



Ricardo
Energy & Environment



Fife Air Quality Annual Progress Report 2019

Fife Council

Report for Fife Council

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2019 Air Quality Annual Progress Report (APR) for
Fife Council

In fulfilment of Part IV of the
Environment Act 1995

Local Air Quality Management

June 2019

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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 (NO₂) and fine particulate matter (PM₁₀ and PM_{2.5}) 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 2018. Fife Council carry out monitoring of NO₂ at four automatic stations in Cupar, Kirkcaldy, Dunfermline and Rosyth. Non-automatic monitoring of NO₂ was carried out using diffusion tubes at 62 sites (total of 81 tubes). During 2018, 2 monitoring locations were relocated and monitoring ceased at 10 sites due to continuously low readings over recent years. All NO₂ concentrations measured during 2018 were below the annual mean objective of 40 µg m⁻³.

PM₁₀ and PM_{2.5} is measured at the four automatic sites within Fife at Cupar, Kirkcaldy, Dunfermline and Rosyth. During 2018 all concentrations were below the annual mean objective of 18 µg m⁻³ for PM₁₀ and 10 µg m⁻³ for PM_{2.5}.

The review of all available data relating to carbon monoxide (CO), sulphur dioxide (SO₂) and benzene monitoring during 2018 indicates that it is unlikely that any AQS objectives relating to these pollutants were exceeded during 2018.

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.

Fife Council are in the process of carrying out the National Low Emission Framework (NLMF) screening process and updating the associated Air Quality Actions Plans for Bonnygate, Cupar and Appin Crescent, Dunfermline. An update will be provided in the 2020 Annual Progress Report in relation to this screening process.

There are currently two AQMAs for NO₂ and PM₁₀ located within the Fife Council boundary, these are:

- Bonnygate, Cupar, declared in October 2008.
- Appin Crescent, Dunfermline, declared in November 2011 for NO₂ and August 2012 for PM₁₀.

The AQAP for the Bonnygate, Cupar AQMA was last updated in 2015 and has been successful in reducing both NO₂ and PM₁₀ concentrations within the Bonnygate area. During 2018 all annual mean concentrations were below the objective level of 40 µg m⁻³ for NO₂ and 18 µg m⁻³ for PM₁₀.

The AQAP for Appin Crescent, Dunfermline was last updated in 2015. The AQAP aims to reduce NO₂ and PM₁₀ concentrations within Appin Crescent. Initially an AQMA was declared in November 2011 for NO₂ only, however this was amended in August 2012 to include PM₁₀. During 2018 all annual mean concentrations were below the objective level of 40 µg m⁻³ for NO₂ and 18 µg m⁻³ for PM₁₀.

Mobile monitoring was carried out in St Andrews by Ricardo Energy & Environment on behalf of Fife Council to measure NO₂, PM₁₀ and PM_{2.5}. The aim was to demonstrate how air pollution concentrations vary within St Andrews. NO₂ hotspots were identified along Links Crescent and North Street (A917) and along City Road. Similar hotspots were identified for PM₁₀ and PM_{2.5}. Considering the hotspots, NO₂ diffusion tubes are currently located at the worst-case locations. Following the study, a new monitoring location has been selected at North Street in St Andrews as of January 2019 whereby the result from this new monitoring location will be discussed in the 2020 Annual Progress Report.

The Air Quality Strategy (AQS) for Fife 2015 – 2020 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 quarterly 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".

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

- Continue to monitor NO₂, PM₁₀ and PM_{2.5} concentrations throughout Fife.
- Produce an Annual Progress Report in 2020, reporting concentrations measured during 2019.
- 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 2018. 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 May 2019, there were 184 commercial fleet scheme members (7751 vehicles) and 30 taxi scheme members (157 vehicles). Recruitment of new members continues to reflect the full spectrum of fleets operating in Fife, with van fleets such as RB Grant Electrical Contractors and Bell Group in addition to hauliers such as Robert Summers Transport and local bus operators such as Rennie's Coaches. The scheme is also of interest to national operators, with Scottish Gas Networks now also an ECO Stars member.

Ongoing support of the membership can result in star rating upgrades where good practice has been implemented, having a positive effect on air quality in Fife. One example is local removals company Flemings of Rosyth who have appointed a dedicated Fuel Champion and completed fuel efficient driver training following recommendations made after their initial ECO Stars assessment, resulting in a 3 to 4-star upgrade.

Three AQMesh units were procured and installed in December 2017 to seek to further understand pollutant concentrations and trends in the Appin Crescent, Dunfermline AQMA and Bonnygate, Cupar AQMA. Data is managed and processed by Ricardo Energy and Environment who carry out appropriate QA/QC. The data showed that no exceedances were measured during 2018.

The Fife Regional Dispersion Model has also been updated to account for the latest emission factors. This also includes a GIS tracer study of the Fife Council fleet which, it is anticipated, will enable Fife Council to determine if fleet renewals of their own vehicles would yield tangible air quality benefits in their AQMAs and areas of concern (a useful piece of evidence for framing action plan interventions).

The Regional Dispersion Model uses the Ricardo modelling framework called RapidAir, which has been developed to provide graphical and numerical outputs which are comparable with other models used widely in the UK. 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 NO₂ (Cupar, Dunfermline, Rosyth, Kirkcaldy and St Andrews) and the remaining tube locations in combination.

Ricardo Energy and Environment carried out a mobile air quality monitoring survey in St Andrews on behalf of Fife Council. This survey measured NO₂, PM₁₀ and PM_{2.5} to demonstrate how air pollution

varies in St Andrews. Similar hotspots were identified for NO₂, PM₁₀ and PM_{2.5} confirming that road traffic is likely the main source of pollution.

Fife Council has also updated its air quality guidance note for developers to reflect latest policy and technical guidance and it is expected that this guidance note will facilitate dealing with planning applications with air quality issues. This guidance note is available at the dedicated Fife Council air quality web pages at www.fifedirect.org.uk/airquality

Local Priorities and Challenges

Fife Council has been awarded its grant funding from the Scottish Government for 2019 – 2020. The funding will be used to carry out the following air quality initiatives and studies, which aim to work towards 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 2019. 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.
- Interrogation of monitoring data from the AQMesh unit in the Bonnygate to further understand pollutant concentrations and trends within the Bonnygate AQMA.
- Fife ECO Stars scheme will continue to operate and encourage and promote 'clean fleet operators'.

Appin Crescent, Dunfermline:

Fife Council will continue to implement the measures set out in the Appin Crescent AQAP during 2019. 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.
- Interrogation of monitoring data from the two AQMesh units in Appin Crescent to further understand pollutant concentrations and trends within the Appin Crescent AQMA.
- Fife ECO Stars scheme will continue to operate and encourage and promote 'clean fleet operators'.

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, choose to walk, cycle or take the bus.
- Maintain and look after your vehicle properly.

Further information is available at the dedicated Fife Council air quality web pages at www.fifedirect.org.uk/airquality

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1 Local Air Quality Management

This report provides an overview of air quality in Fife during 2018. It fulfils the requirements of Local Air Quality Management (LAQM) as set out in Part IV of the Environment Act (1995) and the relevant Policy and Technical Guidance documents.

The LAQM process places an obligation on all local authorities to regularly review and assess air quality in their areas, and to determine whether or not the air quality objectives are likely to be achieved. Where an exceedance is considered likely the local authority must declare an Air Quality Management Area (AQMA) and prepare an Air Quality Action Plan (AQAP) setting out the measures it intends to put in place in pursuit of the objectives. This Annual Progress Report (APR) summarises the work being undertaken by Fife Council to improve air quality and any progress that has been made. Table 1.1 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 over recent years. The 2007 APR and 2008 APR concluded that a detailed assessment should be carried out for Bonnygate, Cupar (NO₂) and Appin Crescent, Dunfermline (PM₁₀) and Admiralty Road, Rosyth (PM₁₀). These reports concluded that an AQMA should be declared for NO₂ and PM₁₀ at Bonnygate, Cupar and increased monitoring should be carried out at Appin Crescent, Dunfermline. The monitoring was increased and an additional assessment in 2010 suggested an AQMA should be declared in Appin Crescent for NO₂. Since these AQMAs were declared Air Quality Action Plans have been adopted for these areas to address the air quality issues and the Appin Crescent AQMA was also amended to include PM₁₀ as well as NO₂.

There were a few diffusion tube sites which showed exceedances in Appin Crescent, Dunfermline; Admiralty Road, Rosyth and St Clair Street, Kirkcaldy during 2010. 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 are 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 aim to improve traffic flow through Appin Crescent.

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 NO₂ drop off using the LAQM NO₂ 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 were below the PM₁₀ and PM_{2.5} annual mean objectives with no exceedances of the annual mean or daily mean objective at all sites.

The review of all available data relating to carbon monoxide (CO), sulphur dioxide (SO₂) 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.

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.fifedirect.org.uk/airquality

1.1.2 2018 Annual Progress Report

The 2018 APR utilised monitoring data collected throughout 2017. Fife Council carried out monitoring of NO₂ at four automatic stations in Cupar, Kirkcaldy, Dunfermline and Rosyth. Non-automatic monitoring of NO₂ was carried out using diffusion tubes at 62 sites (total of 81 tubes). During 2017

monitoring commenced at Hendry Road, Kirkcaldy and Links Crescent, St Andrews. These locations were identified as locations of concern, with vehicle movements of greater than 10,000 vehicles per day. Monitoring location Bonnygate, Cupar B6 moved location during 2017 due to numerous no returns, therefore results were reported as Bonnygate, Cupar B6i and Bonnygate, Cupar B6ii. All NO₂ concentrations measured during 2017 were below the annual mean objective of 40 µg m⁻³.

PM₁₀ and PM_{2.5} was measured at the four automatic sites within Fife at Cupar, Kirkcaldy, Dunfermline and Rosyth. During 2017 all concentrations were below the annual mean objective of 18 µg m⁻³ for PM₁₀ and 10 µg m⁻³ for PM_{2.5}.

The review of all available data relating to carbon monoxide (CO), sulphur dioxide (SO₂) and benzene monitoring during 2017 indicated that it was unlikely that any AQS objectives relating to these pollutants were exceeded during 2017.

1.1.3 Fife Emissions Tracer Study 2018

Fife Council carried out an emissions tracer survey on a sample of the Fife Council vehicle fleet to determine if fleet renewals would yield tangible air quality benefits in the AQMA's and areas of concern. NO_x, PM₁₀ and PM_{2.5} emissions during April 2018 were calculated using Ricardo's PyCOPERT model, which is based on COPERT5 emissions factors. Using Python, a custom script was prepared to process the 85,000 GPS points provided by Fife Council.

A number of GPS points were located in the AQMA's in Fife highlighting that the Council fleet travel through these locations. However, there was a much larger number of points located in Bonnygate than in Appin Crescent suggesting Bonnygate is a more common street travelled on the Council fleet route. 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. There is also a large number of GPS points related to vehicles in standstill in these locations. As only a sample of the fleet was used and only a relatively short period of time, Fife Council are looking to extend the survey to include all fleet vehicles and over a long period of time. This would provide a more accurate estimate of the affect the fleet has on overall emissions levels.

1.1.4 St Andrews Mobile Monitoring Study 2018

Ricardo Energy & Environment were contracted by Fife Council to carry out mobile air quality monitoring surveys in the centre of St Andrews, measuring nitrogen dioxide (NO₂) and particulate matter (PM₁₀ and PM_{2.5}). The aim of the mobile monitoring was to demonstrate how air pollution concentrations vary within St Andrews and in turn to review the current NO₂ diffusion tube monitoring locations. In addition to the NO₂ and PM monitoring, black carbon (BC) monitoring was also carried out using an AE51 MicroAeth.

Similar 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 NO₂, PM₁₀ and PM_{2.5} confirming that the main source of pollution is likely to be road traffic. Taking into considering the measured hotspots, in general, the NO₂ diffusion tubes are currently sited at worst-case locations. However, a further PM₁₀ hotspot was measured along Bridge Street at the junction of Kinnessburn Road. It is unclear what the source of these increased PM₁₀ concentrations is but there are un-tarmacked lanes nearby, namely, Kinnessburn Terrace and private drives opposite. These lanes could be a source of resuspended coarse particulate matter.

1.1.5 Cupar North Development Zone and Relief Road: Updated Air Quality Assessment 2018

Ricardo Energy & Environment were commissioned by Fife Council to update the Cupar North Development Zone air quality impact assessment using updated NO_x and particulate vehicle emission factors. Since the 2017 report was prepared, updated (COPERT5) vehicle NO_x emission functions have been published. Ricardo Energy & Environment has also developed their own in-house emission

calculator which uses a more detailed approach to calculating non-exhaust particulate emissions from vehicles than used in the previous assessments.

The assessment provided an updated evidence base regarding how road traffic emissions from the phased rollout of the development may impact upon compliance with the Scottish air quality objectives in the Bonnygate Air Quality Management Area (AQMA) in future years. This aims to provide information that may aid the development of the Bonnygate AQMA air quality action plan; and how the air quality impact of the likely expansion of Cupar can be minimised within the AQMA.

Trip generation and distribution data from the transport assessment for the development has been used to estimate future vehicle emissions and pollutant concentrations within the Bonnygate AQMA.

Two future 'with development' traffic scenarios have been assessed by comparison with future baseline conditions for both annual mean NO₂ and PM₁₀ concentrations:

- Phase 1 2024 when 600 residential units are in use just prior to opening of the relief road.
- Completed development 2030 when all residential and mixed used aspects of development are complete, and the Cupar Relief road is operational.

Two methods of calculating NO_x emissions were used in the assessment - the latest COPERT5 NO_x emission rates; and also using the light duty vehicle NO_x emissions rates adjusted using the latest CURED V3A method published by Air Quality Consultants™ (AQC) for predicting the current and future impact of road traffic emissions. When compared with the vehicle emission factors currently published by Defra, the AQC method provides a more precautionary approach to estimating NO_x emissions from light diesel vehicles in future years beyond 2020. This aims to provide a range of outcomes for each scenario assessed.

All annual mean PM₁₀ concentrations have been modelled using vehicle emission rates calculated using the COPERT5 emissions model for tailpipe emissions, and the EMEP tier 2 method of calculating the non-exhaust emissions - brake wear, tyre wear and road abrasion. This method of calculating non-exhaust particulate emissions differs from Defra's standard emission factor toolkit in that the emission factors vary with speed. As exhaust PM emissions have reduced, the non-exhaust fraction of PM has increased in importance in explaining ambient concentrations of PM₁₀. Both in current and future years the non-exhaust fraction is the largest overall component and hence will not reduce by much over time, even when vehicles are significantly cleaner in terms of their NO_x emissions. This explains what could be perceived as a lack of sensitivity in the model predictions of PM₁₀ to modernisation of the road fleet. Hence it is possible (or even likely) that Local Authorities in Scotland will still note exceedances of the annual mean PM₁₀ standard due to the influence of non-exhaust PM emissions from road vehicles.

Phase 1 2024 scenario results

The Phase 1 scenario modelled emissions from additional vehicles generated by the Cupar North development in 2024, just prior to the relief road becoming operational. No exceedances of the 40 µg m⁻³ NO₂ annual mean objective are predicted in 2024 using either of the emissions calculation methods. The maximum impact is classified as '**slight**' and was predicted using emissions calculated with the CURED V3A emission model, the predicted NO₂ annual mean at this location was 30 µg m⁻³.

The model results therefore indicate that even when using what is currently considered a conservative approach to calculating NO_x emissions from vehicles in future years, annual mean NO₂ concentrations are not predicted to be in excess of the annual mean objective in the Bonnygate AQMA.

Exceedances of the 18 µg m⁻³ Scottish PM₁₀ annual mean objective are predicted in 2024 at three 1st floor height receptors where relevant human exposure may be present and at two ground level locations. The increase in annual mean PM₁₀ concentrations attributable to development traffic are classified as '**substantial**' at five receptors locations and '**moderate**' at another two. The points of maximum impact are located on the southern side of the narrow sections of the Bonnygate street canyon.

The model results indicate that additional emissions from vehicle trips generated by the Cupar North development will contribute to what could be considered a significant increase in annual mean PM₁₀ concentrations within the Bonnygate AQMA in 2024, prior to the relief road becoming operational.

Completed development 2030 scenario results

The completed development scenario assumes that the entire Cupar North mixed use development and the relief road is operational by 2030. Although there will be significantly more traffic generated by the completed development at that time, examination of the trip distribution data in the transport assessment indicates that through traffic will be reduced in Cupar town centre as a result of traffic using the relief road.

No exceedances of the 40 $\mu\text{g m}^{-3}$ NO₂ annual mean objective are predicted in 2030. When using both methods of calculating future year NO_x emissions, the predicted impact of the completed development in 2030 is classified as either beneficial or negligible at all receptors.

Exceedances of the 18 $\mu\text{g m}^{-3}$ Scottish PM₁₀ annual mean objective are predicted at the 1st floor height receptors Bonnygate 7, 8 and 9 and at ground level diffusion tube locations Bonnygate 3 and Bonnygate B4. PM₁₀ concentrations either reduce or stay constant for the 'with full development' scenario in 2030. The model results indicate that the relief road will have a beneficial effect on PM₁₀ concentrations within the Bonnygate AQMA; the reduction will not however be sufficient to achieve compliance with the 18 $\mu\text{g m}^{-3}$ Scottish PM₁₀ annual mean objective.

1.1.6 Bright Green Hydrogen / Levenmouth Community Energy Project

Hydrogen and fuel cell (HFC) technologies can provide services throughout Scotland's energy system and is becoming widely recognised as a key catalyst to decarbonising Scotland's energy production and use, with an emphasis on an integrated approach to **transport** as well as heat and power. There are a number of reasons why Hydrogen and fuel cell (HFC) technologies will be a key component of the future transport fuel mix:

- **Air quality** - Hydrogen produces no air pollution when used in a fuel cell and can have very low emissions in a combustion engine.
- **Low carbon today and zero carbon in future** – Hydrogen is a zero carbon emission fuel at the point of use.
- **No fundamental changes in vehicle operation** – once a nationwide hydrogen station network is established, there would be no operational compromise compared with the vehicles customers are driving today, as they have equivalent ranges and refuelling times to conventional vehicles and so fit into the operational patterns.
- **A viable option for larger heavy vehicles** – there are very few options for either zero or ultra-low emission driving for larger vehicles where the relatively low energy density of batteries is prohibitive.
- **Environmental benefits** - Hydrogen and fuel cell vehicles would ensure transport exhaust emissions no longer contribute to poor air quality in cities and regions.
- **Economic benefits** - The automotive sector is a mainstay of UK manufacturing, along with battery vehicle technologies, HFC technologies have the potential to create or protect 1,000s of jobs in automotive manufacturing.
- **Security of energy supply** – Hydrogen can be generated from a range of indigenous energy sources. By deriving the primary energy for a hydrogen system in the UK, imports of foreign energy products are avoided.

One of Scotland's leading forces behind making this a reality is Fife through its pioneering **Levenmouth Community Energy Project**, a collaborative initiative which is being led by Bright Green Hydrogen and supported by a number of partners including Fife Council and Toshiba. This includes a ground mounted 440 solar PV panel array which contributes to enhancing renewable electricity generation required as part of this innovative and environmentally sustainable project (photograph shown below)

Part of this project also involves Levenmouth becoming home to one of Europe's largest fleet of hydrogen dual-fuel vehicles (17 vehicles), seven of which will be operated by Fife Council. The fleet includes 10 electric-powered Renault Kangoo vans with H₂ fuel cell range extender which will be 100% zero emissions if charged using the Hydrogen Office's 100% green electric vehicle charging station. The project also includes five Ford Transit vehicles that are converted to run on a diesel and hydrogen

mixture as well as 2 Refuse Collection Vehicles (RCVs), which are believed to be a world-first of their kind.

The hydrogen range extender doubles the range of an electric van, allowing it to travel up to 200 miles before charging is required. The vans are to be leased out under the Levenmouth scheme to local organisations, allowing them to improve their green credentials by operating a vehicle that runs on green energy.

Levenmouth has been selected as one of three potential locations for the Hydrogen 100 Project being led by SGN. The aim of the project is to demonstrate the safe, secure and reliable distribution of hydrogen to heat people's homes. The first phase of the selection process is currently underway whereby one of the sites will be selected by 2021 and a demonstration network will be constructed to show the feasibility of the scheme to stakeholders with the potential for this to be rolled out within the local community. There are also on-going discussions with owners and operators at the Levenmouth waterfront area regarding potential infrastructure changes, including the potential for large scale hydrogen generation from offshore wind.

Further information available at: <https://www.investinfife.co.uk/content/levenmouth-community-energy/>



Ground mounted 440 solar PV panel array located at Levenmouth Community Energy Project

1.1.7 Fife Regional Dispersion Model 2018

1.1.7.1 Background

Fife Council commissioned Ricardo Energy and Environment to prepare a regional scale dispersion model to model emissions from road transport. Concentrations of NO₂, PM₁₀ and PM_{2.5} were modelled for 2016 at 3 m resolution over the whole of the Council area using a novel modelling framework developed by Ricardo.

1.1.7.2 Modelling framework and methodology

The Ricardo modelling framework (RapidAir) which has been developed to provide graphical and numerical outputs which are comparable with other models used widely in the UK. The model approach is based on loose-coupling of three elements:

- Road traffic emissions model conducted using fleet specific COPERT5 algorithms to prepare grams/kilometre/second emission rates of NO_x.
- AERMOD dispersion model for development of “kernels” at resolutions ranging from 1 m to 81 m.
- The kernel based RapidAir model running in python to prepare dispersion fields of concentration for further analysis with a set of decision support tools coded by us in Python.

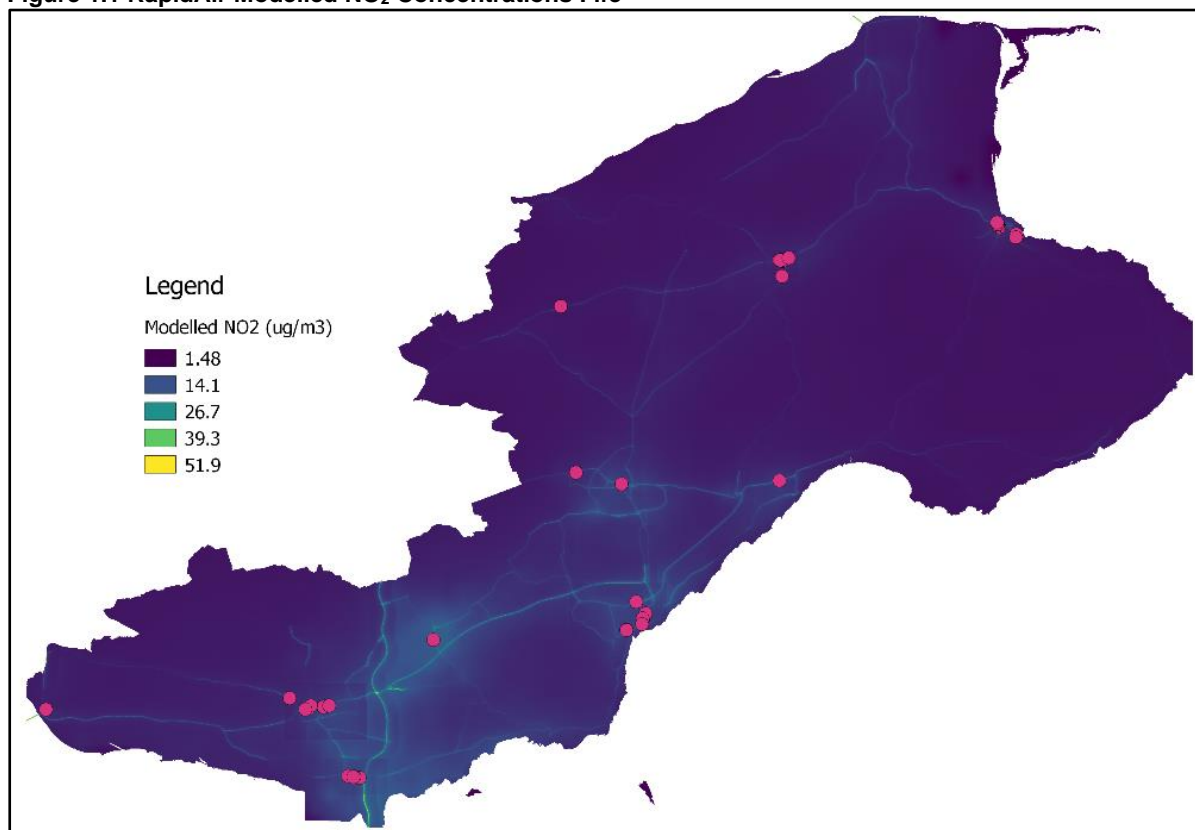
The system is built around the USEPA's public source AERMOD model, which provides the dispersion functions that are applied to emissions in a GIS based modelling platform. RapidAir estimates emissions of airborne pollutants from road traffic by taking into consideration the characteristics and conditions of the roads as well as the fleet composition using emission factors and speed functions from the UK Emissions Factors Toolkit (v7.0); this is based on the COPERT5 emissions model. The emissions estimates were scaled to reflect changes associated with road gradients following Defra's Technical Guidance.¹

RapidAir also has a built-in street canyon model which identifies street canyon locations using the average building height and road width on a street. The concentration, as a result of recirculation of pollution within the canyon, is determined using the AEOLIUS model² and this concentration is added to those concentrations modelled by RapidAir to account for street canyon effects.

1.1.7.3 Model outputs

The concentrations predicted from RapidAir (shown in Figure 1.1) were validated against roadside measurements made in Fife where emissions data was available (n = 48 for NO₂, n = 4 for PM₁₀ and n = 3 for PM_{2.5}, where 'n' is the number of sites). In addition, local validations were carried out for each of the main towns in Fife for NO₂ (Cupar, Dunfermline, Rosyth, Kirkcaldy and St Andrews) and the remaining tubes locations in combination.

Figure 1.1 RapidAir Modelled NO₂ Concentrations Fife



¹ Defra, "Local Air Quality Management Technical Guidance (TG16)," April 2016

² Buckland, A.T., Middleton, D.R., 1999. Nomograms for calculating pollution within street canyons. Atmos. Environ. 33, 1017 - 1036

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 at <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 draft AQAPs for both Bonnygate and Appin Crescent. The steering group considered the findings of the Further Assessments and the wide range of potential options for improving air quality within the AQMAs. The steering group aims to meet regularly to discuss the progress of the action plan measures outlined in the AQAPs.

Following a review of the 2018 Annual Progress Report, SEPA and the Scottish Government both recommended that Fife Council strongly consider revoking both AQMA's due to the pollutant levels having been below the objective levels for several years. Fife Council has taken the decision to retain both AQMA's and continue monitoring to ensure pollutant concentrations remain below the objective levels given the large scale development works either underway (Dunfermline) or planned (Cupar).

Figure 2.1 Bonnygate, Cupar AQMA Boundary

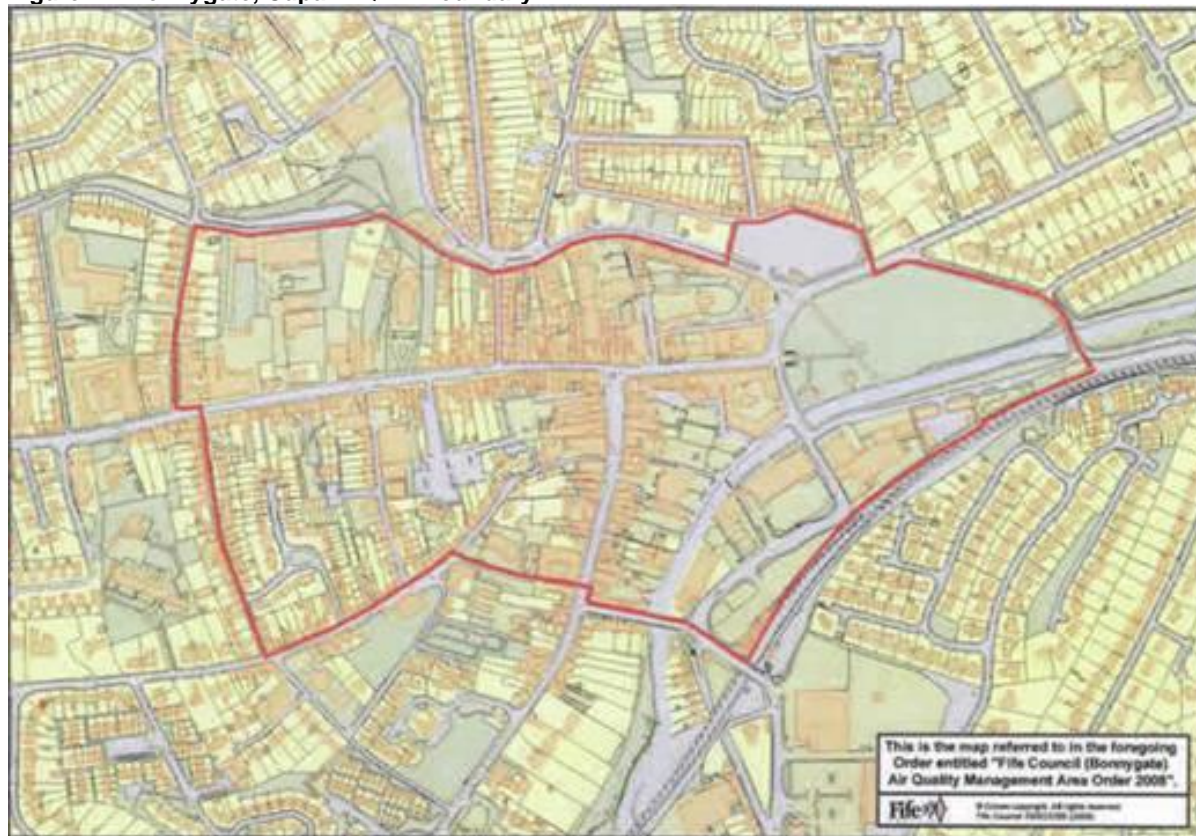
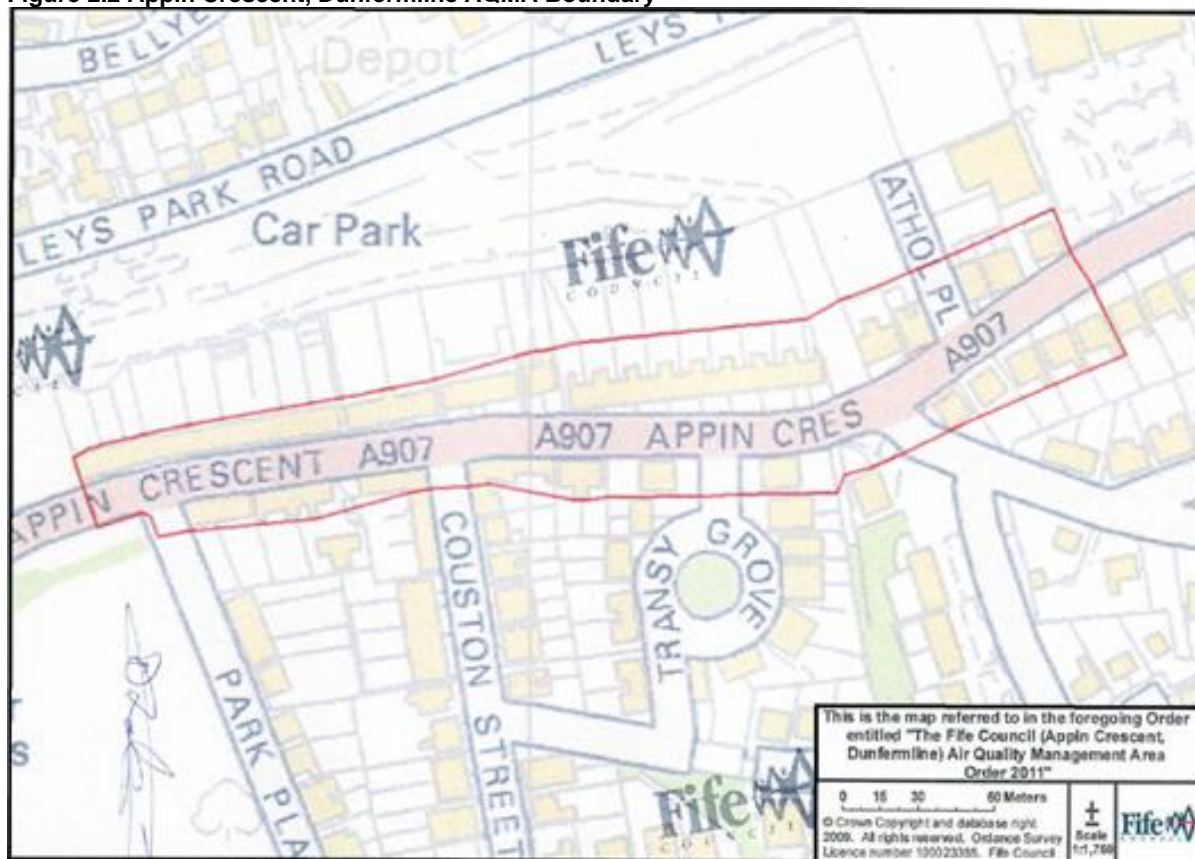


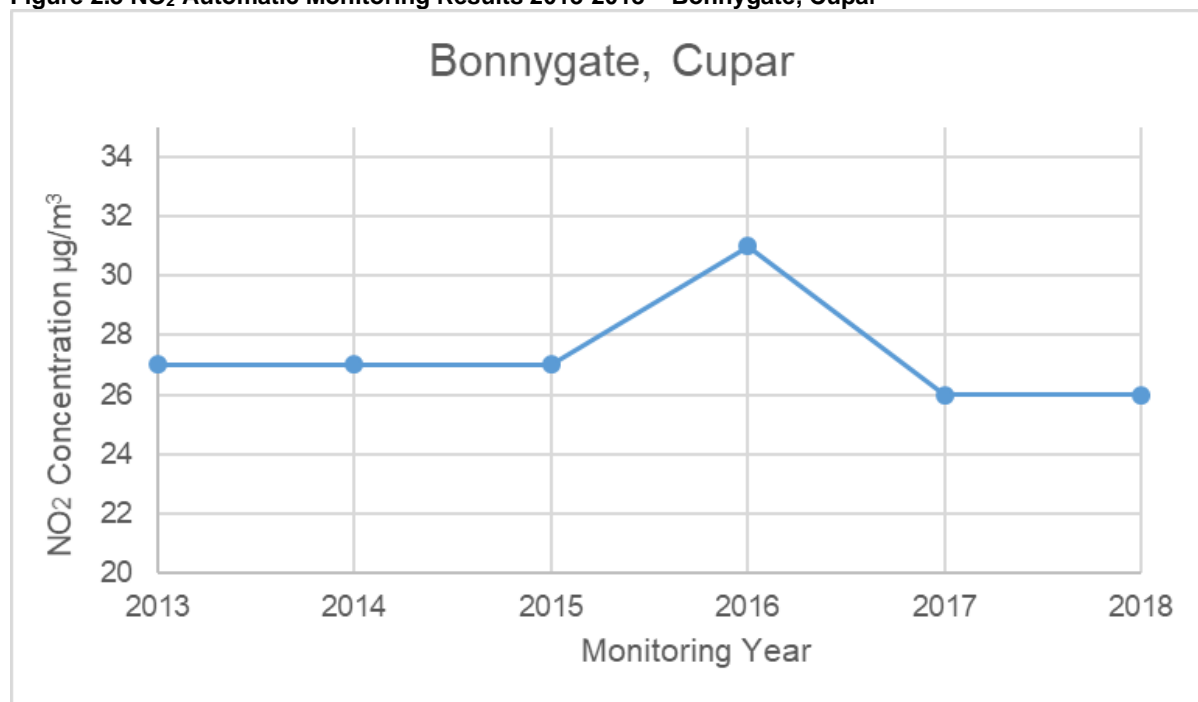
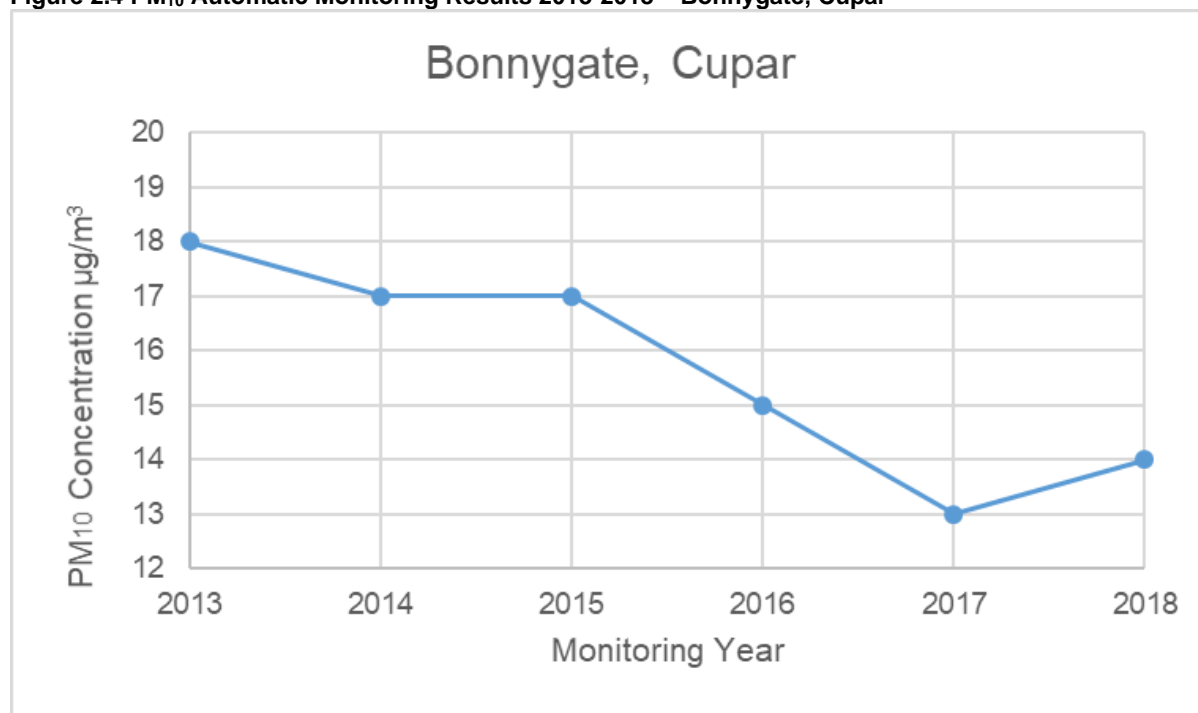
Figure 2.2 Appin Crescent, Dunfermline AQMA Boundary

2.1.1 Bonnygate, Cupar AQMA

The Bonnygate AQAP aims to work towards reducing transport emissions of NO_x and PM₁₀ in the AQMA by approximately 53% and 33% respectively; using a wide range of measures such as road and traffic signalling improvement combined with other measures, for example behaviour-change.

Fife Council has a statutory duty to review and update their Action Plans (LAQM.PG(16)). The Bonnygate, Cupar AQAP was reviewed and updated in 2015. The measures adopted in the latest AQAP and progress against them are outlined in Table 2.2.

NO₂ concentrations at the automatic monitor within Bonnygate, Cupar remained consistent between 2013 and 2015, with a slight increase measured in 2016. Concentrations decreased in 2017 and remained consistent in 2018. NO₂ concentrations at the automatic monitoring station remain well within the NO₂ annual mean objective. PM₁₀ concentrations have steadily declined between 2013 and 2017, with concentrations dropping below the AQS annual mean objective of 18 µg m⁻³. In 2018 the PM₁₀ concentration increased slightly but remained below the AQS annual mean objective. The automatic monitoring results for NO₂ and PM₁₀ are shown in Figure 2.3 and Figure 2.4 respectively.

Figure 2.3 NO₂ Automatic Monitoring Results 2013-2018 – Bonnygate, Cupar**Figure 2.4 PM₁₀ Automatic Monitoring Results 2013-2018 – Bonnygate, Cupar**

2.1.2 Appin Crescent AQMA

The Appin Crescent AQAP aims to work towards reducing transport emissions of NO_x and PM₁₀ in the AQMA by approximately 18% and 40% respectively; and as with the Bonnygate AQAP will involve a combination of road layout and traffic signalling improvements combined with many other measures. As noted previously, Fife Council has a statutory duty to review and update their Action Plans. The Appin Crescent, Dunfermline AQAP was reviewed and updated in 2015. The measures adopted in the latest AQAP and progress against them are outlined in Table 2.3.

NO₂ concentrations within Appin Crescent have decreased since 2013 as a result of the Action Plan measures being implemented. There was a slight increase in 2015 but concentrations decreased again in 2016, 2017 and 2018. PM₁₀ concentrations remained consistent between 2013 and 2014. Concentrations increased slightly in 2015 before steadily declining until 2017, with an annual mean concentration of 10 µg m⁻³ in 2017. There was a slight increase in 2018 but concentrations remained below the annual mean objective. The automatic monitoring results for NO₂ and PM₁₀ are shown in Figure 2.5 and Figure 2.6 respectively.

Figure 2.5 NO₂ Automatic Monitoring Results 2013-2018 – Appin Crescent, Dunfermline

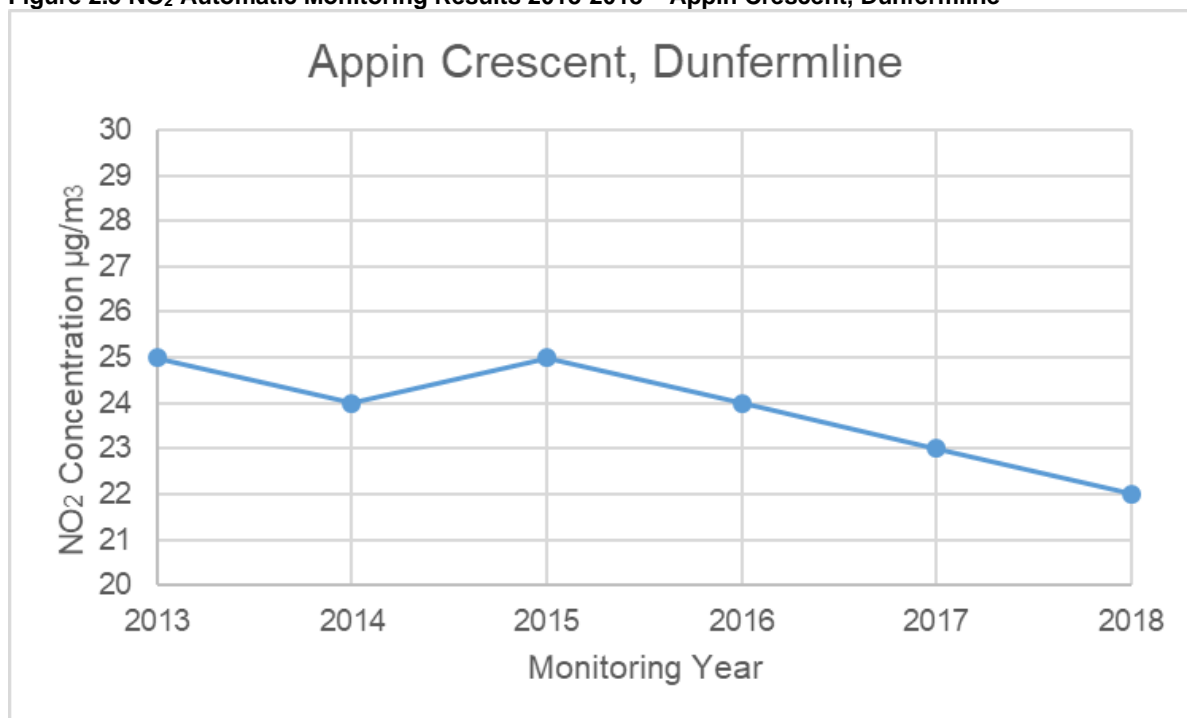


Figure 2.6 PM₁₀ Automatic Monitoring Results 2013-2018 – Appin Crescent, Dunfermline

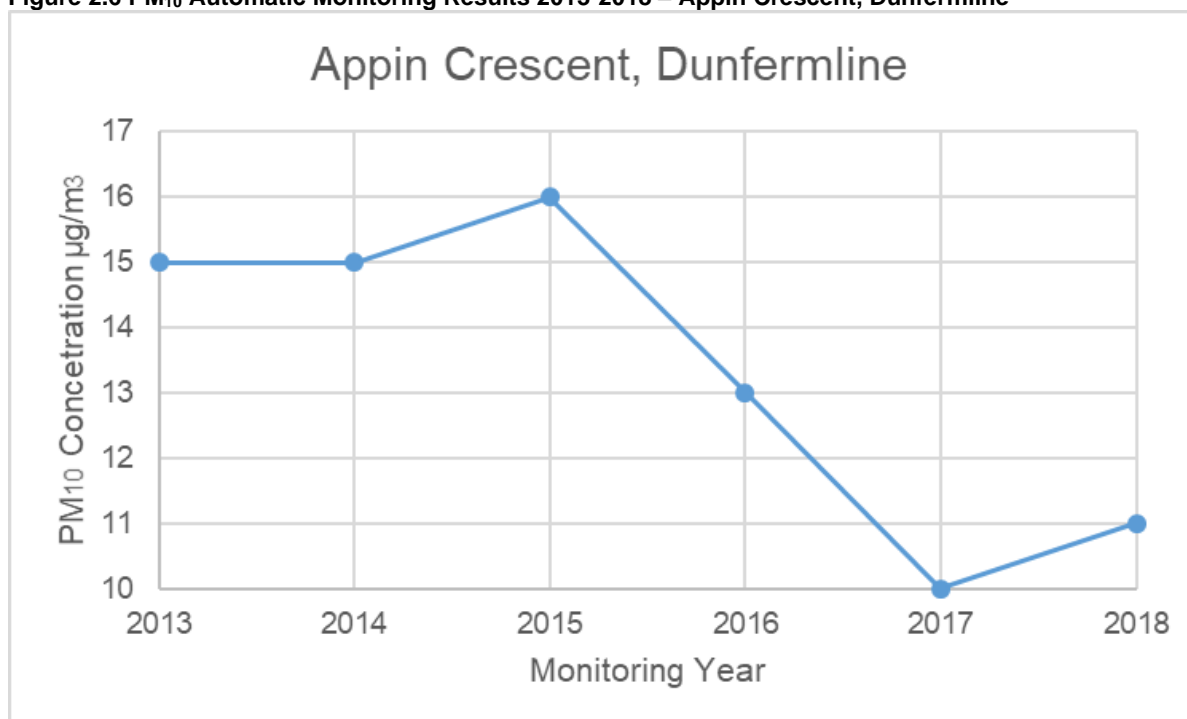


Table 2.1 Declared Air Quality Management Areas

AQMA Name	Pollutants and Air Quality Objectives	City/Town	Description	Action Plan
Cupar, Bonnygate	NO ₂ annual mean 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 1 st floor height above commercial properties.	Bonnygate Cupar, AQAP can be accessed at: http://publications.fifedirect.org.uk/c64_FifeCouncilBonnygateAQAPUpdate20156.pdf
Appin Crescent, Dunfermline	NO ₂ annual mean 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 1 st floor height.	Appin Crescent, AQAP can be accessed at: http://publications.fifedirect.org.uk/c64_FifeCouncilAppinCrescentAQAPUpdate20151.pdf

2.2 Progress and Impact of Action Plan Measures

In April 2015 a review and update of both the Appin Crescent and Bonnygate Air Quality Action Plans was completed by Fife Council. A brief summary of the additional measures incorporated into both action plans as a result of the AQAP review are provided in Table 2.2 and Table 2.3. Further details of the AQAP's and their progress are detailed in Table 2.6 and Table 2.7.

Table 2.2 New measures included within the Bonnygate Air Quality Action Plan (2015)

No.	Measure	Timescale
1	Fife ECO Stars	Short Term
2	Fife Council Air Quality Strategy 2015-2020	Short Term
3	Air Quality and Planning Toolkit	Short Term

Table 2.3 New measures included within the Appin Crescent Air Quality Action Plan (2015)

No.	Measure	Timescale
1	Fife ECO Stars	Short Term
2	Fife Council Air Quality Strategy 2015-2020	Short Term
3	Air Quality and Planning Toolkit	Short Term
4	Cost-Benefit-Analysis of options to improve air quality within Appin Crescent	Short Term
5	Proposed air dispersion modelling study of the potential Dunfermline Northern Link Road	Short Term

2.2.1 Fife ECO Stars Scheme

Fife's ECO Stars Fleet Recognition scheme, providing free fuel efficiency advice to local fleet operators, continues to recruit strongly. Having completed its 5th year, the scheme strikes a balance between recruitment of new operator members and ongoing support of the existing membership, providing advice on good operational performance and clean vehicles.

The scheme has grown to 184 fleet operator members, who operate 7,751 vehicles in and around Fife. Recruitment of new members continues to reflect the full spectrum of fleets operating in Fife, with van fleets such as RB Grant Electrical Contractors and Bell Group in addition to hauliers operating heavy goods vehicles, such as Robert Summers Transport. Local bus and coach operators, such as Rennies Coaches, are also represented in the new membership. The scheme is also of interest to national operators, with Scottish Gas Networks also joining this year.

Ongoing support of the membership can result in star rating upgrades where good practice has been implemented, having a positive effect on air quality in Fife. One example is local removals company Flemings of Rosyth, who have appointed a Fuel Champion and completed fuel efficient driver training following recommendations made after their initial ECO Stars assessment, resulting in a 3 to 4-star upgrade.

The parallel ECO Stars Taxi and Private Hire scheme has recruited 30 operator members, covering 157 vehicles. This has been achieved through involvement with taxi operator engagement events run by Fife Council as well as new driver workshops. Inclusion of membership as a requirement for social work contracts is starting to have a positive impact on recruitment efforts.

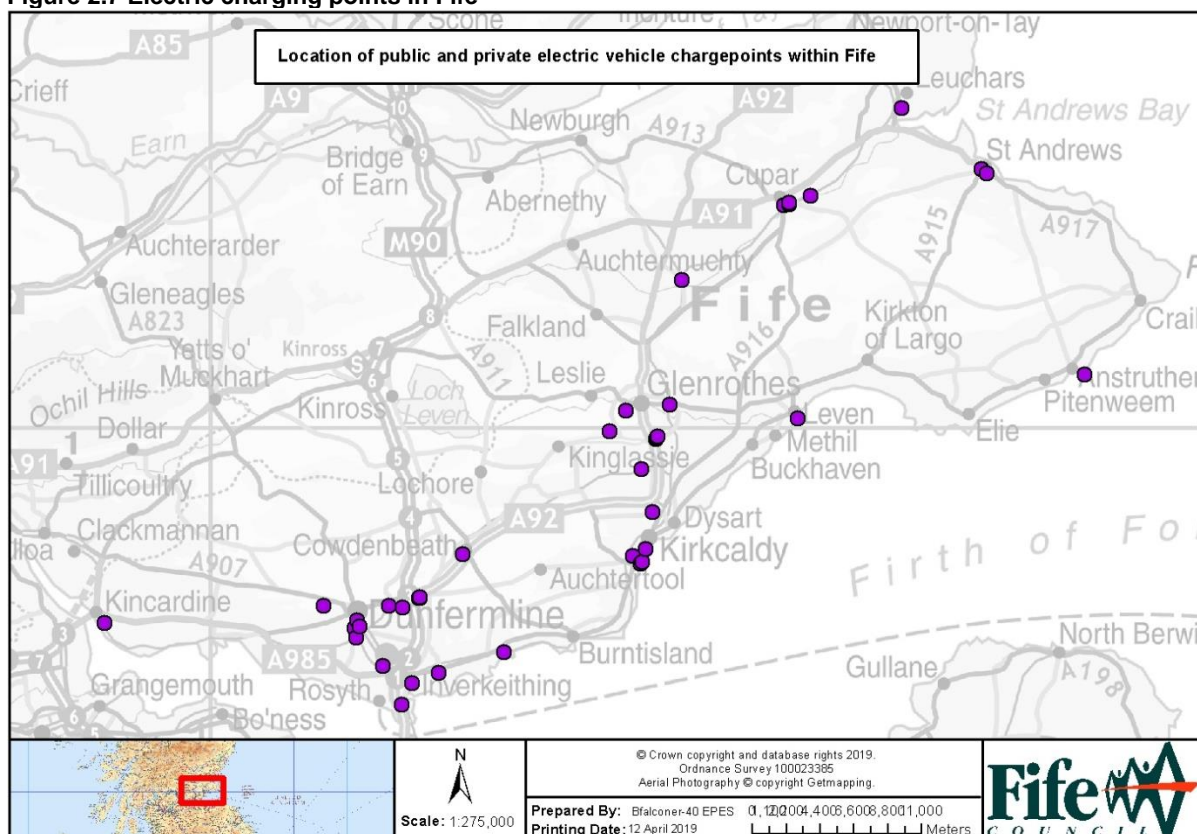
ECO Stars continues to be supported by the Scottish Government as part of its clean air strategy, and TRL also keep the scheme profile high by attending local forums such as the SESTran Logistics and Freight Forum.

2.2.2 Electric Vehicles in Fife

Fife Council has made good progress towards increasing the number of electric vehicles and available charging points in Fife. This action has direct impacts on both the Bonnygate and Appin Crescent AQMAs and works towards reducing transport emissions as detailed in the AQAP for both areas. In 2018 Fife Council's Fleet Operations had 22 full electric vehicles and 11 hybrid vehicles in service and in terms of electric vehicle charge points there were two new rapid chargers installed, one in Charlotte Street, Kirkcaldy and the other at the main Council depot in Glenrothes. This brings the number of public electric vehicle charge points to 34 at 23 different locations. In terms of Cupar there were 184 charge point users in 2018 (up from 141 in 2017) and in terms of Dunfermline there were 724 charge point users in 2018 (up from 619 in 2017) showing an increased use of electric vehicles in these areas.

A map of the electric charging points installed throughout Fife is shown in Figure 2.7 below.

Figure 2.7 Electric charging points in Fife



2.2.3 Completed Measures

Fife Council has taken forward a number of measures during the current reporting year of 2018 in pursuit of improving local air quality. Details of all measures completed, in progress or planned are set out in Table 2.6 for Bonnygate, Cupar and Table 2.7 for Appin Crescent, Dunfermline. The tables summarise progress to date on each of the measures within the AQAP. More details on these measures can be found in the relevant AQAP and Fife Council's Air Quality Strategy 2015-2020.

Key completed measures include the installation of the traffic management system within Bonnygate, Cupar. The traffic management system included a new pedestrian crossing linked at St Catherine Street. The twin mini roundabout system has also been implemented at St Catherine Street/East Bridge to ease the flow of traffic through Cupar, reducing congestion.

Within the Appin Crescent AQMA, revised lane markings and signage were introduced in March 2013. These measures have resulted in a reduction in NO₂ concentrations on the south side of Appin Crescent. The AQAP outlines the consideration of a bypass and a feasibility study was commissioned

to determine if this would be an option to reduce pollutant concentrations within Appin Crescent. The feasibility study suggested that the proposed bypass would achieve the reduction required in pollutant concentrations to reach the Air Quality Strategy annual mean objectives. However, no funding is currently available for this option and Fife Council are considering alternative traffic management (including the outcomes of a recent cost benefit analysis of two traffic management options in 2016) that will result in similar reductions whilst being more cost effective and practicable.

As progress on the action plan measures for Cupar and Dunfermline continues to advance, a number of measures have now been completed - these are summarised in Table 2.4. Similarly, as the action plan measures have been advanced, certain measures have been discounted from further consideration. Details on discounted measures are summarised in Table 2.5.

Table 2.4 Completed AQAP Measures

No.	Measure	Comments
Bonnygate, Cupar		
4	Implementation of new Urban Traffic Management and Control system and changes to pedestrian crossings	New pedestrian crossing linked to the traffic management system has been completed at St Catherine Street and twin mini roundabout scheme has been implemented at St Catherine Street/East Bridge.
Appin Crescent, Dunfermline		
2	Feasibility study	Feasibility studies (2015 and 2016) and a Cost Benefit Analysis report in 2016 have been produced and considered by the AQ Steering Group. It has been concluded from these studies that the options considered to date are not cost effective, feasible or acceptable as defined in AQAP evaluation criteria. Focus is now on the delivery of the Northern Link Road to the North of Appin Crescent in terms of seeking air quality improvements in the Appin Crescent AQMA.
6	Traffic Management optimisation (dependent on feasibility study)	
15	Cost-benefit analysis of traffic management options to improve air quality within Appin Crescent.	

2.2.4 Discounted Measures

Table 2.5 Discounted AQAP Measures

No.	Measure	Justification
Bonnygate, Cupar		
8	AQMA Awareness Signs	Measure has been discounted based on the grounds of cost effectiveness, practicability feasibility and acceptability to members of the public.
Appin Crescent, Dunfermline		
12	Consideration of development of Appin Crescent bypass (Dependent upon feasibility study)	Based on the findings of the feasibility study, the Air Quality Steering Group considers that this option is not as cost effective, practicable and feasible relative to the introduction of the Northern Link Road in Dunfermline

Table 2.6 Progress on Measures to Improve Air Quality- Bonnygate, Cupar

Measure No.	Measure	Category	Focus	Lead Authority	Planning Phase	Key Performance Indicator	Target Pollution Reduction in the AQMA	Progress to Date (February 2019)
1	Improving links with Local Transport Strategy/ Area Transport Plan Implementation Phase: Ongoing	Policy guidance and development control	Measures to ensure the air quality in the AQMA is improved where possible and to avoid future problems are implemented via the Local Transport Strategy.	Fife Council	As outlined in the aims and objectives of Council's Air Quality Strategy 2015-20	Reference to Bonnygate AQMA and measures included in Air Quality Action Plan. Integration of plan with Local Transport Strategy.	Low	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.
2	Improving Air Quality Links with local Planning and Development Framework Implementation Phase: Ongoing	Policy guidance and development control	Local planning considerations aim to mitigate the cumulative negative air quality impacts of new development	Fife Council	Fife Council Air Quality Steering Group outputs are contributing to the development of Fife Council Local Transport Strategy/Area Transport Plan and are to be incorporated in future revisions of these strategies/plans.	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 Fife development plan. This guidance incorporates the air quality development guidelines.
3	Integrate AQ with other Council Strategies Implementation Phase: Ongoing	Policy guidance and development control	Encourage opportunity for contributions towards improving local air quality and minimising negative impacts from existing and future Council strategies. Increase awareness of local air quality	Fife Council	As outlined in the aims and objectives of Council's Air Quality Strategy 2015-20	Continue and enhance joint working between Council Services and other Partnership Organisations to encourage potential air quality implications of existing and future Council strategies. Implementation of the relevant AQS objectives	Low	Submission of AQ grant application for 2019-2020 includes submissions for climate change related measures. In February 2018 Fife Council signed the Covenant of Mayors on Climate Change. This formally committed the Council to develop a Fife Sustainable Energy Climate Action Plan. The plan is now in development and the aim is for an initial approved plan by early 2020. Alongside this Fife Council has committed to renewing its Carbon Management Plan. Reducing carbon emission and adapting to unavoidable climate change are also priorities for the Fife Partnership. The Fife Sustainable Energy Climate Action Plan is an action under the Plan for Fife - the Local Outcome Improvement Plan. Fife Councils Land & Air Quality Team continues to work closely with the Council's Climate Change team to ensure air quality is considered. Developing the Fife Sustainable Energy Climate Action Plan includes a practical action plan for mitigation activities and a Risk and Vulnerability Assessment to outline the challenge for adaption action.
4	Implementation of new Urban Traffic Management and Control system and changes to pedestrian crossings Implementation Phase: Completed and monitoring ongoing	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. Installation of traffic management system.	Fife Council	2009	Pollutant reduction in AQMA. 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
5	Travel Plans for Large Institutions and Businesses Implementation Phase: Ongoing	Promoting travel alternatives	To encourage a shift to more sustainable forms of travel or reducing the need for travel.	Fife Council	As outlined in the aims and objectives of Council's Air Quality Strategy 2015-20	Results of Council Travel surveys	Low	Transportation department continuing to support schools in updating and developing School specific travel plans. Continue to actively promote sustainable travel to school, including initiatives such as Bikeability and WOW (Walk Once a Week).

Measure No.	Measure	Category	Focus	Lead Authority	Planning Phase	Key Performance Indicator	Target Pollution Reduction in the AQMA	Progress to Date (February 2019)
6	Promotion of Travel Choices Implementation Phase: Ongoing	Promoting travel alternatives	Discourage long stay commuter parking as part of the Fife Council's Parking Strategy. To increase awareness of travel choices and encourage changes in behaviour that will contribute to improving local air quality.	Fife Council	As outlined in the aims and objectives of Councils Air Quality Strategy 2015-20	To improve integration between cycling, walking and public transport. To continue to liaise with Scottish Government in the production of KPIs for this action plan measure.	Low	A new traffic counter has been purchased and installed in Cupar (Station Road) in 2018/19 to track changes in traffic flow.
7	Target reduced localised emissions from freight. Implementation Phase: Ongoing	Freight and delivery management	Improve efficiency of transit through the AQMA and facilitate reduced emissions.	Fife Council	As outlined in the aims and objectives of Councils Air Quality Strategy 2015-20	Pollution reduction in AQMA	Medium	Continue to engage with HDV Fleet operators through the ongoing roll out of the Fife ECO Stars scheme.
8	AQMA Awareness Signs Implementation Phase: N/A	Public information	To increase awareness of the Bonnygate AQMA and encourage behavioural change.	Fife Council	N/A	Authorisation, design, procurement and installation	Low	Measure has been discounted based on the grounds of cost effectiveness, practicability, feasibility and acceptability to members of the public.
9	Provision of Information relating to Air Quality Implementation Phase: Ongoing	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	As outlined in the aims and objectives of Council's Air Quality Strategy 2015-20	Production of booklet – travel pack Publication of LAQM reports	Low	This information is covered by the Low Carbon Fife Supplementary Guidance document adopted January 2019.
10	Parking Management and Control Implementation Phase: Short – Medium Term 2020	Traffic management	Reduce traffic by discouraging long stay parking and associated commuting movements. Minimise impacts of commercial deliveries on traffic movement.	Fife Council	As outlined in the aims and objectives of Council's Air Quality Strategy 2015-20	Pollutant reduction in AQMA	Low	Continue to evaluate parking management measures within the Bonnygate AQMA.
11	Promotion of Cycling and Walking Implementation Phase: Ongoing	Promoting travel alternatives	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.	Fife Council	As outlined in the aims and objectives of Council's Air Quality Strategy	Number/length of cycling and walking routes developed.	Low	Adopted FIFE plan 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.

Measure No.	Measure	Category	Focus	Lead Authority	Planning Phase	Key Performance Indicator	Target Pollution Reduction in the AQMA	Progress to Date (February 2019)
12	Review and support proposed infrastructure changes that will contribute to delivering improvements in local air quality Implementation Phase: Long Term/Ongoing	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	As outlined in the aims and objectives of Council's Air Quality Strategy	Pollutant Reduction in AQMA	High	Results from AQMesh pod installed on the southern side of the Bonnygate in December 2017 to be reported within this 2019 APR.
13	Target reductions in emissions from the Council fleet and contract vehicles (including driver training) Implementation Phase: Ongoing	Vehicle fleet efficiency	Target reduced emissions from Council fleet vehicles and Council contract fleet vehicles operating within the Cupar AQMA.	Fife Council	As outlined in the aims and objectives of Council's Air Quality Strategy 2015-20	Fife Council tender specification outlines that all new vehicles must have the latest gas recyclable exhaust and catalyst systems fitted. Number of vehicles in fleet. Number of electric and hydrogen powered vehicles in fleet.	Medium	By February 2019 Fife Council had 22 full electric vehicles and 11 hybrid vehicles in service and two new rapid chargers were installed (one in Kirkcaldy and one in Glenrothes). There are also 3 electric and 5 hybrid vehicles due to be added to the fleet by the end of May 2019. Fife Council Fleet Operations joined the ECO Stars scheme in October 2014 and have been continually improving by introducing low carbon vehicles to the fleet. Fife Council currently have the highest rating of 5-star's. Advantages include: reduction in air pollution (NO ₂ , PM ₁₀), reduction in CO ₂ emissions, meeting EU and National LAQM targets, improved public health, economic efficiency and good communications with members. The size of the Fife Council fleet increased slightly in 2018 and now stands at 1,551. Total diesel use for in 2018 was 4,065,655 litres (a reduction of 99,981 litres from 2017).
14	Target reductions in emissions from buses Implementation Phase: Ongoing	Vehicle fleet efficiency	Target reduced emissions from buses operating within the Bonnygate AQMA.	Fife Council	As outlined in the aims and objectives of Council's Air Quality Strategy 2015-20	Establish a bus quality partnership 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 through the ongoing Fife ECO Stars recruitment process. As of March 2019, there are now 17 bus operators within the ECO Stars scheme with 626 vehicles.
15	Fife ECO Stars Implementation Phase: Ongoing	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	As outlined in the aims and objectives of Council's Air Quality Strategy 2015-20	Develop and promote Fife ECO Stars, a new green recognition scheme aiming to tackle air pollution from transport.	Medium	In 2018 the Fife Commercial Membership grew to 184 members covering 7,751 vehicles operating in Fife & beyond. This is an increase of 37 members and 944 vehicles from last year. The Taxi & Private Hire Membership has also increased with an additional 5 taxi operators and 25 vehicles taking the Taxi & Private Hire Membership up to 30 Operators & 157 vehicles.
16	Air Quality and Planning Toolkit Implementation Phase: Short Term 2020	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	As outlined in the aims and objectives of Council's Air Quality Strategy 2015-20	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.	Medium	No further updates following reported updates last year.
17	Air Quality Strategy 2015-2020 Implementation Phase: Ongoing 2020	Policy guidance and development control	Increase awareness of local air quality issues and promote good practice in reducing emissions of air quality pollutants.	Fife Council	As outlined in the aims and objectives of Council's Air Quality Strategy 2015-20	Develop and adopt an Air Quality Strategy that aims to raise awareness of air quality issues and to promote some of the existing best practice work that the Council has undertaken within existing AQMAs to other parts of Fife.	High	See measures 1-16. These are considered to be consistent with the aims/objectives of Scottish Government Cleaner Air Quality Strategy for Scotland 2015 including the List of Actions in Chapter 14 of this document.

Table 2.7 Progress on measures to Improve Air Quality- Appin Crescent, Dunfermline

Measure No.	Measure	Category	Focus	Lead Authority	Planning Phase	Key Performance Indicator	Target Pollution Reduction in the AQMA	Progress to Date (February 2018)
1	Liaise with Scottish Government to encourage the consideration of national measures Implementation Phase: Ongoing	Policy guidance and development control	Increase focus on background concentrations of PM and encourage national action	Fife Council	As outlined in the aims and objectives of Council's Air Quality Strategy 2015-20	Maintain contact with the Scottish Government regarding the adoption of national air quality measures.	Low 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.
2	Feasibility study Implementation Phase: Completed	Transport planning and infrastructure	To adopt a strategic approach to air quality in Appin Crescent and undertake a detailed assessment of the feasibility and impacts of proposed infrastructure and traffic management measures.	Fife Council	As outlined in the aims and objectives of Council's Air Quality Strategy 2015-20	Undertake a feasibility study to assess the potential impact of local infrastructure developments and traffic management optimisation on air quality in Appin Crescent.	Low to Medium	Completed
3	Improving links with Local Transport Strategy/ Area Transport Plan Implementation Phase: Ongoing	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	As outlined in the aims and objectives of Council's Air Quality Strategy 2015-20	Reference to Appin Crescent AQMA and measures included in Air Quality Action Plan. 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/Area Transport Plan and are to be incorporated in future revisions of these strategies/plans
4	Improving Air Quality links with Local Planning and Development Framework Implementation Phase: Ongoing	Policy guidance and development control	Local planning considerations aim to mitigate the cumulative negative air quality impacts of new development	Fife Council	As outlined in the aims and objectives of Council's Air Quality Strategy 2015-20	Integration of Appin Crescent AQAP with future versions of Local Plan. 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 Fife development plan. This guidance incorporates the air quality development guidelines.
5	Integrate Air Quality with other Council Strategies Implementation Phase: Ongoing	Policy guidance and development control	Encourage opportunity for contributions towards improving local air quality and minimising negative impacts from existing and future Council strategies. Increase awareness of local air quality.	Fife Council	As outlined in the aims and objectives of Council's Air Quality Strategy 2015-20	Maintain regular and ongoing communication between members of the Appin Crescent AQAP steering group.	Low	Submission of AQ grant application for 2019-2020 includes submissions for climate change related measures. In February 2018 Fife Council signed the Covenant of Mayors on Climate Change. This formally committed the Council to develop a Fife Sustainable Energy Climate Action Plan. The plan is now in development and the aim is for an initial approved plan by early 2020. Alongside this Fife Council has committed to renewing its Carbon Management Plan. Reducing carbon emission and adapting to unavoidable climate change are also priorities for the Fife Partnership. The Fife Sustainable Energy Climate Action Plan is an action under the Plan for Fife - the Local Outcome Improvement Plan. Fife Councils Land & Air Quality Team continues to work closely with the Council's Climate Change team to ensure air quality is considered. Developing the Fife Sustainable Energy Climate Action Plan includes a practical action plan for mitigation activities and a Risk and Vulnerability Assessment to outline the challenge for adaption action.

Measure No.	Measure	Category	Focus	Lead Authority	Planning Phase	Key Performance Indicator	Target Pollution Reduction in the AQMA	Progress to Date (February 2018)
6	Traffic Management optimization (dependant on feasibility study) Implementation Phase: Completed	Traffic management	Reduce traffic queuing within the AQMA through the optimisation of the Traffic management system.	Fife Council	As outlined in the aims and objectives of Council's Air Quality Strategy 2015-20	Optimisation of the traffic management system at Appin Crescent and the surrounding network. Progress of this action is dependent on the conclusions of the feasibility study.	High	Completed
7	Travel Plans for large Institutions and Businesses Implementation Phase: Ongoing	Transport planning and infrastructure	To encourage a shift to more sustainable forms of travel or reducing the need for travel.	Fife Council	As outlined in the aims and objectives of Council's Air Quality Strategy 2015-20	Continue the implementation of Fife Council's travel plan Undertake Council travel surveys	Low	Travel plans continue to be implemented and promoted in Schools throughout Fife. Continue the implementation of Fife Council's Travel Plan.
8	Provision of Information and promotion of travel options Implementation Phase: Ongoing	Promoting travel alternatives	To increase awareness of travel choices and encourage changes in behaviour that will contribute to improving local air quality.	Fife Council	As outlined in the aims and objectives of Council's Air Quality Strategy 2015-20	To improve integration between cycling, walking and public transport. Produce Travel Choices facility for Dunfermline. Undertaking Travel Marketing in Dunfermline.	Low	Adopted FIFE plan 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.
9	Provision of information relating to Air Quality Implementation Phase: Ongoing	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	As outlined in the aims and objectives of Council's Air Quality Strategy 2015-20	Continue to make information relating to local air quality management available through the Council website.	Low	This information is covered by the Low Carbon Fife Supplementary Guidance document adopted January 2019.
10	Target reductions in emissions from the Council fleet and contract vehicles (including driver training) Implementation Phase: Ongoing	Vehicle fleet efficiency	Target reduced emissions from Council fleet vehicles and Council contract fleet vehicles.	Fife Council	As outlined in the aims and objectives of Council's Air Quality Strategy 2015-20	Monitor and assess viable options for alternative fuels, technologies and fuel additives. Fife Council tender specification outlines that all new vehicles must meet Euro 6 Engine Emissions or an equivalent emission reduction system. Number of vehicles in Council fleet. Number of electric and hydrogen powered vehicles in Council fleet.	Medium	By February 2019 Fife Council had 22 full electric vehicles and 11 hybrid vehicles in service and two new rapid chargers were installed (one in Kirkcaldy and one in Glenrothes). There are also 3 electric and 5 hybrid vehicles due to be added to the fleet by the end of May 2019. Fife Council Fleet Operations joined the ECO Stars scheme in October 2014 and have been continually improving by introducing low carbon vehicles to the fleet. Fife Council currently have the highest rating of 5-star's. Advantages include: reduction in air pollution (NO2, PM10), reduction in CO2 emissions, meeting EU and National LAQM targets, improved public health, economic efficiency and good communications with members. The size of the Fife Council fleet increased slightly in 2018 and now stands at 1,551. Total diesel use for 2018 was 4,065,655 litres (a reduction of 99,981 litres from 2017).
11	Investigate the potential for establishing voluntary bus agreements Implementation Phase: Ongoing	Promoting travel alternatives	Target reduced emissions from buses operating within the Appin Crescent AQMA.	Fife Council	As outlined in the aims and objectives of Council's Air Quality Strategy 2015-20	Liaise with bus operators regarding emissions from the bus fleet and improvements to bus service infrastructure. Bus quality agreement similar to P&R at Ferrytoll, link to Forth Road Bridge Replacement crossing.	Low	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 through the ongoing Fife ECO Stars recruitment process. As of March 2019, there are now 17 bus operators within the ECO Stars scheme with 626 vehicles.

Measure No.	Measure	Category	Focus	Lead Authority	Planning Phase	Key Performance Indicator	Target Pollution Reduction in the AQMA	Progress to Date (February 2018)
12	Consideration of development of Appin Crescent bypass (Dependent upon feasibility study) Implementation Phase: Completed	Transport planning and infrastructure	If determined to be feasible, the development of a bypass at Appin Crescent may be a potential option to facilitate a reduction the traffic volume passing through the AQMA and consequently, contribute to lower emissions.	Fife Council	As outlined in the aims and objectives of Council's Air Quality Strategy 2015-20.	Development of an Appin Crescent bypass.	High	Completed
13	Fife ECO Stars Implementation Phase: Ongoing	Vehicle Fleet Efficiency in HGV and Taxi Fleets	Encouraging local fleet operators to introduce fleet management systems that improve air quality	Fife Council	As outlined in the aims and objectives of Council's Air Quality Strategy 2015-20	Number of ECO Stars members	Medium	In 2018 the Fife Commercial Membership grew to 184 members covering 7,751 vehicles operating in Fife & beyond. This is an increase of 37 members and 944 vehicles from last year. The Taxi & Private Hire Membership has also increased with an additional 5 taxi operators and 25 vehicles taking the Taxi & Private Hire Membership up to 30 Operators & 157 vehicles.
14	Air Quality and Planning Toolkit Implementation Phase: Ongoing 2020	Development Control	Ensure future development does not compromise achievement of statutory air quality objectives	Fife Council	As outlined in the aims and objectives of Council's Air Quality Strategy 2015-20	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.	Medium	No further updates following reported updates last year.
15	Cost-benefit analysis of traffic management options to improve air quality within Appin Crescent Implementation Phase: Completed	Traffic Management	Evaluation of short to medium term traffic management measures to improve air quality	Fife Council	As outlined in the aims and objectives of Council's Air Quality Strategy 2015-20	CBA analysis Outcomes of two traffic management options	Low to Medium	Completed
16	Proposed Air Dispersion modelling study of the potential Dunfermline Northern Link Road Implementation Phase: Ongoing 2020 (Initial dispersion modelling report produced in 2016 and updated to reflect latest road vehicle emissions factors in 2017).	Traffic Management	Estimate the impact of the proposed northern link road and the proposed Dunfermline strategic land allocation (SLA) zones	Fife Council	As outlined in the aims and objectives of Council's Air Quality Strategy 2015-20	Carry out Air Quality dispersion modelling to quantify the impacts of the proposed Northern Link.	High	Results from the two AQMesh pods installed on the southern side of Appin Crescent in December 2017 to be reported within this 2019 APR.

Measure No.	Measure	Category	Focus	Lead Authority	Planning Phase	Key Performance Indicator	Target Pollution Reduction in the AQMA	Progress to Date (February 2018)
17	Air Quality Strategy for Fife Implementation Phase: Ongoing 2020	Strategy	As outlined in the aims / objectives contained in the Air Quality Strategy Report 2015-2020	Fife Council	As outlined in the aims and objectives of Council's Air Quality Strategy 2015-20	Pollutant reduction in AQMAs KPIs are currently being developed by the Scottish Government as outlined in the Cleaner Air Quality Strategy for Scotland and are anticipated to be finalised in the First Annual Progress Report for this Strategy. Following the introduction of these KPIs, Fife Council will incorporate these into the action planning process.	High	See measures 1-16. These are considered to be consistent with the aims/objectives of Scottish Government Cleaner Air Quality Strategy for Scotland 2015 including the List of Actions in Chapter 14 of this document.

2.3 Cleaner Air for Scotland

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

2.3.1 Transport-Avoiding Travel-T1

“All local authorities should ensure that they have a corporate travel plan (perhaps within a carbon management plan) which is consistent with any local air quality action plan.” (CAFS T1 2015)

Fife Council was the first Local Authority in Scotland to write a travel plan back in 1999 and to monitor how things are changing; an Employee Travel Survey is carried out every two years. The Fife Council Travel Plan³ promotes sustainable travel with a hierarchy of walking, cycling, public transport, car share, which is consistent with key aims and objectives of Fife Council's Air Quality Strategy 2015-20, and the Appin Crescent (Dunfermline) and Bonnygate (Cupar) Air Quality Action Plans (updated 2015).

Fife Council have several initiatives, including:

- TripshareFife.com - allowing you to find people travelling to similar locations to car share with: http://publications.fifedirect.org.uk/c64_LoveYourCar-Shareit.pdf
- Cycle to Work Scheme – providing you an opportunity to purchase a new bike and/or safety accessories and pay direct from your salary, saving money and spreading the cost.
- Working with Schools to assist them in producing school travel plans.
- WOW (Walk Once a Week)
- Bikeability – providing cycle training to primary school children P4 -7 (Discussed below in Section 2.5.3)

The “Walk Once a Week” Campaign has continued over 2018 (and into 2019) and the biggest achievement has been a decline in the percentage of children being driven to school whereby from the journeys logged upto the end of April each year there has been a noticeable decrease from 17% in April 2016 to 8% in April 2019.

National Walk to School Week took place in March 2018 whereby the Walk of Fame was again in place to put the primary schools across Scotland up against each other. Capshard Primary School, Kirkcaldy made it to number one overall with Strathallan Primary, also in Kirkcaldy, placed at number 4 and Milesmark Primary, Dunfermline, placed at number 8.



³ Fife Council Travel Plan- <https://www.fifedirect.org.uk/topics/index.cfm?fuseaction=service.display&p2sid=B8C89CE9-65BF-00F7-DD59C1DCB19187F5&themeid=568AF4CE-B036-4E67-93AB-36B1E13DFA11>

2.3.2 Climate Change-Effective co-ordination of climate change and air quality policies to deliver co-benefits-CC2

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)’.

In February 2018 Fife Council signed the Covenant of Mayors on Climate Change. This formally committed the Council to develop a Fife Sustainable Energy Climate Action Plan. The plan is now in development and the aim is for an initial approved plan by early 2020. Alongside this Fife Council has committed to renewing its Carbon Management Plan.

Reducing carbon emission and adapting to unavoidable climate change are also priorities for the Fife Partnership. The Fife Sustainable Energy Climate Action Plan is an action under the Plan for Fife - the Local Outcome Improvement Plan.

Fife Council's Land & Air Quality Team continues to work closely with the Council's Climate Change team to ensure air quality is considered. Developing the Fife Sustainable Energy Climate Action Plan includes a practical action plan for mitigation activities and a Risk and Vulnerability Assessment to outline the challenge for adaption action.

2.3.3 NHS Boards and their Local Authority Partners will include reference to air quality and health in JHPP-H2

“NHS boards and their local authority partners will include reference to air quality and health in the next revision of their Joint Health Protection Plans, which should identify and address specific local priority issues.” (CAFS H2 2015)

Fife Council has in partnership with NHS Fife updated its Joint Health Protection Plan (JHPP) for 2018-2020 whereby this includes specific reference to air quality in terms of the existing Bonnygate and Appin Crescent AQMAs, Fife Council's Air Quality Strategy 2015-20 and highlights the importance of a collaborative approach to tackling air quality issues.

2.3.4 Planning Authorities – Planning authorities to review the Local Development Plan-P2

“Expect planning authorities to review the Local Development Plan and revise at the next scheduled update to ensure policies are consistent with CAFS objectives and any local authority air quality action plans.” (CAFS P2 2015)

The Low Carbon Fife Supplementary Guidance was adopted in January 2019 and now forms a statutory part of the Local Development Plan (FIFEplan) which was adopted in September 2017. This guidance incorporates the air quality development guidelines which are designed to assist developers in considering and meeting the relevant air quality requirements.

2.3.5 Cycling Action Plan-T3

“We will work with partners to deliver our shared vision in the Cycling Action Plan for Scotland that by 2020, 10% of everyday journeys will be made by bike.” (CAFS T3 2015)

Fife has one of the UK's most comprehensive cycling networks. Over 350 miles of sign posted cycle network includes a variety of leisure and commuting routes. Terrain varies from off road disused railway tracks to routes in forests and from networks in towns and networks in quiet country lanes. In relation to the Appin Crescent Air Quality Action Plan (AQAP), new cycle routes have been developed to link the Public Park with Pittencrieff Park. The Lyne Burn Corridor project from Rex Park to Duloch has numerous purpose-built cycle routes connecting to two High Schools, Queen Margaret Station and the Queen Margaret Hospital.

Cycling is promoted through encouraging active schools. In schools across Fife the latest figures show that 4% of children travel to nursery and primary school by cycling. Cycling is further promoted within schools via the Bikeability scheme. Up to May 2019 the number of pupils achieving Level 1, 2 and 3 across Fife were:

- Level 1 - 1307 pupils (52 schools)
- Level 2 - 810 pupils (38 schools)
- Level 3 - 6 pupils (1 school - Dairsie Primary is the first school in Fife to achieve Level 3)

2.3.6 Work with key partners to investigate the use of hydrogen as a transport fuel-T10

“Work with key partners to investigate the use of hydrogen as a transport fuel, as well as exploring wider environmental and economic opportunities of using hydrogen for energy applications – especially in promoting renewables, energy balancing and storage.” (CAFS T10 2015)

Green hydrogen power is becoming widely recognised as a key catalyst to driving forward transport and associated infrastructure for generations to come. One of Scotland’s leading forces behind making this a reality is Fife through its pioneering Levenmouth Community Energy Project, a collaborative initiative which is led by Bright Green Hydrogen and supported by a number of partners including Fife Council and Toshiba. Part of this involves Levenmouth becoming home to one of Europe’s largest fleet of hydrogen dual-fuel vehicles (17 vehicles), seven of which will be operated by Fife Council. The fleet includes 10 electric-powered Renault Kangoo vans with H₂ fuel cell range extender which will be 100% zero emissions if charged using the Hydrogen Office’s 100% green electric vehicle charging station. The project also includes five Ford Transit vehicles that are converted to run on a diesel and hydrogen mixture as well as 2 Refuse Collection Vehicles (RCVs), which are believed to be a world-first of their kind.

The Council is currently in the final stages of developing a Hydrogen Strategy for Fife. Initial recommendations for areas of future focus include:

- Deployment of hydrogen portable power devices to reduce diesel consumption.
- Explore funding to begin a programme to convert remaining vehicle fleet to dual-fuelled RCVs and selected vans to generate significant localised demand.
- Along with other neighbouring councils, explore the potential a new large scale electrolytic hydrogen production.
- Work with local actors (e.g. Bright Green Hydrogen) and national technology providers to develop a centre of excellence for portable power based on hydrogen fuel cell products
- Prepare and pitch the region to take part in a 100% hydrogen gas grid trial.

In addition, the Council is currently a partner in the Fuel Cell and Hydrogen Joint Undertaking (FCHJU) Regions and Cities initiative. The key project which involves 60 regions across Europe, aims to help cities and regions to identify the most promising FC&H applications, evaluate the potential, and identify and maximise the use of different financing options.

The initiative is currently developing roadmaps and concepts to prepare and implement FC&H deployment projects from 2018 onwards. Application areas include:

- Road transport: particularly urban and rural bus fleets, delivery vehicle fleets, and car club fleets
- Passenger and vehicle ferries using hydrogen. Commuter trains using hydrogen.
- Stationary fuel cell applications, including combined heat and power (CHP) and back-up power systems
- Power-to-Hydrogen applications for local fuel production, energy storage, and injection of hydrogen into the gas grid

Levenmouth has been selected as one of three potential locations for the Hydrogen 100 Project being led by SGN. The aim of the project is to demonstrate the safe, secure and reliable distribution of hydrogen to heat people's homes. The first phase of the selection process is currently underway whereby one of the sites will be selected by 2021 and a demonstration network will be constructed to show the feasibility of the scheme to stakeholders with the potential for this to be rolled out within the local community. There are also on-going discussions with owners and operators at the Levenmouth waterfront area regarding potential infrastructure changes, including the potential for large scale hydrogen generation from offshore wind.

2.3.7 Freight Quality Partnerships-T12

"Encourage each local authority with an AQMA to create a Freight Quality Partnership (or utilise an existing RTP Freight Quality Partnership) and consider appropriate measures for local air quality improvement by 2017." (CAFS T12 2015)

Fife Council continues to explore the potential to develop Freight Quality Partnerships through the on-going implementation of the Fife ECO Stars scheme which includes the running of future workshop events with key stakeholders.

3 Air Quality Monitoring Data and Comparison with Air Quality Objectives

3.1 Summary of Monitoring Undertaken

3.1.1 Automatic Monitoring Sites

This section sets out the monitoring that has taken place within Fife during 2018 and how local concentrations of the main air pollutants compare with the relevant objectives. Fife Council undertook automatic (continuous) monitoring at four sites during 2018, which measure NO₂, PM₁₀, and PM_{2.5} concentrations.

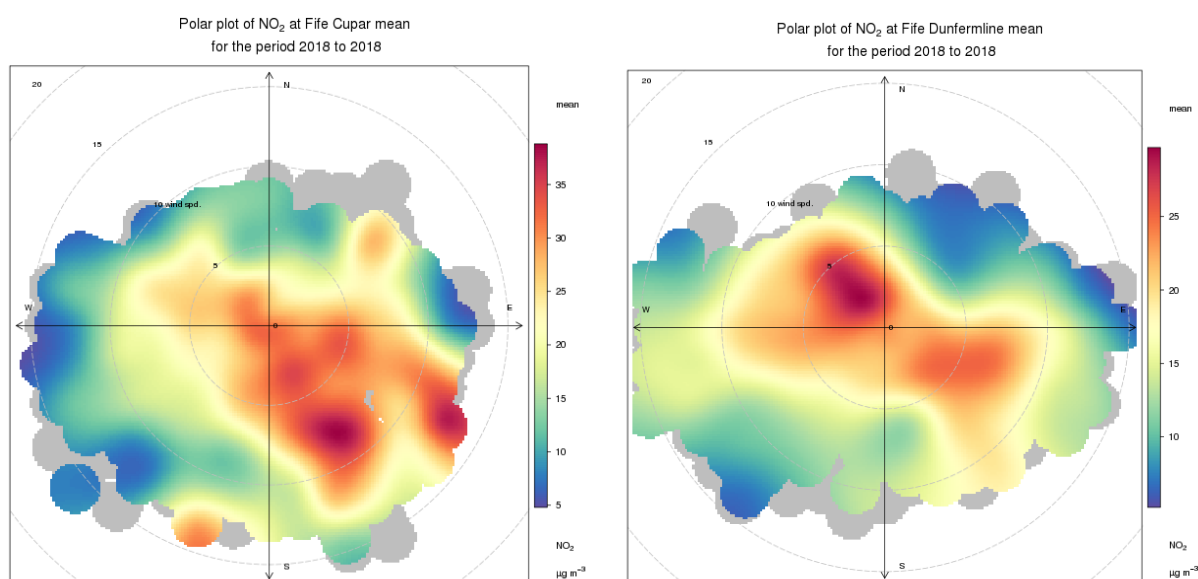
All PM₁₀ analysers were upgraded to FIDAS during 2016 and included monitoring of PM_{2.5}, PM₁ and total suspended particles (TSP). FIDAS analysers have been assessed as equivalent to the EU reference method. Results for 2018 have been reported for PM₁₀ and PM_{2.5}. Table A.1 in Appendix A shows the details of the sites. National monitoring results are available at: <http://www.scottishairquality.scot/data/data-selector>.

Maps showing the location of the automatic monitoring sites in 2018 are provided in Figure 3.2 to Figure 3.5. Further details on the QA/QC of the automatic monitoring sites are included in Appendix C. Automatic SO₂ was historically available from Scottish Power Generation Ltd. from a monitoring site close to Longannet Power Station, however Longannet Power Station ceased operation in March 2016.

Polar plots of NO₂ concentrations by wind speed and wind direction are shown in Figure 3.1 for Bonnygate, Cupar and Appin Crescent, Dunfermline where AQMA's have been declared. Polar plots are useful to show geographical representation of the relationship between pollutant concentrations and the meteorological conditions.

Polar plots for both locations indicate a relationship between concentrations and wind speed/direction. There is a clear signal arising when winds blow parallel to the street canyon to the east, which is as would be expected. The plots show a broadly east-west signal which is consistent with parallel winds through the street canyon. It should also be noted that the meteorological conditions in the Open Air 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 years'.

Figure 3.1 Polar plots of NO₂ concentrations by wind speed and direction



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 in 2018 are summarised in INEOS Grangemouth Oil Refinery Annual Community Air Quality Monitoring Report⁴.

3.1.2 Non-Automatic Monitoring Sites

Fife Council operates an extensive NO₂ diffusion tube monitoring survey with sites in East, West and Central Fife. In total there are 62 NO₂ diffusion tube monitoring sites throughout the Fife area. Of these, eight 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 additional diffusion tube sites which commenced in 2018. Appin Crescent 1 was relocated from 80 Appin Crescent to 76 Appin Crescent early in 2018 due to permission issues and 57 Halbeath Road was removed at the end of 2018 due to low readings. This has been replaced with a new site at North Street, St Andrews, following the mobile monitoring study which was undertaken. 10 sites ceased monitoring after April 2018, due to continuously low readings over recent years. These were:

- 24 St Clair Street, Kirkcaldy
- Lamond Drive 1, St Andrews
- St Marys Street 1, St Andrews
- St Marys Street 2, St Andrews
- 8 Balgarvie Road, Cupar
- Orchard Balgarvie Road, Cupar
- 4 East Road, Cupar
- South Road, Cupar
- 49 Ramsay Place, Rosyth
- St Leonards Primary School, Dunfermline

Table A.2 in Appendix A shows the details of these ceased sites and the existing monitoring locations. Maps showing the location of the nitrogen dioxide diffusion tubes in 2018 are provided in Figure 3.2 to **Figure 3.7**. Figure 3.2 shows the spread of these tubes across Fife while Figure 3.3 to **Figure 3.7** 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. Monitoring ceased at 10 sites throughout Fife during 2018 and therefore these sites required to be annualised in accordance with TG.16, details are provided in Appendix D.

⁴ Community Air Quality Monitoring Report, Ambient Atmospheric Survey in the Vicinity of Grangemouth – 2018, INEOS March 2019

Figure 3.2 Nitrogen dioxide diffusion tube locations – Fife Wide

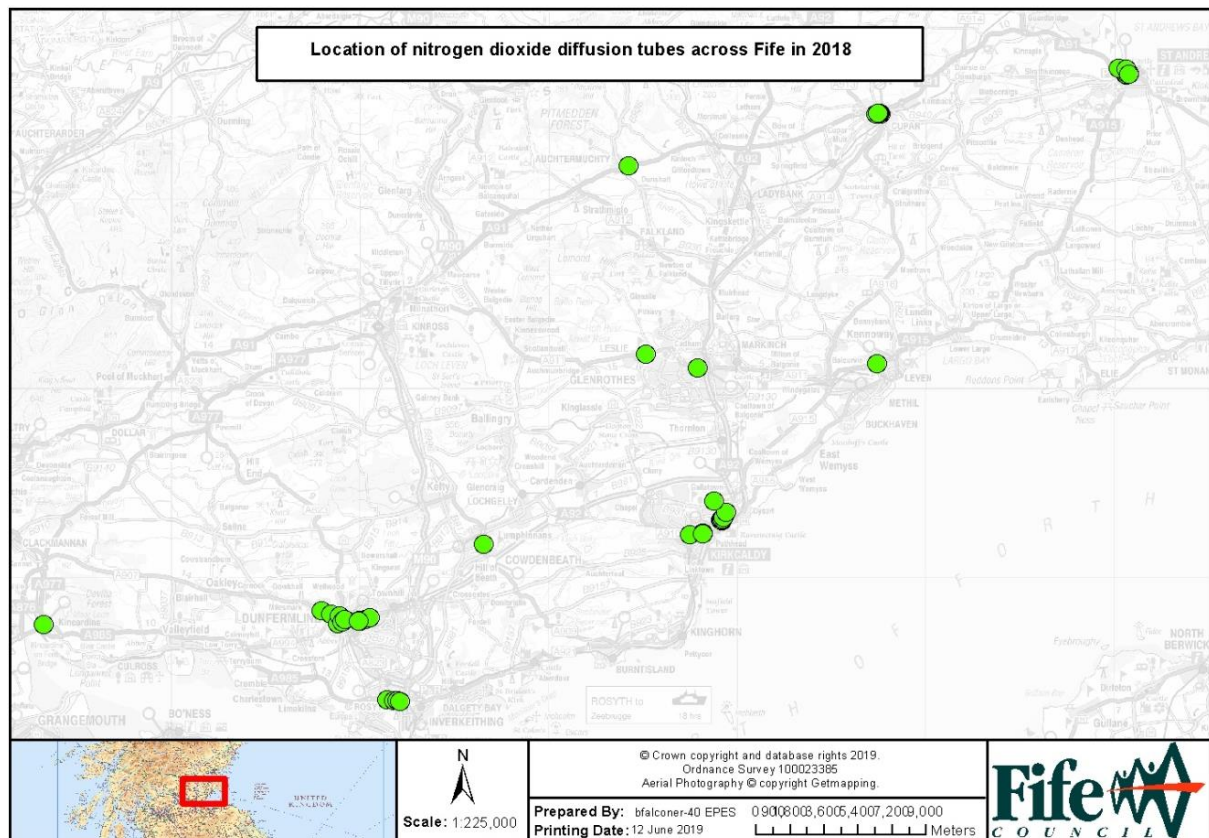


Figure 3.3 Nitrogen dioxide diffusion tube locations - Cupar AQMA

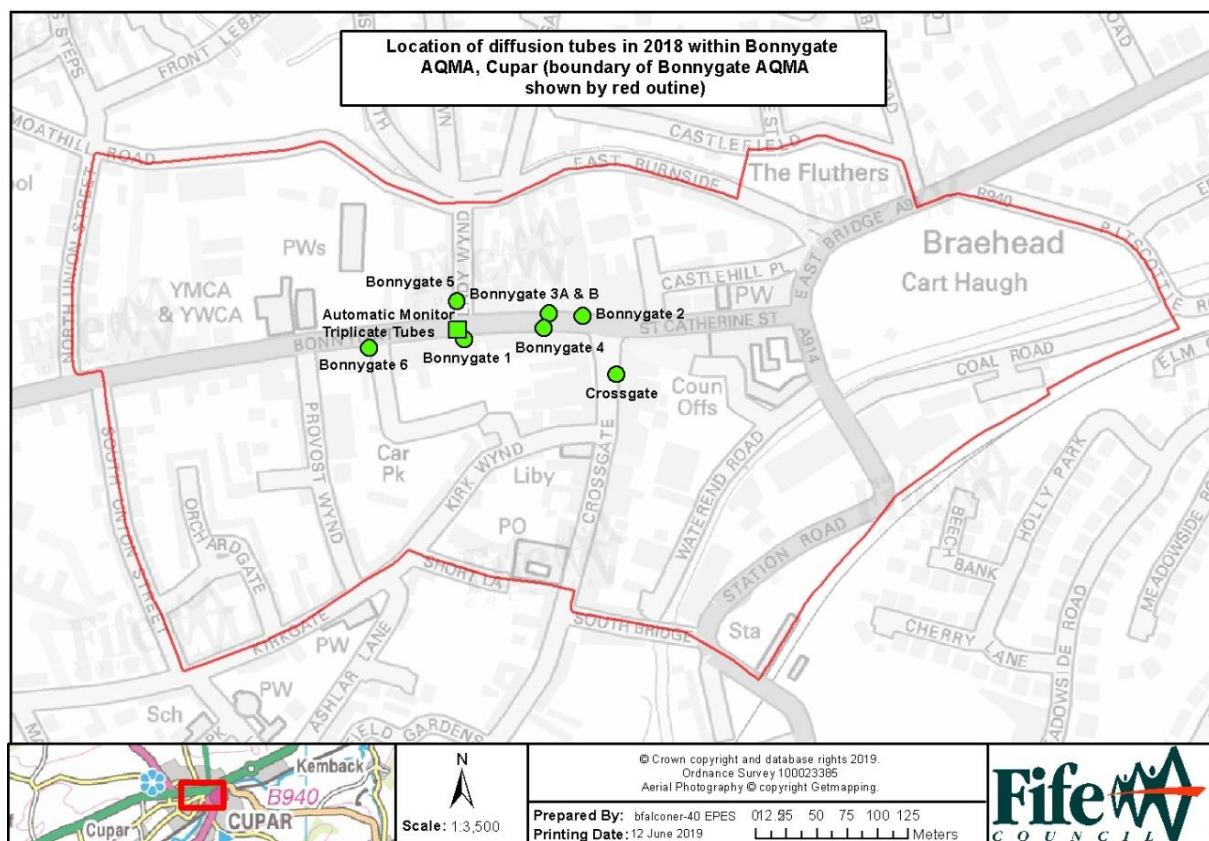


Figure 3.4 Nitrogen dioxide diffusion tube locations - Appin Crescent, Dunfermline AQMA

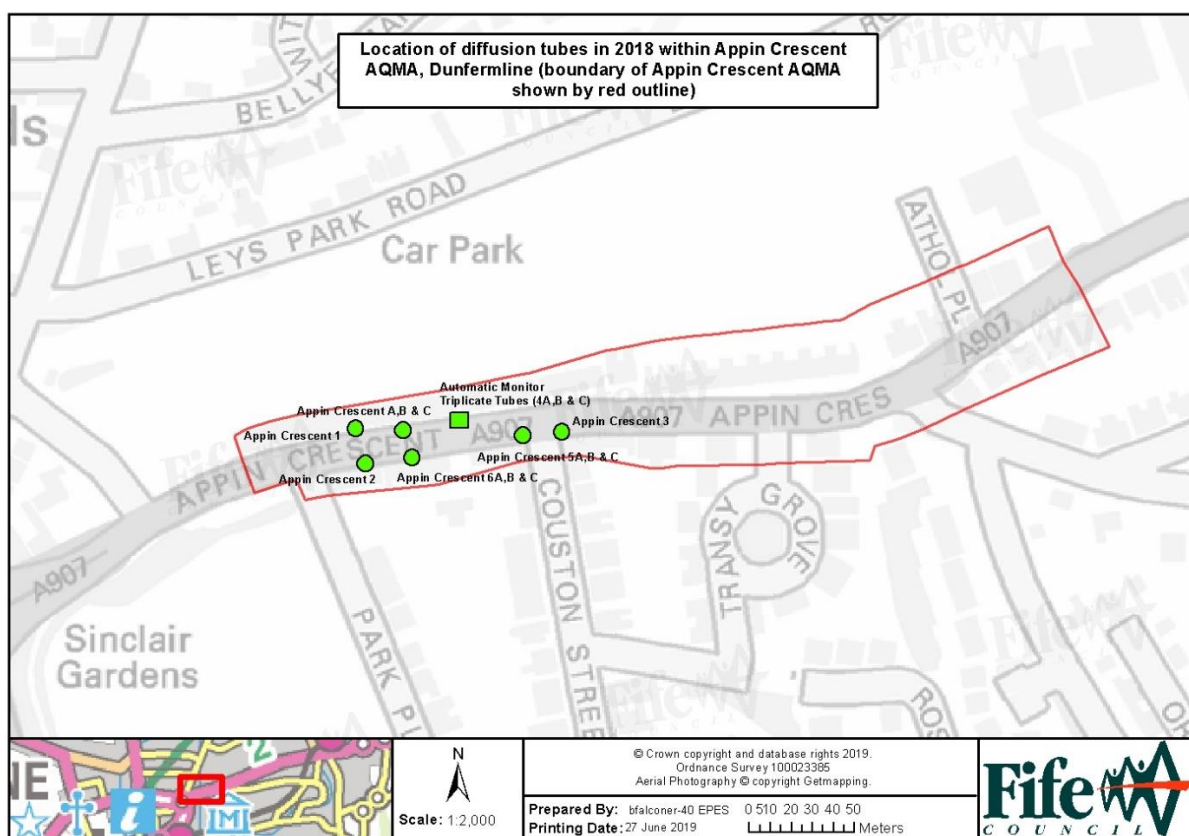


Figure 3.5 Nitrogen dioxide diffusion tube locations - Kirkcaldy

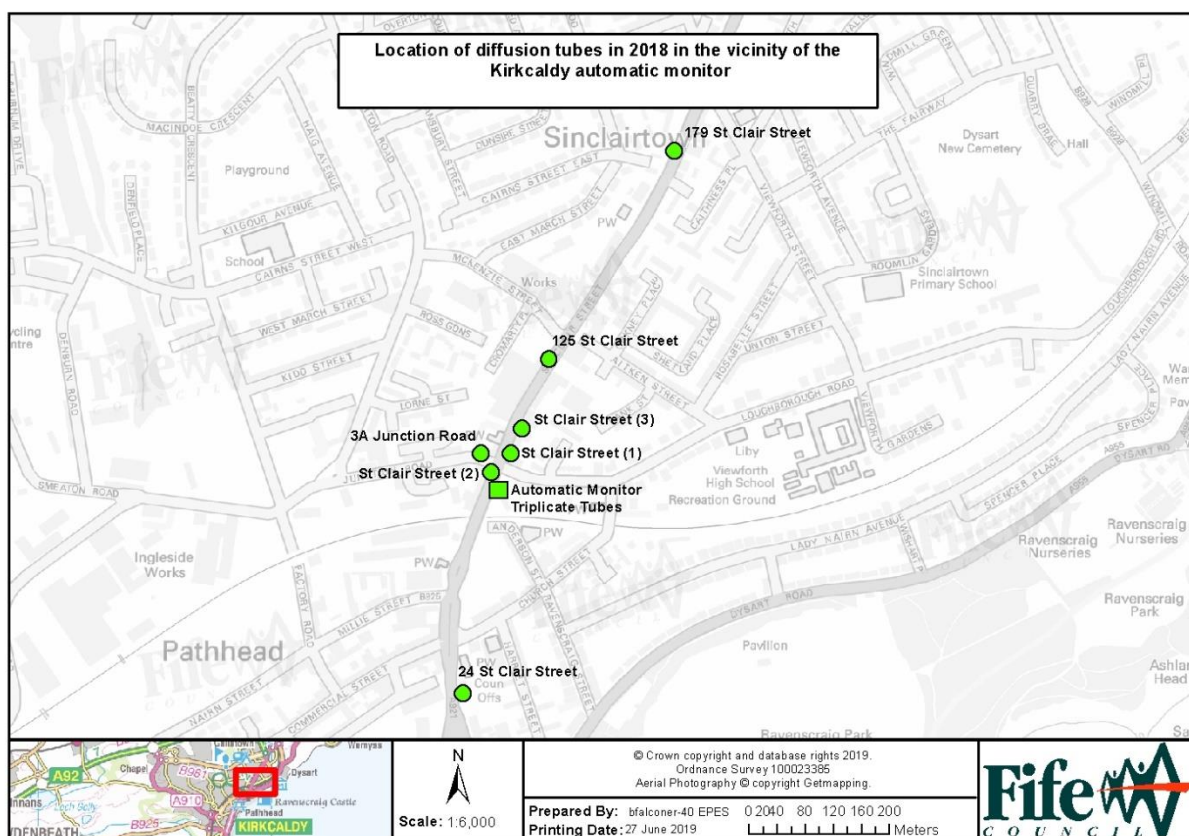


Figure 3.6 Nitrogen dioxide diffusion tube locations – Rosyth

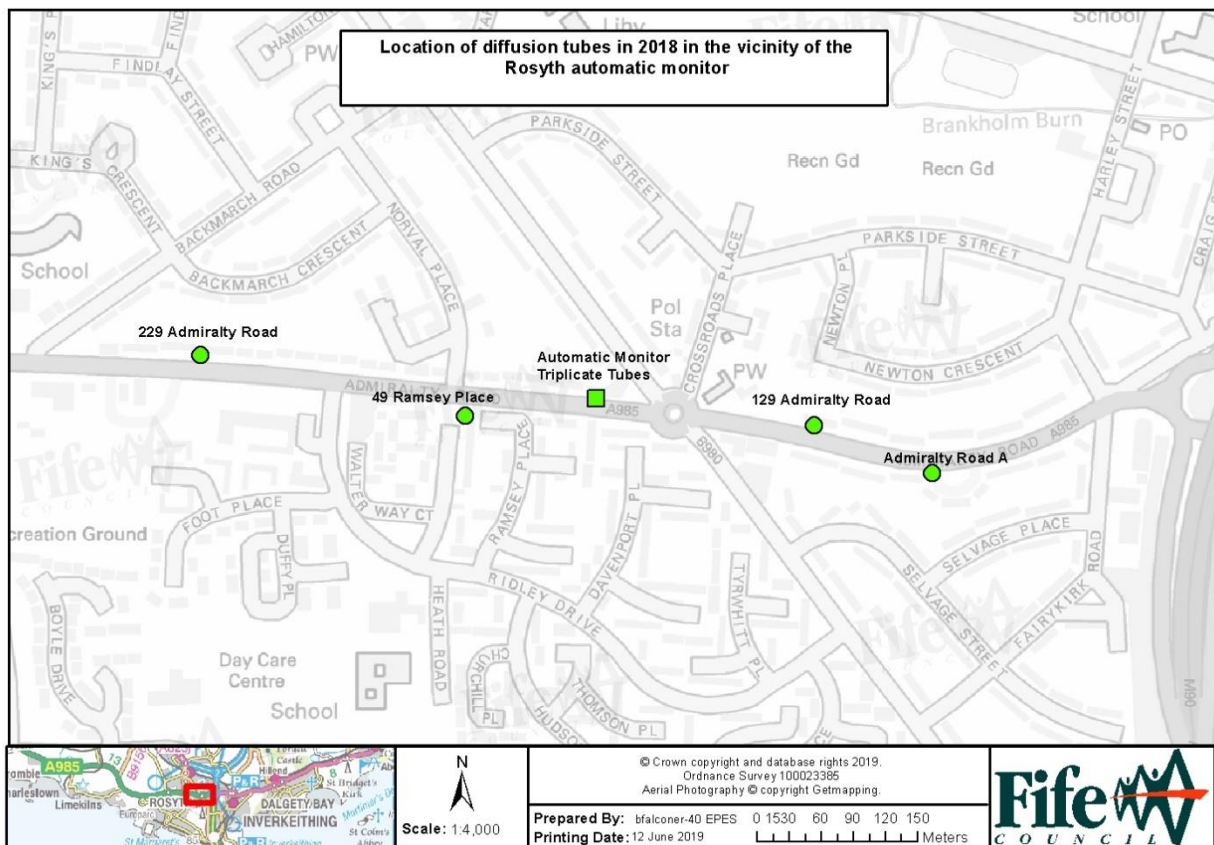
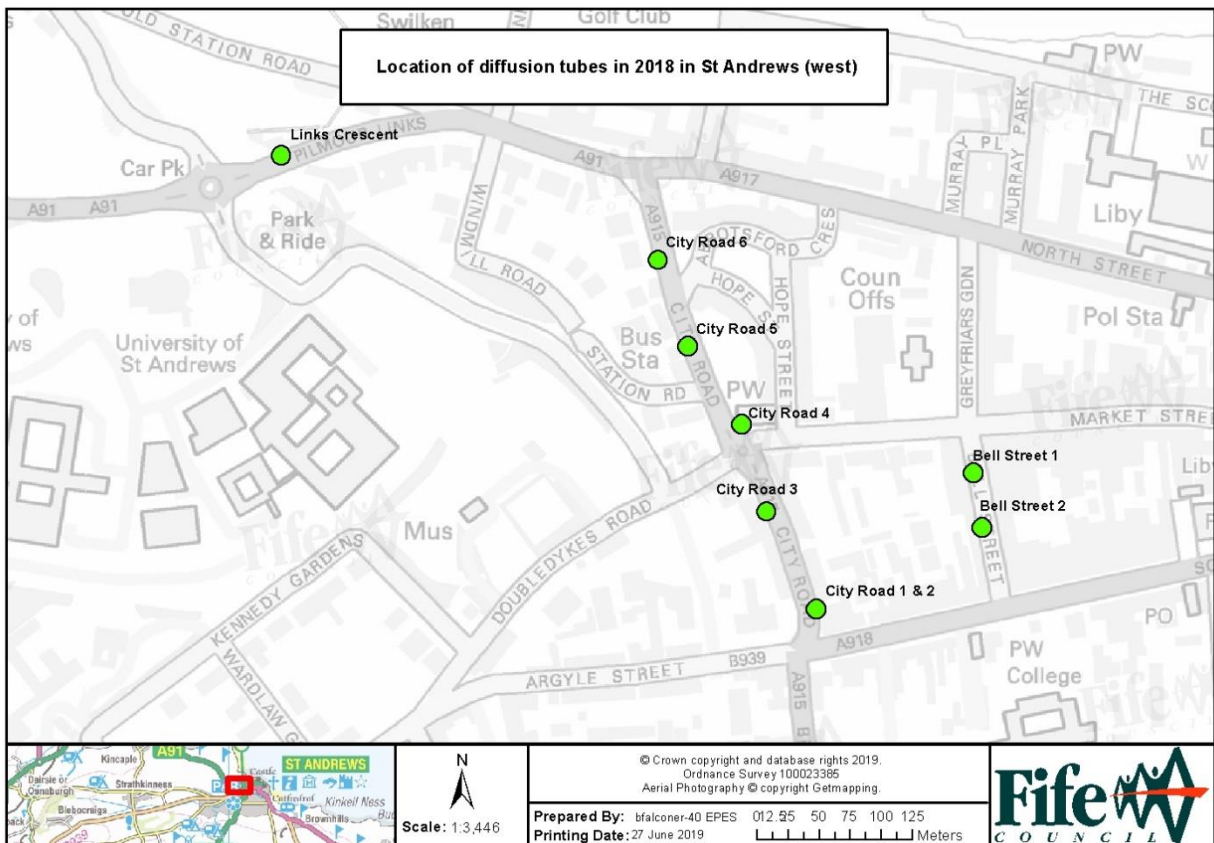


Figure 3.7 Nitrogen dioxide diffusion tube locations – St Andrews (West)



3.2 Individual Pollutants

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

3.2.1 Nitrogen Dioxide (NO₂)

Automatic Monitoring Data

Appendix A presents the monitoring results for 2018. The automatic sites at Cupar, Dunfermline, Kirkcaldy and Rosyth did not record any exceedances of the AQS NO₂ annual mean (Table A.3) or 1-hour mean objectives (Table A.5) during 2018.

The trend of decreasing concentrations seen at Appin Crescent, Dunfermline suggest that the action plan measures introduced have had a positive impact. During 2018 concentrations decreased in Cupar with all monitoring locations measuring annual mean concentrations below the AQS annual mean objective of 40 µg m⁻³. The automatic monitoring site at Bonnygate, Cupar, measured an annual mean concentration of 26 µg m⁻³ during 2018. In Appin Crescent, Dunfermline, the automatic monitoring site measured an annual mean concentration of 22 µg m⁻³ during 2018.

The annual mean NO₂ concentrations from 2013-2018 are displayed in Figure 2.3 for Bonnygate, Cupar and Figure 2.5 for Appin Crescent, Dunfermline (provided in Section 2.1 of this report). The graph demonstrates that NO₂ concentrations are generally declining in both AQMAs, with concentrations declining further in 2018. Overall concentrations have continued to decline within the designated AQMAs in Dunfermline and Cupar as a result of AQAP measures being implemented.

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 Energy and Environment who carry out appropriate QA/QC. The data showed that no exceedances were measured during 2018. Analysis of the monitoring data from these units is presented in Section 3.3.3

Diffusion Tube Monitoring Data

The annual diffusion tube data is presented in Appendix A, Table A.4. The data has been bias corrected using the local bias adjustment factor, or a combined factor for areas out with the automatic sites. This approach was used as Fife Council changed their diffusion tube supplier from Tayside Scientific Services to SOCOTEC part way through the year. The following local bias adjustments were calculated – further details are provided in Appendix C:

- Cupar = 0.78
- Dunfermline = 0.74
- Kirkcaldy = 0.78
- Rosyth = 0.84
- Average of Local = 0.78

The local bias adjustment was applied to all diffusion tubes within the area. While the average of the local was used for all other sites for consistency. The local bias calculations are outlined in the data QA/QC in Appendix C. The full 2018 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 2013 to 2018 are presented in Appendix A, Table A.4. The 2018 diffusion tube results indicate that there were no exceedances of the AQS annual mean objective at any monitoring locations, including locations within Dunfermline and Cupar which had previously exceeded are now marginally below 40 µg m⁻³. The highest annual mean concentration measured in Appin Crescent, Dunfermline

during 2018 was $34.8 \mu\text{g m}^{-3}$ at Appin Crescent 6(A,B,C). The highest annual mean measured at Bonnygate, Cupar during 2018 was $34.2 \mu\text{g m}^{-3}$ at Bonnygate B4.

During early 2018 Appin Crescent 1 was relocated from 80 Appin Crescent to 76 Appin Crescent due to permission issues. 57 Halbeath Road was removed at the end of 2018 due to low readings and was replaced with a new monitoring site at North Street, St Andrews following completion of the mobile study, the results from this site will be presented in the 2020 Annual Progress Report.

Monitoring ceased at the following 10 sites after April 2018:

- 24 St Clair Street, Kirkcaldy
- Lamond Drive 1, St Andrews
- St Marys Street 1, St Andrews
- St Marys Street 2, St Andrews
- 8 Balgarvie Road, Cupar
- Orchard Balgarvie Road, Cupar
- 4 East Road, Cupar
- South Road, Cupar
- 49 Ramsay Place, Rosyth
- St Leonards Primary School, Dunfermline

Therefore, annual mean concentrations have been annualised in accordance with TG.16, further details are provided in Appendix D.

3.2.2 Particulate Matter (PM₁₀)

Table A.6 in Appendix A compares the ratified and adjusted monitored PM₁₀ annual mean concentrations between 2013 and 2018 with the air quality objective of $18 \mu\text{g m}^{-3}$. Table A.7, Appendix A compares the ratified continuous monitored PM₁₀ daily mean concentrations between 2013 and 2018 with the air quality objective of $50 \mu\text{g m}^{-3}$, not to be exceeded more than 7 times per year. The 2018 monitoring results indicate that the daily mean objective of $50 \mu\text{g m}^{-3}$ (not to be exceeded more than 7 times in a year) was not exceeded at any of the PM₁₀ monitoring sites in Fife.

PM₁₀ concentrations are monitored at automatic monitoring sites in Bonnygate in Cupar, Admiralty Road in Rosyth, St Clair Street in Kirkcaldy and Appin Crescent in Dunfermline. Details of these sites are given in Table A.1, Appendix A.

Data collected for 2018 shows that all the Fife monitoring sites meet the annual mean objective with concentrations lower than $18 \mu\text{g m}^{-3}$.

- Appin Crescent, Dunfermline – $10.9 \mu\text{g m}^{-3}$
- Bonnygate, Cupar – $13.7 \mu\text{g m}^{-3}$
- Admiralty Road, Rosyth – $10.5 \mu\text{g m}^{-3}$
- St Clair Street, Kirkcaldy – $10.3 \mu\text{g m}^{-3}$

PM₁₀ concentrations within the Bonnygate, Cupar AQMA for PM₁₀ have steadily decreased from $18 \mu\text{g m}^{-3}$ in 2013 to $13 \mu\text{g m}^{-3}$ in 2017, although there was a slight increase of less than $1 \mu\text{g m}^{-3}$ in 2018. It is believed that the decrease in PM₁₀ is a result of the implemented measures for traffic management outlined in the AQAP. It is hoped that future and ongoing action plan measures being carried out in Cupar will help reduce concentrations further.

The 2018 annual mean PM₁₀ concentrations at Admiralty Road, Rosyth ($10.5 \mu\text{g m}^{-3}$) was below the annual mean PM₁₀ objective. Appendix A, Figure A.2 shows the change in PM₁₀ concentrations at Bonnygate, Cupar and Appin Crescent, Dunfermline and highlights that the action plans can be effective in reducing concentrations of pollutants in AQMAs.

The 2018 annual mean PM₁₀ concentration at Appin Crescent, Dunfermline (10.9 µg m⁻³) was below the AQS annual mean PM₁₀ objective. The Further Assessment of the Air Quality in Appin Crescent (2012) indicated that the relevant PM₁₀ objective may be compromised and the Air Quality Management Area Order should be amended to include this pollutant. The Appin Crescent AQMA Declaration Order was amended to include PM₁₀ in November 2012. The monitored PM₁₀ concentrations have now been consistently below the annual mean objective for multiple years.

The annual mean PM₁₀ concentrations for St Clair Street, Kirkcaldy in 2018 continued to be below the PM₁₀ annual mean objective with a measured concentration of 10.3 µg m⁻³, a slight increase on 2017 concentrations. As shown in Figure A.2, Appendix A, the PM₁₀ concentrations at St Clair Street, Kirkcaldy have been consistently well below the air quality objective.

3.2.3 Particulate Matter (PM_{2.5})

During 2018, PM_{2.5} was measured at four automatic monitoring sites in Appin Crescent in Dunfermline, Bonnygate in Cupar, Admiralty Road in Rosyth and St Clair Street in Kirkcaldy. 2018 is the second year where PM_{2.5} concentrations have been reported for Cupar. Measured 2018 concentrations were below the PM_{2.5} annual mean objective at all sites. Details of these sites and concentrations measured are presents in Appendix A.

3.2.4 Sulphur Dioxide (SO₂)

Fife Council does not undertake any SO₂ monitoring.

3.2.5 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 BP.

INEOS Grangemouth Benzene Monitoring

Benzene monitoring is presented for INOES Grangemouth oil refinery in their annual monitoring report for 2018⁵. 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).

BP 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 2018 (5th January 2018 to 3rd January 2019). Nine locations on the Estuary North shore between North Queensferry and West Wemyss (including 4 locations between Dalgety Bay and Burntisland) were used, and 3 locations on the Estuary South shore between South Queensferry and Whitehouse Point were used.

The ambient air samples were collected over 2 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.

⁵ Community Air Quality Monitoring Report, Ambient Atmospheric Survey in the Vicinity of Grangemouth – 2018, INEOS March 2019

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 most locations was n-butane for which annual mean concentrations ranged from 1.9 to 14.5 ppb v/v.
- The annual mean concentrations of other individual substances ranged from <0.3 to 6.6 ppb v/v.
- The annual mean concentrations of total hydrocarbons (C4 to C10) at different locations ranged from 7 to 33 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 2018 indicate that concentrations of most of the monitored substances were very similar to those measured in 2017 at most of the locations.

3.2.6 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 2018, 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)
Dunfermline, Bothwell Gardens (Site 3)	17/04/18 – 23/04/18	0.54
	04/07/18 – 10/07/18	0.48
	19/10/18 – 25/10/18	0.21
	10/05/18 – 16/05/18	0.24
Leven, Glenlyon Road/ Windygates Road (Site 7)	08/08/18 – 14/08/18	0.73
	07/02/19 – 13/02/19	0.50
	17/04/18 – 23/04/18	0.34
Dunfermline, Carnegie Drive/Pilmuir Street (Site 13)	04/07/18 – 10/07/18	1.58
	19/10/18 – 25/10/18	0.78
	05/06/18 – 11/06/18	0.29
	25/09/18 – 01/10/18	0.83
Kirkcaldy, Dunnikier Road/Victoria Road (Site 16)	08/03/19 – 14/03/19	0.61
	08/06/18 – 14/06/18	1.69
	25/09/18 – 01/10/18	0.56
	08/03/19 – 14/03/19	0.61
Rosyth, Admiralty Road/ Queensferry Road (Site 24)	10/05/18 – 16/05/18	0.50
	08/08/18 – 14/08/18	0.16
	07/02/19 – 13/02/19	0.14
	17/04/18 – 23/04/18	0.58
Cupar, Bonnygate (Site 34)	04/07/18 – 10/07/18	0.51
	19/10/18 – 25/10/18	1.10
	05/06/18 – 11/06/18	0.40
	25/09/18 – 01/10/18	0.08
Dunfermline, Appin Crescent (Site 35)	08/03/19 – 14/03/19	0.24
	04/04/18 – 01/04/18	0.56
	08/03/19 – 14/03/19	0.24
	04/04/18 – 01/04/18	0.56
Kirkcaldy, St Clair Street/Junction Road (Site 36)	04/04/18 – 01/04/18	0.56
	04/04/18 – 01/04/18	0.56
	04/04/18 – 01/04/18	0.56
	04/04/18 – 01/04/18	0.56
A909 Mossmorran (Site 37)	04/04/18 – 01/04/18	0.56
	04/04/18 – 01/04/18	0.56
	04/04/18 – 01/04/18	0.56
	04/04/18 – 01/04/18	0.56

Site Number/Location	Monitoring Period	Max 8-Hour Concentration (ppm)
St Andrews, Bell Street (Site 39)	21/07/18 – 27/07/18	0.38
	19/10/18 – 25/10/18	0.46
	10/05/18 – 16/05/18	0.40
	08/08/18 – 14/08/18	0.46
	07/02/19 – 13/02/19	0.43
St Andrews, City Road (Site 40)	22/05/18 – 28/05/18	1.03
	22/08/18 – 28/08/18	0.61
	20/02/19 – 26/02/19	1.66
St Andrews, St Mary' Place (Site 41)	22/05/18 – 28/05/18	0.78
	22/08/18 – 28/08/18	0.74
	Faulty equipment	No data
St Andrews, Lamond Drive (Site 42)	22/05/18 – 28/05/18	0.71
	22/08/18 – 28/08/18	0.40
	20/02/19 – 26/02/19	1.55

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 Grangemouth as part of their annual reporting for 2018⁶. Annual average concentrations are lower than the set air quality limit for these substances. The INEOS Grangemouth annual community air monitoring report for 2018 states that there were no significant changes in the annual average concentrations for all hydrocarbon components across all locations, when compared with historical data.

At the time of writing, The Mossmorran and Braefoot Bay Independent Air Quality Monitoring Review Annual Report 2018 has not yet been published. A summary will be added to this report once it is available.

3.2.7 Summary of Compliance with AQS Objectives

New monitoring data measured in 2018 identified no exceedances of the AQS annual mean objective for NO₂ at any of the automatic or non-automatic monitoring locations in Fife. The highest annual mean concentration measured in Appin Crescent, Dunfermline during 2018 was 34.8 µg m⁻³ at Appin Crescent 6(A,B,C). The highest annual mean concentration in Bonnygate, Cupar during 2018 was 34.2 µg m⁻³ at Bonnygate B4.

All the automatic monitoring sites in Fife measured PM₁₀ concentrations below the annual and daily mean objectives during 2018. Bonnygate, Cupar and Appin Crescent, Dunfermline have both already been declared AQMAs for NO₂ and PM₁₀. PM₁₀ 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 2018 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 appropriate. The monitoring data for 2019 will be reported in the next Annual Progress Report (2020) which will evaluate the most recent monitoring data.

⁶ Community Air Quality Monitoring Report, Ambient Atmosphere Survey in the Vicinity of Grangemouth – 2018, INEOS March 2019

3.3 Additional Monitoring studies undertaken in 2018

During 2018 additional air quality studies were carried out to help Fife Council to get a better understanding of air quality within the region. These studies were;

- Fife Vehicle fleet Emissions Tracer Survey
- St Andrews Mobile Monitoring Study
- AQ Mesh sensor monitoring studies

3.3.1 Fife Vehicle Fleet Emissions Tracer Study

Fife Council carried out an emissions tracer survey on a sample of the Fife Council vehicle fleet to determine if fleet renewals would yield tangible air quality benefits in the AQMA's and areas of concern.

Emissions estimates for ~650 LDV vehicles in Fife Council's fleet were calculated using information from GPS data collected from the vehicles. NO_x, PM₁₀ and PM_{2.5} emissions during April 2018 were calculated using Ricardo's PyCOPERT model, which is based on COPERT5 emissions factors. Using Python, a custom script was prepared to process the 85,000 GPS points provided by Fife Council.

The GPS data was only provided for 1 month, and the use of this data to predict longer duration trends e.g. over a year should be made with care. The emissions data highlighted the Council fleet is mainly located in the main towns in the Council area, and travel between the towns is via the main A roads.

A number of GPS points were located in the AQMA's in Fife highlighting that the Council fleet travel through these locations. The number of points in Appin Crescent were low compared to the number of points in the whole dataset suggesting that Council vehicles do not use this route a large amount and are unlikely to be a large contributor to total emission in the AQMA. In Bonnygate, however, a much larger number of GPS points were located from the Council vehicles suggesting this is a common street travelled on the Council fleet route. Without annual estimates of the number of trips we are unable to establish the impact of the council fleet on the total emissions in the AQMA. Fife Council could look at their current fleet routes and, where possible, divert vehicles to avoid the Bonnygate AQMA.

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. There is also a large number of GPS points related to vehicles in standstill in these locations. Providing the drivers of the vehicles with information regarding eco-driving, including turning engines off during extended periods of standstill traffic could help reduce emissions in these areas.

As only a sample of the fleet was used and only a relatively short period of time, Fife Council are looking to extend the survey to include all fleet vehicles and over a long period of time. This would provide a more accurate estimate of the affect the fleet has on overall emissions levels.

3.3.2 St Andrews Mobile Monitoring Study

Ricardo Energy & Environment were contracted by Fife Council to carry out mobile air quality monitoring surveys⁷ in the centre of St Andrews, measuring nitrogen dioxide (NO₂) and particulate matter (PM₁₀ and PM_{2.5}). The aim of the mobile monitoring was to demonstrate how air pollution concentrations vary within St Andrews and in turn to review the current NO₂ diffusion tube monitoring locations. In addition to the NO₂ and PM monitoring, black carbon (BC) monitoring was also carried out using an AE51 MicroAeth.

Meteorological data from Leuchars airfield was used to investigate the potential impacts of weather on pollutant concentrations. The wind was predominantly from the southwest with wind speeds of up to 11.8 ms⁻¹ or 26.4 mph. Minimum wind speeds were measured on 28/09/2018 and there was a decreasing trend in wind speed between the four mobile monitoring exercises.

⁷ Mobile Air Quality Monitoring Survey, St Andrews Fife – Investigations of the spatial variation of pollutant concentrations around St Andrews Centre (Dec 2018)

For NO₂, 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 – these hotspots are highlighted in Figure 3.8. Taking into considering the measured hotspots, in general, the NO₂ diffusion tubes are currently sited at worst-case locations. It might however, be appropriate to add further monitoring on the north side of North Street between Golf Place and Abbotsford Crescent as no monitoring is currently carried out in that area.

Figure 3.8 Spatial distribution of normalised 1-minute average NO₂ concentrations, St Andrews



For PM₁₀ and PM_{2.5}, similar hotspots were identified as NO₂ confirming that the main source of pollution is likely to be road traffic. However, a further PM₁₀ hotspot was measured along Bridge Street at the junction of Kinnessburn Road (Figure 3.9). It is unclear what the source of these increased PM₁₀ concentrations is but there are un-tarmacked lanes nearby, namely, Kinnessburn Terrace and private drives opposite. These lanes could be a source of resuspended coarse particulate matter.

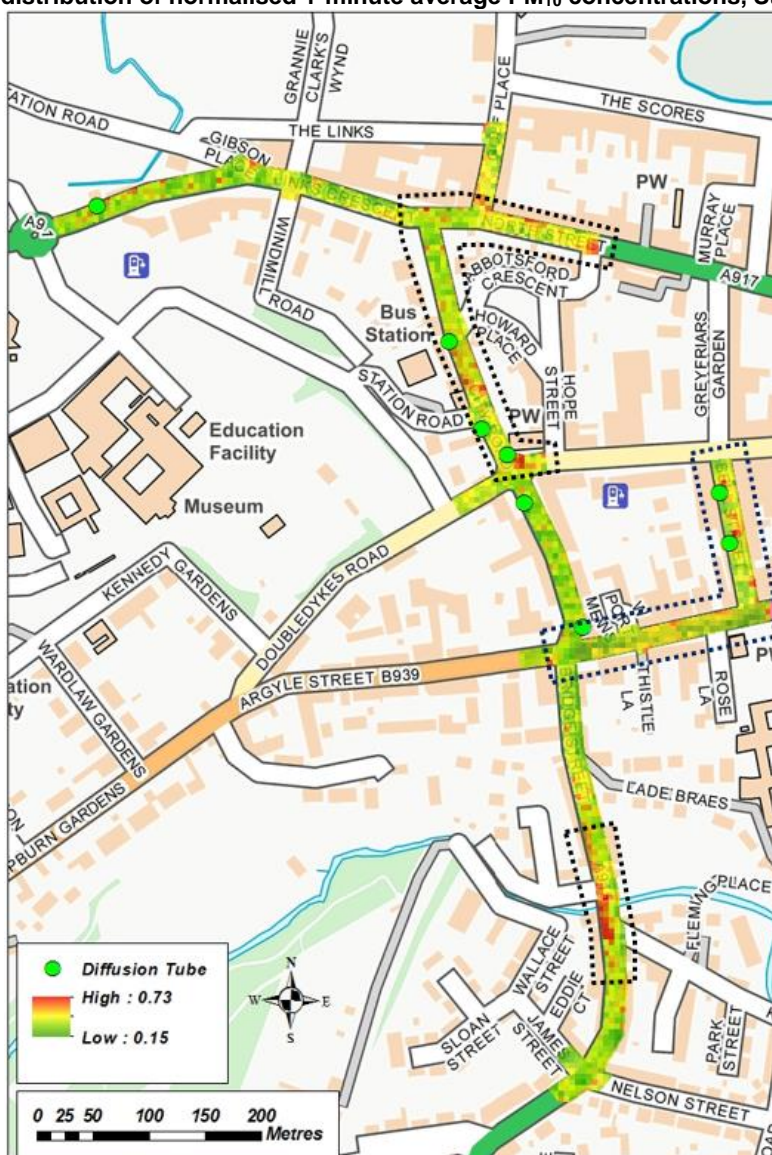
Figure 3.9 Spatial distribution of normalised 1-minute average PM₁₀ concentrations, St Andrews

Figure 3.8 and Figure 3.9 show mapped normalised (normalised between 0 – 1) pollutant concentrations of NO₂ and PM₁₀. Please note that absolute pollutant concentrations are not reported as the data could not be scaled. It is not appropriate to compare mobile monitoring concentrations to the Scottish air quality objectives due to the length of the study. Normalised concentrations do however provide relevant information regarding pollution hotspots and therefore a comparison between the measured hotspots and the current diffusion tube locations can be carried out.

3.3.3 AQ Mesh Sensor Monitoring Study

In November 2017, Fife Council began an AQMesh sensor monitoring study to gain a better understanding of air pollution concentrations in the Bonnygate, Cupar and Appin Crescent, Dunfermline AQMAs. Fife Council then contracted Ricardo Energy and Environment (Ricardo) to manage and quality assure and quality control the data from this study. This report provides a summary of the data from this study from 1st January – 31st December 2018.

3.3.3.1 Methodology

In terms of this study, the pollutants of concern that the AQMesh sensor systems are monitoring are NO₂, PM₁₀ and PM_{2.5}. The AQMesh is an air quality sensor system which is designed 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 Particulate Matter (PM₁₀ 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 UK equivalence programme (e.g. 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 the AQMesh pods were set to measure 15-minute averages. Two pods were installed at the Appin Crescent AQMA and one at the Bonnygate AQMA. The locations are illustrated in Figure 3.10 and Figure 3.11. These locations had not previously been monitored for Particulate Matter due to accessibility reasons. NO₂ is currently measured at these locations using diffusion tubes, which provide indicative annual averages of NO₂. Photographs of the installed AQMesh units are also shown below.

Ricardo used their dedicated data management system (MODUS) to manage and process all data from the 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.

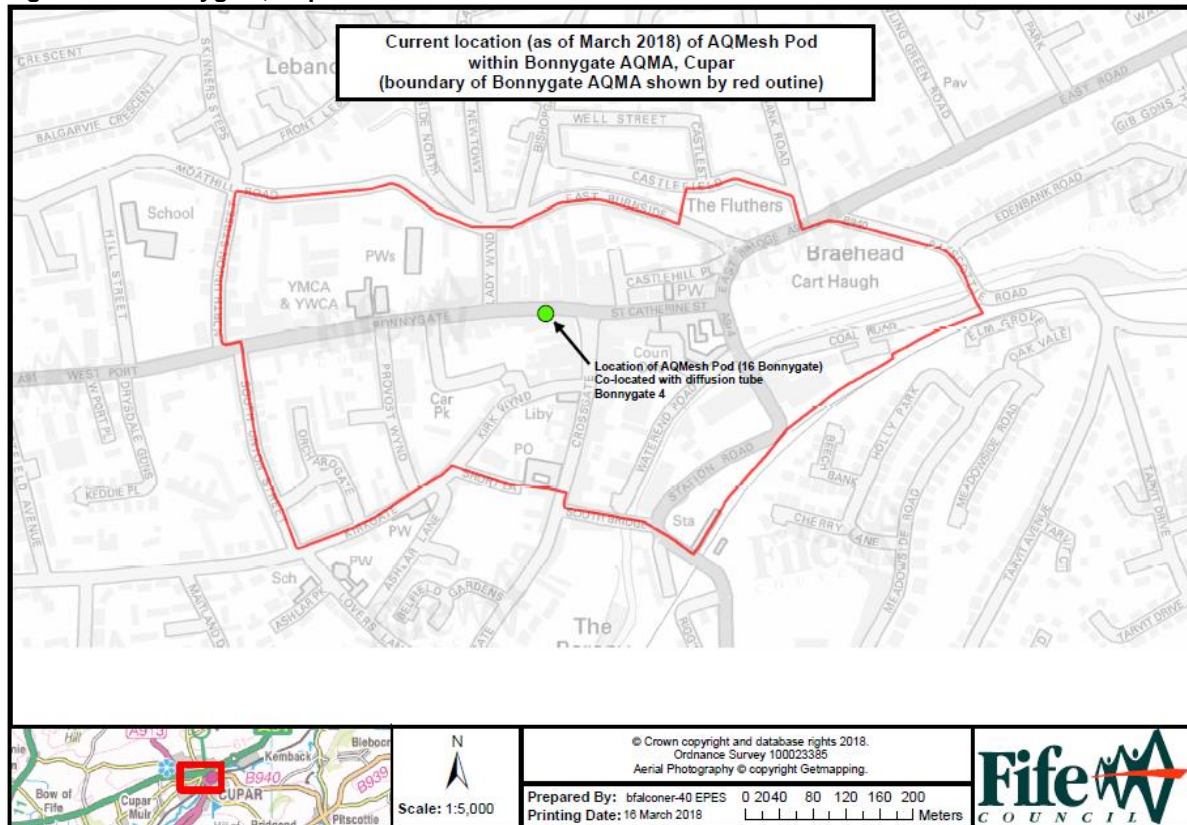
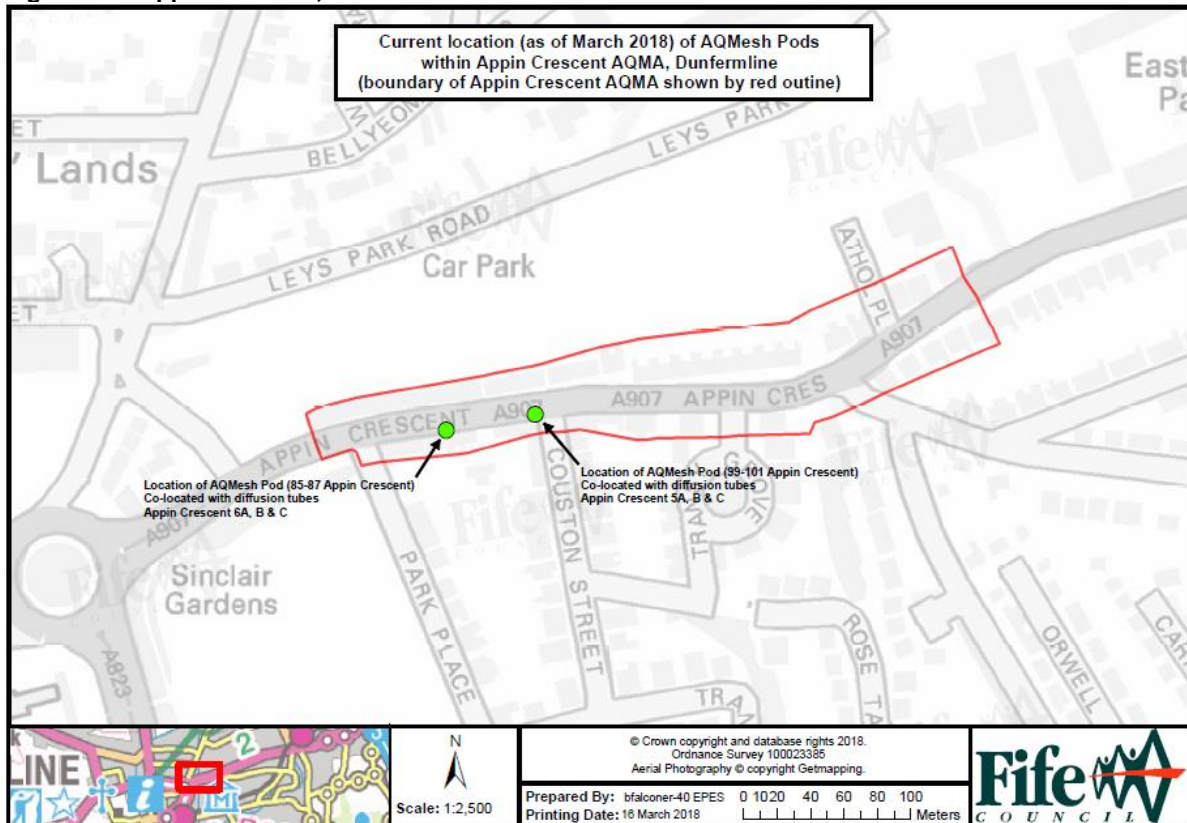
Ricardo's data management system provided:

- 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 AQEG on the Defra UK air website (<https://uk-air.defra.gov.uk/library/ageg/pollution-sensors.php>) and included:

- Co-location of the AQMesh sensors at the nearest automatic site for at least one week every 3 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. An example of this analysis is provided in the Appendix F of this report.

Figure 3.10 Bonnygate, Cupar AQ Mesh sensor location**Figure 3.11 Appin Crescent, Dunfermline AQ Mesh sensor 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)

3.3.3.2 Data

Table 3.2, Table 3.3 and Table 3.4 provide a summary of statistics for the concentrations measured by the AQMesh sensors from 1st January to the 31st December 2018. Table 3.5 and Table 3.6 provide a summary of statistics for the automatic monitoring sites located in Appin Crescent, Dunfermline and Bonnygate, Cupar for the same time period. More detailed Air Pollution reports from the AQMesh sensors and automatic sites can be found in the Appendix G of this report.

As can be seen, none of the pollutants measured by any of the AQMesh sensors measured concentrations that exceeded the annual mean objectives for NO₂ (40 µg m⁻³), PM₁₀ (18 µg m⁻³) or PM_{2.5} (10 µg m⁻³). The most significant of the AQMesh measurements made during the study to date is found at Bonnygate, where NO₂ concentrations were indicated to be 39 µg m⁻³.

For the NO₂ 1-hour mean objective (200 µg m⁻³ not to be exceeded more than 18 times a year) only Bonnygate, Cupar measured concentrations over 200 µg m⁻³, and this was less than the 18 times allowed (4 in total).

For the PM₁₀ 24-hour mean objective (50 µg m⁻³ not to be exceeded more than 7 times a year), Bonnygate measured one 24-hour mean concentration over the 50 µg m⁻³, Appin Crescent East measured six 24 hour mean concentrations over the 50 µg m⁻³, and Appin Crescent West measured seven 24 hour mean concentrations over the 50 µg m⁻³. It should be noted that Scotland only has an annual mean objective for PM_{2.5}.

When comparing the AQMesh sensors with the nearby automatic sites, statistics show that all averaged concentrations were found to be higher at the AQMesh pods than that measured at the automatic sites for all pollutants. For PM₁₀ and PM_{2.5} concentrations measured at both Appin Crescent AQMesh sensors, short term average concentrations are significantly higher than that measured at the Dunfermline automatic site.

Due to the low data capture for PM_{2.5} and PM₁₀ a direct comparison of data with the Fife, Cupar automatic site is not appropriate. The low data capture for the PM₁₀ and PM_{2.5} at Bonnygate was due to a fault which resulted in erroneously low data being measured from between 16th April to 11th December 2018. This data was removed from the dataset.

The AQMesh pods were co-located with diffusion tubes (as illustrated in Figure 3.10 and Figure 3.11 and shown in the associated photographs). Table 3.7 provides the bias corrected annual concentrations for these diffusion tubes. As can be seen the AQMesh sensor at Bonnygate measured an annual mean concentration 5 µg m⁻³ higher than the diffusion tube. Appin Crescent West measured an annual mean concentration 4 µg m⁻³ higher than the co-located triplicate diffusion tubes and Appin Crescent East measured the same value as the co-located triplicate diffusion tubes.

Table 3.2 Fife Bonnygate AQ Mesh monitoring Statistics 1st January to 31st December 2018

	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	463	181	328	185	54	73.2
NO₂ (µg m ⁻³)	0	0	4	269	223	84	139	86	39	72.4
PM₁₀ (µg m ⁻³)	0	0	1	116	135	75	96	76	13	32.2
PM_{2.5} (µg m ⁻³)	0	0	1	116	76	42	53	42	8	32.2

Table 3.3 Fife Appin Crescent West AQ Mesh monitoring Statistics 1st January to 31st December 2018

	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 ($\mu\text{g m}^{-3}$)	0	0	0	0	367	107	183	114	18	78.1
NO₂ ($\mu\text{g m}^{-3}$)	0	0	0	320	162	70	106	71	31	85.8
PM₁₀ ($\mu\text{g m}^{-3}$)	1	0	6	265	353	116	140	117	13	75.0
PM_{2.5} ($\mu\text{g m}^{-3}$)	0	1	3	266	118	59	78	60	8	74.2

Table 3.4 Fife Appin Crescent East AQ Mesh monitoring Statistics 1st January to 31st December 2018

	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 ($\mu\text{g m}^{-3}$)	0	0	0	0	295	100	175	101	24	85.4
NO₂ ($\mu\text{g m}^{-3}$)	0	0	0	313	148	68	109	72	31	84.6
PM₁₀ ($\mu\text{g m}^{-3}$)	2	1	3	287	1005	115	276	155	15	80.4
PM_{2.5} ($\mu\text{g m}^{-3}$)	0	0	2	309	122	47	77	59	6	85.5

Table 3.5 Fife Cupar Automatic monitoring site statistics 1st January to 31st December 2018

	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 ($\mu\text{g/m}^3$)	0	0	0	0	365	126	227	137	26	99.8
NO₂ ($\mu\text{g/m}^3$)	0	0	0	365	173	74	111	74	26	99.5
PM₁₀ ($\mu\text{g/m}^3$)	0	0	1	364	220	61	149	62	14	99.8
PM_{2.5} ($\mu\text{g/m}^3$)	0	0	0	365	60	27	35	31	7	99.8

Table 3.6 Fife Dunfermline Automatic monitoring site statistics 1st January to 31st December 2018

	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 ($\mu\text{g}/\text{m}^3$)	0	0	0	0	261	74	145	84	11	99.3
NO₂ ($\mu\text{g}/\text{m}^3$)	0	0	0	364	101	62	88	64	22	99.3
PM₁₀ ($\mu\text{g}/\text{m}^3$)	0	0	0	365	168	33	48	35	11	99.7
PM_{2.5} ($\mu\text{g}/\text{m}^3$)	0	0	0	365	40	25	35	29	6	99.7

Table 3.7 Co-located Diffusion tube annual concentrations

Diffusion Tube Name	Annual Concentration for 2018 ($\mu\text{g}/\text{m}^3$)
Bonnygate 4	34
Appin Crescent 5A,B,C (collocated with AQMesh East)	31
Appin Crescent 6A,B,C (collocated with AQMesh West)	35

3.3.3.3 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 2018 to 31st December 2018). This section compares the respective AQMesh and automatic monitoring (Cupar and Dunfermline) site diurnal variation data.

As can be seen in Figure 3.12 and Figure 3.13, for both Bonnygate, Cupar and Appin Crescent, Dunfermline monitoring locations the AQMesh monitoring sites followed a very similar diurnal profile to the automatic sites. Both locations highlight the traffic rush hour periods which as expected shows that the main source of the NO₂ in these areas are vehicle emissions. Both Cupar and Dunfermline locations also show that the AQMesh monitoring sites measured significantly higher than the automatic sites when the emission source is active.

Figure 3.12 NO₂ Diurnal Variation Plot for Fife Bonnygate AQMesh sensor and Fife Cupar automatic monitor 2018

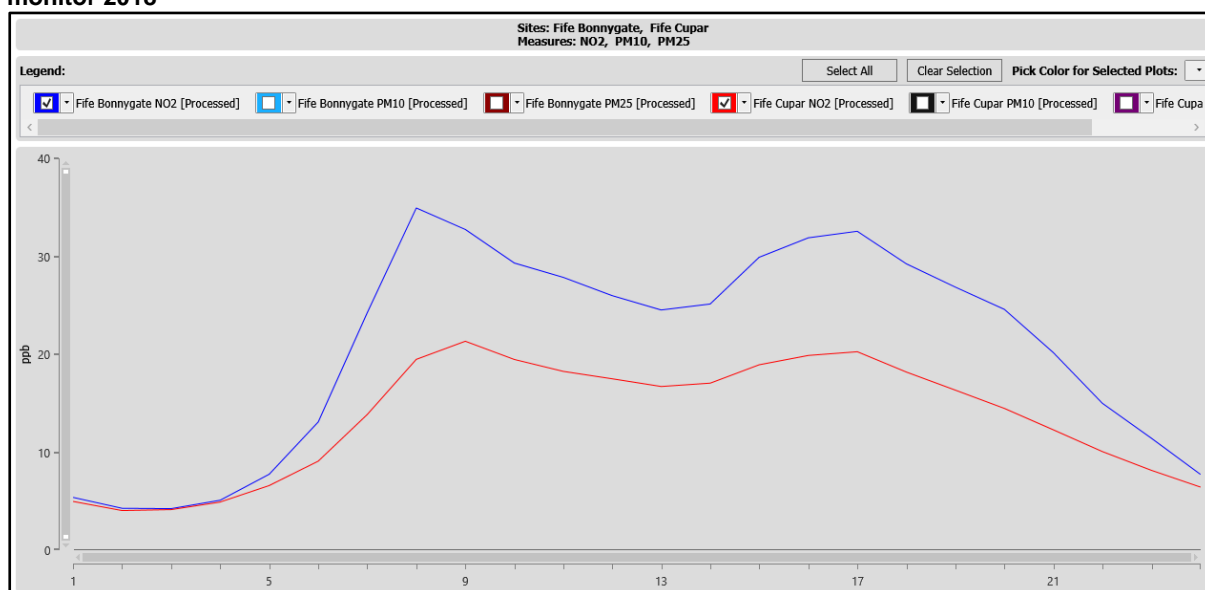


Figure 3.13 NO₂ Diurnal Variation Plot for Fife Appin Crescent East & West AQMesh and Fife Dunfermline automatic monitor 2018

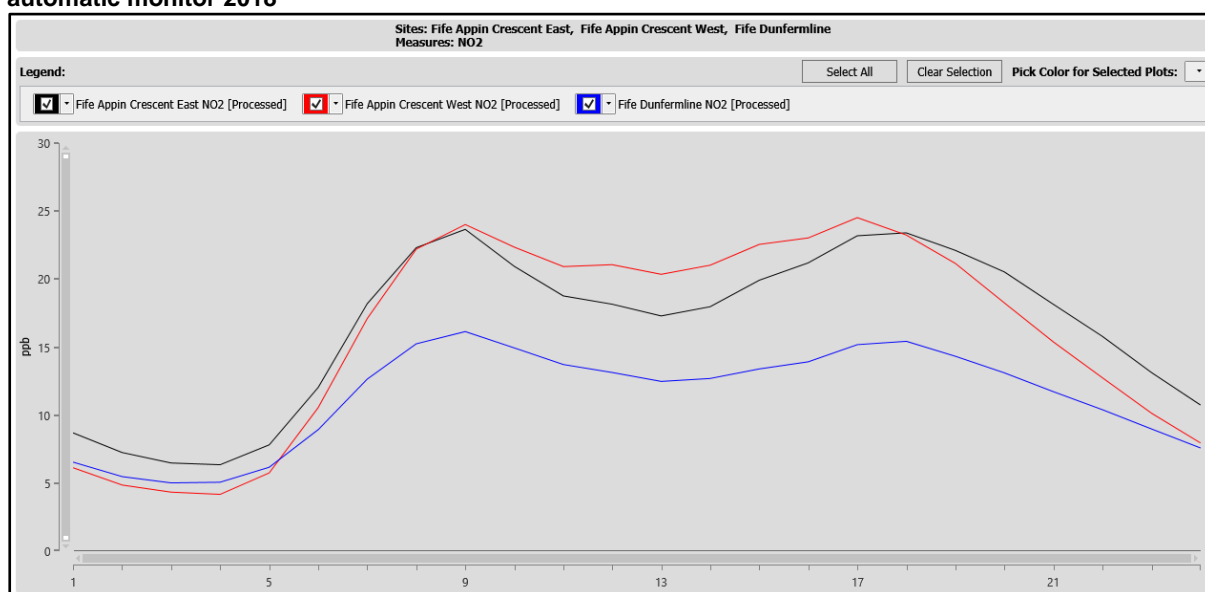
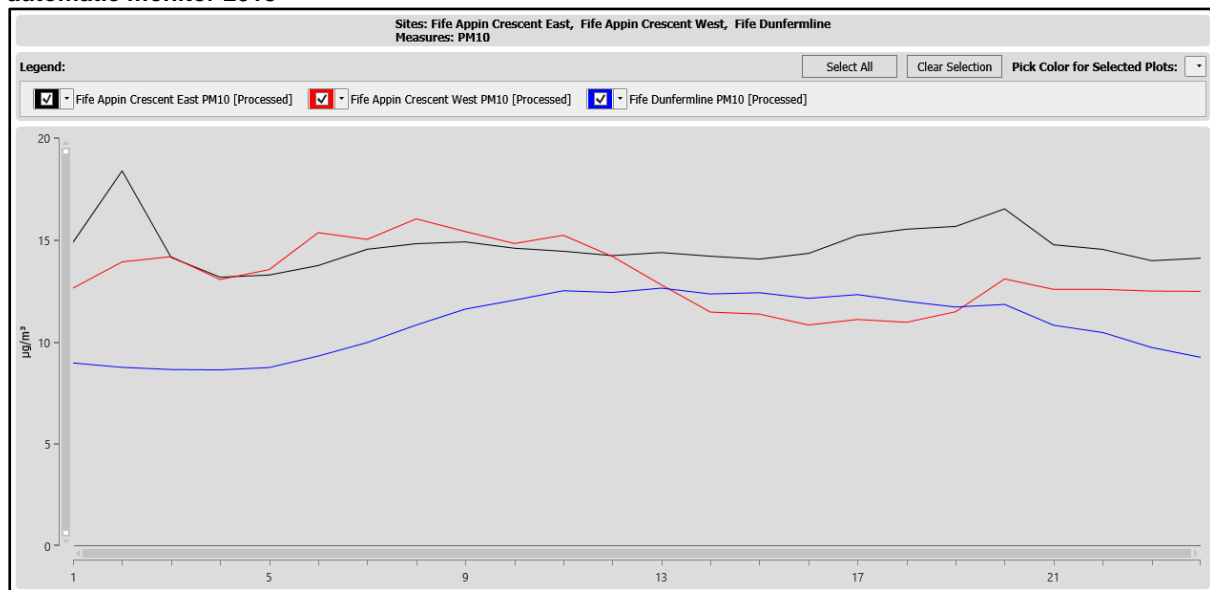
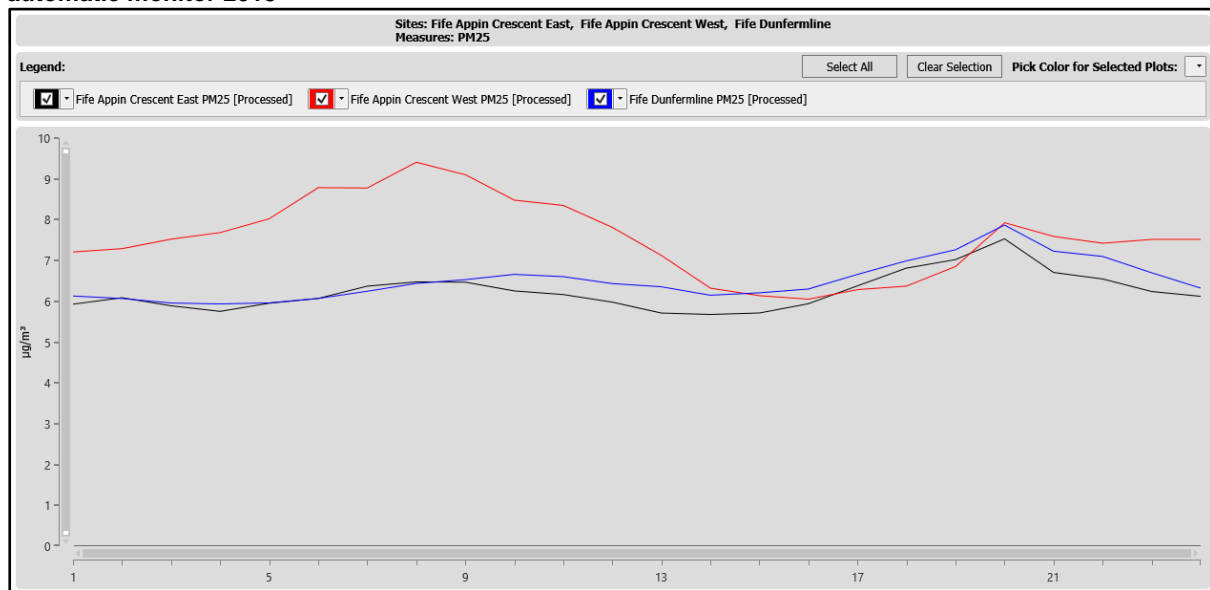


Figure 3.14 illustrates the PM₁₀ diurnal variation data for Fife Appin Crescent East and West AQMesh sensors and the Fife Dunfermline automatic site for 2018. As can be seen, the AQMesh profiles are different to the Dunfermline automatic site. They are also different to the NO₂ profiles in Figure 3.13. This suggests that the main emissions source of PM₁₀ for these locations are not specific to traffic. Generally, concentrations are higher at both AQMesh sites throughout the day compared to the automatic monitor in Dunfermline. The exception to this is between 14:00 and 20:00 at Appin Crescent West.

Figure 3.15 illustrates the PM_{2.5} diurnal variation data for Fife Appin Crescent East and West AQMesh and Fife Dunfermline automatic sites for 2018. As with PM₁₀ the data profile does not show the rush hour periods, again suggesting that the main emissions source of PM_{2.5} are not specific to traffic. As can be seen from Figure 3.15 Appin Crescent West AQMesh and Fife Dunfermline profiles are very similar. For Appin Crescent East, concentrations are higher in the morning. PM₁₀ and PM_{2.5} diurnal variation analysis was not carried out for the Bonnygate AQMesh due to the poor data capture.

Figure 3.14 PM₁₀ Diurnal Variation Plot for Fife Appin Crescent East, West AQMesh and Fife Dunfermline automatic monitor 2018**Figure 3.15 PM_{2.5} Diurnal Variation Plot for Fife Appin Crescent East, West AQMesh and Fife Dunfermline automatic monitor 2018**

4 New Local Developments

4.1 Road Traffic Sources

There have been no major changes or additions to the existing local and trunk road network in 2018.

4.1.1 Forth Replacement Crossing

During the construction of the Forth Replacement Crossing and associated road network, air quality monitoring was undertaken by the Forth Crossing Bridge Constructors (FCBC)⁸. Air quality was monitored using automatic light scatter dust meters and Frisbee gauge dust deposition monitoring. Three automatic light scatter meters were installed at various sensitive locations to measure real time particulate matter (PM₁₀) concentrations and the Total Suspended Particles (TSP) concentrations. Three Frisbee gauges were present at sensitive locations across the site to measure dust deposition rates.

The Queensferry Crossing opened to traffic on 30th August 2017, as a result, the number of monitoring sites was reduced and the only monitoring location within Fife (Whinny Hill) was removed from the monitoring programme.

During 2018 monitoring continued at the remaining monitoring sites outwith the Fife area and these Forth Replacement Crossing air quality monitoring reports are publicly available at the project website: www.transport.gov.scot/road/forth-replacement-crossing/frc-air-quality-documents

4.2 Other Transport Sources

Edinburgh Airport Limited (Edinburgh Airport) is proposing to upgrade its aircraft arrival and departure flight paths and apply new methods of operation as part of its overall Airspace Change Programme (ACP) 2016-2018. Fife Council has provided comments on this consultation in terms of ensuring that these proposals will not compromise the achievement of statutory air quality objectives in its area.

4.3 Industrial Sources

Fife Council confirms that there are no new industrial sources that have not been adequately considered in previous rounds of Review and Assessment.

4.4 Poultry Farms

Fife Council confirms that there are no new poultry farms that have not been adequately considered in previous rounds of Review and Assessment.

SEPA has recently issued two new permits in Fife (Garrit PPC/A/1157119 and Elmbank PPC/A/1157580) but these only have 48,420 places each which is well below Fife Council's and TG.16 screening threshold.

4.5 Commercial and Domestic Sources

Fife Council confirms there is no requirement to proceed to a Detailed Assessment for the following sources:

- Biomass combustion - Individual installations;

⁸ Forth Replacement Crossing: Air Quality Monitoring Report December 2017, Forth Crossing Bridge Constructors, available at: <https://www.transport.gov.scot/projects/forth-replacement-crossing/document-library/frc-air-quality-documents/>

- Biomass combustion - Combined Impacts;
- Domestic Solid Fuel Burning and
- Proposed Residual and Commercial Installations.

4.6 New Developments with Fugitive or Uncontrolled Sources

SEPA have advised that the following amendments to Part A and Part B processes have been made during 2018:

- PPC/B/1085660 – BiFab (Methil) installation of new spray paint booth and blast facility. Carbon filters installed as abatement, unlikely to have a significant impact.
- PPC/B/1004481 – ESA Macintosh (Havelock) Kirkcaldy – replaced boiler used for heating, switched from Heavy oil to Kerosene.
- PPC/A/1096556 – RWE, Glenrothes - variation added Glenrothes energy centre which includes 3 back up boilers.

During 2018, the following processes ceased operation:

- PPC/A/1016554 - Saline and Dinmoss Poultry units which result in 136,500 less poultry places.
- PPC/A/1000040 - Raytheon Systems Ltd (Semiconductor operations) – operations ceased and not operated in 2018 but permit not yet surrendered.

5 Planning Applications

5.1 Applications

The relevant planning guidance controls how Fife Council will manage potential air quality impacts from proposed developments. During 2018 the Land & Air Quality Team commented on numerous planning applications in relation to air quality matters with these ranging from proposed wood burning stoves and biomass boilers to large scale residential developments where an Air Quality Impact Assessment (AQIA) was required in support of the application. Below are details of all the planning applications commented on by the Land & Air Quality Team in 2018:

January 2018

17/03487/FULL (our ref. PC170291.C2) External alterations including erection of biomass boiler and flue (in retrospect) at 11 Inzievar Courtyard, Oakley, Dunfermline. [Biomass Information Request form completed, no further comment.](#)

16/03718/FULL & 16/03601/FULL (our ref. PC150332.C8) Use of Land to form local authority depot including access and parking, vehicle wash, truck stop and storage at Land at Crossgates Road, Halbeath, Dunfermline; and Alteration to factory building to form a local authority depot with associated offices, external storage area and SUDS at Regency House, Crossgates Road, Halbeath, Dunfermline. [Discussions with applicant's consultant regarding proposed methodology. Proposed methodology considered suitable.](#)

17/03551/FULL (our ref. PC140107.C4) Proposed redevelopment of former swimming pool and erection of cinema, leisure and food and drink/public house use with associated infrastructure, access and landscaping at Kirkcaldy Swimming Pool, Esplanade, Kirkcaldy. [Query from Planner confirming no AQ concerns regarding the proposal.](#)

18/00077/FULL (our ref. PC170346) Alterations and single storey extension to rear of dwelling house (including flue) at 18 Adia Road, Torryburn, Dunfermline. [Proposal noted to include a flue, confirmation was requested as to whether the flue was for a biomass boiler.](#)

17/03197/FULL (our ref PC140335.C3) Erection of 29 dwelling houses with associated access, parking and landscaping (demolition of former hospital) at Netherlea 65 West Road Newport On Tay Fife DD6 8HR. [Further Information Requested - Air Quality Impact Assessment.](#)

17/04015/FULL (our ref PC160085.C2) Erection of dwelling house with associated landscaping and parking on Land To The South Of 77 Main Street Colinsburgh Fife. [Further Information Requested – Biomass/Wood Burning Stove Information Form.](#)

18/00001/FULL (our ref. PC170322) Installation of flue pipe for wood burning stove at 8 Hillview Court Halbeath. [Awaiting Biomass Boiler Information Form.](#)

18/00126/PREAPP (our ref PC170334.C1) - Pre-application for development of North Dunfermline SDA (Swallowdrum) at land to north-west of Parkneuk and North of Carnock Road, Dunfermline. [Given the scale of the proposed development an Air Quality Impact Assessment will be required in terms of any future planning applications.](#)

February 2018

16/03718/FULL & 16/03601/FULL (our ref. PC150332.C9) Use of Land to form local authority depot including access and parking, vehicle wash, truck stop and storage at Land at Crossgates Road, Halbeath, Dunfermline; and Alteration to factory building to form a local authority depot with associated offices, external storage area and SUDS at Regency House, Crossgates Road, Halbeath, Dunfermline. [Supplementary information considered satisfactory, awaiting report.](#)

16/03718/FULL & 16/03601/FULL (our ref. PC150332.C10) Use of Land to form local authority depot including access and parking, vehicle wash, truck stop and storage at Land at Crossgates Road, Halbeath, Dunfermline; and Alteration to factory building to form a local authority depot with associated offices, external storage area and SUDS at Regency House, Crossgates Road, Halbeath, Dunfermline. [Air quality screening assessment submitted, information appears generally satisfactory, no further comment.](#)

17/00536/FULL (our ref. PC130469.C6) Planning permission for the erection of 55 houses, proposed site layout for up to a further 113 houses, provision of employment land (Class 4), together with access, infrastructure, drainage, sustainable urban drainage systems, landscaping and open space and Gilliesfaulds Farm, Carslogie, Cupar. [Air quality assessment submitted, information appears generally satisfactory, no further comment.](#)

18/00138/PREAPP (our ref. PC170375) Pre-application for residential development with related access, open space, landscaping and SUDs provision at Land to North of Kent Street, Dunfermline. [Air quality impact assessment advised given the nature and scale of the proposal and the proximity to an existing AQMA.](#)

18/00264/PREAPP (our ref. PC170351) Pre-application for proposed residential at Balcomie Caravan Park Crail. [Awaiting Air Quality Impact Assessment.](#)

18/00192/BW (our ref. PC15001) Erection of 295 No. residential development at Land at Spencerfield The Avenue Inverkeithing. [Air Quality Assessment Satisfactory.](#)

18/00280/EIA (our ref PC170008.C5) - Application for Planning in Principle for Mixed Use Development (comprising Residential (Circa 900 private and affordable homes); University Uses; Secondary School; Business and Employment; Retail; Care Home; Hotel; Green Network; Road Link; and associated infrastructure) at land to the west of Andrew Melville Hall, North Haugh, St Andrews, Fife. [Comments provided on draft Air Quality Impact Assessment.](#)

18/00078/FULL (our ref PC170007.C2) - Construction of 357 residential units with associated engineering, landscape and infrastructure works at Land at Seggie Farm, Seggie, Guardbridge, Fife. [Submitted Air Quality Impact Assessment considered to be satisfactory.](#)

March 2018

17/03956/SCO (our ref. PC170197.C6) Air Quality Assessment Methodology for residential led mixed-use development at Former Tullis Russell Mill, Glenrothes. [Proposed methodology considered satisfactory.](#)

18/00632/FULL (our ref. PC170411) Installation of flue at 21 Telny Place, Aberdour, Burntisland
Flue to be installed for a wood burning stove. [Technical specifications of the stove requested.](#)

Our ref. PC170413 Queen Margaret Hospital, Dunfermline. [Pre-application discussion with consultants regarding replacement gas fired steam boiler. Air quality impact assessment not considered necessary.](#)

16/04155/EIA (our ref. PC150473.C5) Application for Planning Permission in Principle for a residential led mixed-use development comprising a minimum of 2,150 residential units, employment/commercial land, landscape framework (landscaping, parks, green space), community facilities, healthcare, local retail, new primary school(s), roads and drainage infrastructure and associated development at Broomhall Site at Land Adjacent to Pitreavie Business Park, Grange Road, Dunfermline. [Review of AQ information being reviewed by contracted consultants, comments to be provided when available.](#)

18/00578/PREAPP (our ref PC170387.C1) Pre application for residential development of approximately 59 houses with vehicular access, pedestrian access, suds feature and associated open space and landscaping. [Request Air Quality Impact Assessment in support of any future application.](#)

18/00365/PREAPP (our ref. PC150138) Pre-application for residential development at Lynebank Hospital Halbeath Road Dunfermline. [Awaiting Air Quality Impact Assessment.](#)

18/00280/EIA (our ref PC170008.C5) - Application for Planning in Principle for Mixed Use Development (comprising Residential (Circa 900 private and affordable homes); University Uses; Secondary School; Business and Employment; Retail; Care Home; Hotel; Green Network; Road Link; and associated infrastructure) at land to the west of Andrew Melville Hall, North Haugh, St Andrews, Fife. [Submitted Air Quality Assessment considered to be satisfactory.](#)

17/04060/PPP (our ref PC170331.C2) - Planning permission in principle for the erection of 80 residential units and associated roads, drainage and landscaping at land to the south of Nether Bouprie Farm, Bouprie, Fife. [Given the scale of the proposed development an Air Quality Impact Assessment will be required in terms of any future planning applications.](#)

18/00536/LBC (our ref PC170400.C1) - Listed Building consent for installation of multi-stove and flue at The Old Barn, 38 Cupar Road, Auchtermuchty, Cupar, Fife, KY14 7DJ. [Requested completion of a Biomass Boiler/Wood Burning Stove Information Request Form to understand fuel sources and emissions.](#)

April 2018

16/04155/EIA (our ref. PC150473.C6) Application for Planning Permission in Principle for a residential led mixed-use development comprising a minimum of 2,150 residential units, employment/commercial land, landscape framework (landscaping, parks, green space), community facilities, healthcare, local retail, new primary school(s), roads and drainage infrastructure and associated development at Broomhall Site at Land Adjacent to Pitreavie Business Park, Grange Road, Dunfermline. [Further information/clarification required regarding the submitted air quality impact assessment.](#)

18/00632/FULL (our ref. PC170411.C2) Installation of flue at 21 Telny Place, Aberdour, Burntisland. [Additional information submitted satisfactory, no further comment.](#)

18/00936/FULL (our ref. PC180029) Installation of flue to rear and installation of window to side of dwelling house at 8 Rosetay Court, Dunfermline. [Flue to be installed for a wood burning stove. Technical specifications of the stove requested.](#)

18/00622/FULL (our ref. PC180028) Installation of two flues at Plant Room, Victoria Hospital, Hayfield Road, Kirkcaldy. [Flues being installed for new gas fired boilers. Technical specifications requested.](#)

18/00431/FULL (our ref. PC180027) Change of use from steading to dwelling house with associated garden ground and external alterations including erection of extension at The Neuk, Lucklawhill, Balmulla, St Andrews. [Flue to be installed for a stove. Technical specifications of the stove requested.](#)

18/00978/FULL (our ref. PC010022.C5) Erection of retail (Class 1) and food and drink (including takeaway)(Class 3 and Sui Generis) units with associated access, servicing, car parking and ancillary works (alternative scheme in respect of consent 15/04188/FULL) at Reekie Group Garage, South Road, Cupar. [Updated air quality impact assessment required.](#)

18/00431/FULL (our ref. PC180027.C2) Change of use from steading to dwelling house with associated garden ground and external alterations including erection of extension at The Neuk, Lucklawhill, Balmulla, St Andrews. [Query from agent, stove details requested.](#)

18/00917/PREAPP (our ref PC160137.C2) Pre-application to regularise Consent 07/04033/WEIA covering all operations and developments at the existing quarry together with the development of a lateral extension to the south west of the existing extraction void into land owned by Forestry Commission Scotland | Easter Bucklyvie Farm Easter Bucklyvie Crossgates Fife. [Further Information Requested - Update Air Quality Impact Assessment.](#)

May 2018

18/00622/FULL (our ref. PC180028.C2) Installation of two flues at Plant Room, Victoria Hospital, Hayfield Road, Kirkcaldy. [Information submitted satisfactory, no further comment.](#)

16/04155/EIA (our ref. PC150473.C7) Application for Planning Permission in Principle for a residential led mixed-use development comprising a minimum of 2,150 residential units, employment/commercial land, landscape framework (landscaping, parks, green space), community facilities, healthcare, local retail, new primary school(s), roads and drainage infrastructure and associated development at Broomhall Site at Land Adjacent to Pitreavie Business Park, Grange Road, Dunfermline. [Request for comment received, however no additional air quality information had been submitted for review.](#)

16/04155/EIA (our ref. PC150473.C8) Application for Planning Permission in Principle for a residential led mixed-use development comprising a minimum of 2,150 residential units, employment/commercial land, landscape framework (landscaping, parks, green space), community facilities, healthcare, local retail, new primary school(s), roads and drainage infrastructure and associated development at Broomhall Site at Land Adjacent to Pitreavie Business Park, Grange Road, Dunfermline. [Further air quality information submitted and forwarded to contracted consultants for review.](#)

18/00936/FULL (our ref. PC180029.C2) Installation of flue to rear and installation of window to side of dwellinghouse at 8 Rosetay Court, Dunfermline. [Information submitted satisfactory, no further comment.](#)

18/01009/FULL(our ref PC180038.C1) Erection of 6no. single storey business units (Class 4, 5 and 6), bin store and substation with associated landscaping, formation of new access and other ancillary works. | Hillend Industrial Estate West Way Hillend Industrial Park Dalgety Bay Fife. [Further Information Requested - Air Quality Impact Assessment.](#)

18/01136/FULL (our ref PC180044.C1) Single storey extension to rear of flatted dwelling including installation of flue for woodburning stove | 12 Witchbrae Dunfermline Fife KY12 0LG. [Further Information Requested – Biomass/Wood Burning Stove Information Form.](#)

18/00295/EIA (our ref. PC170352) Construction of secondary school (class 10) at Land to the West of St Andrews. [Air Quality Assessment Satisfactory.](#)

18/01222/FULL (our ref PC180050.C1) - External alterations to dwellinghouse including alterations to windows, replacement doors, installation of sun tunnel and installation of flues at 8 Hilton Farm Steadings, Hilton Road, Rosyth, Fife, KY11 3HA. [Requested completion of a Biomass Boiler/Wood Burning Stove Information Request Form to understand fuel sources and emissions.](#)

June 2018

18/01692/FULL (our ref. PC190020.C7) RWE Generation UK plc wish to develop an area of approximately 0.21ha adjacent to its Markinch Power Station as a reserve generation peaker plant site. The proposed site was part of the former Tullis Russell paper mill. The site will house 10 containerised reciprocating gas engines, with an embedded electrical export capacity of 19.9MW at Markinch Power Station, Markinch. [Information submitted satisfactory, no further comment.](#)

18/01314/PREAPP (our ref PC180062.C1) Pre-application for residential and mixed use development including Class 1,2,3, and 4 with associated parking, landscaping, and access. [Request Air Quality Impact Assessment in support of any future application.](#)

18/01615/SCO (our ref PC160137.C3) Request for EIA Scoping Opinion to regularise planning consent 07/04033/WEIA incorporating other developments on site with no planning consents in place | Easter Bucklyvie Farm Easter Bucklyvie Crossgates Fife. [Further Information Requested – Retain Cond - Update Air Quality Impact Assessment.](#)

18/01366/PREAPP (our ref. PC160113) Proposed residential approximately 63 dwellings at Viewforth High School Loughborough Road Kirkcaldy. [Awaiting Air Quality Impact Assessment.](#)

18/01508/PREAPP (our ref. PC180072) Proposed erection of 18No. dwelling houses at Site To North Of 3 Hugh Ave Lochgelly. [Awaiting Air Quality Impact Assessment.](#)

18/01315/FULL (our ref. PC180102) Installation of replacement doors, rooflight and flue at 5 West Fergus Place Kirkcaldy. [General advice was given on Air Quality.](#)

18/01619/PREAPP (our ref. PC180101) Residential and ancillary development at Animal Farm Middlebank Dunfermline. [Awaiting Air Quality Impact Assessment.](#)

18/01623/PREAPP (our ref. PC180100) Residential development of circa 100 homes at Ferryfield Brighton Rd Cupar. [Awaiting Air Quality Impact Assessment.](#)

18/01722/PREAPP (our ref. PC180103) Proposed residential development at North of 10 to 22 Cameron Crescent Windygates. [Awaiting Air Quality Impact Assessment.](#)

18/01531/FULL (our ref PC170030.C4) - Proposed student accommodation development and facilities building including seasonal public café with associated landscaping, parking and ancillary facilities for prospective student accommodation at Albany Park, St Andrews, Fife. [Submitted Air Quality Impact Assessment considered to be satisfactory.](#)

18/02091/FULL (our ref PC180079.C1) - Installation of 19.9MW Gas Peaking Plant and associated infrastructure including upgrading and extension of existing access track at land to North of Duniface Farm, Leven, Fife. [Correspondence relating to the meteorological data to be used for the Air Quality Impact Assessment.](#)

18/02091/FULL (our ref PC180079.C2) - Installation of 19.9MW Gas Peaking Plant and associated infrastructure including upgrading and extension of existing access track at land to North of Duniface Farm, Leven, Fife. [Further information received, and scope agreed as being acceptable for Air Quality Impact Assessment.](#)

July 2018

18/01721/PREAPP (our ref. PC180112) Pre-application for residential development of approximately 330 units at Land to the North of Hilton Road, Rosyth. [Air quality impact assessment advised given the nature and scale of the proposal.](#)

17/02345/FULL (our ref. PC180115) Erection of agricultural building and biomass boiler (retrospective) at Farm Steading Shop, Blacketyside Farm, Leven. [Information submitted satisfactory, no further comment.](#)

18/01009/FULL (our ref PC180038.C3) Erection of 6no. single storey business units (Class 4, 5 and 6), bin store and substation with associated landscaping, formation of new access and other ancillary works. | Hillend Industrial Estate West Way Hillend Industrial Park Dalgety Bay Fife. [Reviewed proposed Air Quality Assessment Methodology – Satisfactory.](#)

18/00438/FULL (our ref PC180110.C1) Erection of biomass building | Muddy Boots Shop Balmalcolm Farm Shore Road Balmalcolm Cupar Fife KY15 7TJ. [Further Information Requested – Biomass/Wood Burning Stove Information Form](#)

18/00438/FUL (our ref PC180110.C2) Erection of biomass building | Muddy Boots Shop Balmalcolm Farm Shore Road Balmalcolm Cupar Fife KY15 7TJ. [Biomass/Wood Burning Stove Information Satisfactory – Suspensive AQ Condition AQC2 – Should final plant spec/fuel/maintenance differ from proposal.](#)

17/01870/PPP (our ref. PC170108) Approximately 125 residential units at Hillside School Aberdour. [Air Quality Assessment Satisfactory.](#)

18/01009/FULL (our ref. SR170057) Erection of 6no. single storey business units at Havelock Shopfitters Donibristle. [Air Quality Assessment Satisfactory.](#)

18/01864/SCR (our ref PC180126.C1) - EIA Screening request for proposed residential development of up to 100 dwellings with related access, drainage infrastructure and open space at land to north and south of Cardenden Road, Cardenden, Fife. [Given the scale of the proposed development an Air Quality Impact Assessment will be required in terms of any future planning applications.](#)

18/01959/PREAPP (our ref PC180128.C1) - Pre-application for residential development including affordable housing, access, landscaping, open space and associated engineering works at land to the south of Cuddyhouse Road, Kingseat. [Given the scale of the proposed development an Air Quality Impact Assessment will be required in terms of any future planning applications.](#)

18/01959/PREAPP (our ref PC180128.C1b) - Pre-application for residential development including affordable housing, access, landscaping, open space and associated engineering works at land to the south of Cuddyhouse Road, Kingseat. [Scope agreed as being acceptable for Air Quality Impact Assessment.](#)

August 2018

18/02214/SCO (our ref. PC150028.C6) EIA Scoping for Old Landfill Site, Balbie Farm, Orrock, Auchtertool. [Air quality assessment to be scoped into the EIA.](#)

18/01902/FULL (our ref. PC180165) Change of use from fish shed to dwelling house and installation of flue at Old Fish Shed to East of 83A Main Street, Largo. [Flue to be installed. Technical specifications of the stove/boiler requested.](#)

18/00978/FULL (our ref. PC010022.C6) Erection of retail (Class 1) and food and drink (including takeaway)(Class 3 and Sui Generis) units with associated access, servicing, car parking and ancillary works (alternative scheme in respect of consent 15/04188/FULL) at Reekie Group Garage, South Road, Cupar. [Proposed methodology considered suitable. Report to be provided.](#)

16/04155/EIA (our ref. PC150473.C9) Application for Planning Permission in Principle for a residential led mixed-use development comprising a minimum of 2,150 residential units, employment/commercial land, landscape framework (landscaping, parks, green space), community facilities, healthcare, local retail, new primary school(s), roads and drainage infrastructure and associated development at Broomhall Site at Land Adjacent to Pitreavie Business Park, Grange Road, Dunfermline. [Further information/clarification required regarding the submitted air quality impact assessment.](#)

18/01781/PREAPP (our ref. PC180167) Major development framework for sites NEB001 and NEB002 for proposed mixed use development, including housing and affordable housing, employment land, primary school expansion, and cemetery extension at Field South of Guthrie Court, Newburgh. [Air quality impact assessment advised given the nature and scale of the proposal.](#)

18/02262/FULL (our ref. PC180168) Erection of single storey boiler room at St Salvators Hall, The Scores, St Andrews. [Technical specifications of the boiler requested.](#)

18/02342/ARC (our ref. PC150463.C8) Application for the approval of matters specified in conditions – Condition 2 plus the discharge of Conditions 10 (Datum Point), 13 (Landscaping) and 18 (Noise Assessment), solely in relation to the Energy Recovery Facility)and associated Auxiliary Energy Centre) component of the Westfield Restoration and Regeneration Project, as approved in principle under permission reference: 16/03661/EIA. [Information submitted satisfactory, no further comment.](#)

18/00978/FULL (our ref. PC010022.C7) Erection of retail (Class 1) and food and drink (including takeaway)(Class 3 and Sui Generis) units with associated access, servicing, car parking and ancillary works (alternative scheme in respect of consent 15/04188/FULL) at Reekie Group Garage, South Road, Cupar. [Information submitted satisfactory, no further comment.](#)

18/01009/FULL (our ref PC180038.C4) Erection of 6no. single storey business units (Class 4, 5 and 6), bin store and substation with associated landscaping, formation of new access and other ancillary works. | Hillend Industrial Estate West Way Hillend Industrial Park Dalgety Bay Fife. [Air Quality Assessment Submission – Satisfactory – No Further Comment.](#)

18/02115/PREAPP (our ref PC180134.C1) Pre-Application to prepare an Environmental Impact Assessment (EIA) for the proposed replacement of the piled viaduct at the southern end of the Kincardine Bridge | Street Record Kincardine Bridge Kincardine Fife. [Advice provided Re Diffusion Tube Location - Request Air Quality Impact Assessment in support of any future application.](#)

18/02059/PREAPP (our ref PC180136.C1) Pre-application for erection of a retail store and associated works [Site: Main Street, Halbeath - Land between Main Street, Halbeath and A907] | Land To West Of Macdonald Square Main Street Halbeath Fife. [Request Air Quality Impact Assessment in support of any future application.](#)

18/02303/FULL (our ref PC180189.C1) Installation of flue for wood burning stove | 18 Toll Road Cellardyke Anstruther Fife KY10 3BJ. [Further Information Requested – Biomass/Wood Burning Stove Information Form.](#)

17/01688/FULL (our ref. PC170107) Erection of 140 affordable dwellings at East of B920 at Kirkland Farm Ballingry. [Air Quality Assessment Satisfactory.](#)

18/01733/FULL Our ref PC180146.C2) - Part change of use of agricultural shed to house 2 no. biomass boilers and installation of associated external flues at Airdrie Farm. [Completed Biomass Boiler/Wood Burning Stove Information Request Form reviewed and no further comment to make.](#)

18/02091/FULL (our ref PC180079.C1) - Installation of 19.9MW Gas Peaking Plant and associated infrastructure including upgrading and extension of existing access track at land to North of Duniface Farm, Leven, Fife. [Submitted Air Quality Impact Assessment considered to be satisfactory.](#)

September 2018

18/01902/FULL (our ref. PC180165.C2) Change of use from fish shed to dwelling house and installation of flue at Old Fish Shed to East of 83A Main Street, Largo. [Flue being removed, air quality comments no longer valid.](#)

18/02262/FULL (our ref. PC180168.C2) Erection of single storey boiler room at St Salvators Hall, The Scores, St Andrews. [Technical specifications \(emission data\) of the boiler requested.](#)

18/02283/FULL (our ref PC180190.C1) Construction of a boiler house | Strathtyrum House Strathtyrum St Andrews Fife KY16 9SF. [Further Information Requested – Biomass/Wood Burning Stove Information Form.](#)

18/02355/FULL (our ref PC180191.C1) Installation of flue | 4 Smithy Road Balmullo St Andrews Fife KY16 0BG. [Further Information Requested – Biomass/Wood Burning Stove Information Form.](#)

18/02292/FULL (our ref PC180188.C1) Single storey extension to rear of dwelling house | 12 David 1st Street Kinghorn Burntisland Fife KY3 9SR. [Further Information Requested – Biomass/Wood Burning Stove Information Form.](#)

18/02303/FULL (our ref PC180189.C2) Installation of flue for wood burning stove | 18 Toll Road Cellardyke Anstruther Fife KY10 3BJ. [Wood Burning Stove Information – Generally Satisfied – No Further Comment.](#)

18/02355/FULL (our PC180191.C2) Installation of flue | 4 Smithy Road Balmullo St Andrews Fife KY16 0BG. [Wood Burning Stove Information – Generally Satisfied – No Further Comment.](#)

15/03458/EIA (our ref. PC130456) Installation of district heating pipeline works at Curtis Guardbridge District Heating. [General advice was given on Air Quality.](#)

18/02441/FULL (our ref PC180194.C1) - Installation of external boiler and flue (retrospective) at 10 Wilkie Court, Pittlessie, Cupar, Fife, KY15 7SW. [Requested completion of a Biomass Boiler/Wood Burning Stove Information Request Form to understand fuel sources and emissions.](#)

18/01331/FULL (our ref PC170380.C5) - Erection of 161 affordable dwellings with associated infrastructure and landscaping at land to north of Nairn Street, Kirkcaldy, Fife. [Comments provided in response to proposed methodology of Air Quality Impact Assessment.](#)

18/01331/FULL (our ref PC170380.C6) - Erection of 161 affordable dwellings with associated infrastructure and landscaping at land to north of Nairn Street, Kirkcaldy, Fife. [Amended assessment methodology for Air Quality Impact Assessment considered to be satisfactory.](#)

October 2018

18/02763/PPP (our ref. PC180221) Planning permission in principle for residential development and bakery, including use Class 4 (Business), 5 (General Industrial) and 6 (Storage or Distribution) at Land to North of Primrose Lane, Whinnyburn Place, Rosyth. [Air quality impact assessment advised given the nature and scale of the proposal.](#)

18/02140/FULL (our ref PC180217.C1) Erection of 48 houses and associated roads, paths and landscaping. | Site Adjacent To The Avenue Lochgelly Fife. [Further Information Requested - Air Quality Impact Assessment.](#)

18/03243/FULL (our ref PC160232.C2) Infrastructure enhancements consisting of provision of standby boiler facilities on the site (Section 42 application to vary condition 1 of planning permission 18/02803/FULL to permit the temporary boiler house for an additional 2 years) | Victoria Hospital Hayfield Road Kirkcaldy Fife KY2 5AH. [Retain Air Quality Condition \(3\) from previous app.](#)

16/02803/FULL [Further Information Requested - Air Quality Impact Assessment](#)

18/02283/FULL (our ref PC180190.C1) Construction of a boiler house | Strathtyrum House Strathtyrum St Andrews Fife. [Further Information Requested – Biomass/Wood Burning Stove Information Form/Confirmation of Boiler Type.](#)

18/02283/FULL (our ref 180190.C2) Construction of a boiler house | Strathtyrum House Strathtyrum St Andrews Fife. [Confirmation of Boiler Type \(LPG\) no further comment.](#)

17/03194/BW (our ref. PC170065) Erection of 78 affordable dwellings at Land to East of Cullen Drive Glenrothes. [Air Quality Assessment Satisfactory.](#)

18/02943/PREAPP (our ref. PC180005) Pre-application for housing development at West of Boreland Road Dysart. [Awaiting Air Quality Impact Assessment.](#)

18/03031/SCR (our ref PC170181.C2) - Screening opinion for the erection of agricultural feed mill with associated infrastructure, offices, landscaping Land To The South Of St Margaret Way, Rosyth, Fife. [Await submission of an Air Quality Impact Assessment in support of the application.](#)

November 2018

16/04155/EIA (our ref. PC150473.C10) Application for Planning Permission in Principle for a residential led mixed-use development comprising a minimum of 2,150 residential units, employment/commercial land, landscape framework (landscaping, parks, green space), community facilities, healthcare, local retail, new primary school(s), roads and drainage infrastructure and associated development at Broomhall Site at Land Adjacent to Pitreavie Business Park, Grange Road, Dunfermline. [Further information/clarification required regarding the submitted air quality impact assessment.](#)

18/00318/PREAPP (our ref. PC170375.C2) 18/00138/PREAPP (our ref. PC170375) Pre-application for residential development with related access, open space, landscaping and SUDs provision at Land to North of Kent Street, Dunfermline. [Comments provided on proposed methodology.](#)

18/03293/FULL (our ref. PC170375.C3) Construction of 92 residential units, access, landscaping and associated development at Land to North of Kent Street, Dunfermline. [Air quality impact assessment advised given the nature and scale of the proposal and the proximity to an existing AQMA.](#)

18/03293/FULL (our ref. PC170375.C4) Construction of 92 residential units, access, landscaping and associated development at Land to North of Kent Street, Dunfermline. [Additional methodology information provided.](#)

18/03293/FULL (our ref. PC170375.C5) Construction of 92 residential units, access, landscaping and associated development at Land to North of Kent Street, Dunfermline. [Additional methodology information provided considered satisfactory.](#)

18/01331/FULL (our ref PC170380.C7) - Erection of 161 affordable dwellings with associated infrastructure and landscaping at land to north of Nairn Street, Kirkcaldy, Fife. [Submitted Air Quality Impact Assessment considered to be satisfactory.](#)

18/02441/FULL (our ref PC180194.C2) - Installation of external boiler and flue (retrospective) at 10 Wilkie Court, Pitlessie, Cupar, Fife, KY15 7SW. [Completed Biomass Boiler/Wood Burning Stove Information Request Form reviewed and no further comment to make.](#)

December 2018

18/02900/FULL (our ref. PC180241.C2) Erection of 44 affordable dwelling houses at Land to West of Carden Crescent. [Proposed methodology provided, additional information/clarification requested.](#)

18/03132/PREAPP (our ref. PC180300) Pre-application for housing development (approx. 88 units) at Millburn Avenue, Coaltown of Balgonie. [Air quality impact assessment advised given the nature and scale of the proposal.](#)

18/03293/FULL (our ref. PC170375) Construction of 92 residential units at Land to North of Kent Street, Dunfermline. [Air Quality Assessment Satisfactory.](#)

18/02763/PPP (our ref. PC180221) Residential development and bakery at Land to North of Primrose Lane Rosyth. [Air Quality Assessment Satisfactory.](#)

18/02900/FULL (our ref. PC180241) Erection of 44 affordable dwelling houses at Land to West of Carden Crescent. [Air Quality Assessment Satisfactory.](#)

18/02506/BW (our ref. PC160085) Erection of Dwelling house at Land to the South of 77 Main Street Colinsburgh. [Awaiting Biomass Boiler Information Form.](#)

18/03545/PREAPP (our ref. PC180311) Pre-application for residential development at Cuddyhouse Road Kingseat. [Awaiting Air Quality Impact Assessment.](#)

6 Conclusions and Proposed Actions

6.1 Conclusions from New Monitoring data

Nitrogen Dioxide

The 2019 APR has considered the available monitoring data measured during 2018. During 2018 non-automatic, diffusion tube monitoring was undertaken at 62 locations within Fife. There were no exceedances of the NO₂ annual mean objective at any automatic or non-automatic monitoring location during 2018. The highest annual mean concentration measured in Appin Crescent, Dunfermline during 2018 was 34.8 µg m⁻³ at Appin Crescent 6(A, B, C). The highest annual mean concentration measured in Bonnygate, Cupar during 2018 was 34.2 µg m⁻³ at Bonnygate B4.

During 2018 Appin Crescent 1 moved location from 80 Appin Crescent to 76 Appin Crescent due to permission issues. Due to low readings 57 Halbeath Road was removed at end of 2018. This has been replaced with a new site in St Andrews following the mobile monitoring study. 10 sites ceased monitoring after April 2018, due to continuously low readings over the past several years. The annual mean concentrations for these sites have been annualised in accordance with TG.16, further details are provided in Appendix D.

St Andrews mobile monitoring was carried out in the centre of St Andrews to measure nitrogen dioxide (NO₂) and particulate matter (PM₁₀ and PM_{2.5}). The aim of the mobile monitoring was to demonstrate how air pollution concentrations vary within St Andrews and in turn to review the current NO₂ diffusion tube monitoring locations

NO₂ 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 NO₂. Similar hotspots were identified for PM₁₀ and PM_{2.5} confirming that the main source of pollution is likely to be road traffic. Taking into considering the measured hotspots, in general, the NO₂ diffusion tubes are currently sited at worst-case locations. However, a further PM₁₀ hotspot was measured along Bridge Street at the junction of Kinnessburn Road. It is unclear what the source of these increased PM₁₀ concentrations is but there are un-tarmacked lanes nearby, namely, Kinnessburn Terrace and private drives opposite. These lanes could be a source of resuspended coarse particulate matter.

Three AQMesh sensors have been procured and installed in December 2017 to seek to further understand pollutant concentrations and trends in the Appin Crescent, Dunfermline AQMA (and Bonnygate, Cupar AQMA. Data is managed and processed by Ricardo Energy and Environment who carry out appropriate QA/QC. The data showed that no exceedances were measured during 2018.

Particulate Matter

PM₁₀ concentrations are measured at four locations in Fife at Bonnygate, Cupar; Appin Crescent, Dunfermline; Admiralty Road, Rosyth and St Clair Street, Kirkcaldy. Measured 2018 concentrations were below the PM₁₀ annual mean objective with no exceedances of the annual mean or daily mean objective at all sites.

During 2018 PM_{2.5} was measured at four automatic monitoring sites in Bonnygate in Cupar, Admiralty Road in Rosyth, St Clair Street in Kirkcaldy and Appin Crescent in Dunfermline. Measured 2018 concentrations were below the PM_{2.5} annual mean objective at all sites.

Sulphur Dioxide

No SO₂ concentrations were measured in Fife during 2018. Historical SO₂ 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 2018 indicates that the AQS objective for CO is unlikely to have been exceeded during 2018.

1,3 Butadiene and Benzene

Benzene and 1,3 Butadiene monitoring carried out in the area of the 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 BP Production and Exploration, Houndpoint, and subsequently INEOS FPS from 5th June 2019 states that concentrations of most of the monitored substances in 2018 were very similar to 2017 at most locations.

At the time of writing, The Mossmorran and Braefoot Bay Independent Air Quality Monitoring Review Annual Report 2018 has not yet been published. A summary will be added to this report once it is available.

6.2 Conclusions Relating to New Developments

Fife Council have not identified any New Local Developments outwith 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. Continue the additional monitoring for NO₂ which commenced in 2016 within St Andrews Town Centre to ensure ongoing compliance with Air Quality Objectives. Consider relocating or extending monitoring within St Andrews to locations where relevant exposure is present.
2. Submit the next Air Quality Progress Report in June 2020.
3. Maintain the current monitoring programme.
4. Continue to implement the measures outlined in the action plans for Appin Crescent, Dunfermline and Bonnygate, Cupar.

Fife Confirms it will undertake these recommended actions.

Appendices

Appendix A: Monitoring Results

Appendix B: Full Monthly Diffusion Tube Results for 2018

Appendix C: Data QA/QC

Appendix D: Annualisation of Data

Appendix E: Technical Specification of Automatic Monitoring Equipment

Appendix F: Example Co-location Data Orthogonal Regression Analysis

Appendix G: Air Pollution reports from the AQ Mesh sensors

Appendix A – Monitoring Results

Table A.1 - Details of Automatic Monitoring Sites

Site Name	Site Type	X OS Grid Ref	Y OS Grid Ref	Pollutants Monitored	In AQMA?	Monitoring Technique	Distance to Relevant Exposure (m) ⁽¹⁾	Distance to kerb of nearest road (m) ⁽²⁾	Inlet Height (m)
Appin Crescent, Dunfermline	Roadside	309926	687722	NO ₂ , PM ₁₀ , PM _{2.5}	Y	NO _x Analyser (Chemiluminescence), FIDAS (since September 2016)	Y (1m)	4m	2m
Bonnygate, Cupar	Kerbside	337403	714571	NO ₂ , PM ₁₀ , PM _{2.5}	Y	NO _x Analyser (Chemiluminescence), FIDAS (since December 2016)	N (1m)	<0.5m	1.9m
Admiralty Road, 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
St Clair Street, Kirkcaldy	Roadside	329143	692986	NO ₂ , PM ₁₀ , PM _{2.5}	N	NO _x Analyser (Chemiluminescence), FIDAS (since April 2016)	N (10m)	5m	2m

Table A. 1 - Details of Non-Automatic Monitoring

Site Name	Site Type	X OS Grid Ref	Y OS Grid Ref	Pollutants Monitored	In AQMA?	Relevant Exposure? (m) ⁽¹⁾	Distance to kerb of nearest road (m) ⁽²⁾	Tube collocated with a Continuous Analyser?
Central Area								
Queensway, Glenrothes	K	327849	701114	NO ₂	N	N (17.0)	1	N
Leslie High Street	R(F)	325111	701806	NO ₂	N	Y	3	N
Glenlyon Road, Levenmouth	K	337357	701318	NO ₂	N	N (26.8)	1	N
Asda Roundabout, Kirkcaldy	K	328742	694045	NO ₂	N	N (28.0)	1	N
Dunnikier Road, Kirkcaldy	R(F)	328152	692352	NO ₂	N	Y	3.4	N
3A Junction Road, Kirkcaldy	R(F)	329123	693029	NO ₂	N	Y	1.5	N
St Clair Street 1, Kirkcaldy	R	329157	693030	NO ₂	N	N (2)	1.3	N
St Clair Street 2, Kirkcaldy	R	329131	693008	NO ₂	N	N (2)	1.8	N
St Clair Street 3 (MS), Kirkcaldy	R(F)	329174	693069	NO ₂	N	Y	2	N
24 St Clair Street, Kirkcaldy	R(F)	329091	692682	NO ₂	N	Y	1.5	N
125 St Clair Street, Kirkcaldy	R(F)	329208	693163	NO ₂	N	Y	1.5	N
179A St Clair Street, Kirkcaldy	R(F)	329310	693326	NO ₂	N	Y	1.5	N
St Clair Street ROMON (A,B,C,)* Kirkcaldy	R	329143	692986	NO ₂	N	N(10.0m)	5	Y

Site Name	Site Type	X OS Grid Ref	Y OS Grid Ref	Pollutants Monitored	In AQMA?	Relevant Exposure? (m) ⁽¹⁾	Distance to kerb of nearest road (m) ⁽²⁾	Tube collocated with a Continuous Analyser?
Victoria Road, Kirkcaldy	R(F)	328144	692315	NO ₂	N	Y	2.5	N
Hendry Road Kirkcaldy	R	327437	692270	NO ₂	N	N (16)	1.7	N
East Area								
Cupar Road, Auchtermuchty	R(F)	324186	711800	NO ₂	N	Y	1.8	N
Bell Street 1, St Andrews	R(F)	350712	716691	NO ₂	N	Y	1.6	N
Bell Street 2, St Andrews	R(F)	350721	716646	NO ₂	N	Y	2.1	N
City Road 1,2, St Andrews	R	350590	716570	NO ₂	N	N (1.0)	1.5	Y
City Road 3, St Andrews	R	350538	716682	NO ₂	N	N (14m)	1.5	N
City Road 4, St Andrews	R	350523	716725	NO ₂	N	N (26m)	2.2	N
City Road 5, St Andrews	R	350499	716748	NO ₂	N	N (5m)	1.9	N
City Road 6, St Andrews	R	350470	716826	NO ₂	N	N (5m)	2.2	N
Lamond Drive 1, St Andrews	R	351601	715956	NO ₂	N	N (7m)	1.8	N
St Marys Street 1, St Andrews	R	351667	715969	NO ₂	N	Y	3.5	N
St Mary's Street 2, St Andrews	R	351627	716143	NO ₂	N	N (4m)	1.8	N
Links Crescent, St Andrews	R(F)	350156	716947	NO ₂	N	Y	3	N

Site Name	Site Type	X OS Grid Ref	Y OS Grid Ref	Pollutants Monitored	In AQMA?	Relevant Exposure? (m) ⁽¹⁾	Distance to kerb of nearest road (m) ⁽²⁾	Tube collocated with a Continuous Analyser?
Bonnygate 1, Cupar	R(F)	337409	714570	NO ₂	Y	Y	5.3	N
Bonnygate 2, Cupar	R(F)	337507	714584	NO ₂	Y	Y	1.7	N
Bonnygate 3 (A, B), Cupar	R(F)	337480	714586	NO ₂	Y	Y	1.6	Y
Bonnygate B4, Cupar	R(F)	337467	714576	NO ₂	Y	Y	1.9	N
Bonnygate West B6, Cupar	R	337333	714559	NO ₂	Y	N (4)	3	N
8 Balgarvie Road, Cupar	R(F)	336669	714719	NO ₂	N	Y	10	N
Orchard, Balgarvie Road, Cupar	R	336826	714506	NO ₂	N	N (18m)	2	N
Crossgate, Cupar	K	337536	714537	NO ₂	Y	N (3.0)	0.5	N
4 East Road, Cupar	R(F)	337915	714721	NO ₂	Y	Y	14	N
Ladywynd, Cupar, B5	R(F)	337405	714596	NO ₂	Y	Y	1	N
South Road, Cupar	R	337513	713616	NO ₂	N	N (17.0)	1.8	N
Bonnygate, Cupar, Monitor BA, BB, BC *	K	337403	714571	NO ₂	Y	N (4.8)	0.6	Y
West Area								
High Street, Cowdenbeath	K	316527	691742	NO ₂	N	N (3.5)	0.5	N
North Approach Road (A, B), Kincardine	K	293182	687527	NO ₂	N	N (11.0)	0.5	N

Site Name	Site Type	X OS Grid Ref	Y OS Grid Ref	Pollutants Monitored	In AQMA?	Relevant Exposure? (m) ⁽¹⁾	Distance to kerb of nearest road (m) ⁽²⁾	Tube collocated with a Continuous Analyser?
Admiralty Road A, Rosyth	R(F)	312069	683431	NO ₂	N	Y	9	N
129 Admiralty Road, Rosyth	R (F)	311960	683477	NO ₂	N	Y	12	N
229 Admiralty Road, Rosyth	R (F)	311384	683543	NO ₂	N	Y	11	N
Admiralty Road (A,B,C) ROMON*	R(F)	311755	683503	NO ₂	N	Y	6.5	Y
49 Ramsay Place, Rosyth	R (F)	311633	683488	NO ₂	N	Y	14	N
Appin Crescent 1, Dunfermline	R(F)	309888	687719	NO ₂	Y	Y	6.5	N
Appin Crescent 2, Dunfermline	R(F)	309883	687701	NO ₂	Y	Y	1.5	N
Appin Crescent 3, Dunfermline	R(F)	309975	687716	NO ₂	Y	Y	1.8	N
Appin Crescent 4(A)(B)(C), Dunfermline*	R(F)	309926	687722	NO ₂	Y	Y	3.9	Y
Appin Crescent 5(A)(B)(C)* Dunfermline	R(F)	309957	687714	NO ₂	Y	Y	1.5	N
Appin Crescent 6(A)(B)(C)* Dunfermline	R(F)	309904	687704	NO ₂	Y	Y	1.5	N
Appin Crescent (A)(B)(C)*, Dunfermline	R	309900	687716	NO ₂	Y	N (5.1)	1.6	N

Site Name	Site Type	X OS Grid Ref	Y OS Grid Ref	Pollutants Monitored	In AQMA?	Relevant Exposure? (m) ⁽¹⁾	Distance to kerb of nearest road (m) ⁽²⁾	Tube collocated with a Continuous Analyser?
Carnegie Drive (A,B,C), Dunfermline*	R(F)	309023	687632	NO ₂	N	Y	2.3	N
11 Halbeath Road, Dunfermline	R (F)	310245	687784	NO ₂	N	Y	14	N
57 Halbeath Road, Dunfermline	R (F)	310488	687873	NO ₂	N	Y	6	N
Pilmuir Road, Dunfermline	R	309143	687774	NO ₂	N	Y	2	N
Mill Street, Dunfermline	R	308888	687968	NO ₂	N	Y	2	N
Rumblingwell, Dunfermline	R	307898	688224	NO ₂	N	N (6.3)	1.7	N
St Leonards Primary School, Dunfermline	R(F)	309787	686549	NO ₂	N	Y	10.6	N
42 Chalmers Street, Dunfermline	R	308808	687555	NO ₂	N	Y	1.8	N

Y= if the monitoring site is at a location of exposure (e.g. installed on/adjacent to the façade of a residential property).

*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

UB = Urban background, >50m from any busy road.

Table A. 2 Annual Mean NO₂ Monitoring Results (µg m⁻³)

Site Name	Site Type	Valid Data Capture 2018 (%) ⁽²⁾	2013	2014	2015	2016	2017	2018
Appin Crescent, Dunfermline	Roadside	99	25	24	25	24	23	22
Bonnygate, Cupar	Kerbside	99	27	27	27	31	26	26
Admiralty Road, Rosyth	Roadside	100	25	25	23	25	22	22
St Clair Street, Kirkcaldy	Roadside	94	20	18	18	17	18	17

Notes: Exceedances of the NO₂ annual mean objective of 40 µg m⁻³ are shown in **bold**.

NO₂ annual means exceeding 60 µg m⁻³, indicating a potential exceedance of the NO₂ 1-hour mean objective are shown in **bold and underlined**.

(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%).

NO₂ Annual Mean concentrations are presented in Figure A.1. Over the past five years NO₂ concentrations have declined and have generally stabilised between 2013 and 2018. With the exception of Cupar in 2016 which increased from 27 µg m⁻³ to 31 µg m⁻³ and Rosyth, which increased by 2 µg m⁻³. In 2017 there was a decline in concentrations at all sites with the exception of Kirkcaldy, which increased from 17 µg m⁻³ to 18 µg m⁻³.

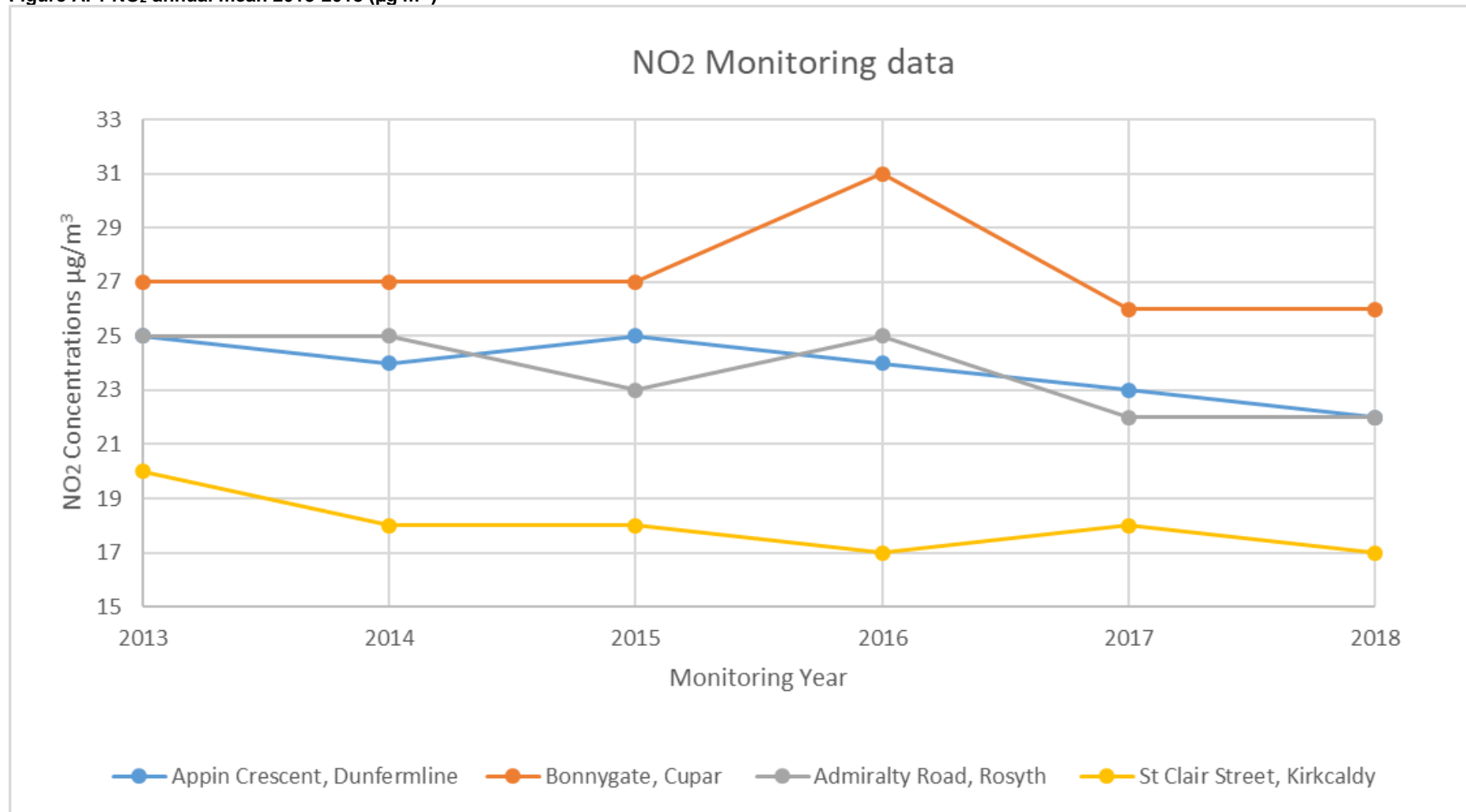
Figure A. 1 NO₂ annual mean 2013-2018 ($\mu\text{g m}^{-3}$)

Table A. 3 - Annual mean NO₂ Monitoring Results – Non-Automatic sites (µg m⁻³)

Site Name	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2018 (%) (2)	2013	2014	2015	2016	2017	2018 BIAS Adjusted
Central Area									
Queensway, Glenrothes	K	N/A	100	20	20	18	20	17	18
Leslie High Street	R(F)	N/A	100	21	20	19	20	17	17
Glenlyon Road, Levenmouth	K	N/A	100	24	26	25	26	24	24
Asda Roundabout, Kirkcaldy	K	N/A	100	30	28	26	28	24	27
Dunnikier Road, Kirkcaldy	R(F)	N/A	100	27	27	25	26	21	23
3A Junction Road, Kirkcaldy	R(F)	N/A	100	27	27	26	27	22	23
St Clair Street 1, Kirkcaldy	R(F)	N/A	100	34	35	31	32	33*	30
St Clair Street 2, Kirkcaldy	R(F)	N/A	100	36	36	37	37	34	33
St Clair Street 3 (MS), Kirkcaldy	R(F)	N/A	100	30	31	27	28	25	26
24 St Clair Street, Kirkcaldy	R(F)	N/A	33.33	19	20	20	20	19	17*
125 St Clair Street, Kirkcaldy	R(F)	N/A	100	31	31	32	32	29	28
179A St Clair Street, Kirkcaldy	R(F)	N/A	100	27	26	27	28	26	25
St Clair Street ROMON (A,B,C) Kirkcaldy	R	N/A	100	20	18	19	20	19	17

Site Name	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2018 (%) (2)	2013	2014	2015	2016	2017	2018 BIAS Adjusted
Victoria Road, Kirkcaldy	R(F)	N/A	91.67	29	29	26	25	23	25
Hendry Road, Kirkcaldy	R	100	100	-	-	-	-	26*	24
East Area									
Cupar Road, Auchtermuchty	R(F)	N/A	100	25	22	22	25	21	20
Bell Street 1, St Andrews	R(F)	N/A	100	35	32	32	30	27	28
Bell Street 2, St Andrews	R(F)	N/A	100	25	28	21^^	26	24	23
City Road 1,2, St Andrews	R	N/A	100	27	25	23	24	20	22
City Road 3, St Andrews	R	N/A	100	N/A	N/A	N/A	25	22	23
City Road 4, St Andrews	R	N/A	100	N/A	N/A	N/A	23^^^	18	18
City Road 5, St Andrews	R	N/A	100	N/A	N/A	N/A	29^^^	23	22
City Road 6, St Andrews	R	N/A	100	N/A	N/A	N/A	42^^^ ((33))	31	31
Lamond Drive 1, St Andrews	R	N/A	25	N/A	N/A	N/A	13 ^^	9	8*
St Marys Street 1, St Andrews	R	N/A	33.33	N/A	N/A	N/A	19^^	14	13*
St Mary's Street 2, St Andrews	R	N/A	33.33	N/A	N/A	N/A	15^^	12	11*
Links Crescent, St Andrews	R(F)	100	100	-	-	-	-	19*	21

Site Name	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2018 (%) (2)	2013	2014	2015	2016	2017	2018 BIAS Adjusted
Bonnygate 1, Cupar	R(F)	N/A	100	22	26	27	25	24	25
Bonnygate 2, Cupar	R(F)	N/A	100	32	26	29	32	28	28
Bonnygate 3 (A, B), Cupar	R(F)	N/A	91.67	31	34	39	37	31	31
Bonnygate B4, Cupar	R(F)	N/A	100	35	32	36	41	33	34
Bonnygate West B6, Cupar	R(F)	100	100	-	-	-	-	20*	18
8 Balgarvie Road, Cupar	R(F)	N/A	33.33	N/A	N/A	N/A	#Not reported due to low DC	8	8*
Orchard, Balgarvie Road, Cupar	R	N/A	33.33	N/A	N/A	N/A	#Not reported due to low DC	13	13*
Crossgate, Cupar	K	N/A	83.33	26	21	21	20	18	18
4 East Road, Cupar	R(F)	N/A	33.33	15	13	12	12	12	11*
Ladywynd, Cupar	R(F)	N/A	100	18	16	16	15	14	15
South Road, Cupar	R	N/A	33.33	12	11	12	12	10	11*
Bonnygate, Cupar, Monitor BA, BB, BC	K	N/A	91.67	30	28	27	27	26	27
West Area									
High Street, Cowdenbeath	K	N/A	100	21	22	19	21	18	20

Site Name	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2018 (%) (2)	2013	2014	2015	2016	2017	2018 BIAS Adjusted
North Approach Road (A, B), Kincardine	K	N/A	100	17	16	16	16	16	15
Admiralty Road A, Rosyth	R(F)	N/A	100	32	31	28	29	26	25
129 Admiralty Road, Rosyth	R (F)	N/A	100	25	24	22	24	21	22
229 Admiralty Road, Rosyth	R (F)	N/A	100	22	22^	20	21	19	19
Admiralty Road (A,B,C) ROMON	R(F)	N/A	100	26	25	23	25	22	22
49 Ramsay Place, Rosyth	R (F)	N/A	33.33	18	17	14.6	16	14	14*
Appin Crescent 1, Dunfermline	R(F)	N/A	83.33	25	26	27	25	25	25
Appin Crescent 2, Dunfermline	R(F)	N/A	100	39	39	40	38	34	34
Appin Crescent 3, Dunfermline	R(F)	N/A	100	33	33	35	32	29	28
Appin Crescent 4(A)(B)(C), Dunfermline	R(F)	N/A	100	25	25	25	24	23	21
Appin Crescent 5(A)(B)(C), Dunfermline	R(F)	N/A	91.67	36	36	39	35	35	31
Appin Crescent 6(A)(B)(C), Dunfermline	R(F)	N/A	91.67	40	40	43	39	37	35

Site Name	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2018 (%) (2)	2013	2014	2015	2016	2017	2018 BIAS Adjusted
Appin Crescent (A)(B)(C), Dunfermline	R	N/A	100	31	31	32	31	29	27
Carnegie Drive (A,B,C), Dunfermline	R(F)	N/A	91.67	31	32	30	30	26	27
11 Halbeath Road, Dunfermline	R (F)	N/A	100	18	17	18	17	16	15
57 Halbeath Road, Dunfermline	R (F)	N/A	75	18	17	18	18	16	14
Pilmuir Road, Dunfermline	R	N/A	91.67	N/A	N/A	24	26	23	24
Mill Street, Dunfermline	R	N/A	100	N/A	N/A	28	30	30	30
Rumblingwell, Dunfermline	R	N/A	100	21	21	22	22	22	21
St Leonards Primary School, Dunfermline	R(F)	N/A	33.33	14	14	14	15	13	12*
42 Chalmers Street	R	N/A	100	N/A	N/A	N/A	21	19	19

Notes: Exceedances of the NO₂ annual mean objective of 40 µg m⁻³ are shown in **bold**.

NO₂ annual means exceeding 60µg m⁻³, indicating a potential exceedance of the NO₂ 1-hour mean objective are shown in **bold and underlined**.

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

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

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

^ Data annualised (R_a of 0.986 applied to Bias corrected data) to compensate for May to December missing data

^^ 2015 data annualised, adjustment factor of 0.99 to calculate annual mean from period mean concentrations as described in TG(16)

^^ Data Annualised as described in TG.16. Full details in 2017 APR report.

(()) Data distance corrected to nearest receptor, using LAQM NO₂ fall off calculator

*Annualised in accordance with TG.16. Full details in Appendix C.

Table A. 4 - 1-Hour Mean NO₂ Monitoring Results (NO₂ 1-Hour Means > 200 µg m⁻³)

Site Name	Monitoring Type	Valid Data Capture for Monitoring Period (%) ⁽¹⁾	Valid Data Capture 2018 (%) ⁽²⁾	2013 ⁽³⁾	2014 ⁽³⁾	2015 ⁽³⁾	2016 ⁽³⁾	2017 ⁽³⁾	2018 ⁽³⁾
Appin Crescent, Dunfermline	Automatic	n/a	99	0	0	0	0	0	0
Bonnygate, Cupar	Automatic	n/a	100	0 (117)	0 (115)	0	0	0	0
Admiralty Road, Rosyth	Automatic	n/a	100	0	0 (105)	0	0	0	0
St Clair Street, Kirkcaldy	Automatic	n/a	94	0	0	0	0	0	0

Notes: Exceedances of the NO₂ 1-hour mean objective (200 µg m⁻³ not to be exceeded more than 18 times/year) are shown in **bold**.

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

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

(3) If the period of valid data is less than 90%, the 99.8th percentile of 1-hour means is provided in brackets.

Table A. 5 Annual Mean PM₁₀ Monitoring Results (µg m⁻³)

Site Name	Valid Data Capture for Monitoring Period (%) ⁽¹⁾	Valid Data Capture 2018 (%) ⁽²⁾	2013 ⁽³⁾	2014 ⁽³⁾	2015 ⁽³⁾	2016 ⁽³⁾	2017 ⁽³⁾	2018 ⁽³⁾
Appin Crescent, Dunfermline	n/a	100	15	15	16	13	10	11
Bonnygate, Cupar	n/a	100	(18) 18	17	17	15	13	14
Admiralty Road, Rosyth	n/a	100	14	15	14	10	11	11
St Clair Street, Kirkcaldy	n/a	100	12	11	13	10	9	10

Notes: Exceedances of the PM₁₀ annual mean objective of 18 µg m⁻³ are shown in **bold**.

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

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

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

() Data in brackets are Measurements without a period mean adjustment calculated

PM₁₀ Annual Mean concentrations are presented in Figure A.2. Over the past five years PM₁₀ concentrations have declined. The decline in concentrations coincide with implementation of certain AQAP measures.

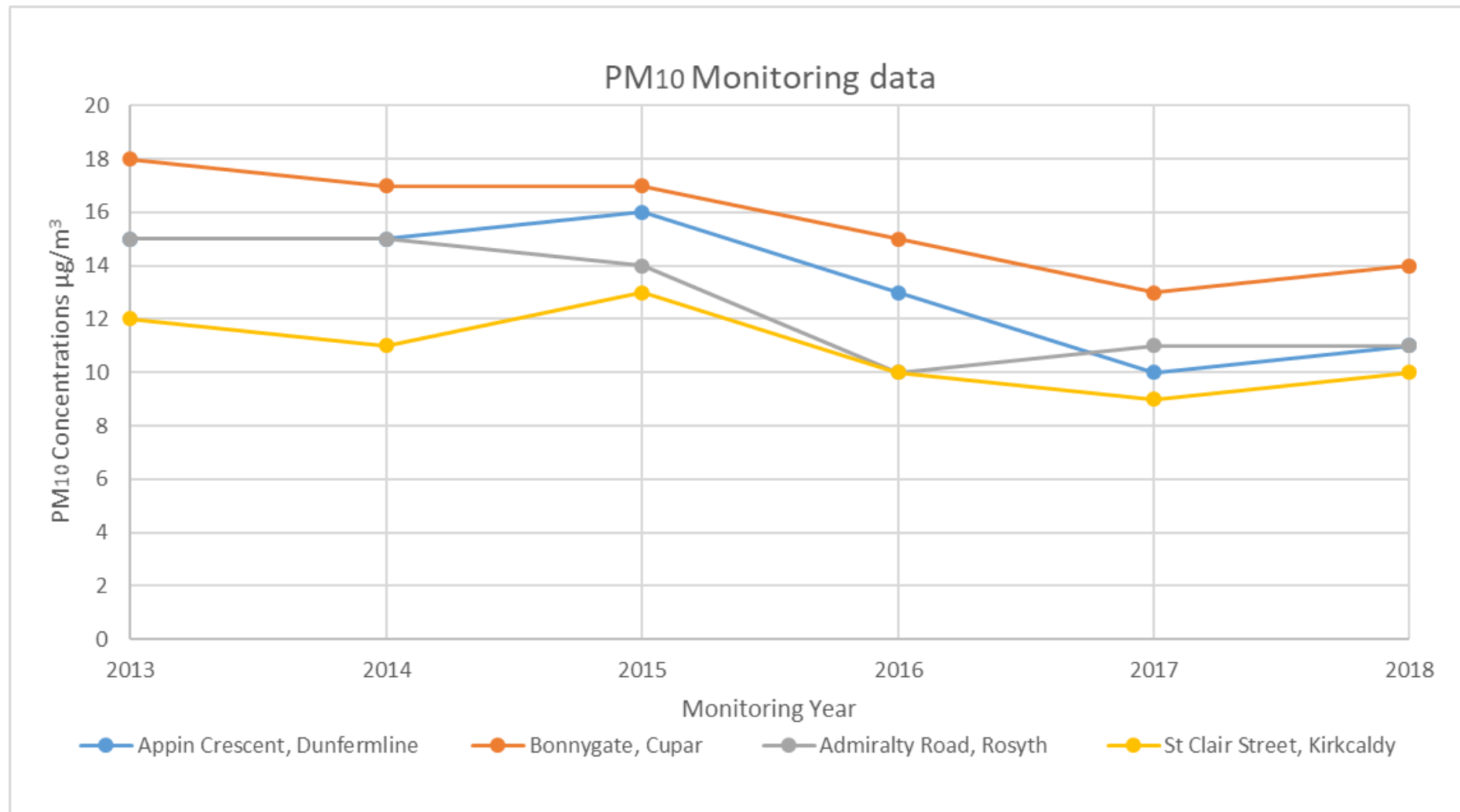
Figure A. 2 PM₁₀ Annual Mean Concentrations 2013-2018 ($\mu\text{g m}^{-3}$)

Table A. 6 24- Hour Mean PM₁₀ Monitoring Results (PM₁₀ 24-Hour Means > 50 µg m⁻³)

Site Name	Valid Data Capture for Monitoring Period (%) ⁽¹⁾	Valid Data Capture 2018 (%) ⁽²⁾	2013 ⁽³⁾	2014 ⁽³⁾	2015 ⁽³⁾	2016 ⁽³⁾	2017 ⁽³⁾	2018 ⁽³⁾
Appin Crescent, Dunfermline	n/a	100	2	0	2 (25)	1	0	0
Bonnygate, Cupar	n/a	100	4 (45)	0 (39)	2 (27)	0	1	1
Admiralty Road, Rosyth	n/a	100	2	0 (37)	3 (24)	1	1	0
St Clair Street, Kirkcaldy	n/a	100	1	1 (25)	2	0	0	0

Notes: Exceedances of the PM₁₀ 24-hour mean objective (50 µg m⁻³ not to be exceeded more than 7 times/year) are shown in **bold**.

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

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

(3) If the period of valid data is less than 90%, the 98.1th percentile of 24-hour means is provided in brackets.

Table A. 7 Annual Mean PM_{2.5} Monitoring Results (µg m⁻³)

Site Name	Valid Data Capture 2018 (%) (2)	2013 ⁽³⁾	2014 ⁽³⁾	2015 ⁽³⁾	2016 ⁽³⁾	2017 ⁽³⁾	2018 ⁽³⁾
Appin Crescent, Dunfermline	100	-	-	-	6^^	6	6
Bonnygate, Cupar	100	-	-	-	-	6	7
Admiralty Road, Rosyth	100	-	-	7^^	6	6	6
St Clair St, Kirkcaldy	100	-	-	-	5.1^^^	5	6

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

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

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

^^ Data annualised as detailed in 2016 Annual Progress Report

^^^ Data annualised as outlined in 2017 Annual Progress Report

Appendix B – Full Monthly Diffusion Tube Results for 2018

Table B. 1- NO₂ Monthly Diffusion Tube Results for 2018 (µg m⁻³)

Site Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Mean Raw	Annual Mean Bias Adjusted ⁽¹⁾
Central Area														
Queensway, Glenrothes	30.7	28.4	27.3	22.4	23.5	17.6	15.1	19.4	17.2	22.4	27.1	32.8	23.7	18.5
Leslie High Street	30.1	25.2	27.6	20.5	20.6	15.0	15.3	19.0	18.3	20.3	25.6	30.6	22.3	17.5
Glenlyon Road, Levenmouth	38.9	28.0	35.0	30.8	28.0	24.0	25.2	28.1	29.1	31.7	33.5	32.1	30.4	23.7
Asda Roundabout, Kirkcaldy	40.8	35.0	38.1	34.9	39.3	28.2	26.9	27.3	23.8	31.2	37.6	44.8	34.0	26.5
Dunnikier Road, Kirkcaldy	33.6	29.9	28.1	31.5	35.6	25.3	23.3	27.2	24.1	26.1	35.7	36.1	29.7	23.2
3A Junction Road, Kirkcaldy	36.7	27.6	35.0	31.9	32.5	22.9	22.2	25.1	22.1	27.1	37.5	38.3	29.9	23.3
St Clair Street 1, Kirkcaldy	43.9	41.1	44.4	42.5	48.7	35.8	32.4	31.5	26.8	32.0	42.5	39.0	38.4	29.9
St Clair Street 2, Kirkcaldy	50.4	37.0	43.2	42.7	36.4	30.9	36.6	43.5	42.7	46.2	42.8	51.7	42.0	32.8
St Clair Street 3 (MS), Kirkcaldy	38.3	36.4	36.2	35.1	45.9	28.8	28.0	25.3	23.1	29.2	38.9	41.4	33.9	26.4
24 St Clair Street, Kirkcaldy	33.2	22.6	25.5	21.1	Monitoring Ceased								25.6*	17.2*
125 St Clair Street, Kirkcaldy	46.9	36.4	38.2	32.9	29.4	22.8	29.4	30.8	37.1	39.7	35.8	44.7	35.3	27.6
179A St Clair Street, Kirkcaldy	46.8	33.4	32.4	27.7	24.7	17.8	26.5	26.5	35.5	38.2	32.9	45.7	32.3	25.2
St Clair Street ROMON (A), Kirkcaldy	33.0	21.9	21.7	21.1	15.3	12.7	11.9	18.8	18.7	23.5	25.0	30.7	21.8	17.0
St Clair Street ROMON (B), Kirkcaldy	34.3	22.3	23.4	21.3	15.2	12.7	15.4	18.8	19.1	24.3	24.8	33.0		
St Clair Street ROMON (C), Kirkcaldy	33.2	22.7	24.6	20.7	16.8	12.3	14.5	18.8	18.9	23.0	26.0	35.0		
Victoria Road, Kirkcaldy	41.1	36.4	29.8	25.2	33.9	22.7	23.5	30.7	-	33.6	37.0	41.8	32.3	25.2

Hendry Road Kirkcaldy	39.9	31.3	29.3	31.9	28.5	20.9	24.6	32.8	29.3	33.3	32.6	40.1	31.2	24.3
East Area														
Cupar Road, Auchtermuchty	35.2	33.0	22.6	24.7	21.9	19.5	21.7	24.1	23.7	27.0	25.6	30.3	25.8	20.1
Bell Street 1, St Andrews	35.4	49.5	39.8	40.5	38.0	25.6	28.7	25.0	31.5	35.3	36.2	43.7	35.8	27.9
Bell Street 2, St Andrews	35.0	40.0	26.6	32.5	29.8	23.2	23.1	24.6	28.1	31.7	29.9	35.0	30.0	23.4
City Road 1, St Andrews	32.5	29.2	29.5	35.5	34.2	27.3	24.4	19.9	18.2	24.2	33.9	30.6	28.3	22.4
City Road 2, St Andrews	33.3	33.7	28.4	35.3	35.3	25.6	24.9	20.6	18.4	25.9	34.0	32.1	29.0	
City Road 3, St Andrews	33.8	38.5	25.9	30.9	28.6	21.6	22.5	31.1	27.0	33.6	28.2	34.9	29.7	23.2
City Road 4, St Andrews	27.0	28.6	21.3	24.6	25.6	18.1	18.8	19.1	17.8	23.8	25.1	25.5	22.9	17.9
City Road 5, St Andrews	35.0	37.4	24.1	30.9	27.7	24.8	24.5	22.6	21.2	27.7	28.7	34.1	28.2	22.1
City Road 6, St Andrews	47.7	49.6	29.6	34.5	44.4	36.6	35.5	36.6	34.6	43.0	36.2	45.4	39.5	30.8
Lamond Drive 1, St Andrews	17.3	-	9.4	10.6	Monitoring Ceased								12.4*	8.5*
St Marys Street 1, St Andrews	28.2	22.4	12.9	16.5	Monitoring Ceased								20.0*	13.3*
St Mary's Street 2, St Andrews	21.3	20.5	12.3	13.5	Monitoring Ceased								16.9*	11.3*
Links Crescent, St Andrews	32.9	30.3	25.8	25.7	28.1	17.5	23.0	22.9	22.5	31.0	26.3	36.9	26.9	21.0
Bonnygate 1, Cupar	42.9	38.1	36.6	33.3	32.8	21.8	29.1	26.3	23.4	23.2	38.6	40.0	32.2	25.1
Bonnygate 2, Cupar	49.1	40.4	37.1	40.3	37.9	29.5	30.9	30.8	31.7	36.2	36.9	36.3	36.4	28.4
Bonnygate 3A, Cupar	47.8	45.2	41.4	44.4	40.9	35.2	35.1	32.5	29.8	29.0	38.9	43.4	40.2	31.4
Bonnygate 3B, Cupar	49.7	46.9	44.4	42.2	43.5	38.3	35.6	-	31.5	38.5	39.9	50.9		
Bonnygate 4B, Cupar	52.7	52.4	42.3	45.9	43.6	37.7	39.3	39.0	37.5	42.3	43.7	50.2	43.9	34.2
Bonnygate West B6, Cupar	32.6	29.8	21.7	22.6	19.5	14.9	16.9	20.3	22.0	24.2	22.7	31.4	23.2	18.1
8 Balgarvie Road, Cupar	16.5	13.8	8.9	7.8	Monitoring Ceased								11.8	7.8*
Orchard, Balgarvie Road, Cupar	25.5	22.9	17.9	13.9	Monitoring Ceased								20.1	13.3*

Crossgate, Cupar	29.9	25.7	28.4	-	25.2	18.9	-	15.5	13.8	20.6	29.0	29.5	23.7	18.4
4 East Road, Cupar	20.3	20.5	13.2	13.0	Monitoring Ceased								16.8	11.1*
Ladywynd B5 Cupar	27.5	23.3	19.7	16.9	15.1	9.9	12.9	15.2	14.6	18.2	22.7	28.9	18.7	14.6
South Road, Cupar	19.9	18.8	13.0	11.5	Monitoring Ceased								15.8	10.5*
Bonnygate Monitor BA, Cupar	43.5	<0.5	37.8	35.5	35.4	27.7	30.3	26.6	27.9	29.9	40.3	39.3	34.8	27.1
Bonnygate Monitor BB, Cupar	45.8	39.6	39.4	35.3	35.2	28.4	29.5	27.5	24.6	31.2	41.6	40.9		
Bonnygate Monitor BC, Cupar	43.7	41.9	41.5	32.2	35.7	29.1	30.4	27.4	27.5	32.9	41.4	41.1		
West Area														
High Street, Cowdenbeath	33.9	31.1	26.2	22.9	23.4	18.7	17.3	17.1	20.1	35.0	34.9	23.9	25.4	19.8
North Approach Road A, Kincardine	32.1	25.8	16.9	14.8	13.4	9.8	11.5	13.2	15.4	23.1	20.6	26.9	19.0	14.8
North Approach Road B, Kincardine	32.6	28.6	15.7	15.7	13.7	10.8	12.2	13.5	15.3	25.1	22.3	26.6		
Admiralty Road A, Rosyth	29.0	35.5	35.6	32.9	27.9	21.4	22.2	22.0	24.7	31.7	36.9	41.2	30.1	25.3
129 Admiralty Road, Rosyth	34.0	33.8	27.4	23.2	21.7	17.7	18.3	17.9	19.4	27.8	32	35.7	25.7	21.6
229 Admiralty Road, Rosyth	31.4	30.6	24.7	19.9	18.4	14.5	14.2	17.1	18.6	24.5	27.1	34.3	22.9	19.3
Admiralty Road A ROMON	32.9	32.7	26.6	21.9	22.6	19.2	18.7	21.5	22.8	25.8	30.7	37.2	26.1	21.9
Admiralty Road B ROMON	33.7	31.5	24.8	23.3	22.5	18.2	19.5	20.6	21.2	29.0	28.2	36.4		
Admiralty Road C ROMON	34.3	35.0	26.8	24.0	25.2	18.6	18.8	21.6	19.6	28.5	29.9	35.1		
49 Ramsay Place, Rosyth	22.6	21.9	18.2	13.5	Monitoring Ceased								19.1*	13.7*
Appin Crescent 1, Dunfermline	40.8	39.1	-	-	27.9	23.1	24.6	28.6	33.6	40.1	38.3	44.6	34.1	25.2
Appin Crescent 2, Dunfermline	59.9	50.7	45.5	37.3	43.8	34.8	35.5	37.1	38.8	48.3	58.2	54.7	45.4	33.6
Appin Crescent 3, Dunfermline	49.1	47.7	37.1	36.1	36.7	29.9	28.4	29.3	32.7	39.2	34.0	54.9	37.9	28.1
Appin Crescent 4A, Dunfermline	39.7	37.2	33.9	27.1	24.7	20.6	19.8	24.5	27.0	28.7	30.8	40.7	29.0	21.5
Appin Crescent 4B, Dunfermline	41.5	36.4	32.7	26.0	24.1	20.6	21.6	25.3	24.1	27.9	28.9	38.8		

Appin Crescent 4C, Dunfermline	38.2	36.8	31.9	28.2	24.0	18.9	19.2	22.5	26.4	30.5	28.9	36.4		
Appin Crescent 5A, Dunfermline	58.4	55.7	41.5	36.3	35.2	31.2	-	33.7	42.4	47.7	44.3	56.6		
Appin Crescent 5B, Dunfermline	57.0	54.4	42.6	39.1	36.0	31.7	-	36.4	39.3	46.0	43.6	36.4	42.1	31.2
Appin Crescent 5C, Dunfermline	58.5	42.6	43.7	39.6	37.1	30.8	29.9	33.9	40.6	47.0	39.4	42.9		
Appin Crescent 6A, Dunfermline	61.4	61.6	48.6	44.2	45.5	38.3	36.9	36.5	42.9	54.9	51.2	53.6		
Appin Crescent 6B, Dunfermline	64.1	62.0	49.5	-	47.4	37.1	39.3	39.1	42.7	50.6	52.2	49.0	47.1	34.8
Appin Crescent 6C, Dunfermline	56.9	53.3	44.3	42.4	42.1	34.3	36.4	39.6	43.8	49.4	49.4	46.7		
Appin Crescent A, Dunfermline	53.0	44.6	42.6	37.8	31.0	27.7	26.0	27.1	31.9	38.3	35.9	50.8		
Appin Crescent B, Dunfermline	50.8	48.3	37.4	35.1	30.4	25.3	23.9	28.3	33.1	42.8	36.4	52.0	36.7	27.2
Appin Crescent C, Dunfermline	48.9	47.9	38.5	34.0	27.8	23.2	24.3	29.4	34.2	39.5	38.1	46.2		
Carnegie Drive A, Dunfermline	43.3	51.8	36.9	36.2	42.4	32.1	30.3	28.3	26.9	35.7	33.3	44.6		
Carnegie Drive B, Dunfermline	41.5	42.6	39.0	35.8	41.8	32.8	32.4	28.5	27.8	35.0	40.4	42.0	36.3	26.8
Carnegie Drive C, Dunfermline	42.9	-	34.9	34.1	41.3	32.3	29.8	27.8	24.2	36.8	41.5	42.8		
11 Halbeath Road, Dunfermline	29.9	25.3	20.0	16.8	14.3	9.6	12.9	13.9	17.6	22.9	23.1	30.0	19.7	14.6
57 Halbeath Road, Dunfermline	28.8	23.8	21.2	17.1	15.0	-	13.2	14.6	17.0	23.3	Relocated		19.3	14.3
Pilmuir Road, Dunfermline	39.0	<0.5	68.6	25.7	27.3	23.1	23.7	24.0	25.1	29.6	33.5	42.8	32.9	24.4
Mill Street, Dunfermline	54.4	49.4	35.0	28.8	35.9	32.2	30.7	31.2	41.8	44.3	43.8	51.5	39.9	29.5
Rumblingwell, Dunfermline	37.5	38.1	25.4	23.8	25.7	21.7	22.0	24.5	26.0	28.0	27.9	37.6	28.2	20.9
St Leonards Primary School, Dunfermline	21.5	22.2	18.8	15.9	Monitoring Ceased								19.6*	12.5*
42 Chalmers Street, Dunfermline	31.3	31.2	27.5	24.9	22.0	18.5	17.8	20.1	19.8	27.4	31.9	32.4	25.4	18.8

1. See Appendix C for details on bias adjustment
2. Exceedances of the NO₂ annual mean objective of 40 µg m⁻³ are shown in bold.
3. 2018 data annualised, from period mean concentrations as described in TG(16)
4. Bonnygate Monitor BA, Cupar February tube result <0.5 – removed from results.

Appendix C – Data QA/QC

Diffusion Tube Bias Adjustment Factors

Diffusion tubes may over or under predict NO₂ concentrations when compared to the reference method chemiluminescent analyser. This difference in measurement is described as bias. Accuracy in results can be adjusted in order to account for this. Results are adjusted using a calculated bias adjustment factor.

The diffusion tubes deployed by Fife Council were supplied and analysed by Tayside Scientific Services from January to July using a preparation mixture of 20% triethanolamine (TEA) in water. From August to December SOCOTEC supplied and analysed the diffusion tubes using a preparation mixture of 20% triethanolamine (TEA) in water. The national bias adjustment factor was not used in this case as the diffusion tubes were supplied and analysed by Tayside Scientific Services and SOCTOEC.

Figures C1-C4 show the locally derived adjustment factors. Overall the locally derived adjustment factor was 0.78. The local bias adjustment was applied to all diffusion tubes within the area. While the average of the local was used for all other sites for consistency

Figure C. 1 Local Bias adjustment spreadsheet- Cupar
Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

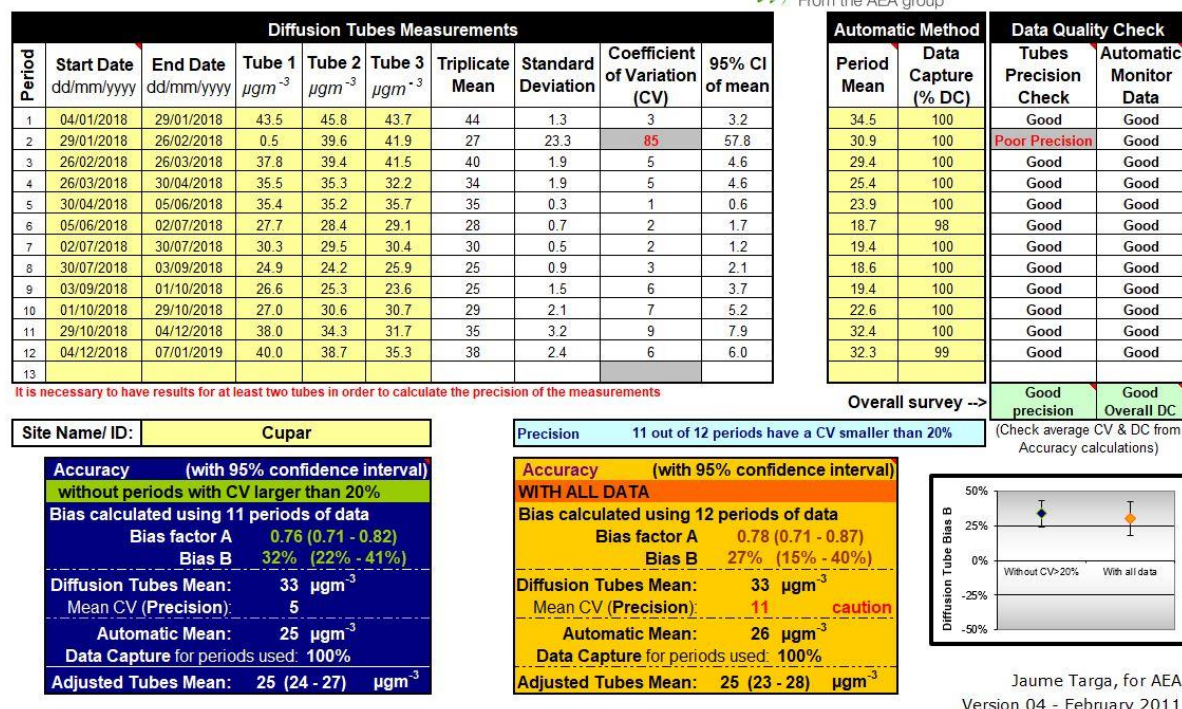


Figure C. 2 Local Bias Adjustment Factor spreadsheet- Dunfermline
Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

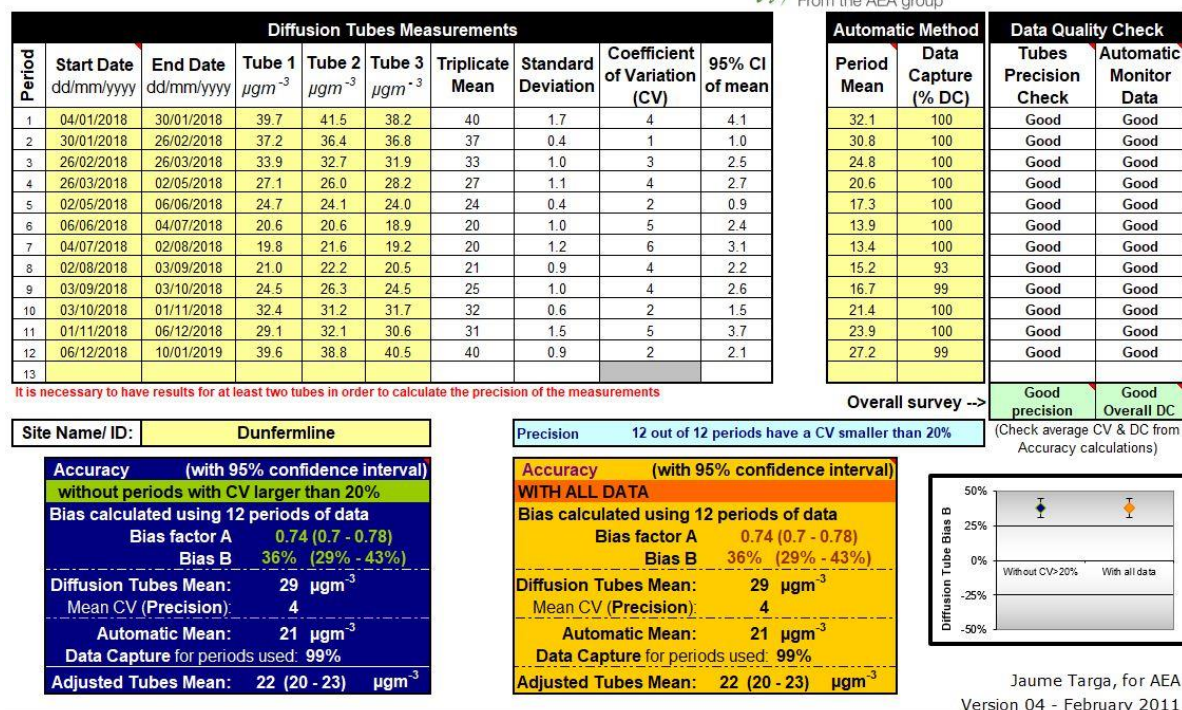


Figure C. 3 Local Bias Adjustment Factor spreadsheet- Kirkcaldy

Checking Precision and Accuracy of Triplicate Tubes

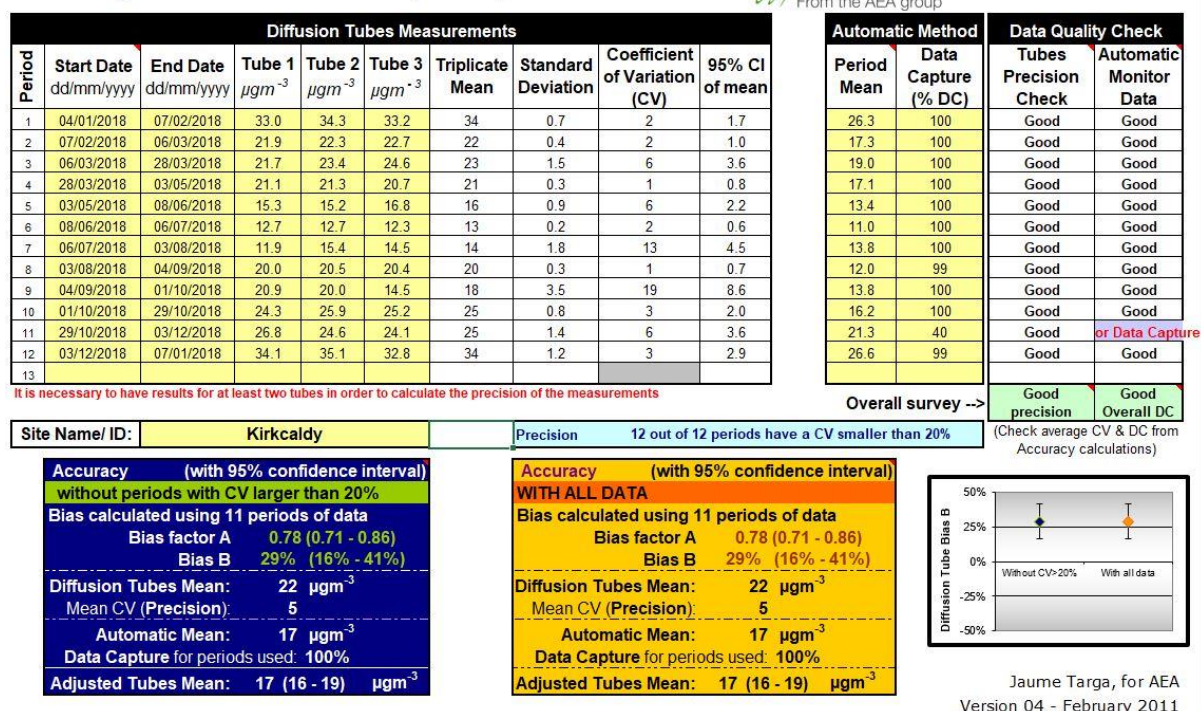
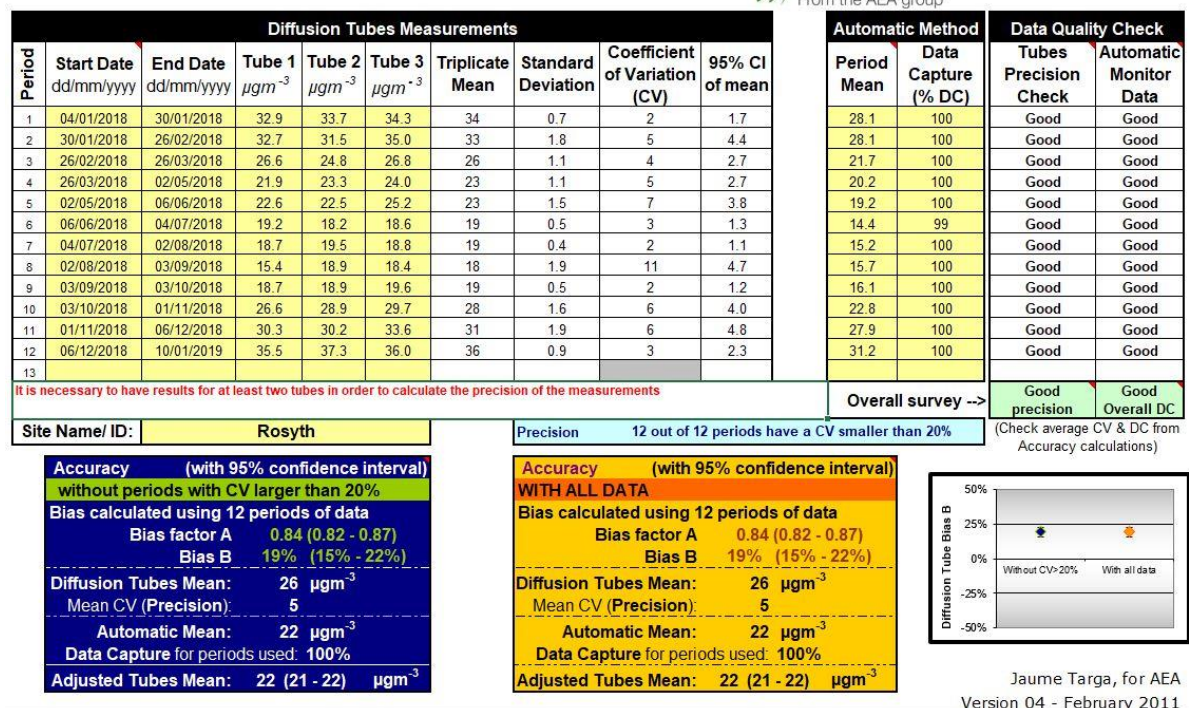

AEA Energy & Environment
 From the AEA group


Figure C. 4 Local Bias Adjustment Factor Spreadsheet – Rosyth

Checking Precision and Accuracy of Triplicate Tubes


AEA Energy & Environment
 From the AEA group


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 NO_x analyser;
- 6-monthly audits and servicing of the monitoring site;
- Data ratification.

Calibrations of the NO_x 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, previously analysed by Tayside Scientific Services. The tube preparation method for both laboratories is 20% TEA in water. Both laboratories are also participants in the centralised QA/QC services provided by Defra and the devolved administrations. These services comprise 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 NO₂ 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 NO₂. 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 0.78.

For this report, in order to keep results comparable, the local bias adjustment was applied to all diffusion tubes within the area. While the average of the local was used for all other sites for consistency.

The survey consists of tubes exposed over a range of settings, which differ from the co-location site, e.g. the co-location site in a very exposed setting and the tubes being assessed are on building façade in a canyon-like street.

Table C. 1 Local BIAS adjustment factors

Source	Bias Adjustment Factors 2018
Bonnygate, Cupar	0.78
Appin Crescent, Dunfermline	0.74
St Clair Street, Kirkcaldy	0.78
Admiralty Road, Rosyth	0.84
Average Local Bias factor	0.78

Appendix D – Annualisation of Data

Data capture for the following sites was less than 75%, therefore the data was annualised in accordance with TG(16) as per Box 7.9.

- 24 St Clair Street, Kirkcaldy – 33%. Periods of valid data = 04/01/18-03/05/18
- Lamond Drive 1, St Andrews – 25%. Periods of valid data = 04/01/18-29/01/18 and 26/02/18-30/04/18
- St Marys Street 1, St Andrews – 33%. Periods of valid data = 04/01/18-30/04/18
- St Marys Street 2, St Andrews – 33%. Periods of valid data = 04/01/18-30/04/18
- 8 Balgarvie Road, Cupar – 33%. Periods of valid data = 04/01/18-30/04/18
- Orchard Balgarvie Road, Cupar – 33%. Periods of valid data = 04/01/18-30/04/18
- 4 East Road, Cupar – 33%. Periods of valid data = 04/01/18-30/04/18
- South Road, Cupar – 33%. Periods of valid data = 04/01/18-30/04/18
- 49 Ramsay Place, Rosyth – 33%. Periods of valid data = 04/01/18-02/05/18
- St Leonards Primary School, Dunfermline – 33%. Periods of valid data = 04/01/18-02/05/18

Table D. 1 Annualisation of NO₂ Diffusion Tubes for Central Area

Automatic Site	Automatic Site Annual mean 2018 (Am) (Central)	Automatic Site Period Mean 2018 (Pm) (24 St Clair Street)
Bush Estate	5.3	6.3
Dundee Mains Loan	12.1	14.0
Edinburgh St Leonards	18.1	20.6
Average Ratio (Am/Pm) – 24 St Clair Street		0.86
24 St Clair Street – Annual Mean (µg m⁻³)		22.0
24 St Clair Street – Annual Mean (µg m⁻³) – BIAS Adjusted		17.2

Table D. 2 Annualisation of NO₂ Diffusion Tubes for East Area

Automatic Site	Automatic Site Annual mean 2018 (Am) (East)	Automatic Site Period Mean 2018 (Pm) (Lamond Drive)	Automatic Site Period Mean 2018 (Pm) (St Marys Street 1)	Automatic Site Period Mean 2018 (Pm) (St Marys Street 2)	Automatic Site Period Mean 2018 (Pm) (8 Balgarvie Road)	Automatic Site Period Mean 2018 (Pm) (Orchard Balgarvie Road)	Automatic Site Period Mean 2018 (Pm) (4 East Road)	Automatic Site Period Mean 2018 (Pm) (South Road)
Bush Estate	5.3	6.7	6.4	6.4	6.4	6.4	6.4	6.4
Dundee Mains Loan	12.1	13.5	14.1	14.1	14.1	14.1	14.1	14.1
Edinburgh St Leonards	18.1	19.3	20.7	20.7	20.7	20.7	20.7	20.7
Average Ratio (Am/Pm) – Lamond Drive				0.87				
Average Ratio (Am/Pm) – St Marys Street 1				0.85				
Average Ratio (Am/Pm) – St Marys Street 2				0.85				
Average Ratio (Am/Pm) – 8 Balgarvie Road				0.85				
Average Ratio (Am/Pm) – Orchard Balgarvie Road				0.85				
Average Ratio (Am/Pm) – 4 East Road				0.85				
Average Ratio (Am/Pm) – South Road				0.85				
Lamond Drive – Annual Mean ($\mu\text{g m}^{-3}$)				10.9				
Lamond Drive – Annual Mean ($\mu\text{g m}^{-3}$) – BIAS Adjusted				8.5				
St Marys Street 1 – Annual Mean ($\mu\text{g m}^{-3}$)				17.1				
St Marys Street 1 – Annual Mean ($\mu\text{g m}^{-3}$) – BIAS Adjusted				13.3				
St Marys Street 2 – Annual Mean ($\mu\text{g m}^{-3}$)				14.4				
St Marys Street 2 – Annual Mean ($\mu\text{g m}^{-3}$) – BIAS Adjusted				11.3				
8 Balgarvie Road – Annual Mean ($\mu\text{g m}^{-3}$)				10.0				
8 Balgarvie Road – Annual Mean ($\mu\text{g m}^{-3}$) – BIAS Adjusted				7.8				
Orchard Balgarvie Road – Annual Mean ($\mu\text{g m}^{-3}$)				17.1				
Orchard Balgarvie Road – Annual Mean ($\mu\text{g m}^{-3}$) – BIAS Adjusted				13.3				

4 East Road – Annual Mean ($\mu\text{g m}^{-3}$)	14.3
4 East Road – Annual Mean ($\mu\text{g m}^{-3}$) – BIAS Adjusted	11.1
South Road – Annual Mean ($\mu\text{g m}^{-3}$)	13.5
South Road – Annual Mean ($\mu\text{g m}^{-3}$) – BIAS Adjusted	10.5

Table D. 3 Annualisation of NO₂ Diffusion Tubes for West Area

Automatic Site	Automatic Site Annual mean 2018 (Am) (West)	Automatic Site Period Mean 2018 (Pm) (49 Ramsay Place)	Automatic Site Period Mean 2018 (Pm) (St Leonards Primary School)
Bush Estate	5.3	6.4	6.4
Dundee Mains Loan	12.1	14.0	14.0
Edinburgh St Leonards	18.2	20.6	20.6
Average Ratio (Am/Pm) – 49 Ramsay Place		0.86	
Average Ratio (Am/Pm) – St Leonards Primary School		0.86	
49 Ramsay Place – Annual Mean ($\mu\text{g m}^{-3}$)		16.4	
St Leonards Primary School – Annual Mean ($\mu\text{g m}^{-3}$) – BIAS Adjusted		13.7	
49 Ramsay Place – Annual Mean ($\mu\text{g m}^{-3}$)		16.8	
St Leonards Primary School – Annual Mean ($\mu\text{g m}^{-3}$) – BIAS Adjusted		12.5	

Appendix E – Technical Specification of Automatic Monitoring Equipment

Figure F. 1 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:	UKAS calibration by Ricardo with Air Liquide gas cylinder
Pollutants measured on site:	PM ₁₀ , PM _{2.5} , PM ₁ , TSP, NO _x , NO, NO ₂
Instrument manufacturer:	FIDAS 200
	Thermo i-series
Calibration procedure and frequency:	2 weekly manual calibrations
Site service arrangements:	6-monthly service by air monitors
Co-located passive sampler	Triplicate NO ₂ tubes installed

Figure F. 2 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:	UKAS calibration by Ricardo with Air Liquide gas cylinder
Pollutants measured on site:	PM ₁₀ , PM _{2.5} , PM ₁ , TSP, NO _x , NO, NO ₂
Instrument manufacturer:	FIDAS 200 Thermo i-series
Calibration procedure and frequency:	2-weekly manual calibration
Site service arrangements:	6-monthly service by Air Monitors
Co-located passive sampler	Triplicate NO ₂ tubes installed

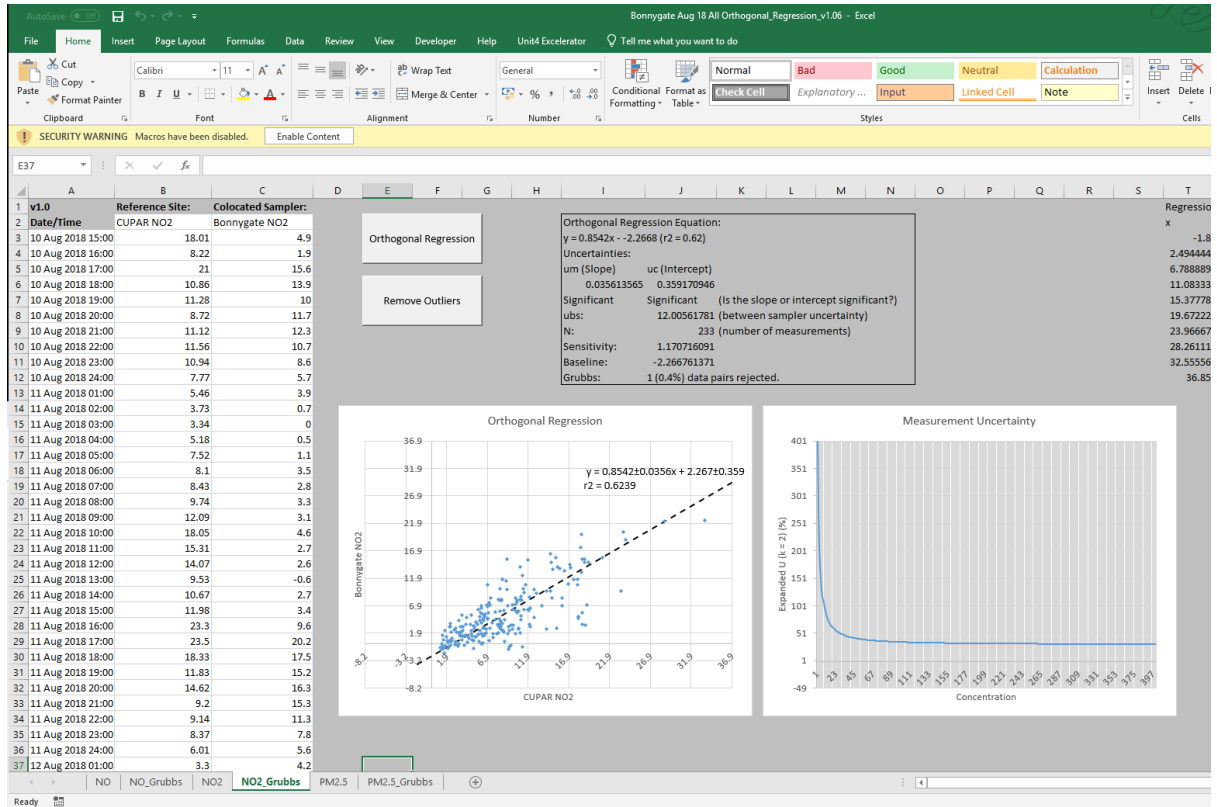
Figure F. 3 Admiralty Road, Rosyth

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:	UKAS calibration by Ricardo with Air Liquide gas cylinder
Pollutants measured on site:	PM ₁₀ , PM _{2.5} , PM ₁ , TSP, NO _x , NO, NO ₂
Instrument manufacturer:	FIDAS 200 NO _x – Thermo 42i
Calibration procedure and frequency:	2-weekly manual calibrations.
Site service arrangements:	6-monthly service by air monitors
Co-located passive sampler	Triplicate NO ₂ tubes installed

Figure F. 4 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:	UKAS calibration by Ricardo with Air Liquide gas cylinder
Pollutants measured on site:	PM ₁₀ , PM _{2.5} , PM ₁ , TSP, NO _x , NO, NO ₂
Instrument manufacturer:	FIDAS 200 NO _x – Thermo 42i
Calibration procedure and frequency:	2-weekly manual calibration
Site service arrangements:	6-monthly service by air monitors
Co-located passive sampler	Triplicate NO ₂ tubes installed

Appendix F – Example Co-location Data Orthogonal Regression Analysis



Appendix G – Air Pollution reports from the AQ Mesh sensors

Fife Bonnygate

01/01/2018 to 31/12/2018

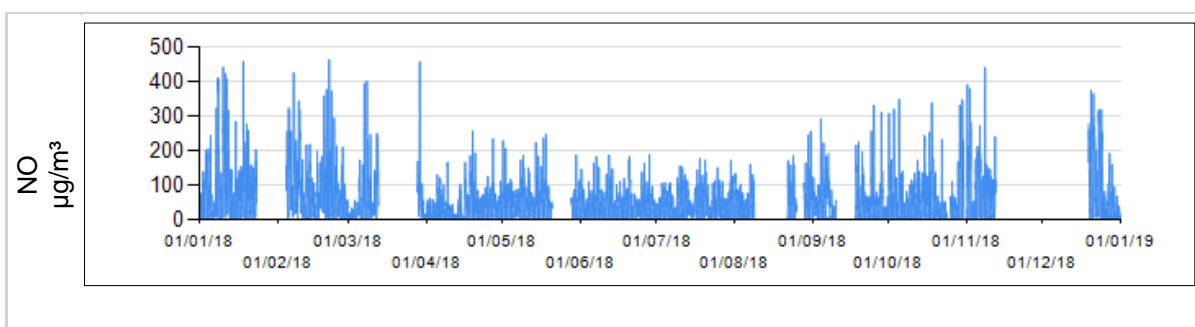
Ad-hoc monitoring job with AQMesh.

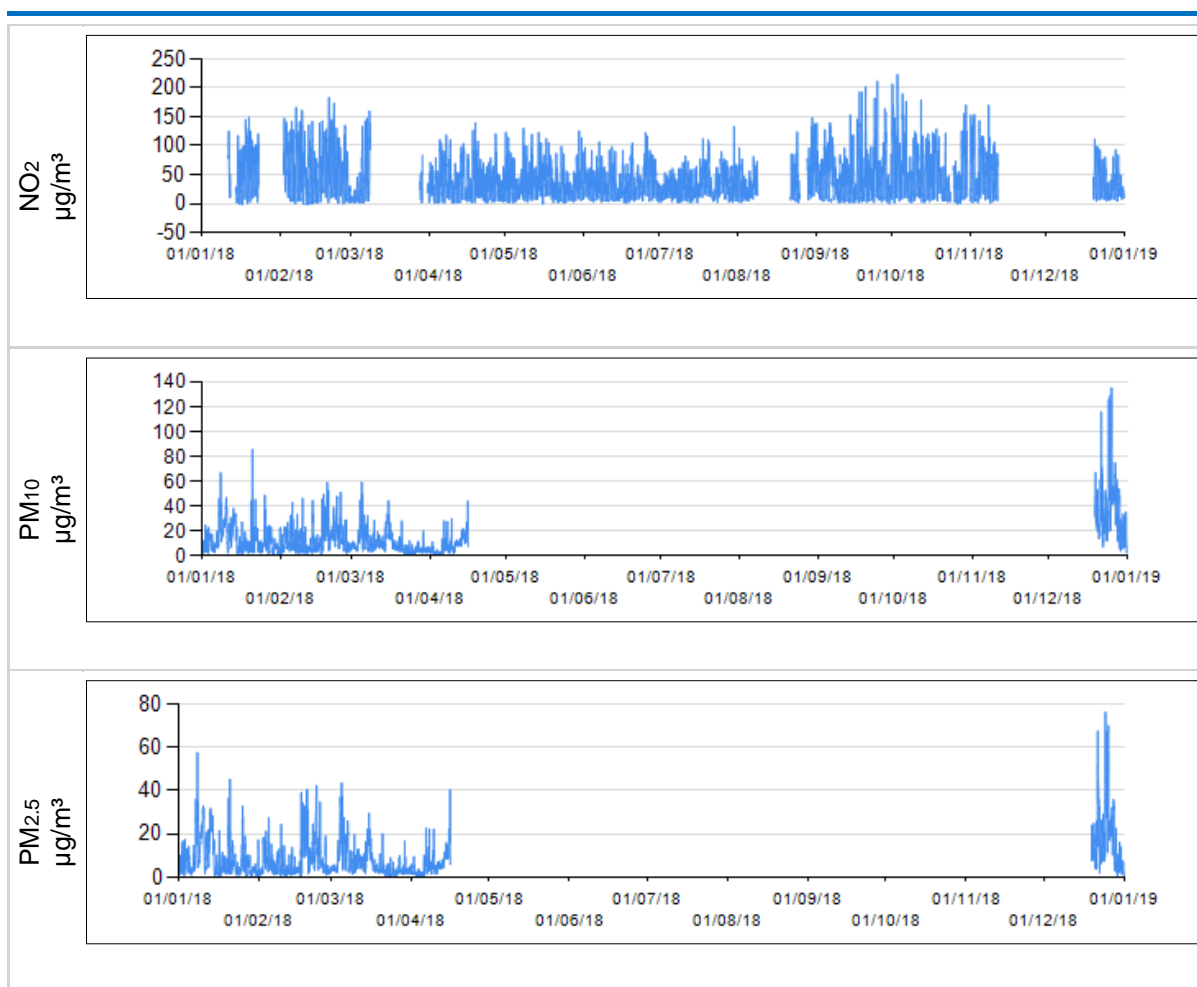
These data have been fully ratified

	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 ($\mu\text{g}/\text{m}^3$)	0	0	0	0	463	181	328	185	54	73.2
NO₂ ($\mu\text{g}/\text{m}^3$)	0	0	4	269	223	84	139	86	39	72.4
PM₁₀ ($\mu\text{g}/\text{m}^3$)	0	0	1	116	135	75	96	76	13	32.2
PM_{2.5} ($\mu\text{g}/\text{m}^3$)	0	0	1	116	76	42	53	42	8	32.2

	Air Quality Objective	Exceedances	Days
NO₂	Hourly mean > 200 $\mu\text{g}/\text{m}^3$	4	4
NO₂	Period mean > annual mean obj 40 $\mu\text{g}/\text{m}^3$	No	
PM₁₀	Daily mean > 50 $\mu\text{g}/\text{m}^3$	1	1
PM₁₀	Period mean > annual mean obj 40 $\mu\text{g}/\text{m}^3$	No	
PM_{2.5}	Period mean > annual mean obj 10 $\mu\text{g}/\text{m}^3$ (Scotland)	No	
PM_{2.5}	Period mean > annual mean obj 20 $\mu\text{g}/\text{m}^3$ (EU)	No	
PM_{2.5}	Period mean > annual mean obj 25 $\mu\text{g}/\text{m}^3$ (UK)	No	

Note: When comparing site measurements against the air quality objectives data capture should meet or exceed 90% across a calendar year.





Fife Appin Crescent West

01/01/2018 to 31/12/2018

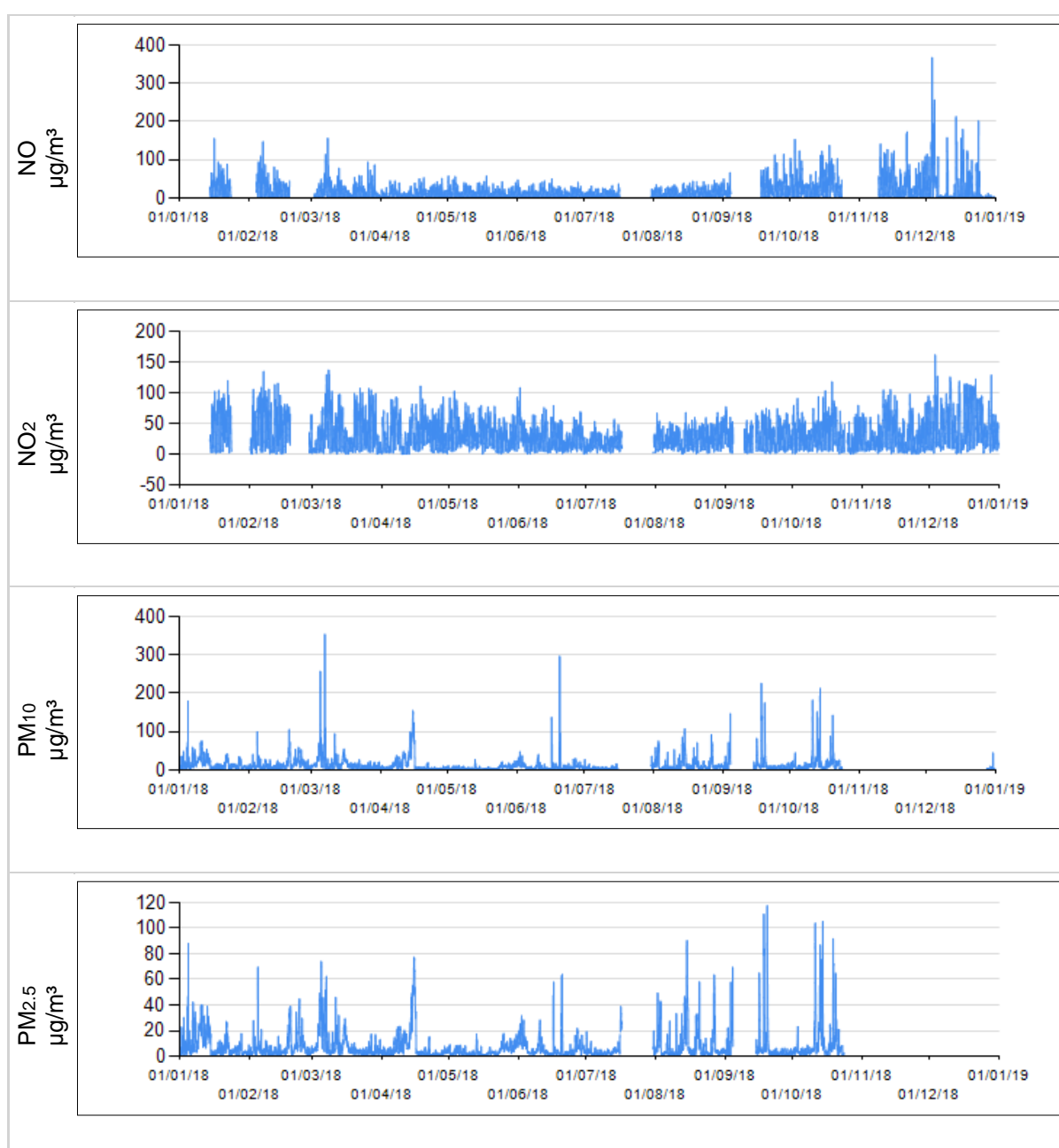
Ad-hoc monitoring job with AQMesh.

These data have been fully ratified

	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	367	107	183	114	18	78.1
NO ₂ (µg/m ³)	0	0	0	320	162	70	106	71	31	85.8
PM ₁₀ (µg/m ³)	1	0	6	265	353	116	140	117	13	75.0
PM _{2.5} (µg/m ³)	0	1	3	266	118	59	78	60	8	74.2

	Air Quality Objective	Exceedances	Days
NO₂	Hourly mean > 200 $\mu\text{g}/\text{m}^3$	None	0
NO₂	Period mean > annual mean obj 40 $\mu\text{g}/\text{m}^3$	No	
PM₁₀	Daily mean > 50 $\mu\text{g}/\text{m}^3$	7	7
PM₁₀	Period mean > annual mean obj 40 $\mu\text{g}/\text{m}^3$	No	
PM_{2.5}	Period mean > annual mean obj 10 $\mu\text{g}/\text{m}^3$ (Scotland)	No	
PM_{2.5}	Period mean > annual mean obj 20 $\mu\text{g}/\text{m}^3$ (EU)	No	
PM_{2.5}	Period mean > annual mean obj 25 $\mu\text{g}/\text{m}^3$ (UK)	No	

Note: When comparing site measurements against the air quality objectives data capture should meet or exceed 90% across a calendar year.



Fife Appin Crescent East**01/01/2018 to 31/12/2018**

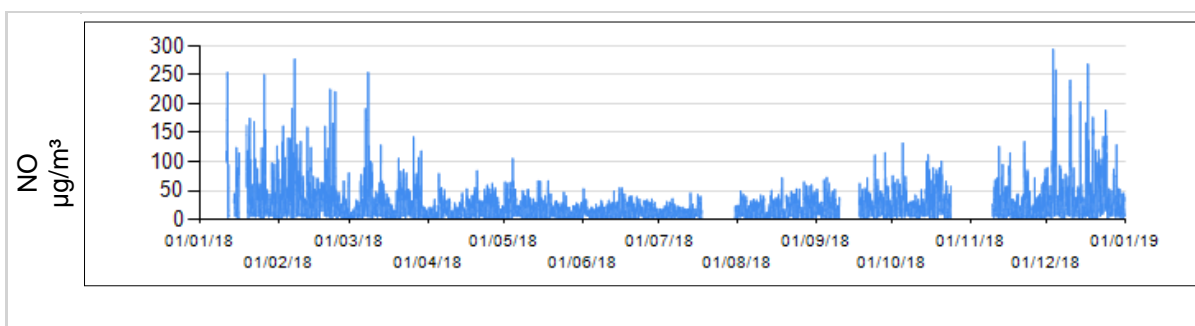
Ad-hoc monitoring job with AQMesh.

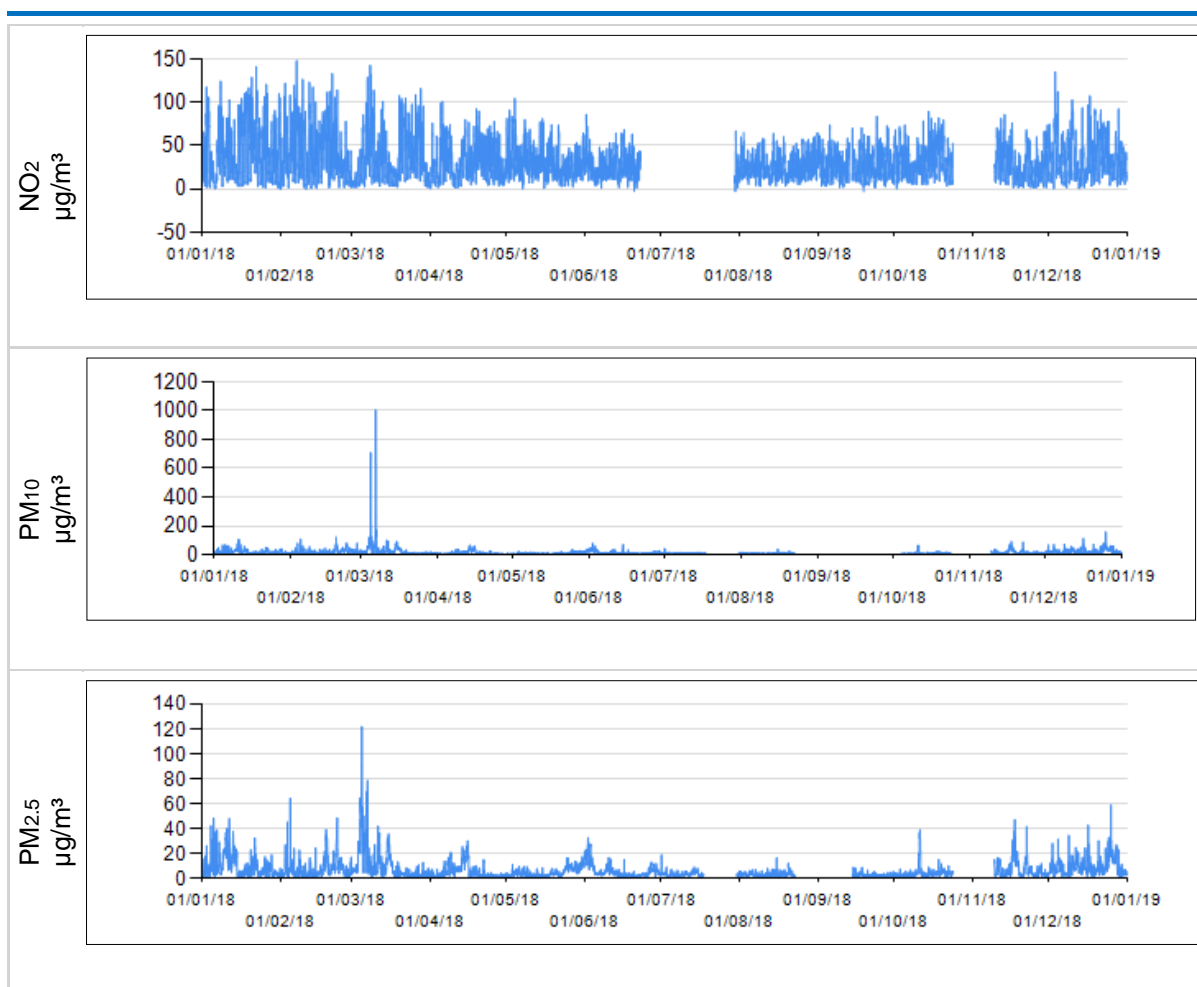
These data have been fully ratified

	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 ($\mu\text{g}/\text{m}^3$)	0	0	0	0	295	100	175	101	24	85.4
NO₂ ($\mu\text{g}/\text{m}^3$)	0	0	0	313	148	68	109	72	31	84.6
PM₁₀ ($\mu\text{g}/\text{m}^3$)	2	1	3	287	1005	115	276	155	15	80.4
PM_{2.5} ($\mu\text{g}/\text{m}^3$)	0	0	2	309	122	47	77	59	6	85.5

	Air Quality Objective	Exceedances	Days
NO₂	Hourly mean > 200 $\mu\text{g}/\text{m}^3$	None	0
NO₂	Period mean > annual mean obj 40 $\mu\text{g}/\text{m}^3$	No	
PM₁₀	Daily mean > 50 $\mu\text{g}/\text{m}^3$	6	6
PM₁₀	Period mean > annual mean obj 40 $\mu\text{g}/\text{m}^3$	No	
PM_{2.5}	Period mean > annual mean obj 10 $\mu\text{g}/\text{m}^3$ (Scotland)	No	
PM_{2.5}	Period mean > annual mean obj 20 $\mu\text{g}/\text{m}^3$ (EU)	No	
PM_{2.5}	Period mean > annual mean obj 25 $\mu\text{g}/\text{m}^3$ (UK)	No	

Note: When comparing site measurements against the air quality objectives data capture should meet or exceed 90% across a calendar year.





Fife Cupar

01/01/2018 to 31/12/2018

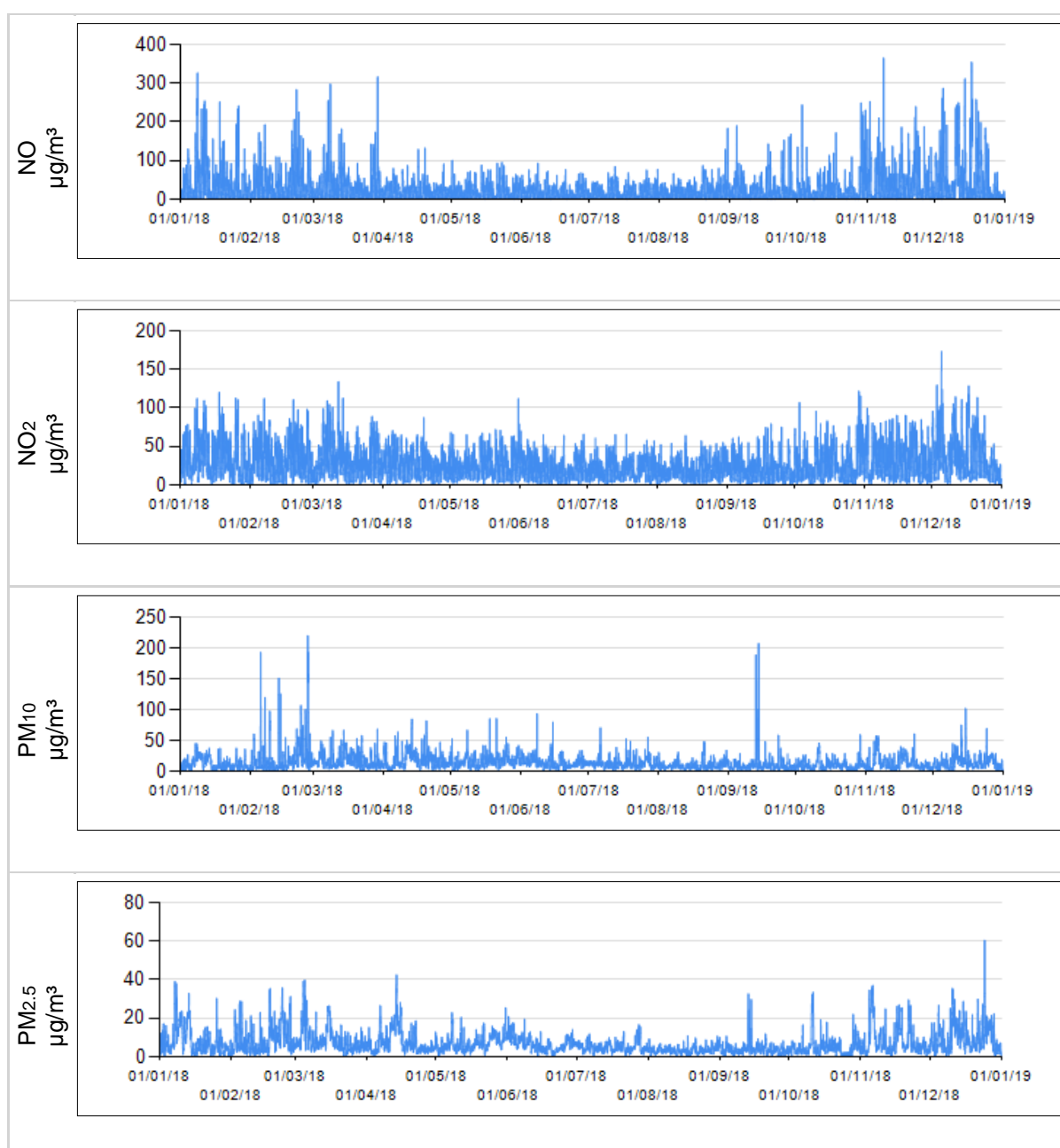
Note: These data are provisional

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/m ³)	0	0	0	0	365	126	227	137	26	99.8
NO ₂ (µg/m ³)	0	0	0	365	173	74	111	74	26	99.5
PM ₁₀ (µg/m ³)	0	0	1	364	220	61	149	62	14	99.8
PM _{2.5} (µg/m ³)	0	0	0	365	60	27	35	31	7	99.8

	Air Quality Objective	Exceedances	Days
NO₂	Hourly mean > 200 µg/m ³	None	0
NO₂	Period mean > annual mean obj 40 µg/m ³	No	
PM₁₀	Daily mean > 50 µg/m ³	1	1
PM₁₀	Period mean > annual mean obj 40 µg/m ³	No	
PM_{2.5}	Period mean > annual mean obj 10 µg/m ³ (Scotland)	No	
PM_{2.5}	Period mean > annual mean obj 20 µg/m ³ (EU)	No	
PM_{2.5}	Period mean > annual mean obj 25 µg/m ³ (UK)	No	

Note: When comparing site measurements against the air quality objectives data capture should meet or exceed 90% across a calendar year.



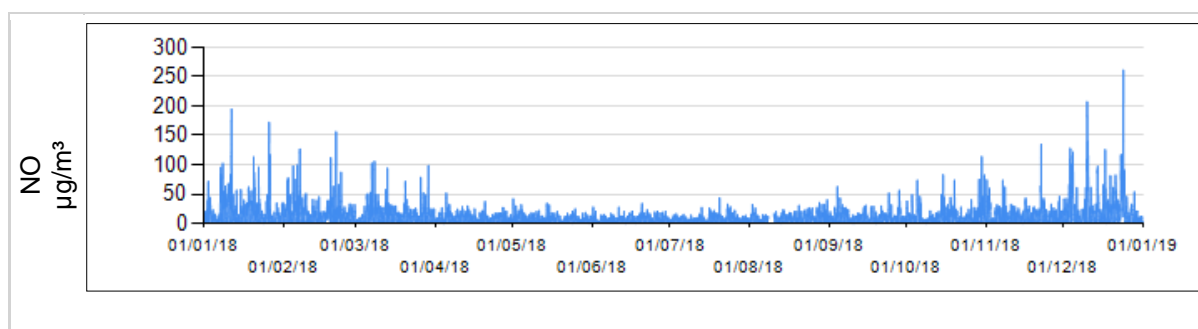
Fife Dunfermline
01/01/2018 to 31/12/2018

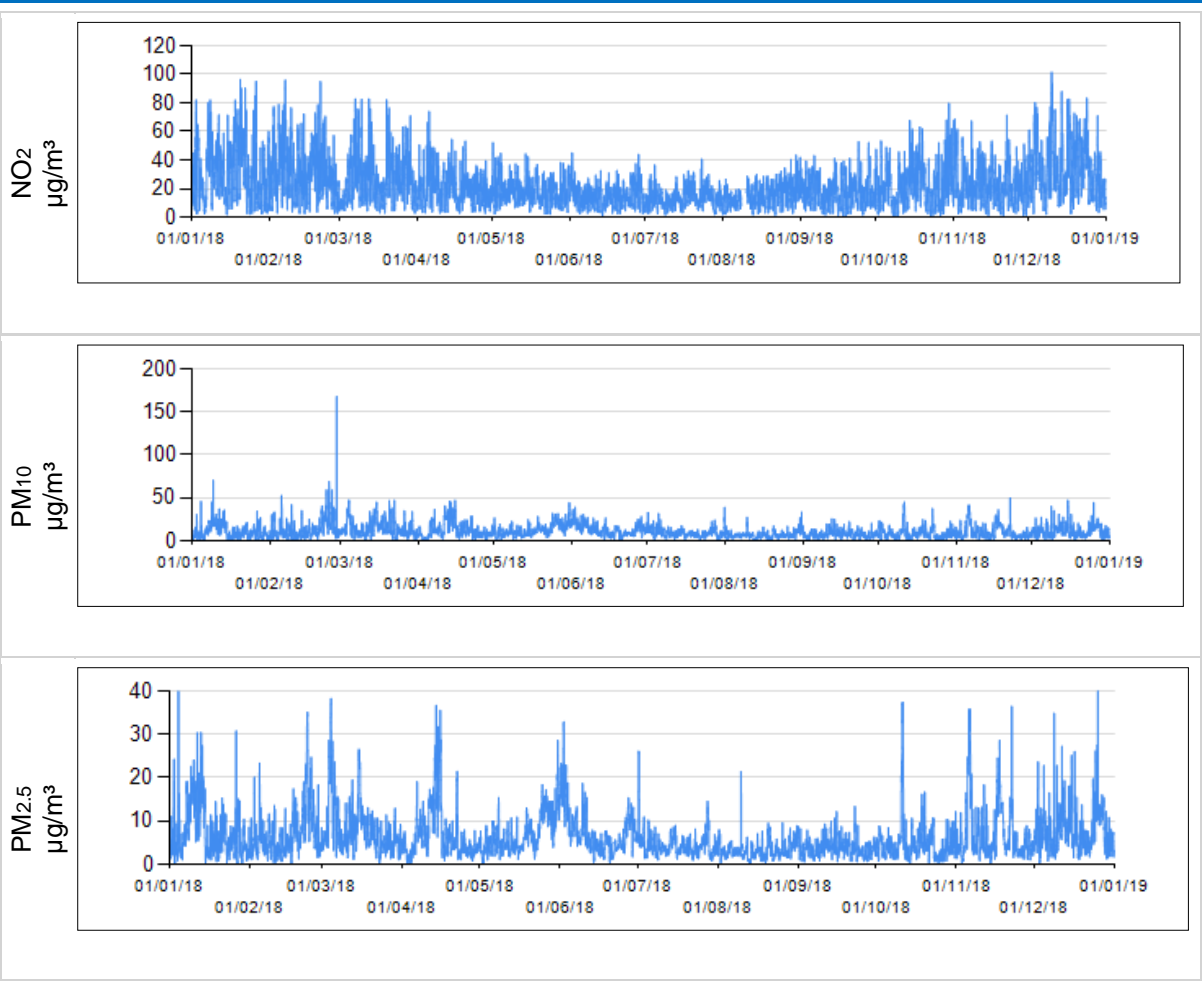
These data have been fully ratified
Correction Factor for Gravimetric Equivalence applied

	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 ($\mu\text{g}/\text{m}^3$)	0	0	0	0	261	74	145	84	11	99.3
NO₂ ($\mu\text{g}/\text{m}^3$)	0	0	0	364	101	62	88	64	22	99.3
PM₁₀ ($\mu\text{g}/\text{m}^3$)	0	0	0	365	168	33	48	35	11	99.7
PM_{2.5} ($\mu\text{g}/\text{m}^3$)	0	0	0	365	40	25	35	29	6	99.7

	Air Quality Objective	Exceedances	Days
NO₂	Hourly mean > 200 $\mu\text{g}/\text{m}^3$	None	0
NO₂	Period mean > annual mean obj 40 $\mu\text{g}/\text{m}^3$	No	
PM₁₀	Daily mean > 50 $\mu\text{g}/\text{m}^3$	None	0
PM₁₀	Period mean > annual mean obj 40 $\mu\text{g}/\text{m}^3$	No	
PM_{2.5}	Period mean > annual mean obj 10 $\mu\text{g}/\text{m}^3$ (Scotland)	No	
PM_{2.5}	Period mean > annual mean obj 20 $\mu\text{g}/\text{m}^3$ (EU)	No	
PM_{2.5}	Period mean > annual mean obj 25 $\mu\text{g}/\text{m}^3$ (UK)	No	

Note: When comparing site measurements against the air quality objectives data capture should meet or exceed 90% across a calendar year.





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
AQS	Air Quality Strategy
AURN	Automatic Urban and Rural Network (UK air quality monitoring network)
CO	Carbon Monoxide
Defra	Department for Environment, Food and Rural Affairs
DMRB	Design Manual for Roads and Bridges – Air Quality screening tool produced by Highways England
FMDS	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 2.5 µm or less
QA/QC	Quality Assurance and Quality Control
SO ₂	Sulphur Dioxide



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