-located passive sampler | Triplicate $NO_2$ tubes installed |

Figure D.2 Appin Crescent, Dunfermline

| | |
|---|---|
| Station Name: | Appin Crescent, Dunfermline |
| Easting: | 309926 |
| Northing: | 687722 |
| Distance to kerb and road name/number | 3m + (A907) |
| Site Classification: | Roadside |
| Manifold type and height: | Single Teflon tube, inlet height 2m |
| Network affiliation: | Scottish Air Quality Database |
| Quality control procedures: | Manual certified calibration by EnviroTechnology Services with 6-monthly audits by Ricardo |
| Pollutants measured on site: | $PM_{10}$, $PM_{2.5}$, $PM_1$, TSP, NOx, NO, $NO_2$ |
| Instrument manufacturer: | FIDAS 200<br>Thermo i-series |
| Calibration procedure and frequency: | 3-weekly manual calibration by EnviroTechnology Services |
| Site service arrangements: | 6-monthly detailed service by EnviroTechnology Services |
| Co-located passive sampler | Triplicate $NO_2$ tubes installed |

Figure D.3 St Clair Street, Kirkcaldy

| | |
|---|---|
| Station Name: | St Clair Street, Kirkcaldy |
| Easting: | 329143 |
| Northing: | 692986 |
| Site Classification: | Roadside |
| Distance to kerb and road name/number | 4.8m, Saint Clair Street/A921 |
| Start date of monitoring | February 2011 |
| Manifold type and height: | Single Teflon tube, Inlet height 2m |
| Network affiliation: | Scottish Air Quality Database |
| Quality control procedures: | Manual certified calibration by EnviroTechnology Services with 6-monthly audits by Ricardo |
| Pollutants measured on site: | $PM_{10}$, $PM_{2.5}$, $PM_1$, TSP, NOx, NO, $NO_2$ |
| Instrument manufacturer: | FIDAS 200<br>NOx – Thermo 42i |
| Calibration procedure and frequency: | 3-weekly manual calibration by EnviroTechnology Services |
| Site service arrangements: | 6-monthly detailed service by EnviroTechnology Services |
| Co-located passive sampler | Triplicate $NO_2$ tubes installed |

## Figure D.4 Admiralty Road, Rosyth

| | |
|---|---|
| Station Name: | Admiralty Road, Rosyth |
| Easting: | 311755 |
| Northing: | 683503 |
| Site Classification: | Roadside |
| Distance to kerb and road name/number | 6m (A985(T)) |
| Start date of monitoring | March 2008 |
| Manifold type and height: | Single Teflon tube, Inlet height 2.1m |
| Network affiliation: | Scottish Air Quality Database |
| Quality control procedures: | Manual certified calibration by EnviroTechnology Services with 6-mothly audits by Ricardo |
| Pollutants measured on site: | $PM_{10}$, $PM_{2.5}$, $PM_1$, TSP, NOx, NO, $NO_2$ |
| Instrument manufacturer: | FIDAS 200<br>NOx – Thermo 42i |
| Calibration procedure and frequency: | 3-weekly manual calibration by EnviroTechnology Services |
| Site service arrangements: | 6-monthly detailed service by EnviroTechnology Services |
| Co-located passive sampler | Triplicate $NO_2$ tubes installed |

# Appendix E AQMesh monitoring Data Management and Processing 2021

## Introduction

In November 2017, Fife Council began a sensor monitoring study to gain a better understanding of air pollution concentrations in the Bonnygate, Cupar and Appin Crescent, Dunfermline Air Quality Management Areas (AQMA) using three AQMesh sensor pods. Fife Council then contracted Ricardo Energy and Environment (Ricardo) to manage, quality assure and quality control (QA/QC) the data from this study. This report provides a summary of the data from this study from 1st January – 31st December 2021.

## Methodology

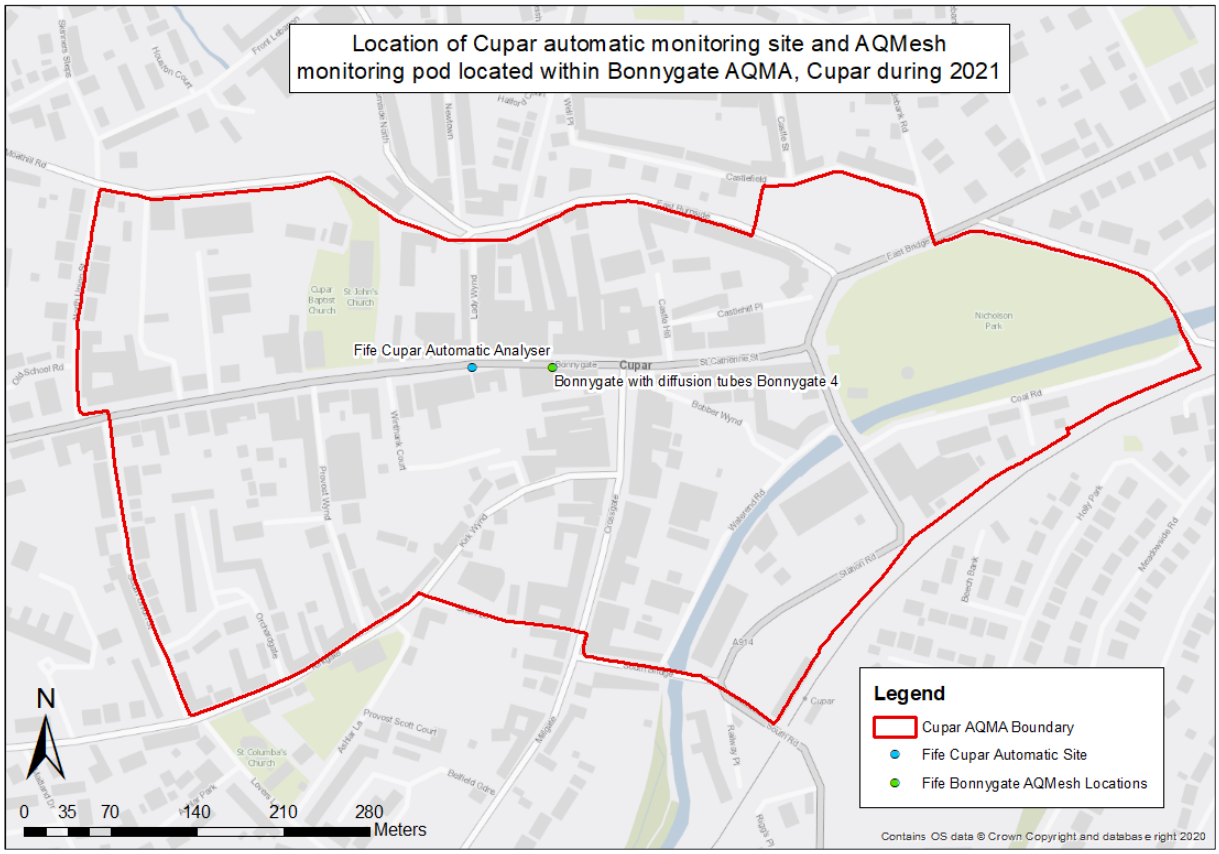
The pollutants of concern that the AQMesh sensor systems are monitoring in this study are nitrogen dioxide ($NO_2$) and particulate matter ($PM_{10}$ and $PM_{2.5}$). The AQMesh is an air quality sensor system which is able to measure real time readings at a resolution as low as 1-minute averages and at locations which have previously been inaccessible to conventional monitoring equipment. For gaseous pollutants the AQMesh uses electrochemical sensors to measure concentrations. For $PM_{10}$ and $PM_{2.5}$ it uses an optical particle counter (https://www.aqmesh.com/).

It should be noted that AQMesh pods have not been assessed through the United Kingdom (UK) equivalence programme (e.g., Environment Agency's Monitoring Certification Scheme (MCERTS)) and so do not currently have a formal equivalence designation. Once the stated quality control processes have been applied, the data should be used for indication purposes only when comparing to the relevant air quality standards.

For this study, all three AQMesh pods were set to measure 15-minute averages. Two pods were installed in the Appin Crescent AQMA (serial number 1892150 & 1894150) and one pod in the Bonnygate AQMA (serial number 1893150). The locations are illustrated in Figure E-1 and Figure E-2. Historically, these locations had not previously been monitored for particulate matter due to accessibility reasons, though $NO_2$ has been measured at these locations using diffusion tubes, which also provide indicative annual average concentrations of $NO_2$. Photographs of the installed AQMesh units are also shown below in Figure E-3.

Since November 2017, the AQMesh pods have been installed at these three locations and have collected indicative QA/QC data for $PM_{10}$, $PM_{2.5}$ and $NO_2$ pollutants.

## Figure E-1 Bonnygate, Cupar AQMesh sensor location




## Figure E-2 Appin Crescent, Dunfermline AQMesh sensor locations

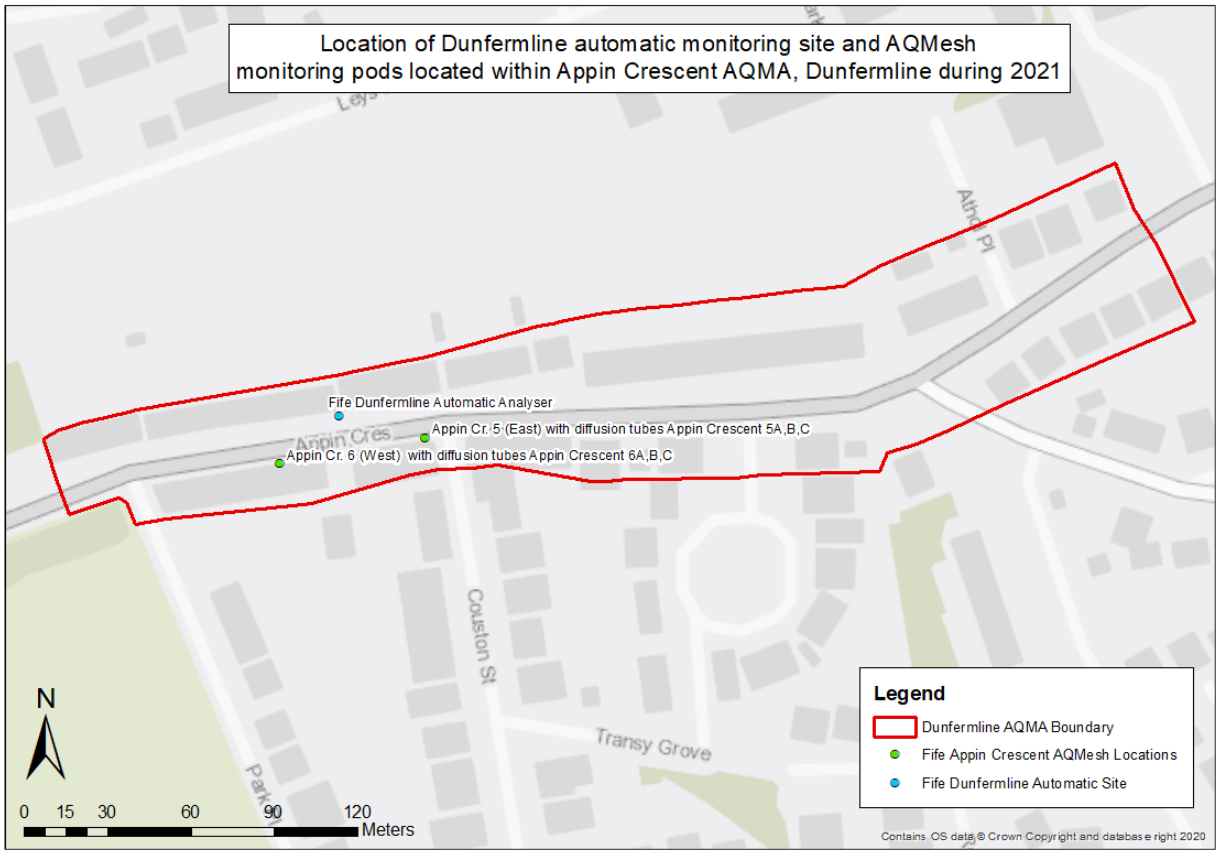


Figure E-3 Photos of the Fife AQMesh Monitoring Locations

Bonnygate AQMesh sensor
(co-located with diffusion tube Bonnygate B4)

Appin Crescent West AQMesh sensor
(co-located with triplicate diffusion tubes
Appin Crescent 6A,B & C)

Appin Crescent East AQMesh sensor
(co-located with triplicate diffusion
Appin Crescent 5A,B & C)

# Data Management and QA/QC

Ricardo used their dedicated data management system (MODUS) to manage and process all data from the three AQMesh pods. MODUS is a state-of-the-art, modular platform for robust, reliable and effective management of air quality data. MODUS is the same data management system that is used by the Scottish Air Quality Database (http://www.scottishairquality.scot/), the UK national network (AURN - https://uk-air.defra.gov.uk/interactive-map) and Air Quality England http://www.airqualityengland.co.uk/), as well as several other national and international air quality networks.

Ricardo's data management system provided:

- Automatic importing of data from the AQMesh.
- Management and processing of raw data.
- Screening and scaling of raw data.
- Statistical analysis.

QA/QC was applied to this data in line with advice published by Air Quality Expert Group (AQEG) on the Defra UK air website (AQEG advice on the use of 'low-cost' pollution sensors - Defra, UK) and included:

- Co-location of the AQMesh sensors at the nearest automatic site for at least one week every three months.
- Co-location of the AQ Mesh sensor after it has been removed from site for repair.
- Where appropriate, the application of correction factors to the raw data using the co-location data acquired.

During processing of the co-location data, orthogonal regression analysis was carried out to help calculate a correction factor (see Appendix A for example).

### Data and Analysis

Tables E.1 to E.3 provide a summary of statistics for the concentrations measured by the AQMesh sensors from 1st January 2021 to the 31st December 2021. Table E.4 and Table E.5 provide a summary of statistics for the automatic monitoring sites located in Bonnygate, Cupar and Appin Crescent, Dunfermline for the same time period. More detailed Air Pollution Reports for the AQMesh sensors and automatic sites can be found in Appendix E-B.

A summary of the Scottish Air Quality (AQ) objectives, of which the data in this report is compared to, is provided in Appendix E-C.

As can be seen in Tables E.1 to E.3, none of Fife's AQMesh sensor sites measured exceedances for any of the Scottish AQ objectives for pollutants $NO_2$, $PM_{10}$ and $PM_{2.5}$ in 2021. This is similar to previous years for Appin Crescent and Bonnygate AQMesh sites, with exception to Bonnygate in 2019, where exceedances were measured for annual ($PM_{10}$ and $PM_{2.5}$) and daily ($PM_{10}$ only) mean objectives. Pollution concentrations across all pollutants measured at all sites were low throughout 2020 and 2021, in comparison to 2018 and 2019. This is especially the case for $NO_2$. This has been attributed to the COVID-19 restrictions and the associated varying range of travel restrictions and guidance through 2020 and 2021.

When comparing the Appin Crescent East and West AQMesh sensors with the nearby automatic site in Dunfermline, the statistics show that $NO_2$ annual mean concentrations for both Appin Crescent AQMesh pods have been consistently higher than that measured at the automatic site. However, with $NO_2$ concentrations decreasing in 2020 and 2021 the difference between the sensor sites and the automatic site has lessened. When considering $PM_{10}$ and $PM_{2.5}$, the Appin Crescent AQMesh sensor sites were higher in 2018 and 2019 but has since measured concentrations below the automatic site for 2020 and 2021. The reasons for this change are currently unclear however it may indicate the contribution traffic has to PM concentrations on the southside of Appin Crescent. As the traffic flow decreased due to COVID-19 restrictions concentrations have decreased. Decreasing long term trends in PM concentrations[6] and a changing traffic fleet may also be contributing.

A similar situation is seen with the Bonnygate AQMesh, in that the $NO_2$ annual mean concentrations have been consistently higher than the Cupar automatic site annual mean concentrations, with the exception of 2020 when the annual mean concentrations were the same. The reason for this similarity in the 2020 concentrations can, again, be attributed to the COVID-19 travel restrictions and the associated downturn in traffic throughout 2020. However, the $PM_{10}$ and $PM_{2.5}$ concentrations for the AQMesh pod in Bonnygate have been very similar since monitoring began in 2018, except for 2019, when both $PM_{10}$ and $PM_{2.5}$ were higher (37% and 27%, respectively) at the AQMesh pod than the automatic site.

Figure E-4 and E-5 provide a visual representation of annual mean concentrations compared to AQ objectives since AQMesh monitoring began and illustrates the difference between the automatic site and AQMesh sensor site locations. Appendix D of this report provides tables of annual mean concentrations for each year since monitoring began for all relevant pollutants and sites.

The AQMesh pods were co-located with diffusion tubes (as illustrated in Figure E-1 and E-2 and shown in the associated photographs in Figure E-3). Table E.6 provides the bias corrected annual mean concentrations for these diffusion tubes. For the Bonnygate and Appin Crescent locations the diffusion tubes measured higher $NO_2$ concentrations than the AQMesh, which is similar to previous year's measurements.

Table E.1 Fife Bonnygate AQ Mesh monitoring Statistics 1st January to 31st December 2021

| | V High (No. of Days) | High (No. of Days) | Mod (No. of Days) | Low (No. of Days) | Max. Hourly Conc. | Max. Daily Conc. | Max. Running 8 Hour Mean | Max. Running 24 Hour Mean | Period Mean Conc. | Period Data Capture (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| **NO** ($\mu g\ m^{-3}$) | 0 | 0 | 0 | 0 | 409 | 154 | 302 | 154 | 37 | 84.1 |
| **$NO_2$** ($\mu g\ m^{-3}$) | 0 | 0 | 0 | 311 | 151 | 64 | 104 | 66 | 25 | 84.0 |
| **$PM_{10}$** ($\mu g\ m^{-3}$) | 0 | 0 | 1 | 295 | 163 | 59 | 77 | 69 | 11 | 81.9 |
| **$PM_{2.5}$** ($\mu g\ m^{-3}$) | 0 | 0 | 1 | 295 | 115 | 38 | 53 | 46 | 7 | 81.9 |

[6] https://www.scottishairquality.scot/sites/default/files/publications/2021-12/SAQD_Annual_Report_2020_Issue_1.pdf

Table E.2 Fife Appin Crescent West AQ Mesh monitoring Statistics 1st January to 31st December 2021

| | V High (No. of Days) | High (No. of Days) | Mod (No. of Days) | Low (No. of Days) | Max. Hourly Conc. | Max. Daily Conc. | Max. Running 8 Hour Mean | Max. Running 24 Hour Mean | Period Mean Conc. | Period Data Capture (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| NO (µg $m^{-3}$) | 0 | 0 | 0 | 0 | 329 | 134 | 211 | 134 | 21 | 86.4 |
| $NO_2$ (µg $m^{-3}$) | 0 | 0 | 0 | 320 | 120 | 42 | 66 | 46 | 18 | 86.2 |
| $PM_{10}$ (µg $m^{-3}$) | 0 | 0 | 0 | 308 | 538 | 37 | 104 | 53 | 8 | 85.3 |
| $PM_{2.5}$ (µg $m^{-3}$) | 0 | 0 | 0 | 308 | 250 | 26 | 53 | 30 | 5 | 85.3 |

Table E.3 Fife Appin Crescent East AQ Mesh monitoring Statistics 1st January to 31st December 2021

| | V High (No. of Days) | High (No. of Days) | Mod (No. of Days) | Low (No. of Days) | Max. Hourly Conc. | Max. Daily Conc. | Max. Running 8 Hour Mean | Max. Running 24 Hour Mean | Period Mean Conc. | Period Data Capture (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| NO (µg $m^{-3}$) | 0 | 0 | 0 | 0 | 325 | 125 | 198 | 125 | 19 | 86.3 |
| $NO_2$ (µg $m^{-3}$) | 0 | 0 | 0 | 320 | 152 | 65 | 99 | 70 | 20 | 86.1 |
| $PM_{10}$ (µg $m^{-3}$) | 0 | 0 | 0 | 301 | 203 | 50 | 88 | 56 | 9 | 83.6 |
| $PM_{2.5}$ (µg $m^{-3}$) | 0 | 0 | 0 | 301 | 113 | 30 | 41 | 32 | 5 | 83.6 |

Table E.4 Fife Cupar Automatic monitoring site statistics 1st January to 31st December 2021

| | V High (No. of Days) | High (No. of Days) | Mod (No. of Days) | Low (No. of Days) | Max. Hourly Conc. | Max. Daily Conc. | Max. Running 8 Hour Mean | Max. Running 24 Hour Mean | Period Mean Conc. | Period Data Capture (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| NO (µg/$m^3$) | 0 | 0 | 0 | 0 | 271 | 94 | 193 | 94 | 18 | 92.2 |
| $NO_2$ (µg/$m^3$) | 0 | 0 | 0 | 346 | 118 | 52 | 81 | 62 | 20 | 92.0 |
| $PM_{10}$ (µg/$m^3$) | 0 | 0 | 0 | 348 | 115 | 40 | 91 | 42 | 13 | 95.8 |
| $PM_{2.5}$ (µg/$m^3$) | 0 | 0 | 0 | 348 | 64 | 24 | 38 | 31 | 6 | 95.8 |

Table E.5 Fife Dunfermline Automatic monitoring site statistics 1st January to 31st December 2021

| | V High (No. of Days) | High (No. of Days) | Mod (No. of Days) | Low (No. of Days) | Max. Hourly Conc. | Max. Daily Conc. | Max. Running 8 Hour Mean | Max. Running 24 Hour Mean | Period Mean Conc. | Period Data Capture (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| NO (µg/m³) | 0 | 0 | 0 | 0 | 165 | 66 | 100 | 66 | 7 | 95.4 |
| $NO_2$ (µg/m³) | 0 | 0 | 0 | 356 | 84 | 45 | 73 | 53 | 16 | 95.4 |
| $PM_{10}$ (µg/m³) | 0 | 0 | 0 | 351 | 320 | 47 | 84 | 50 | 10 | 96.7 |
| $PM_{2.5}$ (µg/m³) | 0 | 0 | 0 | 351 | 225 | 25 | 47 | 26 | 6 | 96.7 |

Figure E.4 Appin Crescent AQMesh and Automatic monitoring annual mean concentrations compared to AQ Objectives since AQMesh monitoring began (2018)

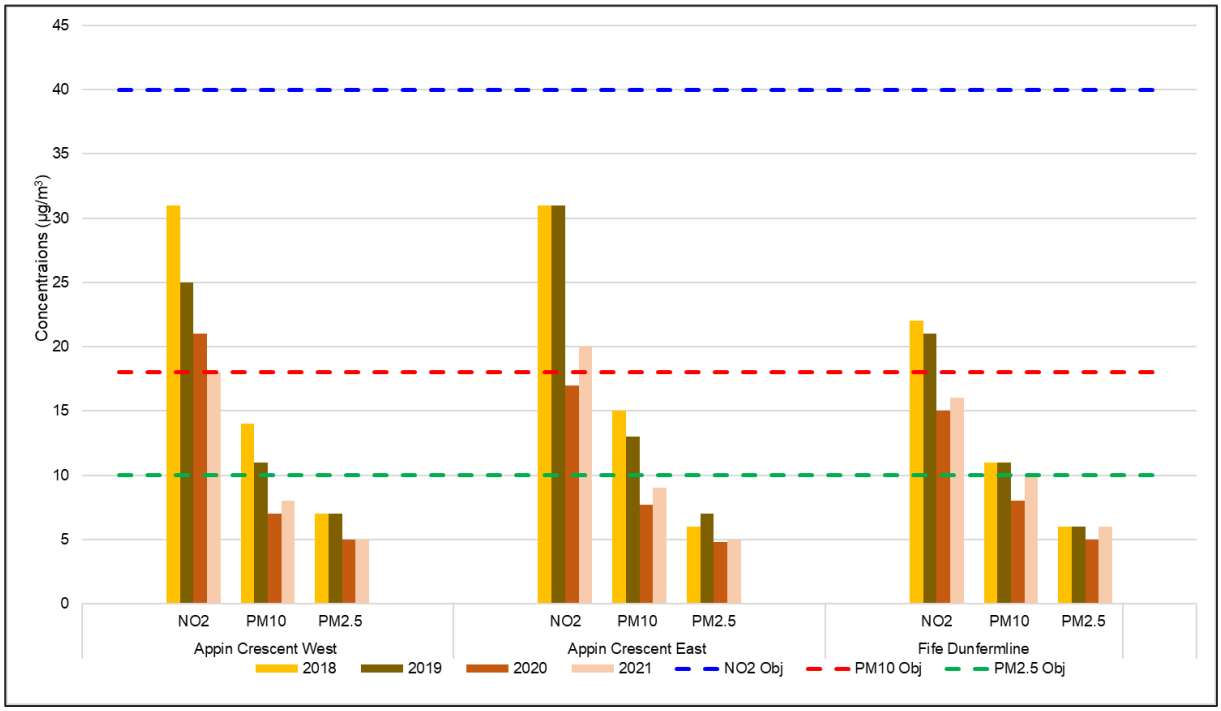


Figure E.5 Bonnygate Annual mean concentrations compared to AQ Objectives since AQMesh monitoring began (2018)

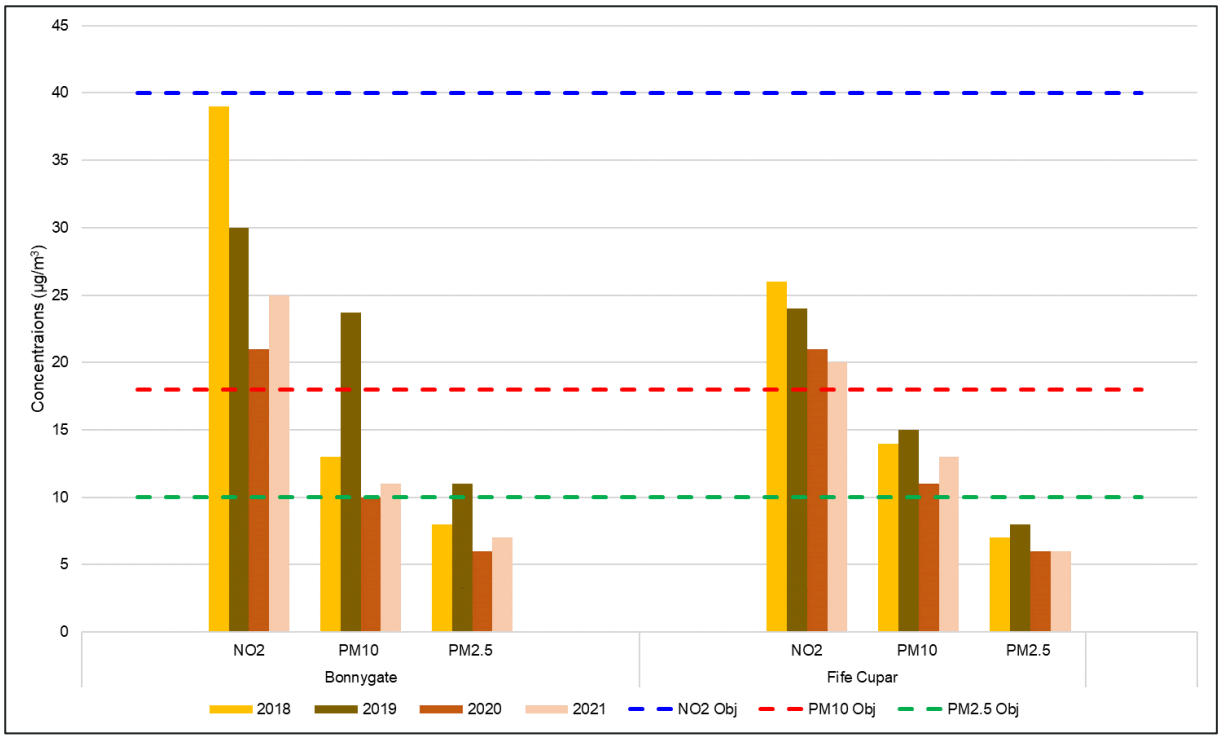



Table E.6 Co-located diffusion tube annual concentrations

| Diffusion Tube Name | Annual Concentration for 2021 (µg/m³) |
|---|---|
| Bonnygate B4 | 27 |
| Appin Crescent 5A, B, C (co-located with AQMesh East) | 24 |
| Appin Crescent 6A, B, C (co-located with AQMesh West) | 26 |

# Diurnal Variation Analysis

Diurnal variation analysis shows the hourly average concentrations (in parts per billion) for each hour of the day over the monitoring period in question (1st January 2021 to 31st December 2021). This section compares the respective AQMesh and automatic monitoring site (Fife Cupar and Fife Dunfermline) diurnal variation data. Locations of the automatic monitoring sites are provided in Figure E-1 and Figure E-2.

Figure E-6 to Figure E-11 compares automatic and AQMesh sites $NO_2$ diurnal analysis for 2019, 2020 and 2021. In 2020, the Bonnygate AQMesh site (Figure E-7) measured similar concentrations as the automatic site throughout the day. However, in 2021 there is a notable higher diurnal profile for the Bonnygate AQMesh site than the automatic site (Figure E-6) especially during standard working hours (9am to 5pm) and the morning and evening rush hours (8am – 9am & 5pm – 6pm). This indicates that the Bonnygate AQMesh site is more affected by traffic $NO_2$ emissions than the Cupar automatic site. Comparing 2020 with 2021 diurnals also shows that traffic emissions are returning back to pre-COVID-19 patterns. When comparing 2021 to 2019 (pre-COVID-19) the pollution profiles are similar, however concentrations are still not as high and peaks during rush hours as pronounced.

In 2020, both Appin Crescent AQMesh sites measured higher $NO_2$ concentrations than the automatic site throughout the day (Figure E-10). However, in 2021 Appin Crescent West diurnal profile converges with the automatic site during standard working hours and is slightly higher during morning and evening rush hours, whereas Appin Crescent East continues to measure higher concentrations during the standard working hours and rush hours than that of the automatic site. When compared to 2020 diurnal profiles, the automatic site and Appin Crescent East show little change in both concentration and diurnal profile pattern to what was measured

in 2021. In 2020 at Appin Crescent West, the $NO_2$ concentrations were found to be higher than that of 2021 concentrations and Appin Crescent West diurnal profile in 2020 appears to show more pronounced and higher peaks during the rush hour period than in 2021.

When comparing 2021 diurnal profiles to 2019 (Figure E-11), the profiles are very similar however the peaks seen at rush hour periods are higher in 2019 than in 2021. The drop off between rush hour peaks are more distinct in 2021 than in 2019 suggesting traffic during this time was less in 2021 than in 2019 (pre-COVID-19). There is no diurnal profile Appin Crescent East in 2019 due to low data capture.

Figure E. 6 $NO_2$ Diurnal Variation Plot for Fife Bonnygate AQMesh sensor and Fife Cupar automatic monitor 2021

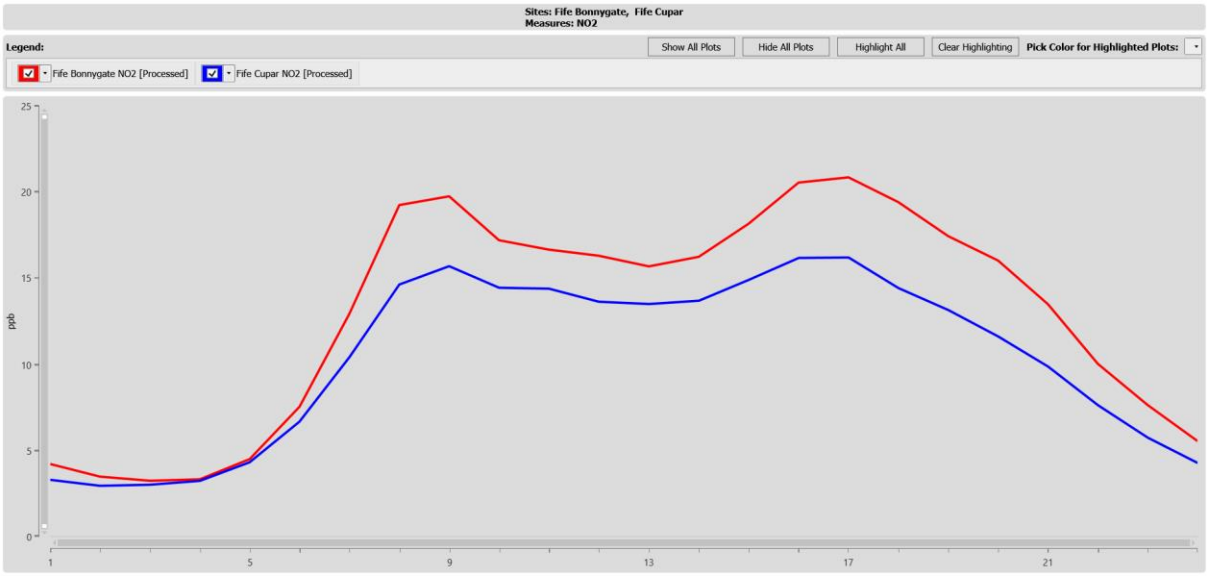



Figure E.7 $NO_2$ Diurnal Variation Plot for Fife Bonnygate AQMesh sensor and Fife Cupar automatic monitor 2020

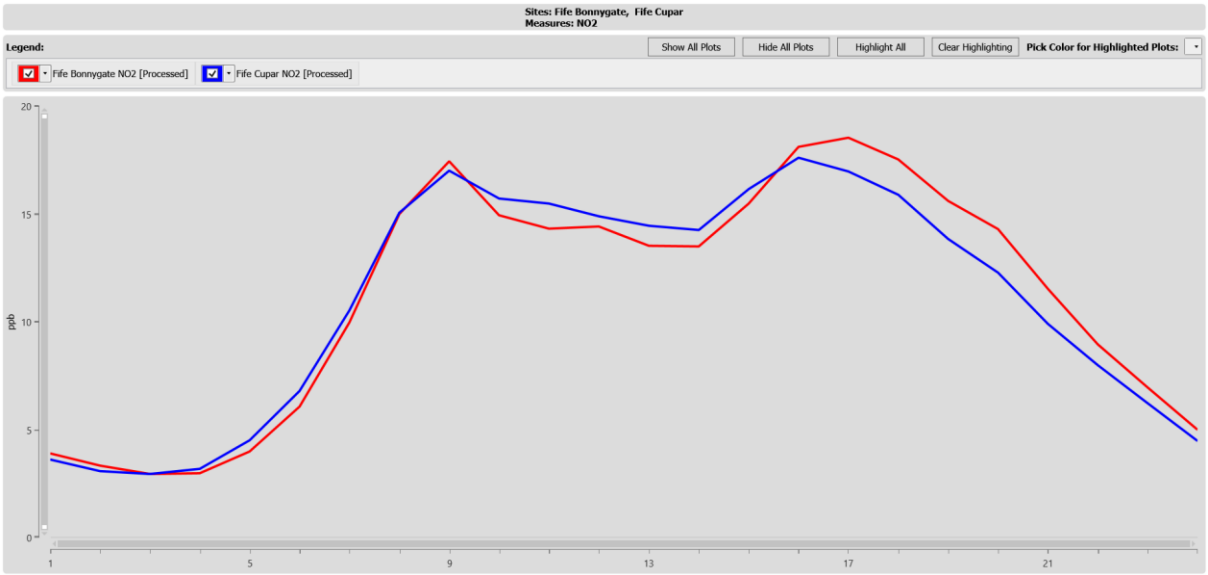


Figure E.8 $NO_2$ Diurnal Variation Plot for Fife Bonnygate AQMesh sensor and Fife Cupar automatic monitor 2019

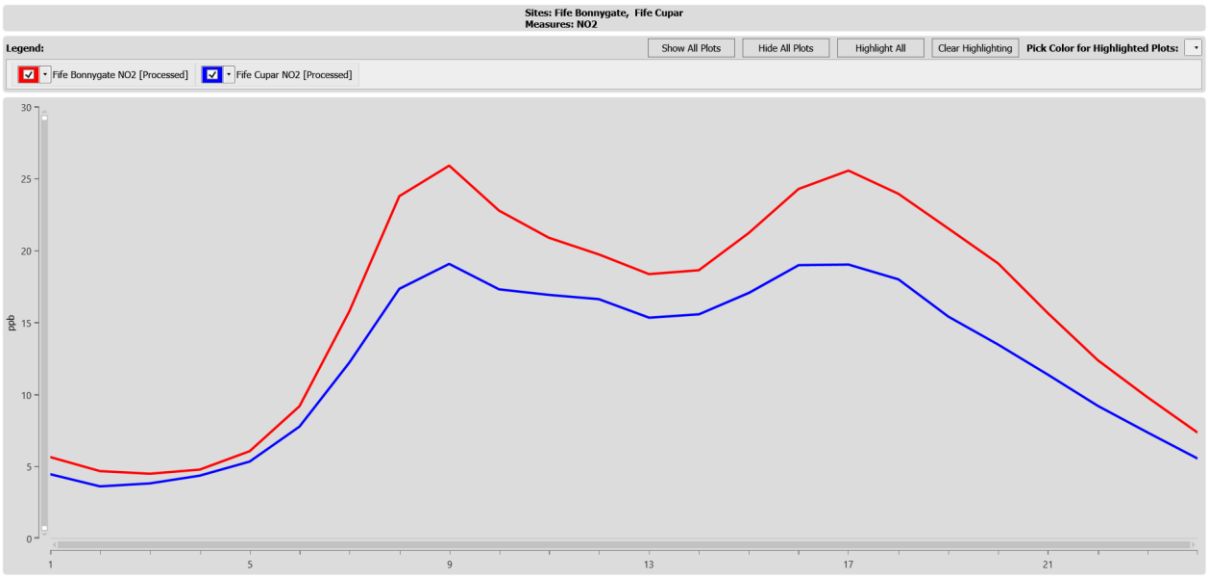



Figure E.9 $NO_2$ Diurnal Variation Plot for Fife Appin Crescent East and West AQMesh sensor and Fife Dunfermline automatic monitor 2021

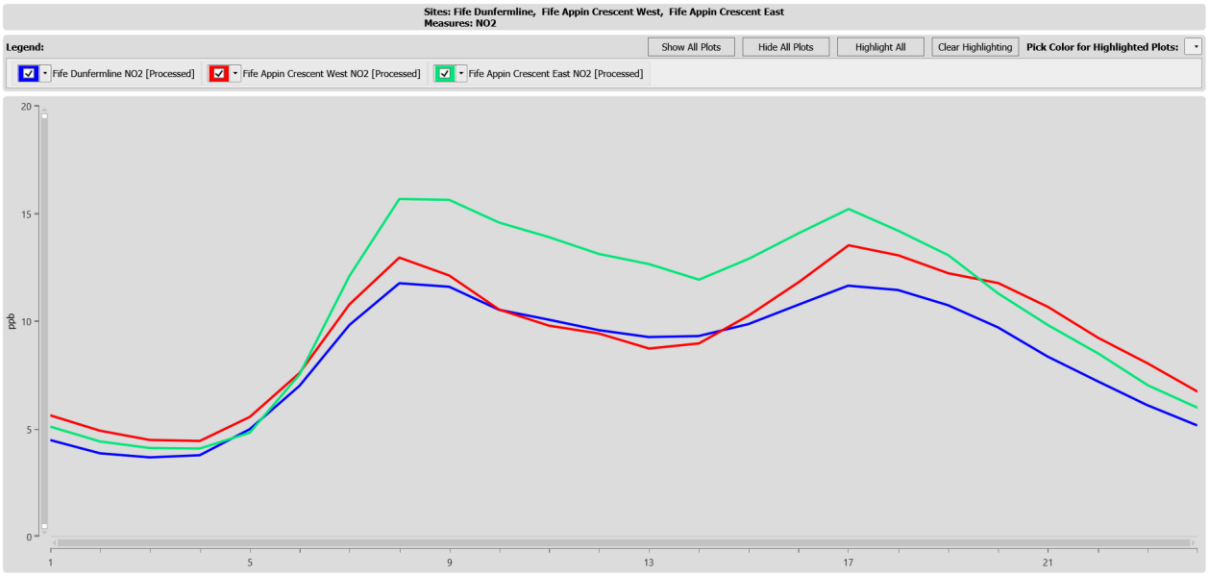


Figure E.10 $NO_2$ Diurnal Variation Plot for Fife Appin Crescent East and West AQMesh sensor and Fife Dunfermline automatic monitor 2020

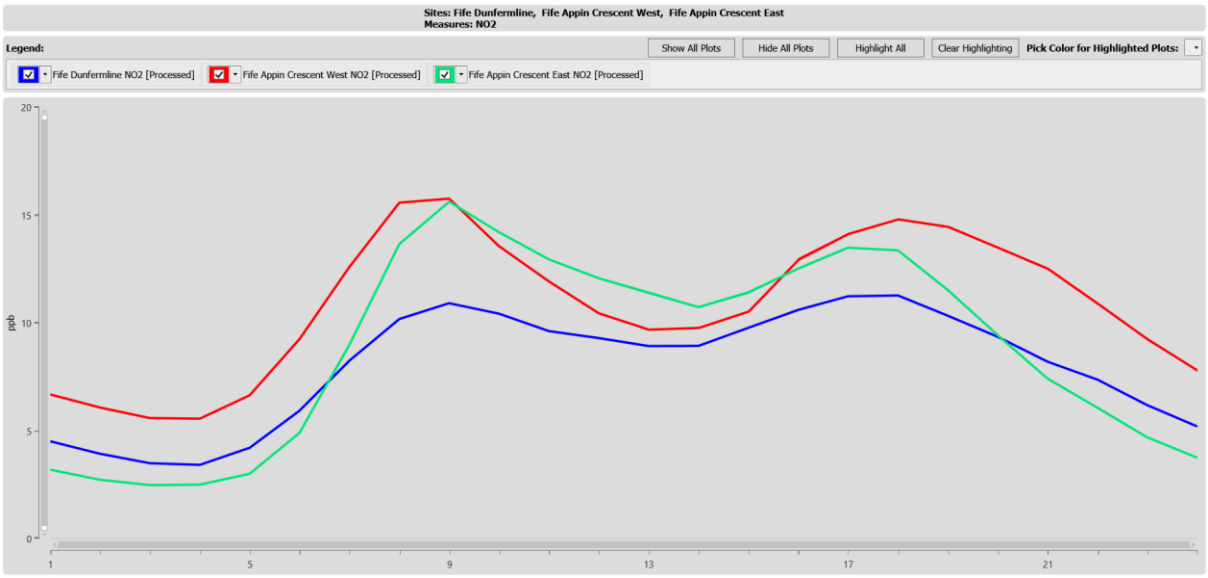



Figure E.11 $NO_2$ Diurnal Variation Plot for West AQMesh sensor and Fife Dunfermline automatic monitor 2019 (NB: low data capture for Fife Appin Crescent East, therefore not included)

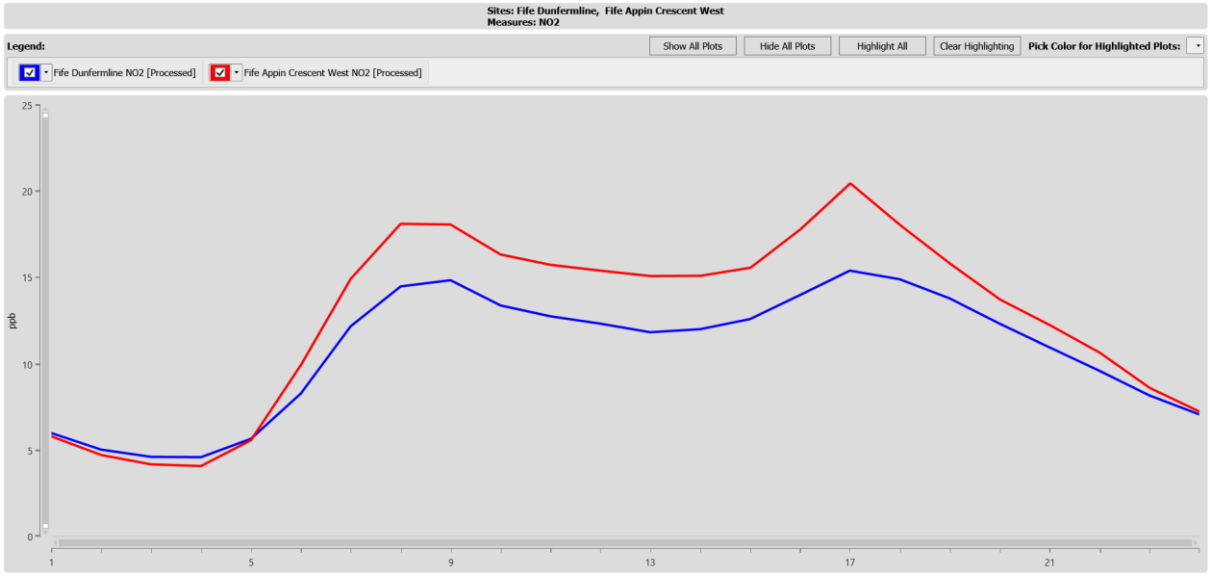



Figure E.12 to Figure E.20 compares automatic and AQMesh sites $PM_{10}$ and $PM_{2.5}$ diurnal analyses for 2019, 2020 and 2021.

Figure E-12 and Figure E-13 compares Bonnygate $PM_{10}$ and $PM_{2.5}$ diurnal variation data for 2020 and 2021. The 2021 (Figure E-12) and 2020 diurnal variation (Figure E-11) profiles are very similar, the differing factor being that the PM concentrations are slightly higher in 2021 than in 2020. The only distinguishable trend in the diurnal analysis for $PM_{10}$ is at the Cupar automatic site where concentrations increase at around 7am and decrease again at 7pm. This is the same for 2019, 2020 and 2021. It could be suggested that this analysis indicates that traffic contributes more to $PM_{10}$ concentrations at the Cupar automatic site than at the Bonnygate AQMesh location. However due to the greater number of Particulate Matter sources and its transboundary nature, there is significantly more uncertainty attributed to this hypothesis compared to when considering $NO_2$ diurnal analysis, where it is known that the vast majority of $NO_2$ emissions are sourced from traffic at roadside locations.

When comparing 2019 diurnal profile (Figure E-14) to 2020 and 2021 diurnal profiles for Bonnygate AQMesh, the diurnal variation in both $PM_{10}$ and $PM_{2.5}$ is not seen in 2020 or 2021. However, it should be noted that particulate matter concentrations measured at the Bonnygate AQMesh site appear to be unusually high in

2019 compared to all other years and may have been affected by a very localised source during this period. It should also be noted that there is no obvious trend in the $PM_{2.5}$ diurnal analysis for all years which indicates that traffic contributes little to concentrations in this area.

Figure E.12 $PM_{10}$ and $PM_{2.5}$ Diurnal Variation Plot for Fife Bonnygate AQMesh sensor and Fife Cupar automatic monitor 2021

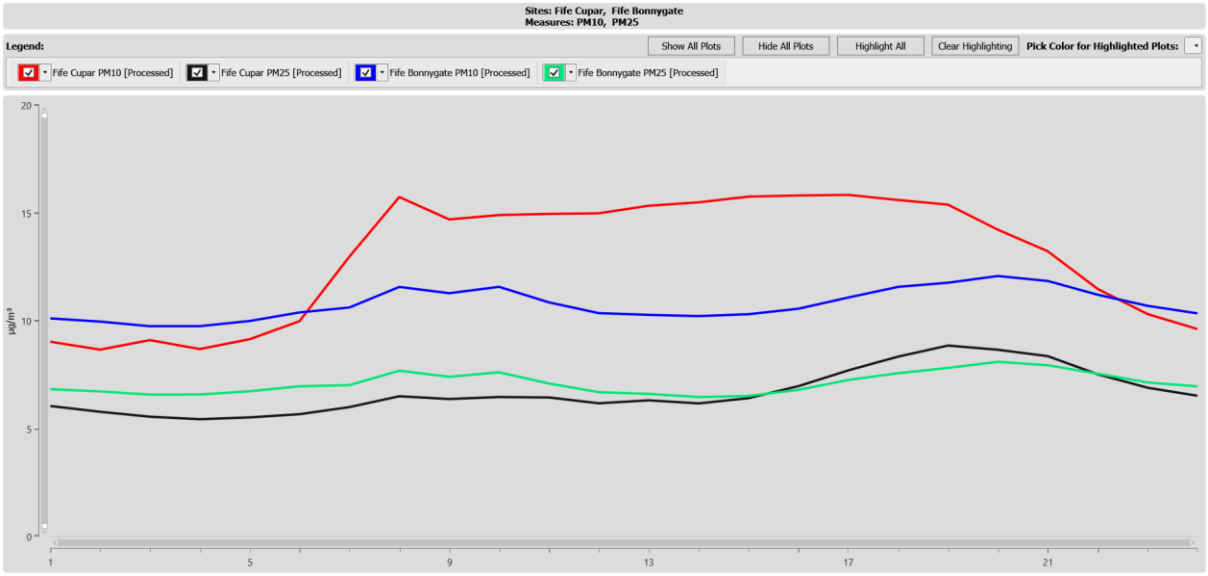



Figure E.13 $PM_{10}$ and $PM_{2.5}$ Diurnal Variation Plot for Fife Bonnygate AQMesh sensor and Fife Cupar automatic monitor 2020

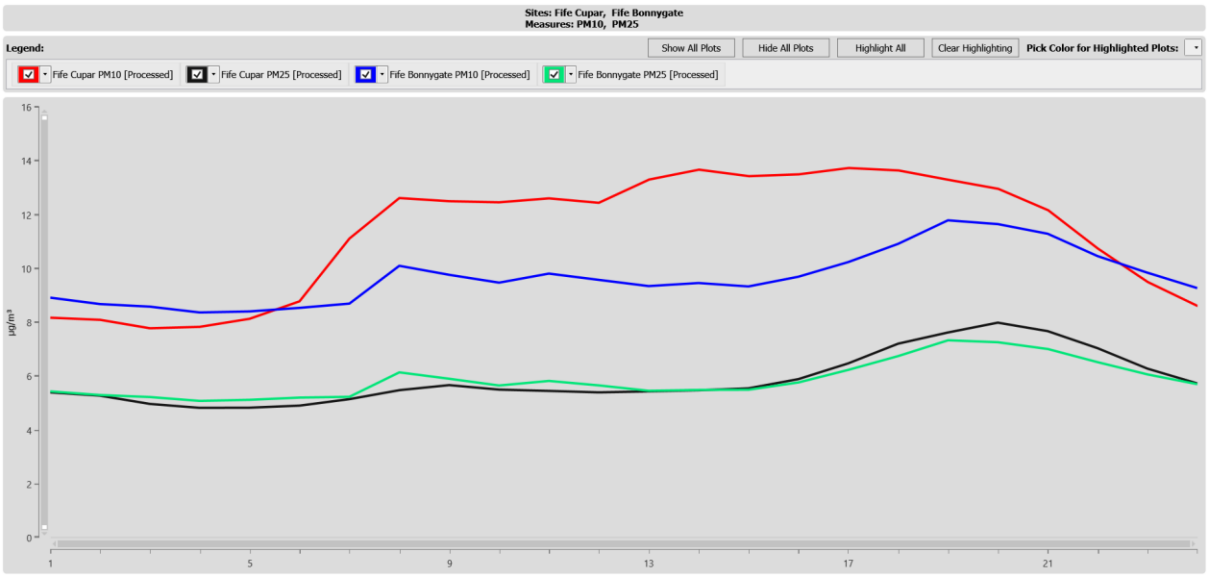
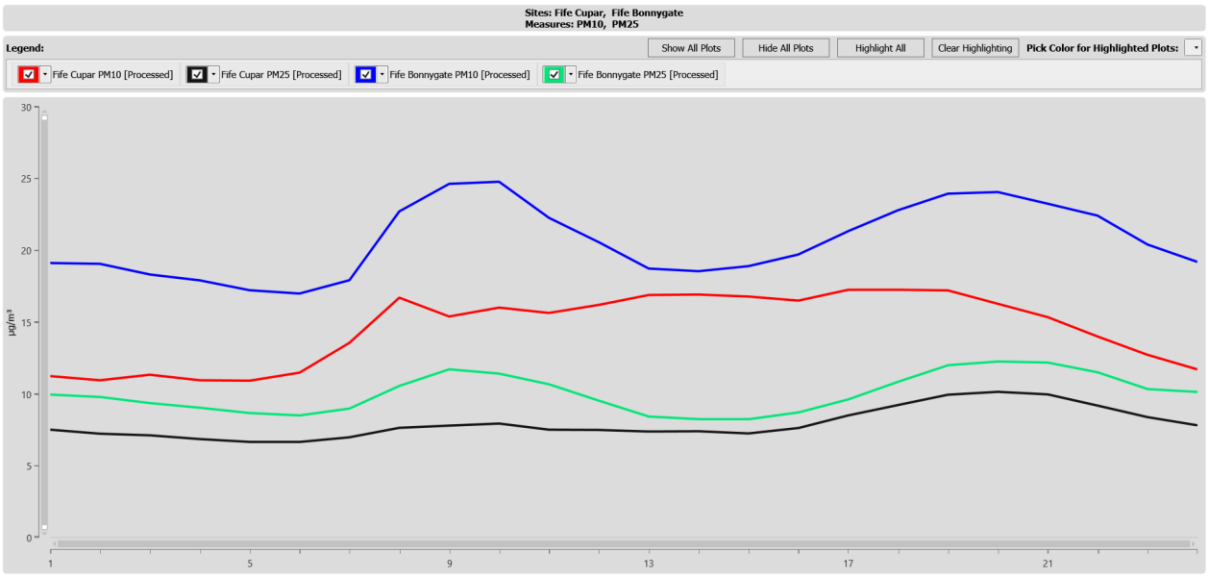


Figure E.14 $PM_{10}$ and $PM_{2.5}$ Diurnal Variation Plot for Fife Bonnygate AQMesh sensor and Fife Cupar automatic monitor 2019




Figures E-15 to E-20 illustrate the $PM_{10}$ and $PM_{2.5}$ diurnal variation data for Fife Appin Crescent West and East AQMesh sensors, and the Fife Dunfermline automatic site for 2019, 2020 and 2021.

As can be seen for all years, $PM_{10}$ diurnal analysis shows little variation throughout the day indicating that traffic has little influence on concentrations. The automatic site does appear to become slightly elevated around 7am, however it remains like this until around 9pm which does not correlate with the $NO_2$ diurnal analysis (which we know is associated to traffic emissions). This alternatively may indicate $PM_{10}$ concentration contributions from domestic household emissions.

For $PM_{2.5}$ (Figure E-18 to Figure E-20), the diurnal variation analysis shows very little change at all sites and for all years. This analysis suggests that traffic has little contributing factor to $PM_{10}$ and $PM_{2.5}$ concentrations at all of these locations.

Figure E.15 $PM_{10}$ Diurnal Variation Plot for Fife Appin Crescent East and West AQMesh sensors and Fife Dunfermline automatic monitor 2021

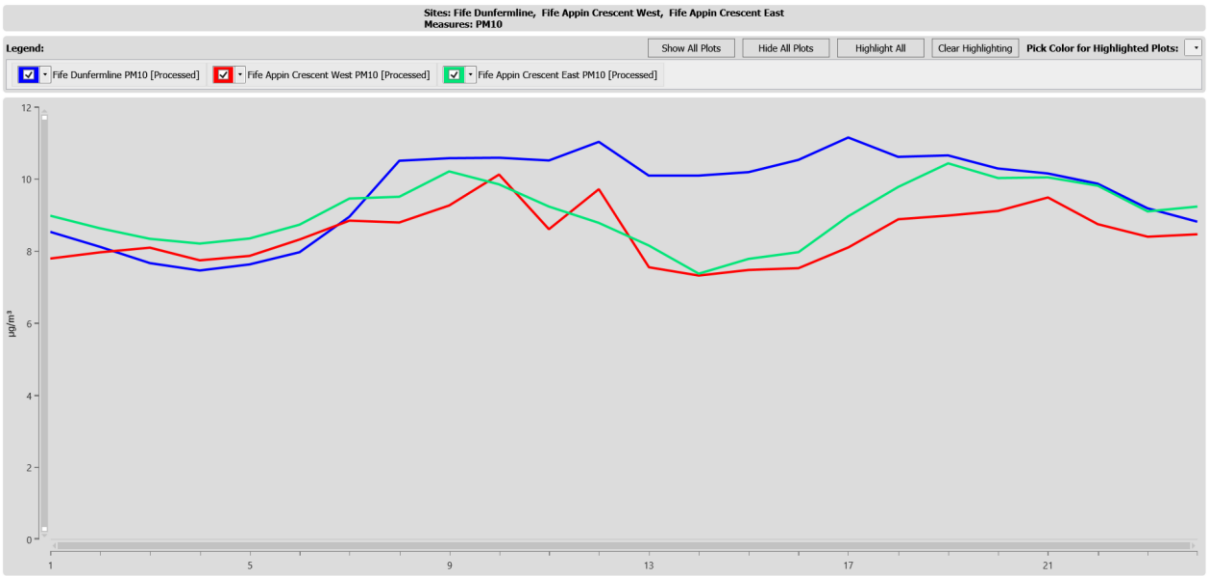


Figure E.16 $PM_{10}$ Diurnal Variation Plot for Fife Appin Crescent West AQMesh sensors and Fife Dunfermline automatic monitor 2020

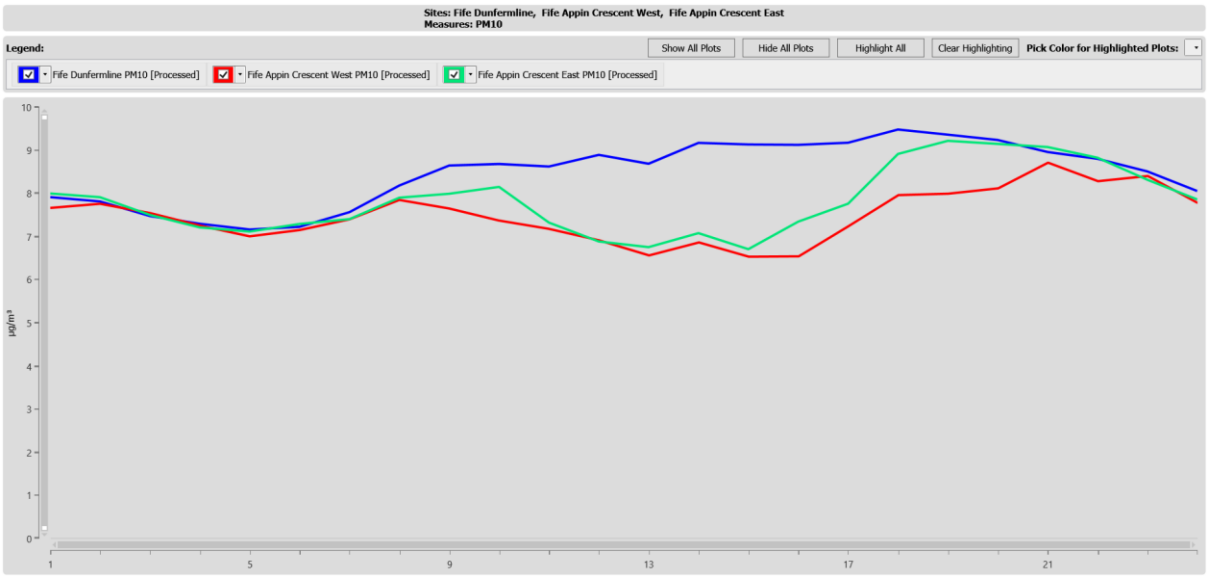



Figure E.17 $PM_{10}$ Diurnal Variation Plot for Fife Appin Crescent West AQMesh sensors and Fife Dunfermline automatic monitor 2019 (low data capture for Fife Appin Crescent East, not included)

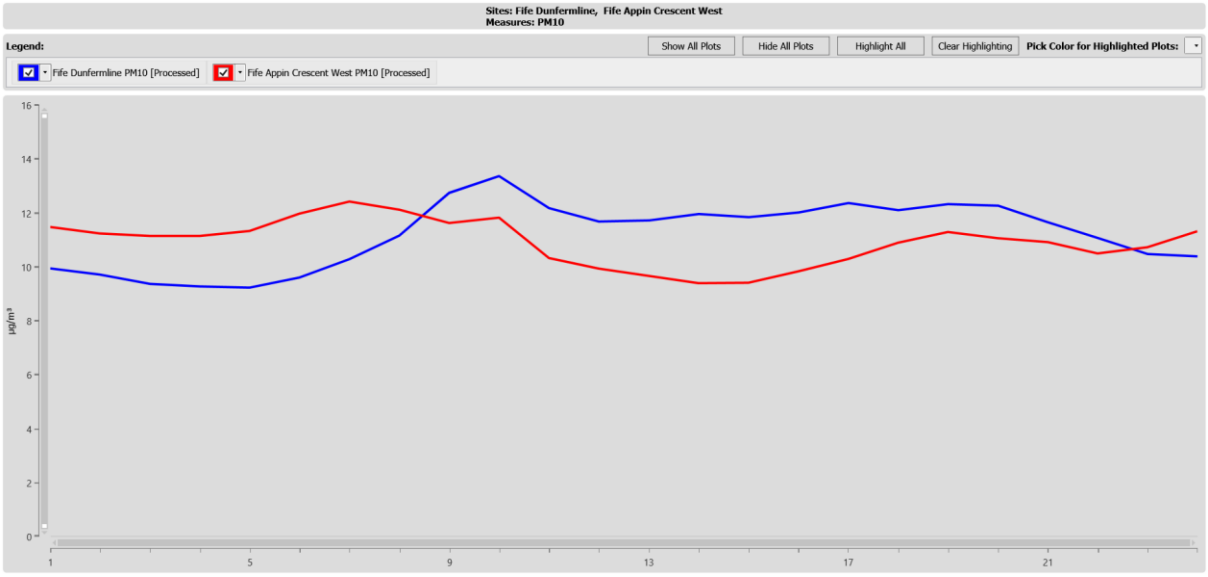


Figure E.18 $PM_{2.5}$ Diurnal Variation Plot for Fife Appin Crescent East and West AQMesh sensors and Fife Dunfermline automatic monitor 2021

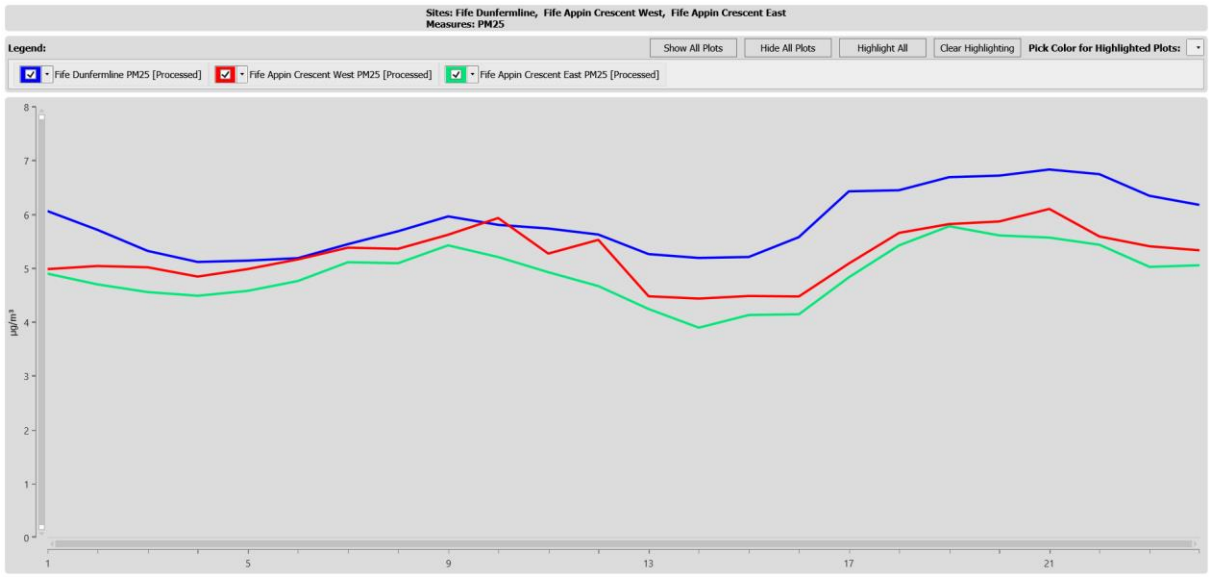



Figure E.19 $PM_{2.5}$ Diurnal Variation Plot for Fife Appin Crescent West AQMesh sensors and Fife Dunfermline automatic monitor 2020

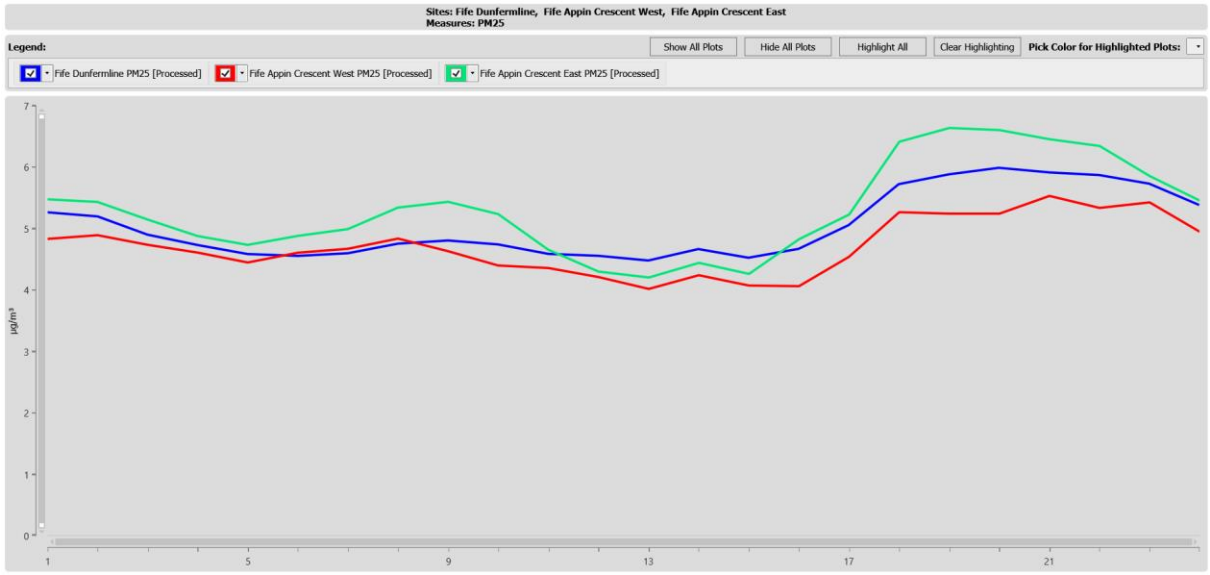
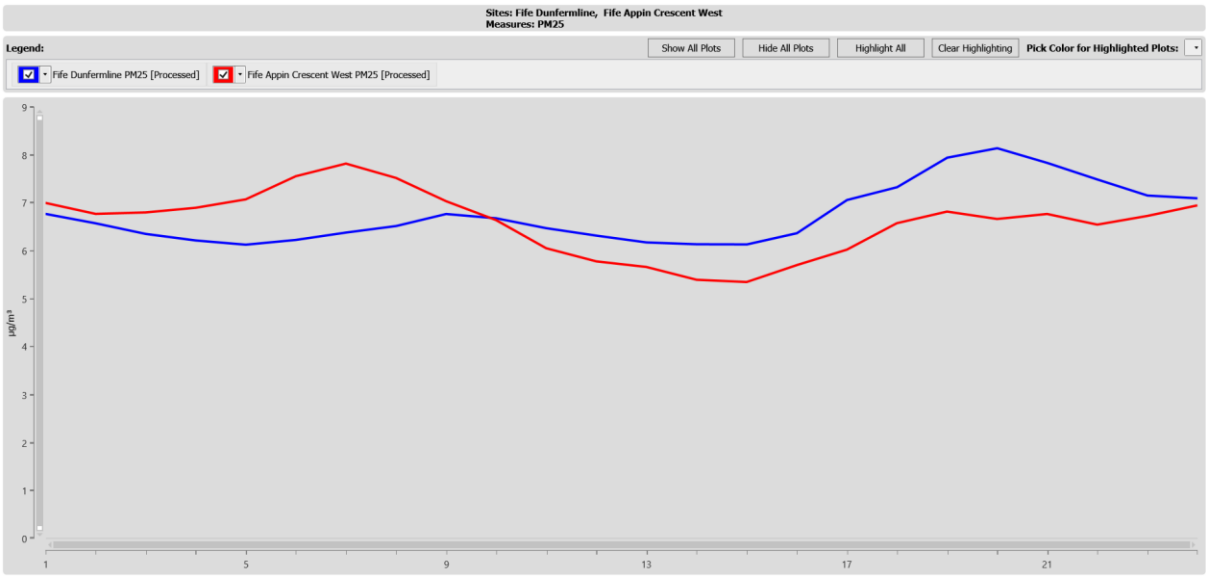


Figure E.20 $PM_{2.5}$ Diurnal Variation Plot for Fife Appin Crescent West AQMesh sensors and Fife Dunfermline automatic monitor 2019 (low data capture for Fife Appin Crescent East, not included)




# Summary

This report provides data analysis of Fife Council's three AQMesh air quality monitoring sensor sites from 1st January – 31st December 2021, measuring particulate matter ($PM_{10}$ and $PM_{2.5}$) and nitrogen dioxide ($NO_2$).

In 2021, none of Fife's AQMesh sensor sites measured exceedances for any of the Scottish AQ objectives for pollutants $NO_2$, $PM_{10}$ and $PM_{2.5}$.

When comparing the Appin Crescent East and West AQMesh sensors with the nearby automatic site in the Dunfermline AQMA, the statistics show that:

- $NO_2$ annual mean concentrations for both Appin Crescent AQMesh pods have consistently been above that measured at the automatic site since monitoring began in 2018.
- $PM_{10}$ and $PM_{2.5}$ concentrations were higher in 2018 and 2019 at both Appin Crescent AQMesh pods than at the automatic site, but since 2020 concentrations have been below the automatic site.

When comparing the Bonnygate AQMesh sensor with the nearby automatic site in the Cupar AQMA, the statistics show that:

- Bonnygate AQMesh $NO_2$ annual mean concentrations have been higher than the Cupar automatic site annual mean concentrations since monitoring began in 2018, with the exception of 2020 when the annual mean concentrations were the same.
- $PM_{10}$ and $PM_{2.5}$ concentrations for the AQMesh pod in Bonnygate have been very similar since monitoring began in 2018, except for 2019, when both $PM_{10}$ and $PM_{2.5}$ were higher at the AQMesh pod than the automatic site.

For both Bonnygate and Appin Crescent locations the co-located diffusion tubes measured higher $NO_2$ concentrations than the AQMesh sensors.

Diurnal variation analysis indicates:

- Bonnygate AQMesh site is more affected by traffic $NO_2$ emissions than the Cupar automatic site. Comparing 2020 with 2021 diurnals also indicates that traffic emissions are returning back to pre-Covid-19 patterns however concentrations are still lower than 2019 levels.
- In 2020, both Appin Crescent AQMesh sites measured higher $NO_2$ concentrations than the Dunfermline automatic site throughout the day. The Appin Crescent East AQMesh site is more affected by traffic $NO_2$ emissions than both the Appin Crescent West and the Dunfermline automatic sites.

- The only distinguishable diurnal variation for $PM_{10}$ is at the Cupar automatic site. This could suggest that traffic contributes more to $PM_{10}$ concentrations at the Cupar automatic site location than at the Bonnygate AQMesh location.
- Diurnal analysis suggests that traffic has little contributing factor to $PM_{10}$ concentrations at Appin Crescent locations.
- There is no obvious variation in $PM_{2.5}$ for all years at both Appin Crescent and Bonnygate which indicates that traffic contributes little to $PM_{2.5}$ concentration in both areas.

# Appendix E-A – Calculated Sensitivities and examples Colocation Data Orthogonal Regression Analysis

## Table A.1 Calculated Data Processing Sensitives from Co-location Studies

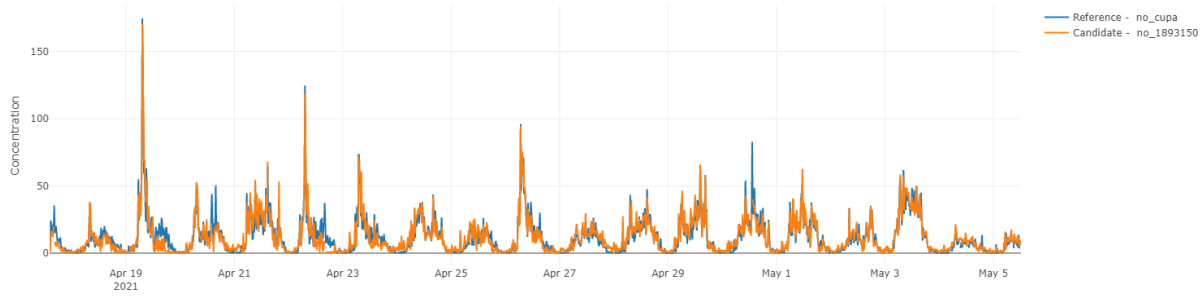
| Calculated Processing Sensitivities From Co-location Studies | | | | |
|---|---|---|---|---|
| **Bonnygate** | | | | |
| Colocation Date | NO | $NO_2$ | $PM_{10}$ | $PM_{2.5}$ |
| 16/10/2020 | 1.009081736 | 0.928505107 | 5.102040816 | 2.688172043 |
| 15/01/2021 | 1.088139282 | 1.13507378 | 2.164502165 | 2.227171492 |
| 05/05/2021 | 0.996015936 | 1.03950104 | 2.754820937 | 2.392344498 |
| 18/08/2021 | 1.070663812 | 0.872600349 | 4.132231405 | 2.427184466 |
| 29/11/2021 | 1.007049345 | 2.941176471 | 3.095975232 | 2.173913043 |
| 01/03/2022 | 0.983284169 | 1.63132137 | | |
| **Appin Crescent West** | | | | |
| 23/11/2020 | 0.999000999 | 1.461988304 | 1.071811361 | 1.19760479 |
| 24/03/2021 | 0.928505107 | 1.013171226 | 1.02145046 | 1.14416476 |
| 15/07/2021 | - | - | - | - |
| 10/11/2021 | 1.037344398 | 1.107419712 | 1.18623962 | 1.331557923 |
| 15/02/2022 | 0.919117647 | 1.461988304 | 1.564945227 | 1.949317739 |
| **Appin Crescent East** | | | | |
| 23/11/2020 | 0.933706816 | 2.016129032 | 1.079913607 | 1.107419712 |
| 24/03/2021 | 0.86281277 | 1.901140684 | 0.981354269 | 0.844594595 |
| 15/07/2021 | - | - | - | - |
| 10/11/2021 | 1.029866117 | 1.071811361 | 1.121076233 | 1.019367992 |
| 15/02/2022 | 0.969932105 | 1.2300123 | 2.257336343 | 1.838235294 |

*15/07/21 – Appin Crescent East and West summer colocation results were discounted due to the data colocation sensitivities being less reliable due to noisier data.

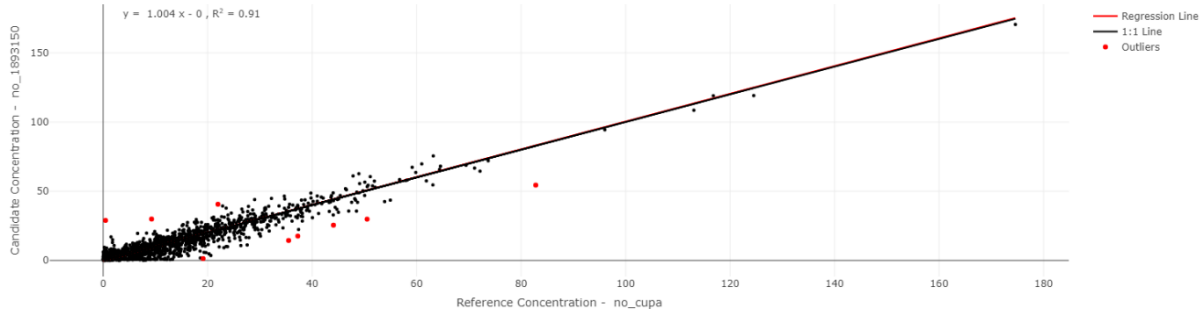
## Table A.2 Example Colocation Data Orthogonal Regression Analysis

| Summary: Bonnygate NO 16/04/2021 – 05/05/2021 | | |
|---|---|---|
| | **Uncorrected Data** | **Uncorrected Data - Outliers Removed** |
| Intercept not forced | 0.02 ±0.141 (Not Significant) | -0.045 ± 0.133 (Not Significant) |
| Slope not forced | 0.996 ± 0.008 (Not Significant) | 1.004 ± 0.007 (Not Significant) |
| R squared | 0.902 | 0.913 |
| No of Measurements | 1678 | 1669 |

## Figure A-1. Time Plot




## Figure A-2. Regression Plot



# Appendix E-B – Air Pollution Reports from the AQMesh Sensors and Automatic Sites

## Automatic Sites

Fife Cupar

01/01/2021 to 31/12/2021

These data have been fully ratified

Correction Factor for Gravimetric Equivalence applied

| | V High (No. of Days) | High (No. of Days) | Mod (No. of Days) | Low (No. of Days) | Max. Hourly Conc. | Max. Daily Conc. | Max. Running 8 Hour Mean | Max. Running 24 Hour Mean | Period Mean Conc. | Period Data Capture (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| **NO (µg/m³)** | 0 | 0 | 0 | 0 | 271 | 94 | 193 | 94 | 18 | 92.2 |
| **$NO_2$ (µg/m³)** | 0 | 0 | 0 | 346 | 118 | 52 | 81 | 62 | 20 | 92.0 |
| **$PM_{10}$ (µg/m³)** | 0 | 0 | 0 | 348 | 115 | 40 | 91 | 42 | 13 | 95.8 |
| **$PM_{2.5}$ (µg/m³)** | 0 | 0 | 0 | 348 | 64 | 24 | 38 | 31 | 6 | 95.8 |

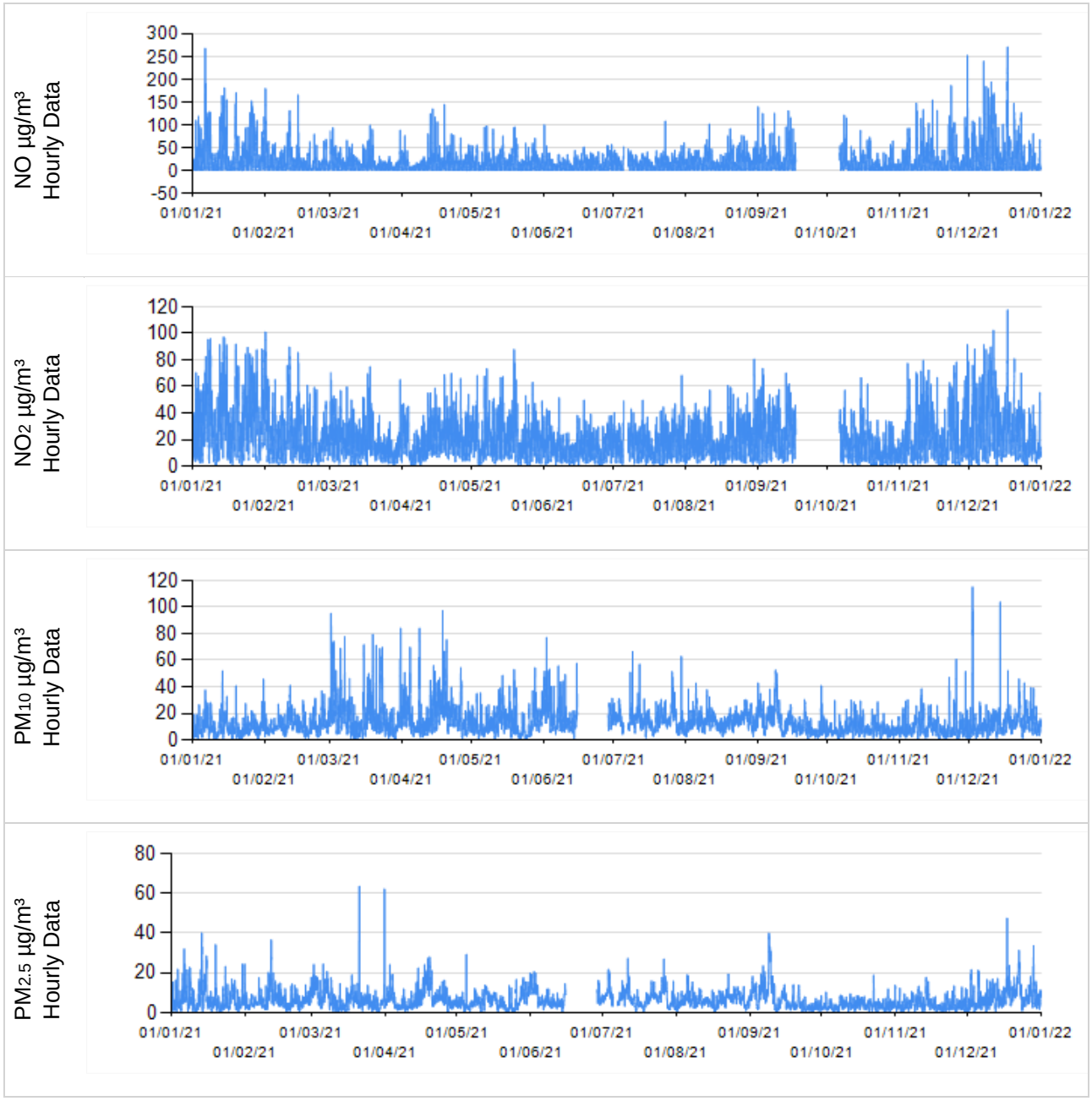
$PM_{10}$ as measured by a TEOM using a gravimetric factor of 1.3 for Indicative Gravimetric Equivalent

$PM_{2.5}$ as measured by a TEOM

Particulate matter concentrations are reported at ambient temperature and pressure.

All mass units are at 20°C and 1013mb.

| | Air Quality Objective | Exceedances | Days |
|---|---|---|---|
| **$NO_2$** | Hourly mean > 200 µg/m³ | None | 0 |
| **$NO_2$** | Period mean > annual mean obj 40 µg/m³ | No | |
| **$PM_{10}$** | Daily mean > 50 µg/m³ | None | 0 |
| **$PM_{10}$** | Period mean > annual mean obj 40 µg/m³ | No | |
| **$PM_{2.5}$** | Period mean > annual mean obj 10 µg/m³ (Scotland) | No | |
| **$PM_{2.5}$** | Period mean > annual mean obj 20 µg/m³ (EU) | No | |
| **$PM_{2.5}$** | Period mean > annual mean obj 25 µg/m³ (UK) | No | |
| Note: When comparing site measurements against the air quality objectives data capture should meet or exceed 90% across a calendar year. | | | |


NO µg/m³ Hourly Data
300
250
200
150
100
50
0
-50
01/01/21
01/02/21
01/03/21
01/04/21
01/05/21
01/06/21
01/07/21
01/08/21
01/09/21
01/10/21
01/11/21
01/12/21
01/01/22
NO2 µg/m³ Hourly Data
120
100
80
60
40
20
0
PM10 µg/m³ Hourly Data
PM2.5 µg/m³ Hourly Data
80
60
40
20
0

Fife Dunfermline

01/01/2021 to 31/12/2021

These data have been fully ratified

Correction Factor for Gravimetric Equivalence applied

| | V High (No. of Days) | High (No. of Days) | Mod (No. of Days) | Low (No. of Days) | Max. Hourly Conc. | Max. Daily Conc. | Max. Running 8 Hour Mean | Max. Running 24 Hour Mean | Period Mean Conc. | Period Data Capture (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| **NO (µg/m³)** | 0 | 0 | 0 | 0 | 165 | 66 | 100 | 66 | 7 | 95.4 |
| **$NO_2$ (µg/m³)** | 0 | 0 | 0 | 356 | 84 | 45 | 73 | 53 | 16 | 95.4 |
| **$PM_{10}$ (µg/m³)** | 0 | 0 | 0 | 351 | 320 | 47 | 84 | 50 | 10 | 96.7 |
| **$PM_{2.5}$ (µg/m³)** | 0 | 0 | 0 | 351 | 225 | 25 | 47 | 26 | 6 | 96.7 |

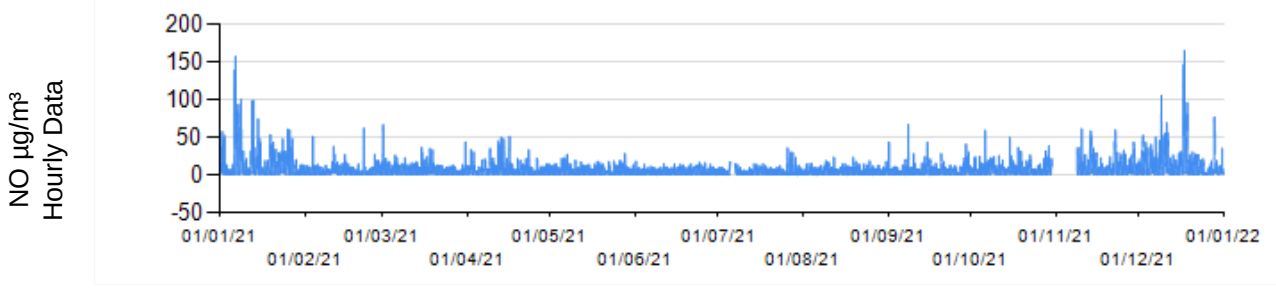
PM10 as measured by a TEOM using a gravimetric factor of 1.3 for Indicative Gravimetric Equivalent

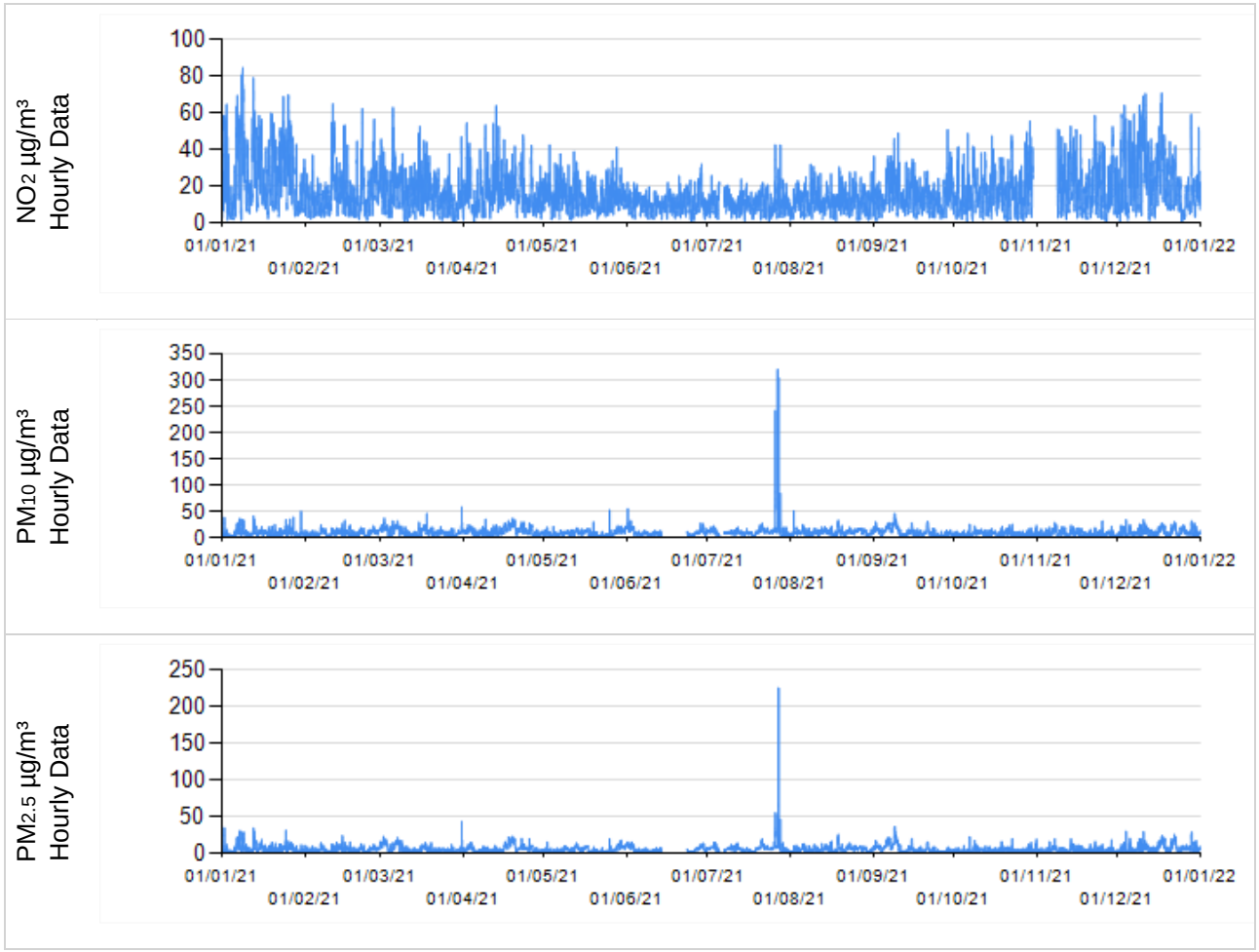
PM2.5 as measured by a TEOM

Particulate matter concentrations are reported at ambient temperature and pressure.

All mass units are at 20°C and 1013mb.

| | Air Quality Objective | Exceedances | Days |
|---|---|---|---|
| **$NO_2$** | Hourly mean > 200 µg/m³ | None | 0 |
| **$NO_2$** | Period mean > annual mean obj 40 µg/m³ | No | |
| **$PM_{10}$** | Daily mean > 50 µg/m³ | None | 0 |
| **$PM_{10}$** | Period mean > annual mean obj 40 µg/m³ | No | |
| **$PM_{2.5}$** | Period mean > annual mean obj 10 µg/m³ (Scotland) | No | |
| **$PM_{2.5}$** | Period mean > annual mean obj 20 µg/m³ (EU) | No | |
| **$PM_{2.5}$** | Period mean > annual mean obj 25 µg/m³ (UK) | No | |
| Note: When comparing site measurements against the air quality objectives data capture should meet or exceed 90% across a calendar year. | | | |




NO2 µg/m³ Hourly Data
100
80
60
40
20
0
01/01/21
01/02/21
01/03/21
01/04/21
01/05/21
01/06/21
01/07/21
01/08/21
01/09/21
01/10/21
01/11/21
01/12/21
01/01/22
PM10 µg/m³ Hourly Data
350
300
250
200
150
100
50
0
PM2.5 µg/m³ Hourly Data
250
200
150
100
50
0

Fife Appin Crescent East

01/01/2021 to 31/12/2021

Ad-hoc monitoring job with AQMesh.

Note: These data are provisional

Correction Factor for Gravimetric Equivalence applied

| | V High (No. of Days) | High (No. of Days) | Mod (No. of Days) | Low (No. of Days) | Max. Hourly Conc. | Max. Daily Conc. | Max. Running 8 Hour Mean | Max. Running 24 Hour Mean | Period Mean Conc. | Period Data Capture (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| **NO (µg/m³)** | 0 | 0 | 0 | 0 | 325 | 125 | 198 | 125 | 19 | 86.3 |
| **$NO_2$ (µg/m³)** | 0 | 0 | 0 | 320 | 152 | 65 | 99 | 70 | 20 | 86.1 |
| **$PM_{10}$ (µg/m³)** | 0 | 0 | 0 | 301 | 203 | 50 | 88 | 56 | 9 | 83.6 |
| **$PM_{2.5}$ (µg/m³)** | 0 | 0 | 0 | 301 | 113 | 30 | 41 | 32 | 5 | 83.6 |

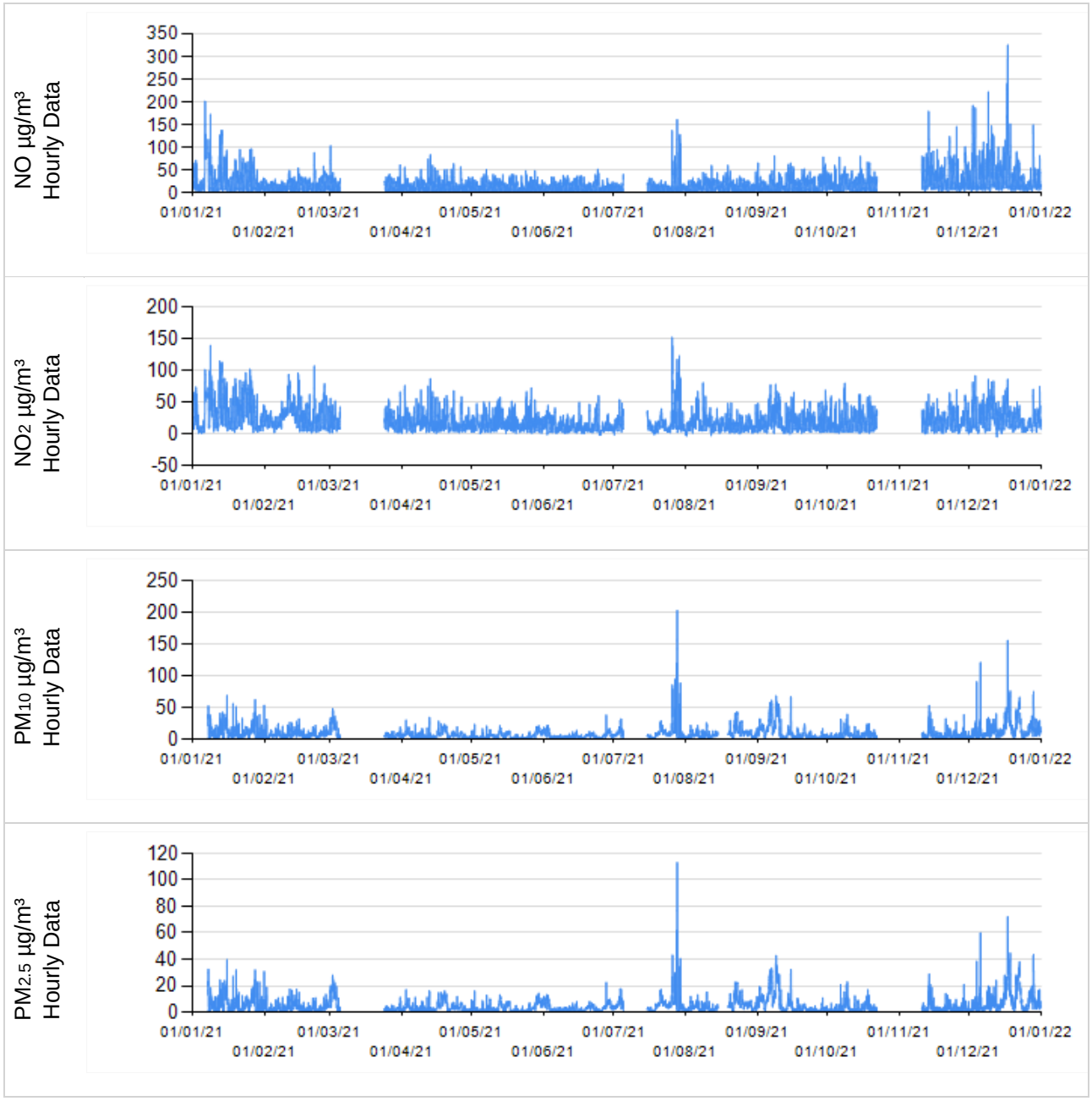
PM10 as measured by a TEOM using a gravimetric factor of 1.3 for Indicative Gravimetric Equivalent

PM2.5 as measured by a TEOM

Particulate matter concentrations are reported at ambient temperature and pressure.

All mass units are at 20°C and 1013mb.

| | Air Quality Objective | Exceedances | Days |
|---|---|---|---|
| **$NO_2$** | Hourly mean > 200 µg/m³ | None | 0 |
| **$NO_2$** | Period mean > annual mean obj 40 µg/m³ | No | |
| **$PM_{10}$** | Daily mean > 50 µg/m³ | None | 0 |
| **$PM_{10}$** | Period mean > annual mean obj 40 µg/m³ | No | |
| **$PM_{2.5}$** | Period mean > annual mean obj 10 µg/m³ (Scotland) | No | |
| **$PM_{2.5}$** | Period mean > annual mean obj 20 µg/m³ (EU) | No | |
| **$PM_{2.5}$** | Period mean > annual mean obj 25 µg/m³ (UK) | No | |
| Note: When comparing site measurements against the air quality objectives data capture should meet or exceed 90% across a calendar year. | | | |


NO µg/m³ Hourly Data
350
300
250
200
150
100
50
0
01/01/21
01/02/21
01/03/21
01/04/21
01/05/21
01/06/21
01/07/21
01/08/21
01/09/21
01/10/21
01/11/21
01/12/21
01/01/22
NO2 µg/m³ Hourly Data
200
150
100
50
0
-50
PM10 µg/m³ Hourly Data
250
200
150
100
50
0
PM2.5 µg/m³ Hourly Data
120
100
80
60
40
20
0

Fife Appin Crescent West

01/01/2021 to 31/12/2021

Ad-hoc monitoring job with AQMesh.

Note: These data are provisional

Correction Factor for Gravimetric Equivalence applied

| | V High (No. of Days) | High (No. of Days) | Mod (No. of Days) | Low (No. of Days) | Max. Hourly Conc. | Max. Daily Conc. | Max. Running 8 Hour Mean | Max. Running 24 Hour Mean | Period Mean Conc. | Period Data Capture (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| **NO (µg/m³)** | 0 | 0 | 0 | 0 | 329 | 134 | 211 | 134 | 21 | 86.4 |
| **$NO_2$ (µg/m³)** | 0 | 0 | 0 | 320 | 120 | 42 | 66 | 46 | 18 | 86.2 |
| **$PM_{10}$ (µg/m³)** | 0 | 0 | 0 | 308 | 538 | 37 | 104 | 53 | 8 | 85.3 |
| **$PM_{2.5}$ (µg/m³)** | 0 | 0 | 0 | 308 | 250 | 26 | 53 | 30 | 5 | 85.3 |

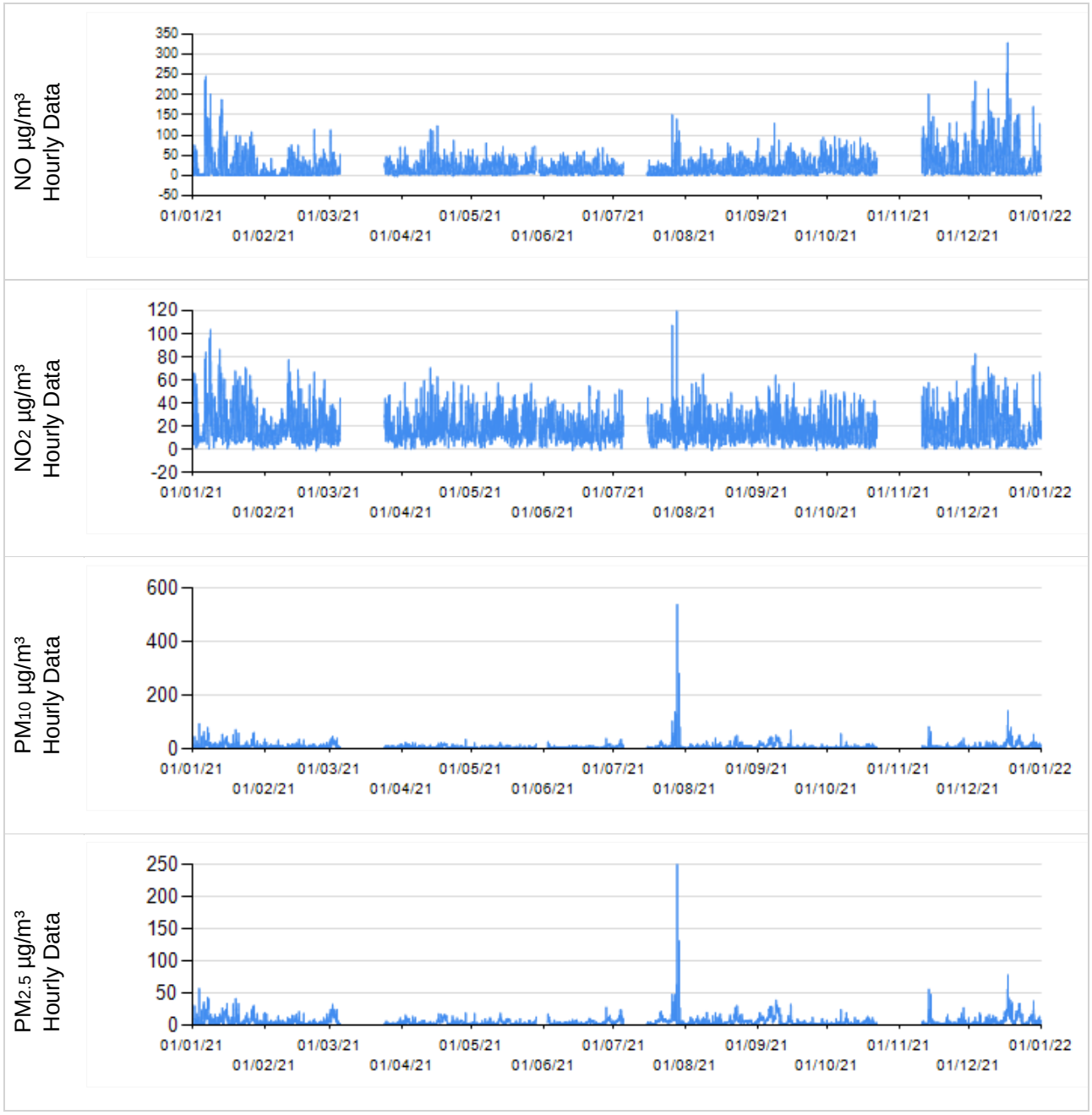
PM10 as measured by a TEOM using a gravimetric factor of 1.3 for Indicative Gravimetric Equivalent

PM2.5 as measured by a TEOM

Particulate matter concentrations are reported at ambient temperature and pressure.

All mass units are at 20°C and 1013mb.

| | Air Quality Objective | Exceedances | Days |
|---|---|---|---|
| **$NO_2$** | Hourly mean > 200 µg/m³ | None | 0 |
| **$NO_2$** | Period mean > annual mean obj 40 µg/m³ | No | |
| **$PM_{10}$** | Daily mean > 50 µg/m³ | None | 0 |
| **$PM_{10}$** | Period mean > annual mean obj 40 µg/m³ | No | |
| **$PM_{2.5}$** | Period mean > annual mean obj 10 µg/m³ (Scotland) | No | |
| **$PM_{2.5}$** | Period mean > annual mean obj 20 µg/m³ (EU) | No | |
| **$PM_{2.5}$** | Period mean > annual mean obj 25 µg/m³ (UK) | No | |
| Note: When comparing site measurements against the air quality objectives data capture should meet or exceed 90% across a calendar year. | | | |


NO µg/m³ Hourly Data
350
300
250
200
150
100
50
0
-50
01/01/21
01/02/21
01/03/21
01/04/21
01/05/21
01/06/21
01/07/21
01/08/21
01/09/21
01/10/21
01/11/21
01/12/21
01/01/22
NO2 µg/m³ Hourly Data
120
100
80
60
40
20
0
-20
PM10 µg/m³ Hourly Data
600
400
200
0
PM2.5 µg/m³ Hourly Data
250
200
150
100
50
0

Fife Bonnygate

01/01/2021 to 31/12/2021

Ad-hoc monitoring job with AQMesh.

Note: These data are provisional

Correction Factor for Gravimetric Equivalence applied

| | V High (No. of Days) | High (No. of Days) | Mod (No. of Days) | Low (No. of Days) | Max. Hourly Conc. | Max. Daily Conc. | Max. Running 8 Hour Mean | Max. Running 24 Hour Mean | Period Mean Conc. | Period Data Capture (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| **NO (µg/m³)** | 0 | 0 | 0 | 0 | 409 | 154 | 302 | 154 | 37 | 84.1 |
| **$NO_2$ (µg/m³)** | 0 | 0 | 0 | 311 | 151 | 64 | 104 | 66 | 25 | 84.0 |
| **$PM_{10}$ (µg/m³)** | 0 | 0 | 1 | 295 | 163 | 59 | 77 | 69 | 11 | 81.9 |
| **$PM_{2.5}$ (µg/m³)** | 0 | 0 | 1 | 295 | 115 | 38 | 53 | 46 | 7 | 81.9 |

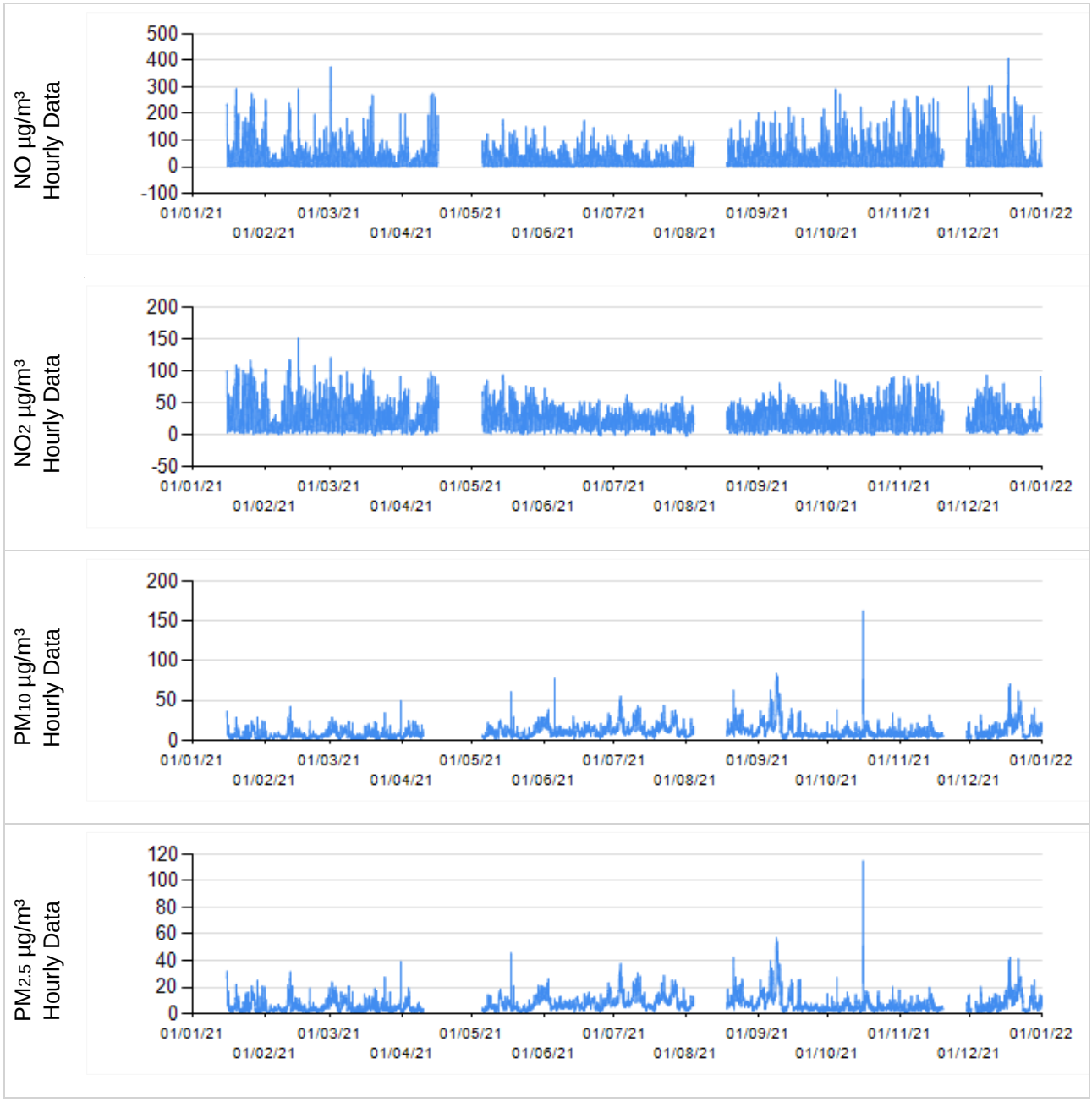
PM10 as measured by a TEOM using a gravimetric factor of 1.3 for Indicative Gravimetric Equivalent

PM2.5 as measured by a TEOM

Particulate matter concentrations are reported at ambient temperature and pressure.

All mass units are at 20°C and 1013mb.

| | Air Quality Objective | Exceedances | Days |
|---|---|---|---|
| **$NO_2$** | Hourly mean > 200 µg/m³ | None | 0 |
| **$NO_2$** | Period mean > annual mean obj 40 µg/m³ | No | |
| **$PM_{10}$** | Daily mean > 50 µg/m³ | 1 | 1 |
| **$PM_{10}$** | Period mean > annual mean obj 40 µg/m³ | No | |
| **$PM_{2.5}$** | Period mean > annual mean obj 10 µg/m³ (Scotland) | No | |
| **$PM_{2.5}$** | Period mean > annual mean obj 20 µg/m³ (EU) | No | |
| **$PM_{2.5}$** | Period mean > annual mean obj 25 µg/m³ (UK) | No | |
| Note: When comparing site measurements against the air quality objectives data capture should meet or exceed 90% across a calendar year. | | | |


NO µg/m³ Hourly Data
500
400
300
200
100
0
-100
01/01/21
01/02/21
01/03/21
01/04/21
01/05/21
01/06/21
01/07/21
01/08/21
01/09/21
01/10/21
01/11/21
01/12/21
01/01/22
NO2 µg/m³ Hourly Data
200
150
100
50
0
-50
PM10 µg/m³ Hourly Data
PM2.5 µg/m³ Hourly Data
120
100
80
60
40
20

## Appendix E-C – Summary of Air Quality Objectives in Scotland

| AQ Objective-Pollutant | Concentration | 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 |
| | 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 |
| | 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 |
| | 125 µg $m^{-3}$, not to be exceeded more than 3 times a year | 24-hour mean | 31.12.2004 |
| | 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 |
| Lead | 0.25 µg $m^{-3}$ | Annual Mean | 31.12.2008 |

# Appendix E-D – Table of Annual Results for AQMesh and Automatic Sites (2018 – 2021)

Table D.1. Dunfermline Sites $NO_2$ Annual Mean (µg $m^{-3}$) (2018 – 2021)

| | Appin Crescent West | Appin Crescent East | Fife Dunfermline |
|---|---|---|---|
| 2018 | 31 | 31 | 22 |
| 2019 | 25 | 31 | 21 |
| 2020 | 21 | 17 | 15 |
| 2021 | 18 | 20 | 16 |

Table D.2. Dunfermline Sites $PM_{10}$ Annual Mean (µg $m^{-3}$) (2018 – 2021)

| | Appin Crescent West | Appin Crescent East | Fife Dunfermline |
|---|---|---|---|
| 2018 | 14 | 15 | 11 |
| 2019 | 11 | 13 | 11 |
| 2020 | 7 | 7.7 | 8 |
| 2021 | 8 | 9 | 10 |

Table D.3. Dunfermline Sites $PM_{2.5}$ Annual Mean (µg $m^{-3}$) (2018 – 2021)

| | Appin Crescent West | Appin Crescent East | Fife Dunfermline |
|---|---|---|---|
| 2018 | 7 | 6 | 6 |
| 2019 | 7 | 7 | 6 |
| 2020 | 5 | 4.8 | 5 |
| 2021 | 5 | 5 | 6 |

Table D.4. Cupar Sites $NO_2$ Annual Mean (µg $m^{-3}$) (2018 – 2021)

| | Bonnygate | Fife Cupar |
|---|---|---|
| 2018 | 39 | 26 |
| 2019 | 30 | 24 |
| 2020 | 21 | 21 |
| 2021 | 25 | 20 |

Table D.5. Cupar Sites $PM_{10}$ Annual Mean (µg $m^{-3}$) (2018 – 2021)

| | Bonnygate | Fife Cupar |
|---|---|---|
| 2018 | 13 | 14 |
| 2019 | 23.7 | 15 |
| 2020 | 10 | 11 |
| 2021 | 11 | 13 |

Table D.6. Cupar Sites $PM_{2.5}$ Annual Mean (µg $m^{-3}$) (2018 – 2021)

| | Bonnygate | Fife Cupar |
|---|---|---|
| 2018 | 8 | 7 |
| 2019 | 11 | 8 |
| 2020 | 6 | 6 |
| 2021 | 7 | 6 |

# Appendix F Dynamic Report

A dynamic style report containing embedded statistical data for Fife can be found here: https://www.scottishairquality.scot/assets/reports/372/Fife_annual_2021.html. The key areas have been extracted and included below however further detail can be found online. The embedded data allows the reader a level of interaction with some of the report findings, providing additional insight. This approach enables a more easily navigated and streamlined report providing an engaging and intuitive reader experience. The analysis has been carried out for the pollutants $NO_2$, $PM_{10}$ and $PM_{2.5}$ using the Openair analysis tool. This type of analysis helps the Council inform future policy making.

Openair is an innovative tool to analyse, interpret and understand air pollution data using "R". R is a free and open source programming language designed for the analysis of data. The Openair tool can perform complex and innovative analysis of current and archived air pollutant data allowing powerful data visualisation and interrogation. For this report Fife Council has utilised the following analysis tools;

- **Time variation** - This tool produces four separate panes combined into a single plot: The plotted output shows the average variation by day of the week and hour of the day combined (the top-most pane), hour of the day (diurnal variation, shown in the lower left pane), month of the year (seasonal variation in the lower middle pane) and day of week (lower right pane) of one or more variables or at one or multiple sites over a user selected time range. The plots have been created for all four automatic monitoring sites in Fife for the period 1st January – 31st December 2021. The variation of a pollutant by time of day and day of week can reveal useful information concerning the likely sources at a particular site.
- **Polar Plots** – This tool produces polar plots of pollutant concentrations by wind speed and wind direction. Polar plots are useful to gain a quick graphical representation of the relationship between pollutant concentrations and the meteorological conditions. This can be useful in identifying potential sources of pollution affecting the location, for example particle suspension is increased at higher wind speeds come from a specific direction.
- **Calendar Plots** – This tool provides a way of visualising trends in daily pollutant concentrations across a year in the familiar form of a calendar. Concentrations are represented with a colour scale and the meteorological conditions can be represented using arrows giving the vector averaged wind direction, scaled according to the wind speed based on modelled wind speed and direction from data from the UK air quality forecast. In this way pollution episodes can be identified by date and sources potentially indicated by the combination of pollutant and meteorological conditions.
- **Back trajectory Analysis Plots** – The back trajectory plots show data from the HYSPLIT model (NOAA HYSPLIT ) run in the analysis mode. This shows the air mass back trajectories for the period covered by this report. Two different kinds of plot are shown. One statistically groups the trajectories into similar clusters and shows the proportion of time during the report period that each represents. This is useful to get an overview of air mass origins during the report period. Plots in Trajectories associated with top ten most polluted days provide information on the trajectory direction associated with the top 10 measured concentrations.

Table F.1 Summary statistics for $NO_2$ (µg $m^{-3}$)

| Site | Mean | Data capture | Hourly max | Daily max | Low | Moderate | High | Hours exceeding | 99.8th Percentile | 98th Percentile | 95th Percentile | 50th Percentile |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fife Cupar | 20 | 92.0% | 117.6 | 51.8 | 346 | 0 | 0 | 0 | 88.2 | 66.8 | 52 | 15.7 |
| Fife Dunfermline | 16.1 | 95.4% | 84.4 | 45.5 | 356 | 0 | 0 | 0 | 67.3 | 49.7 | 40.3 | 13.2 |
| Fife Kirkcaldy | 14.1 | 99.9% | 105.9 | 50.3 | 365 | 0 | 0 | 0 | 73.8 | 49.6 | 37.2 | 10.9 |
| Fife Rosyth | 19.3 | 98.4% | 133.4 | 75.4 | 365 | 0 | 0 | 0 | 89.6 | 62 | 49.2 | 15.5 |

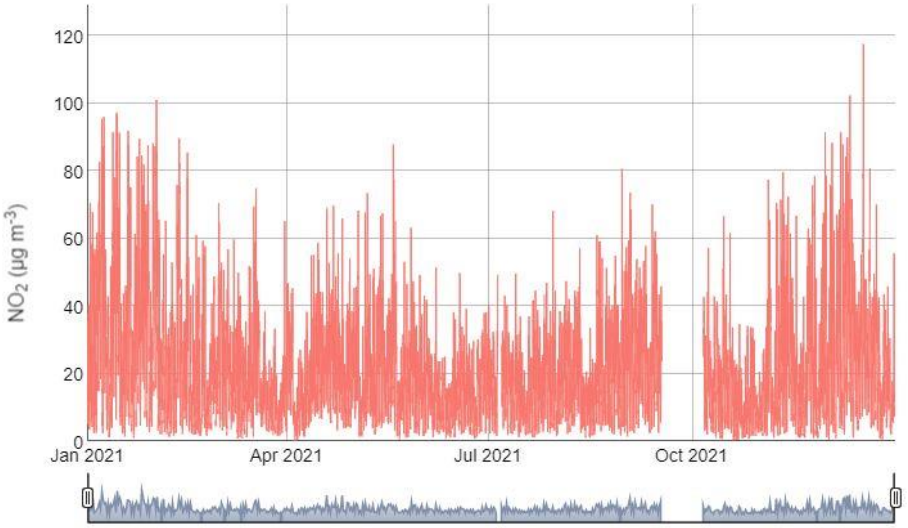
Table F.2 Summary statistics for $PM_{10}$ (µg $m^{-3}$)

| Site | Mean | Data capture | Hourly max | Max 24-hour mean | Low | Moderate | High | Days exceeding | 98th Percentile daily | 90th Percentile daily | 98th Percentile hourly | 95th Percentile hourly |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fife Cupar | 13 | 96% | 115.2 | 39.6 | 348 | 0 | 0 | 0 | 28.3 | 21.8 | 39.7 | 29 |
| Fife Dunfermline | 9.6 | 97% | 320.4 | 46.9 | 351 | 0 | 0 | 0 | 22.2 | 14.5 | 25.7 | 20.8 |
| Fife Kirkcaldy | 9.4 | 100% | 101.6 | 27.8 | 365 | 0 | 0 | 0 | 19.6 | 14.7 | 23.6 | 19.3 |
| Fife Rosyth | 10 | 54% | 126 | 29.4 | 197 | 0 | 0 | 0 | 21 | 17.4 | 26.9 | 21.9 |

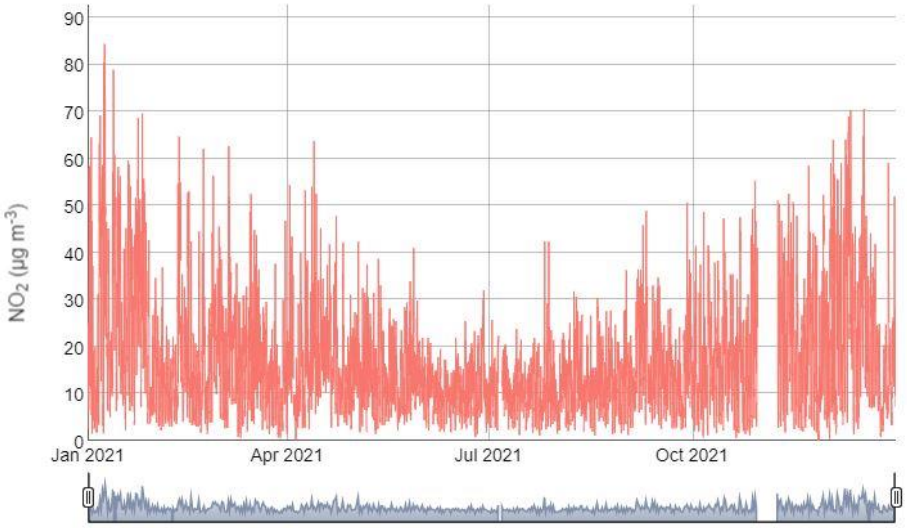
Table F.3 Summary statistics for $PM_{2.5}$ (µg $m^{-3}$)

| Site | Mean | Data capture | Max 24-hour mean | Low | Moderate | High |
|---|---|---|---|---|---|---|
| Fife Cupar | 6.3 | 96% | 24 | 348 | 0 | 0 |
| Fife Dunfermline | 5.5 | 97% | 24.6 | 351 | 0 | 0 |
| Fife Kirkcaldy | 5.3 | 100% | 21.1 | 365 | 0 | 0 |
| Fife Rosyth | 5.6 | 55% | 18.5 | 198 | 0 | 0 |

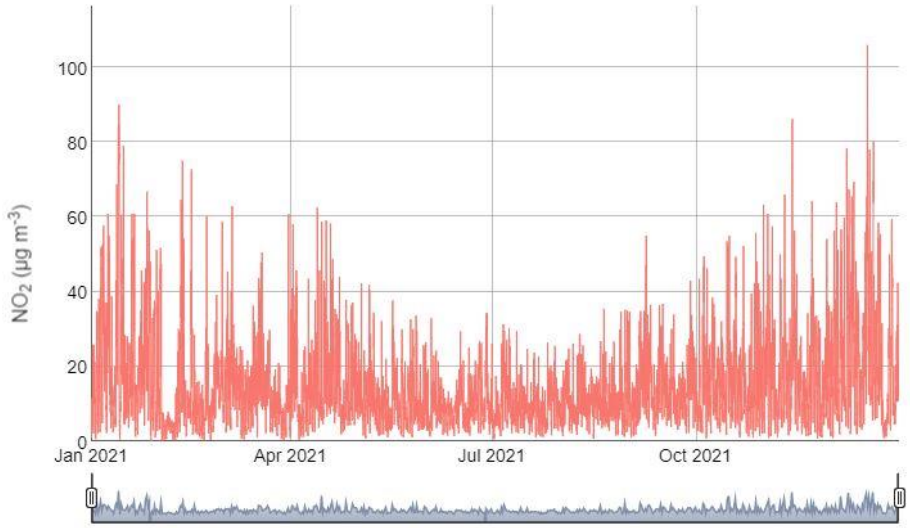
## Figure F-1 Cupar $NO_2$ time series



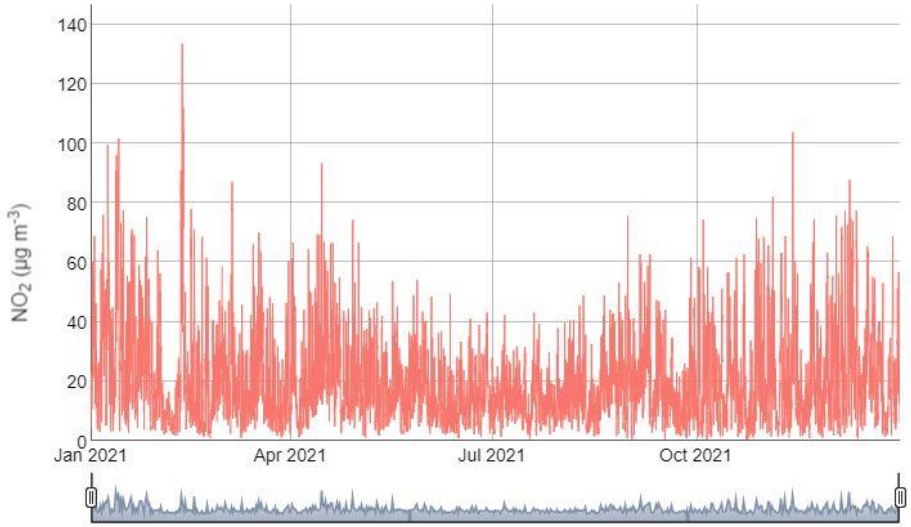

## Figure F-2 Dunfermline $NO_2$ time series



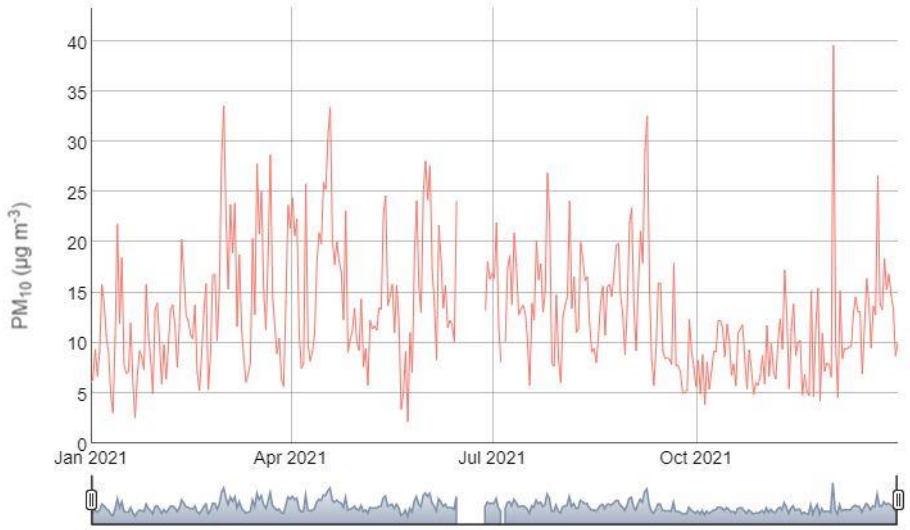

## Figure F-3 Kirkcaldy $NO_2$ time series



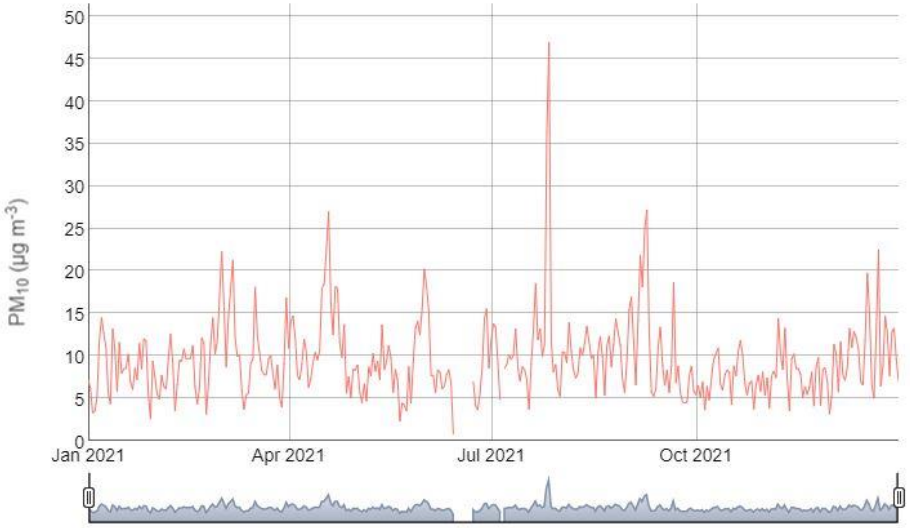

## Figure F-4 Rosyth $NO_2$ time series



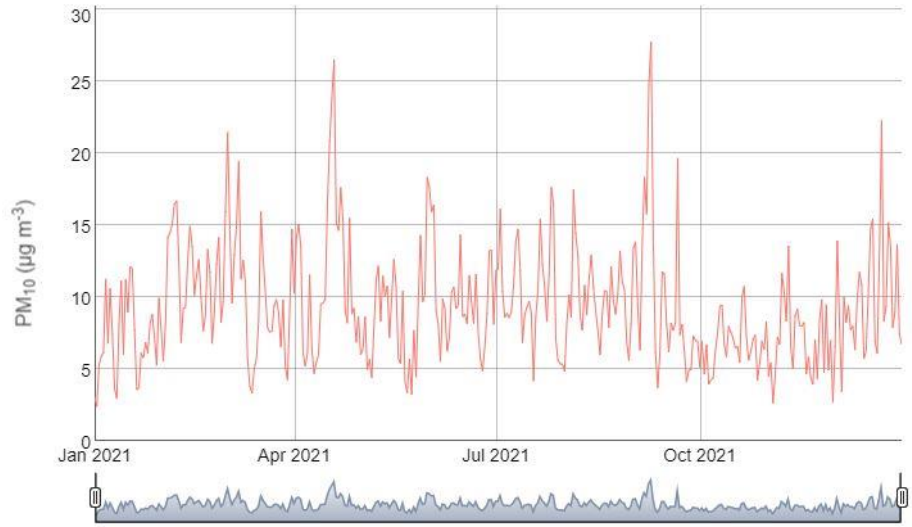
## Figure F-5 Cupar $PM_{10}$ time series



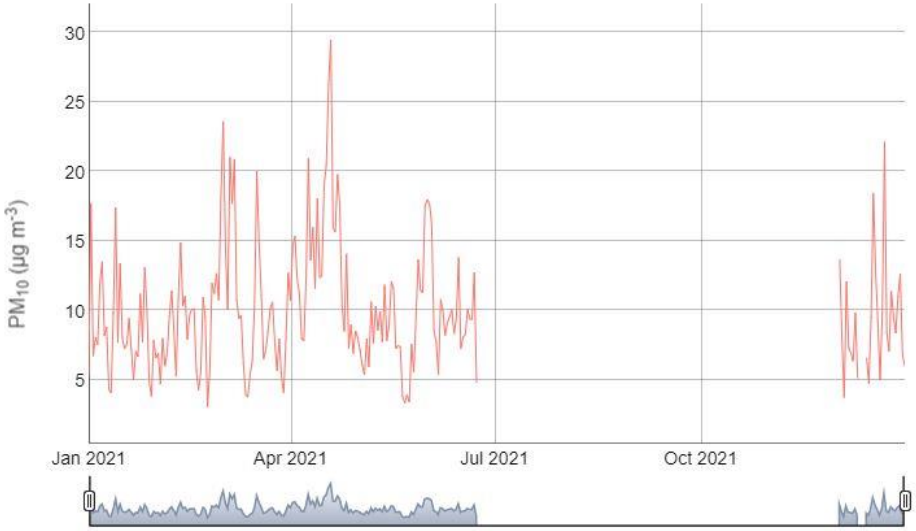

## Figure F-6 Dunfermline $PM_{10}$ time series



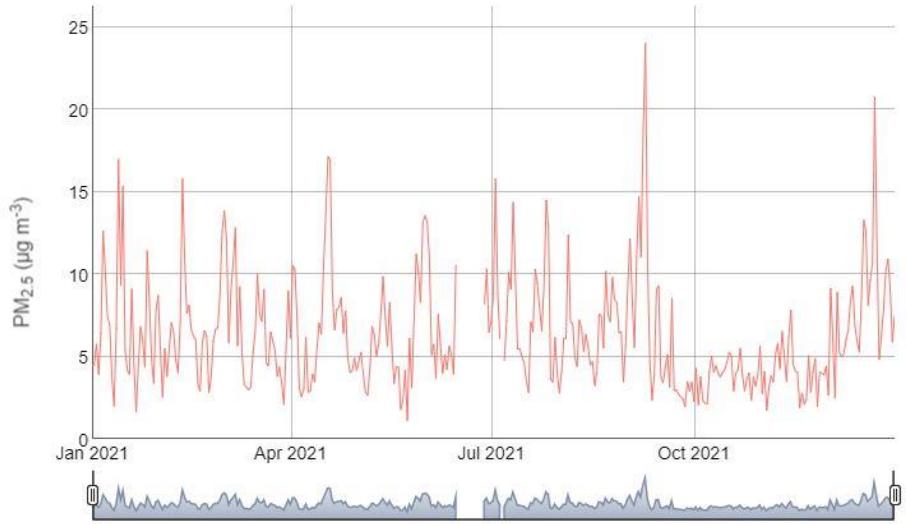

## Figure F-7 Kirkcaldy $PM_{10}$ time series



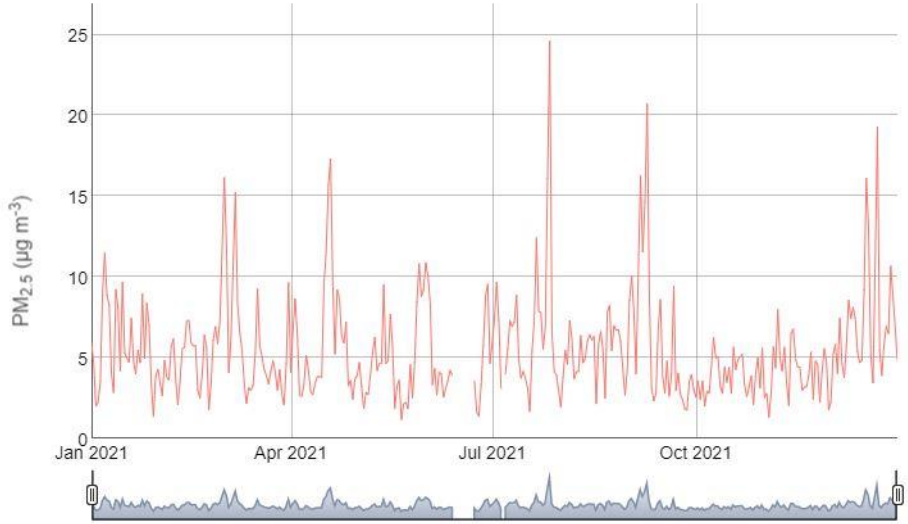

## Figure F-8 Rosyth $PM_{10}$ time series



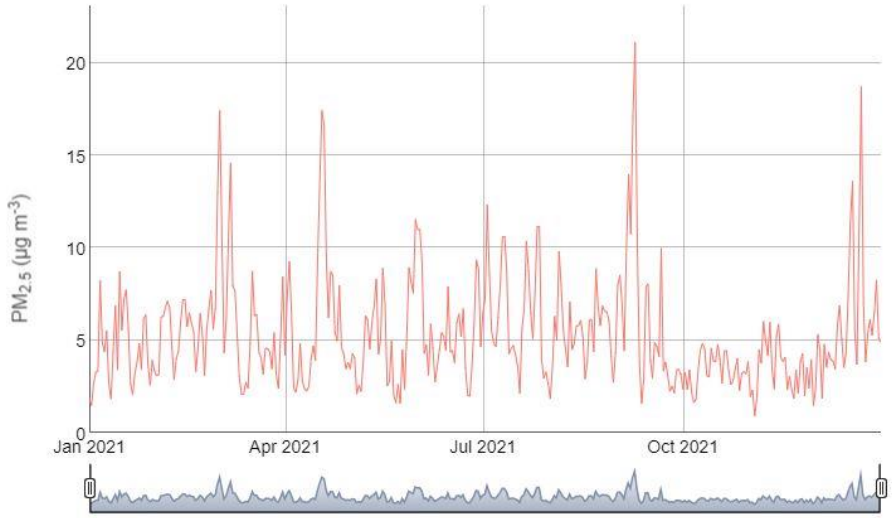
## Figure F-9 Cupar $PM_{2.5}$ time series



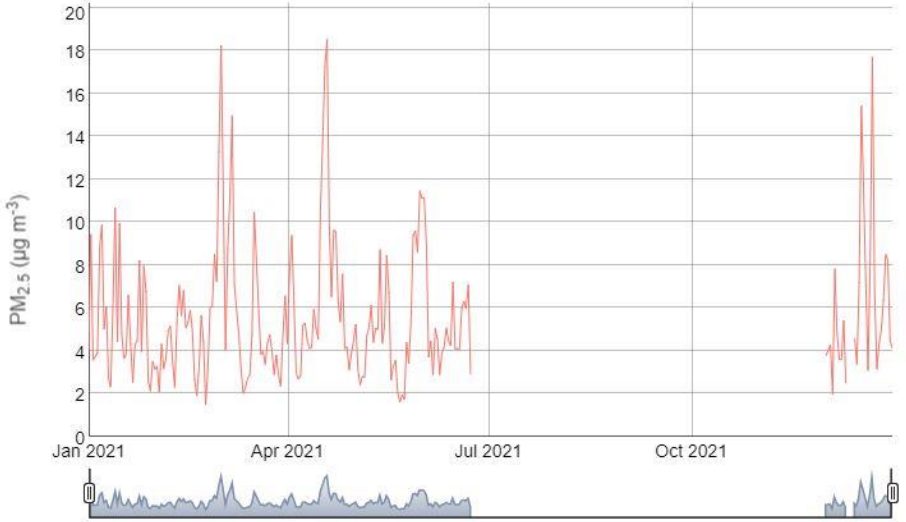

## Figure F-10 Dunfermline $PM_{2.5}$ time series



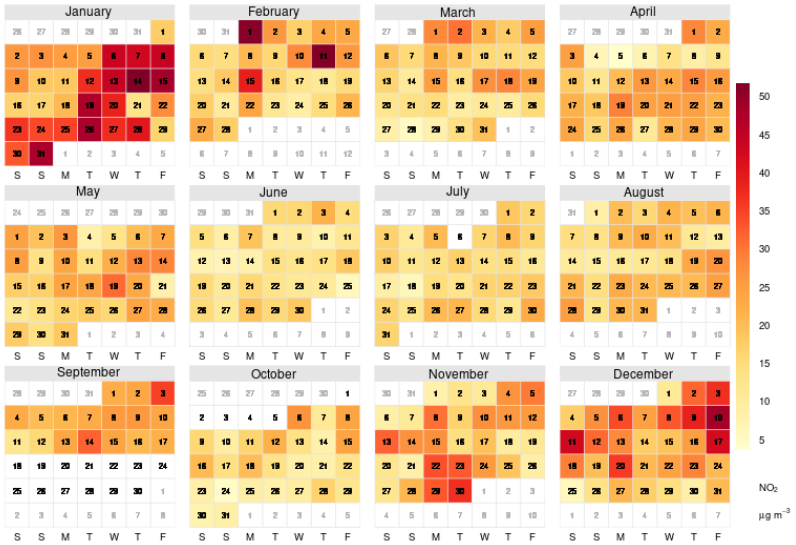

## Figure F-11 Kirkcaldy $PM_{2.5}$ time series



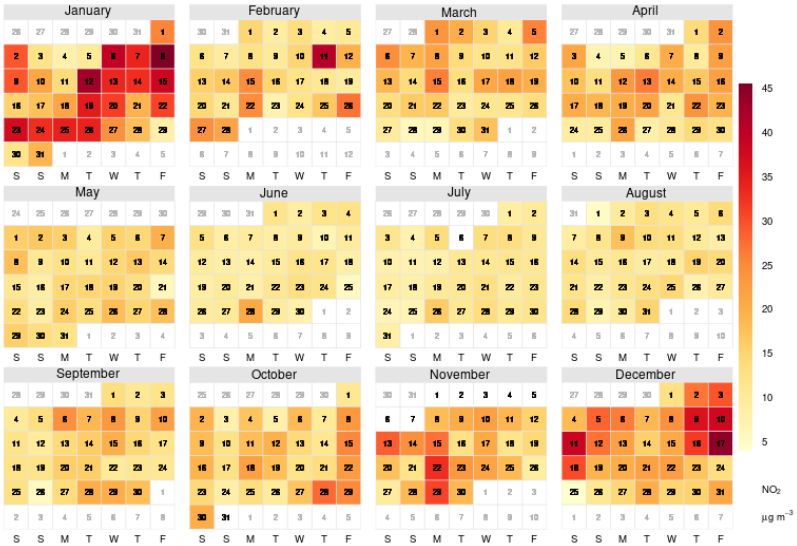

## Figure F-12 Rosyth $PM_{2.5}$ time series



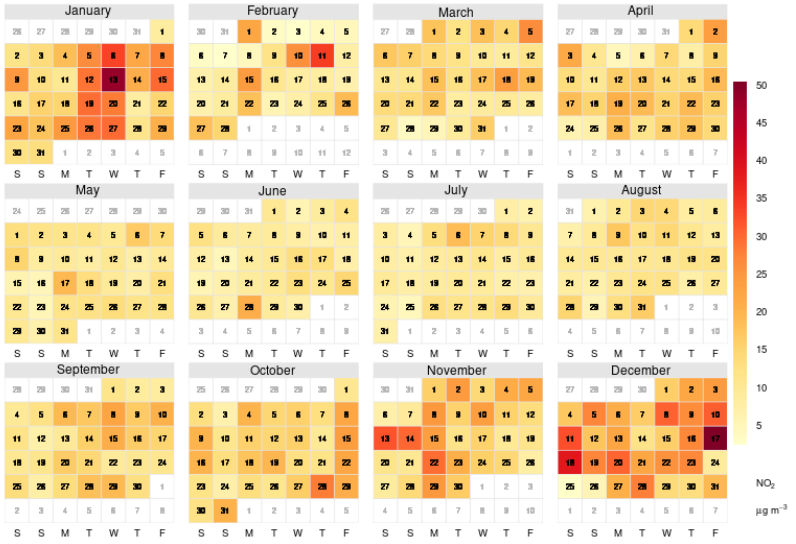
## Figure F-13 Cupar NO2 calendar plots



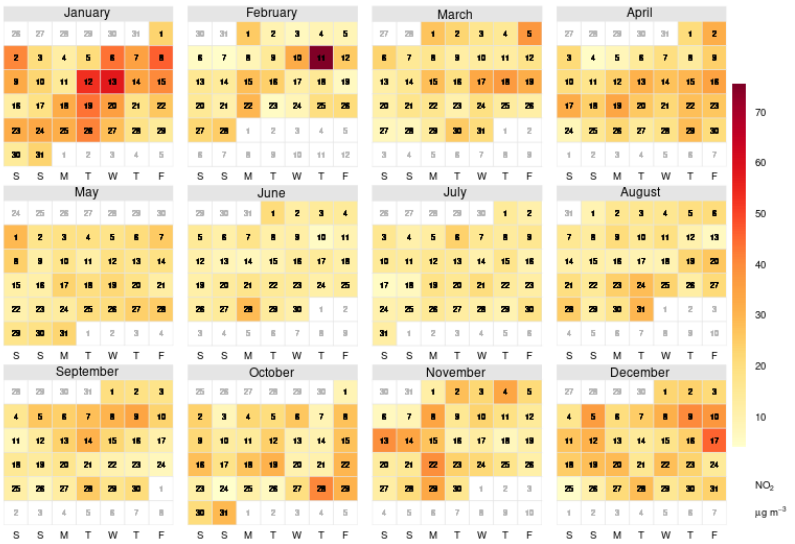

## Figure F-14 Dunfermline $NO_2$ calendar plots



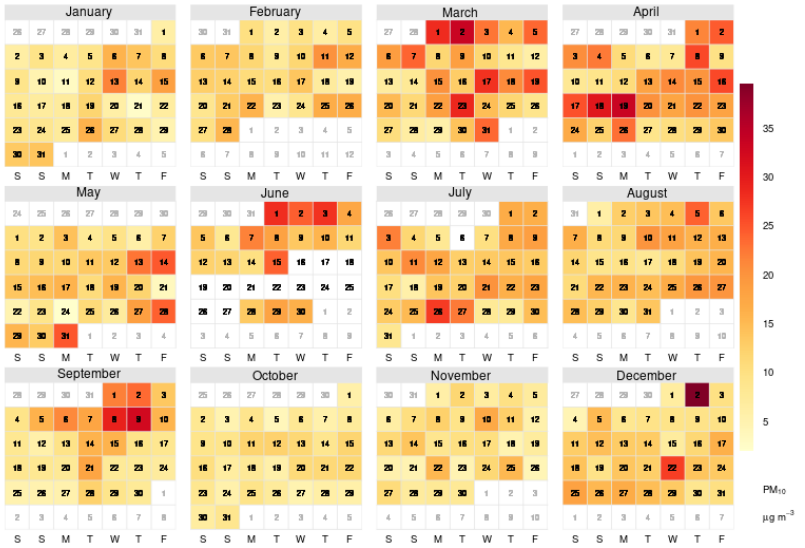

## Figure F-15 Kirkcaldy $NO_2$ calendar plots



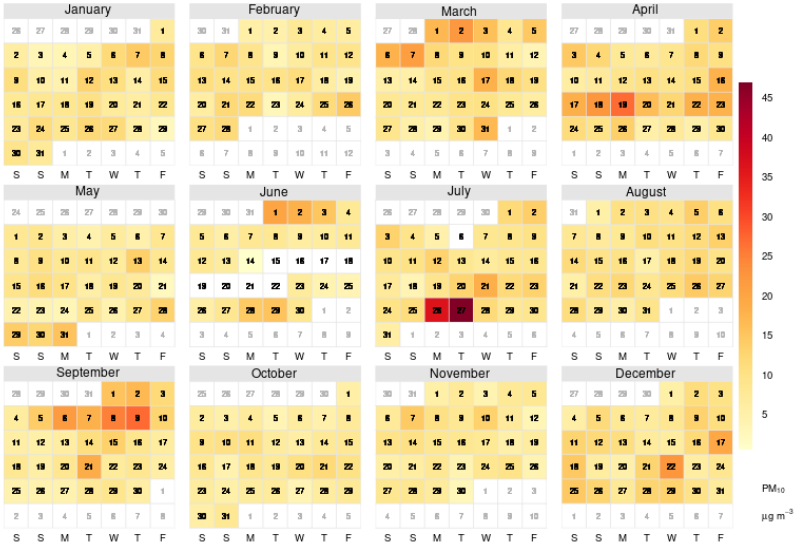

## Figure F-16 Rosyth $NO_2$ calendar plots



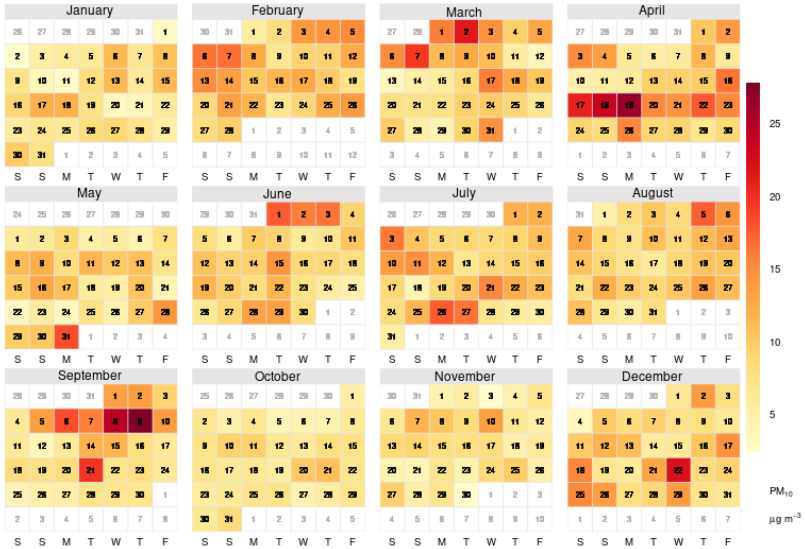
## Figure F-17 Cupar $PM_{10}$ calendar plots



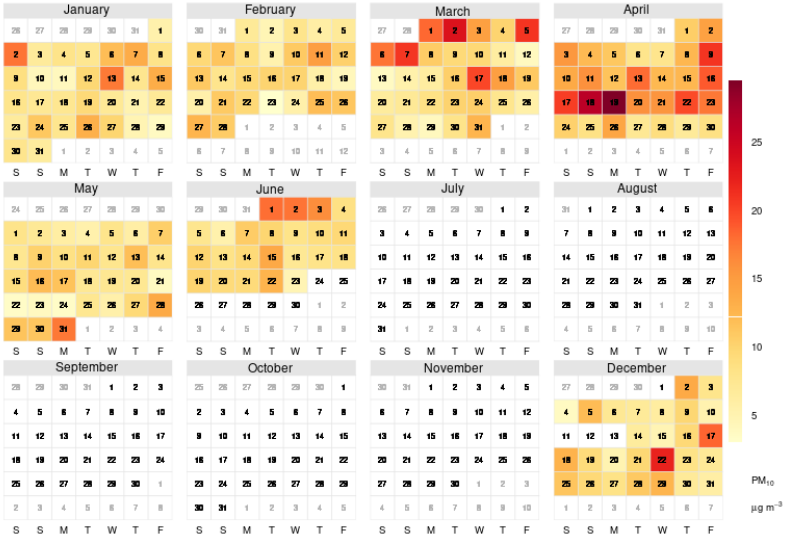

## Figure F-18 Dunfermline $PM_{10}$ calendar plots



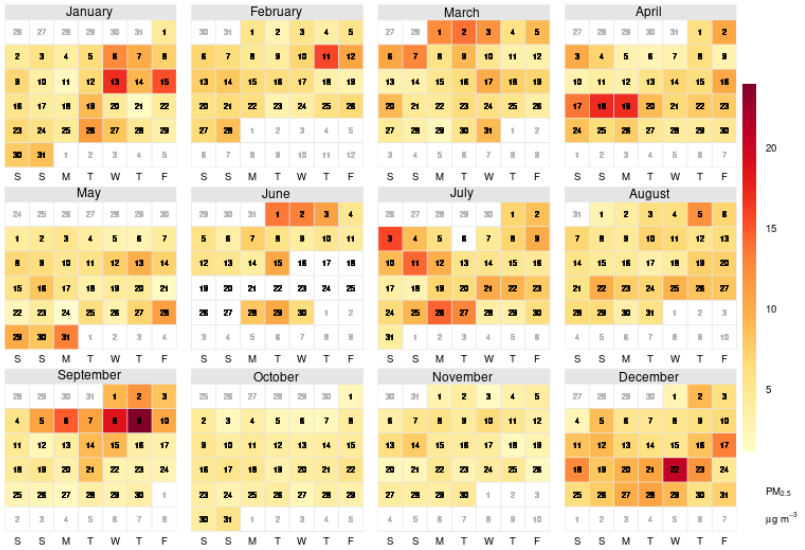

## Figure F-19 Kirkcaldy $PM_{10}$ calendar plots



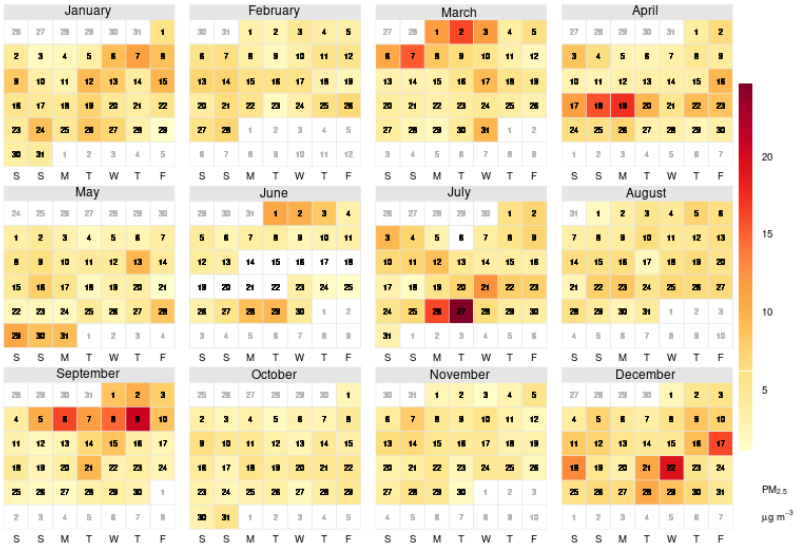

## Figure F-20 Rosyth $PM_{10}$ calendar plots



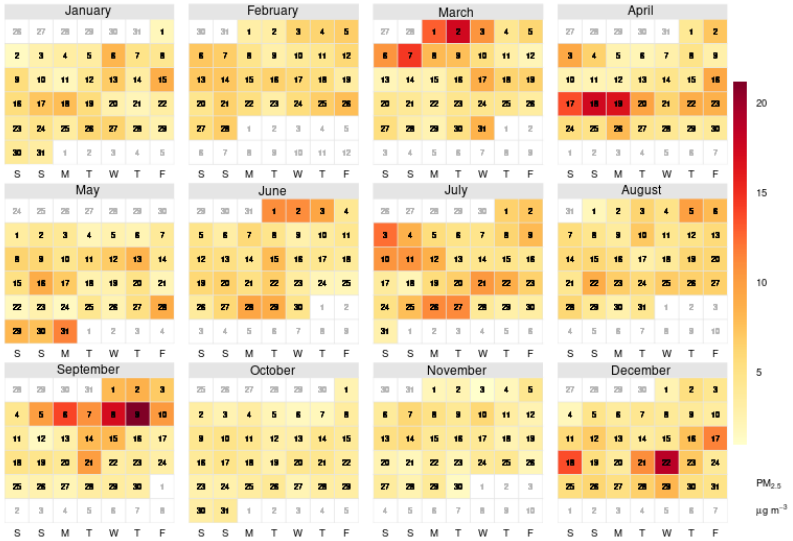
## Figure F-21 Cupar $PM_{2.5}$ calendar plots



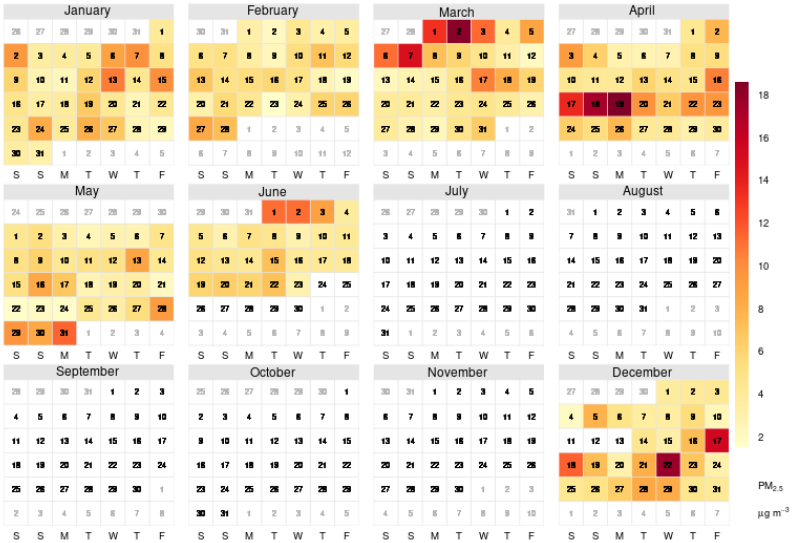

## Figure F-22 Dunfermline $PM_{2.5}$ calendar plots



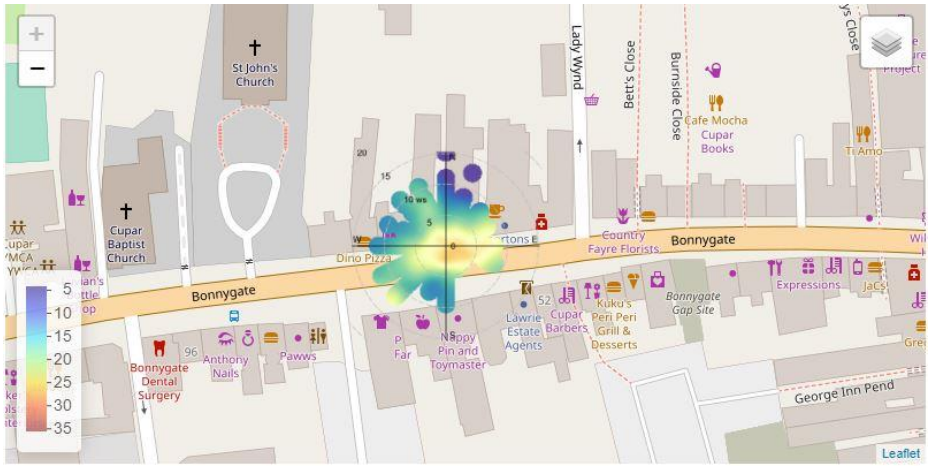

## Figure F-23 Kirkcaldy $PM_{2.5}$ calendar plots



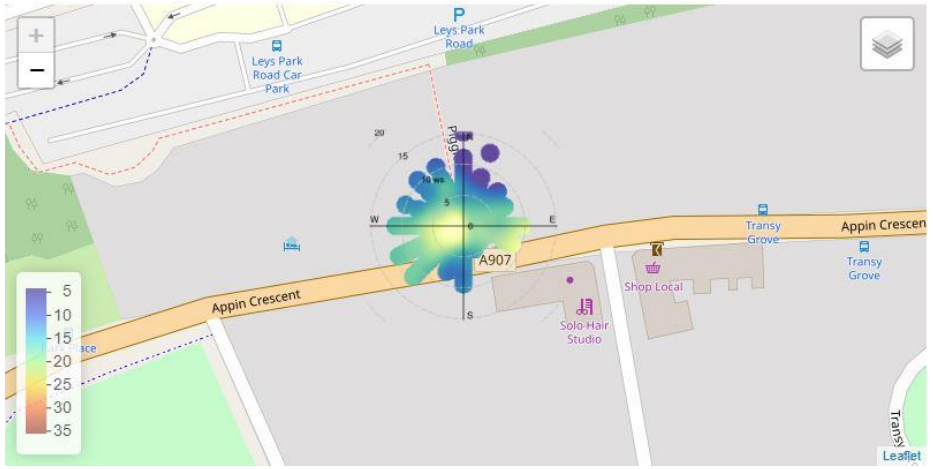

## Figure F-24 Rosyth $PM_{2.5}$ calendar plots



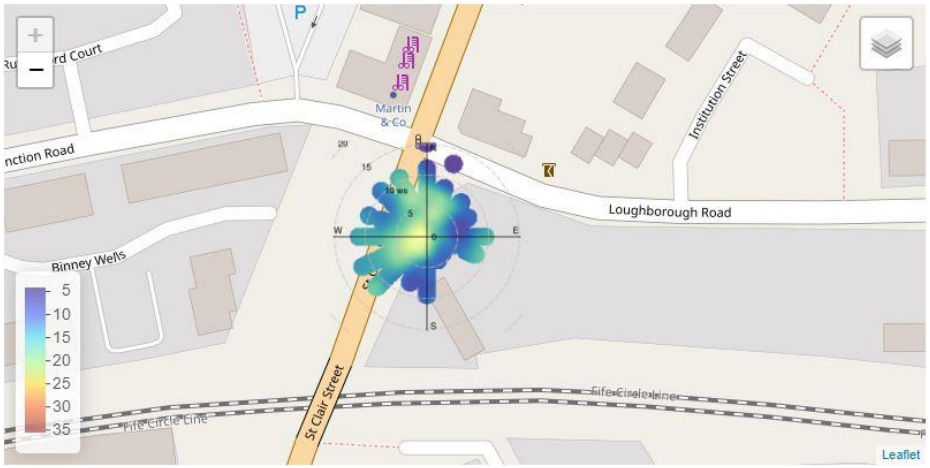
## Figure F-25 Cupar NO2 polar plot




## Figure F-26 Dunfermline $NO_2$ polar plot

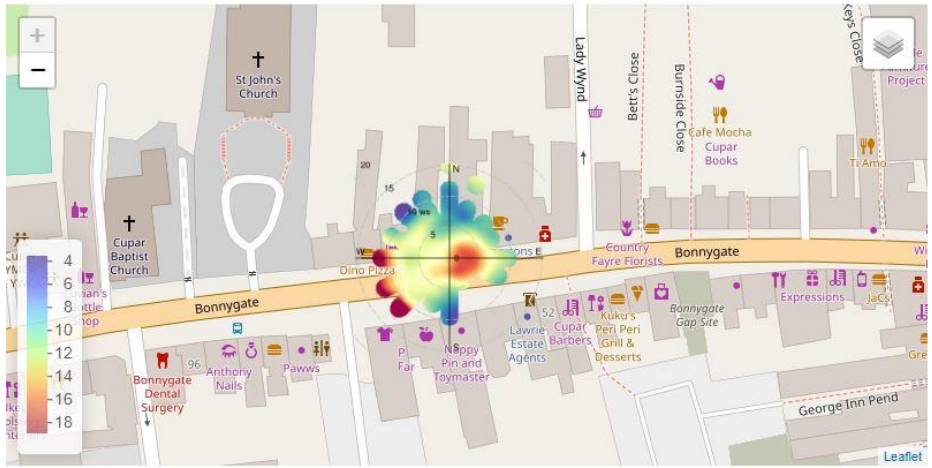



## Figure F-27 Kirkcaldy $NO_2$ polar plot

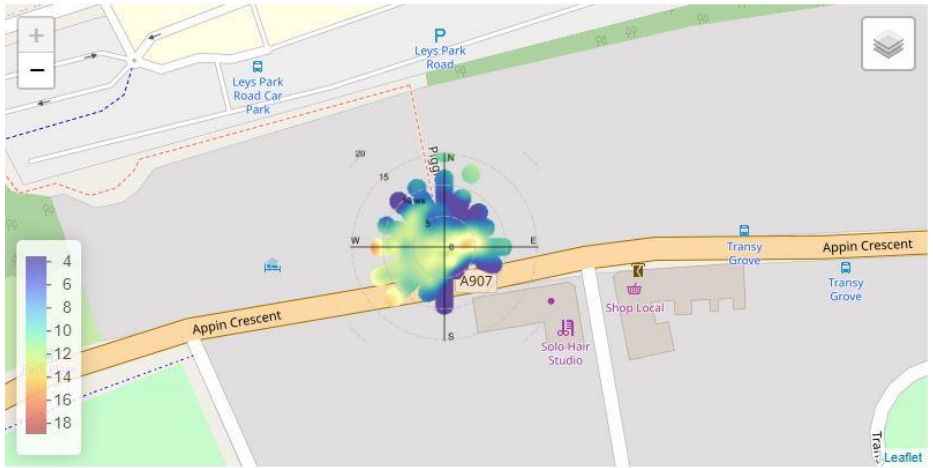



## Figure F-28 Rosyth $NO_2$ polar plot

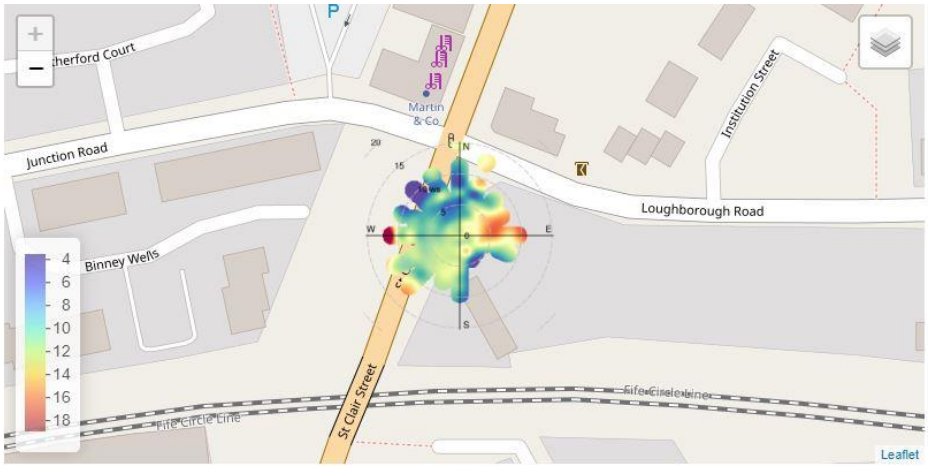
## Figure F-29 Cupar $PM_{10}$ polar plot



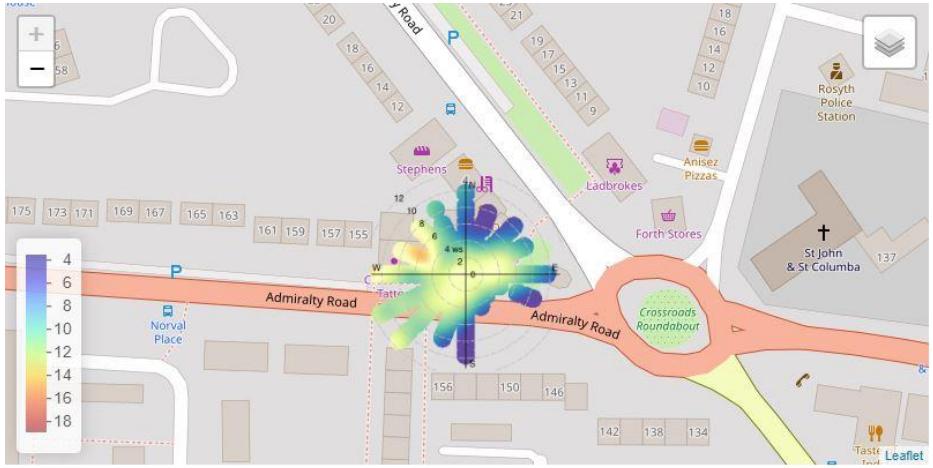

## Figure F-30 Dunfermline $PM_{10}$ polar plot



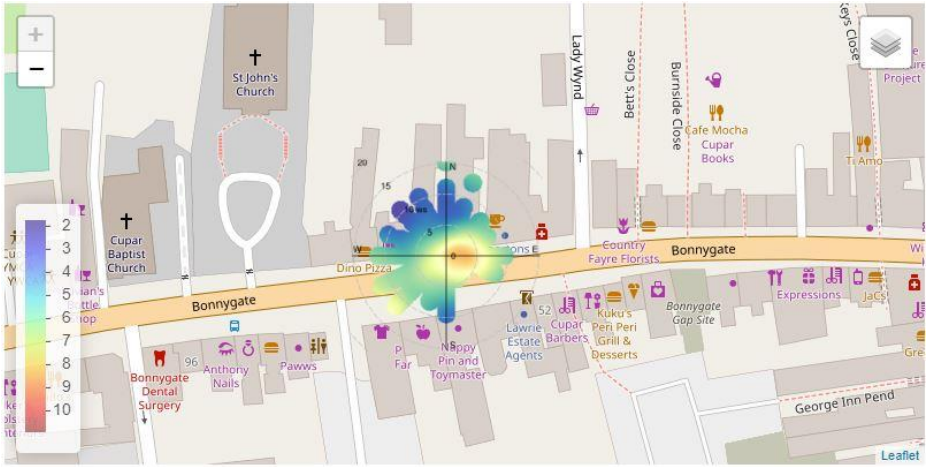

## Figure F-31 Kirkcaldy $PM_{10}$ polar plot




## Figure F-32 Rosyth $PM_{10}$ polar plot

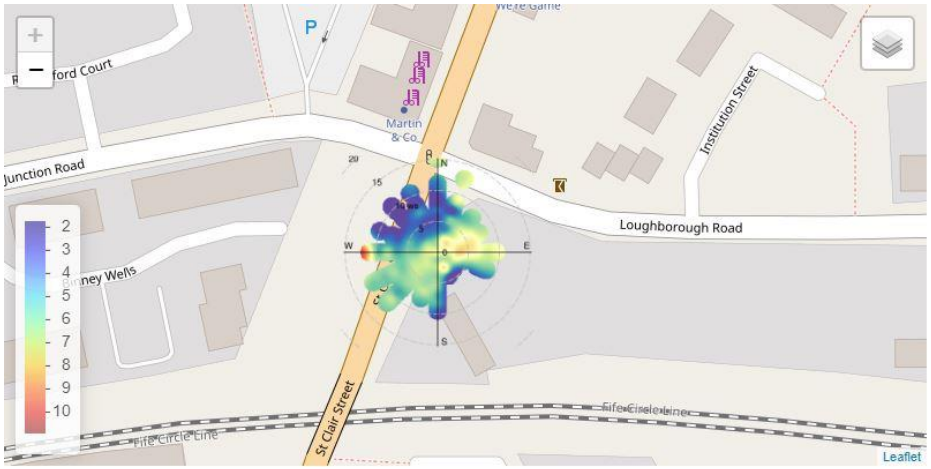


## Figure F-33 Cupar $PM_{2.5}$ polar plot

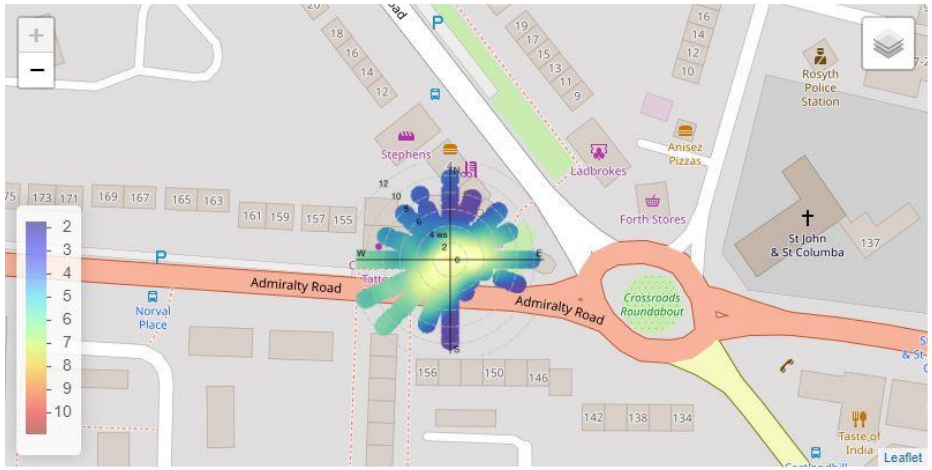



## Figure F-34 Dunfermline $PM_{2.5}$ polar plot

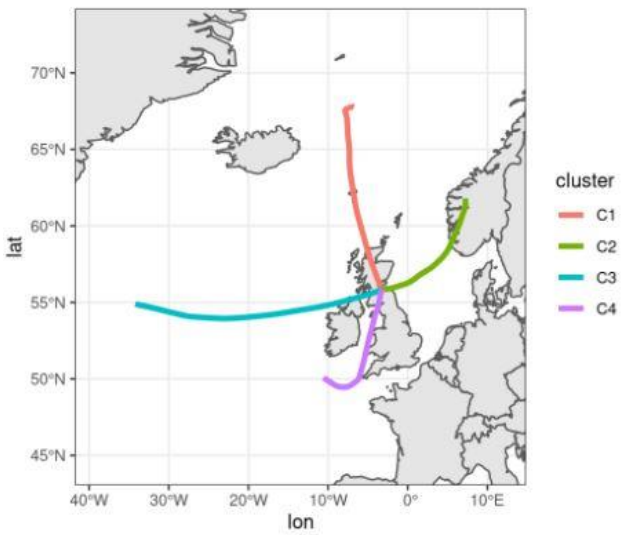

## Figure F-35 Kirkcaldy $PM_{2.5}$ polar plot




## Figure F-36 Rosyth $PM_{2.5}$ polar plot

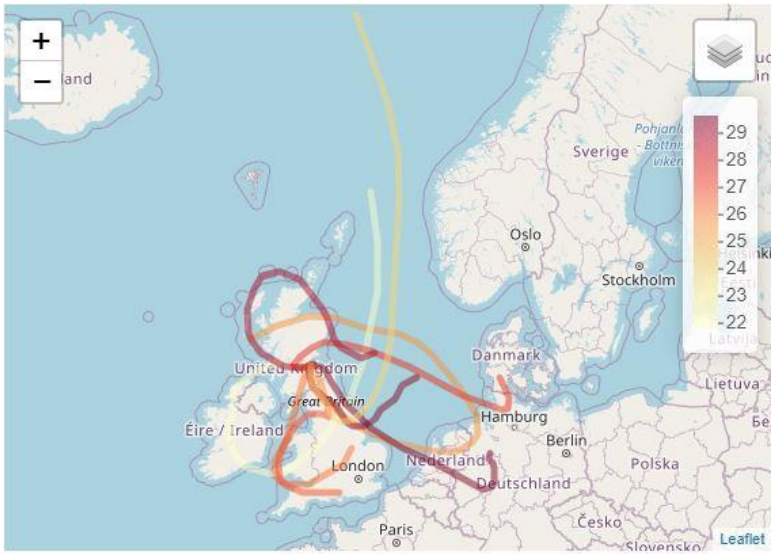


## Figure F-37 Trajectory Clusters




## Figure F-38 Trajectory plot for top ten highest daily $NO_2$ concentration


## Figure F-39 Trajectory plot for top ten highest daily $PM_{10}$ concentration




## Figure F-40 Trajectory plot for top ten highest daily $PM_{2.5}$ concentration

# 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 |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