Fife Air Quality Annual Progress Report 2016

Fife Council

Report for Kenny Bisset
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Executive summary

Air Quality in Fife

The Annual Progress Report utilises monitoring data collected throughout 2015. Fife Council carry out monitoring of nitrogen dioxide (NO_2) at 4 automatic stations in Cupar, Kirkcaldy, Dunfermline and Rosyth. Non automatic monitoring of NO_2 was carried out using diffusion tubes at 48 sites in 2015.

The concentrations measured in 2015, following bias adjustment, were compared against the Air Quality Strategy (AQS) annual mean objective of 40 ug m^{-3} for NO_2. Exceedances of the Annual mean objective were evident at the following sites:

- Appin Crescent (2), Dunfermline (40 µg m^{-3})
- Appin Crescent (6), (A), (B), (C), Dunfermline (43 µg m^{-3})

The marginal exceedances measured are within the current Appin Crescent, Dunfermline Air Quality Management Area (AQMA). The Air Quality Action Plan (AQAP) for Appin Crescent presents actions that will be implemented to address these exceedances.

Particulate matter (PM_{10}) is measured at the four automatic sites within Fife at Cupar, Dunfermline, Kirkcaldy and Rosyth. In 2015 the concentrations measured were below the PM_{10} annual mean objective of 18 ug m^{-3} at all sites.

$PM_{2.5}$ is measured at the Admiralty Road, Rosyth air quality site starting July 2015. As the monitoring commenced in the latter half of 2015, results have been annualised in accordance with TG16 and are presented in Appendix A. The AQS annual mean objective from $PM_{2.5}$ came into force on 1st April 2016; the annual mean objective set is 10 ug m^{-3}. During 2015 the annual mean for $PM_{2.5}$ at Rosyth was 7 ug m^{-3}.

The review of all available data relating to carbon monoxide (CO), sulphur dioxide (SO_2) and benzene monitoring during 2015 indicates that it is unlikely that any AQS objectives relating to these pollutants were exceeded during 2015. The review of all other local developments has not identified any locations where there may be a risk of the air quality objectives being exceeded and so no additional air quality assessment is recommended at this time.

There are currently two AQMAs for NO_2 and PM_{10} located within the Fife Council boundary, these are:

- Bonnygate, Cupar, declared in October 2008
- Appin Crescent, Dunfermline, declared in November 2011 for NO_2 and November 2012 for PM_{10}.

The AQAP for the Bonnygate, Cupar AQMA was last updated in 2015 and has been successful in reducing both NO_2 and PM_{10} concentrations within the Bonnygate area. The reductions have principally been a result of the traffic signalling and road layout improvements carried out during 2009. No exceedances of the NO_2 or PM_{10} AQS objectives were measured within the Bonnygate AQMA during 2015, however it was noted that NO_2 concentrations had slightly increased since 2014 but still remained well within the AQS annual mean objective of 40 µg m^{-3}.

The AQAP for Appin Crescent, Dunfermline was last updated in 2015. The AQAP aims to reduce NO_2 and PM_{10} concentrations within Appin Crescent. Initially an AQMA was declared in October 2011 for NO_2 only, however this was amended in August 2012 to include PM_{10}. In 2015, two diffusion tube locations in Appin Crescent were found to be marginally exceeding the NO_2 annual mean objective. The annual mean NO_2 concentration at the automatic monitoring site in Appin Crescent during 2015 was 25µg m^{-3}.

PM_{10} concentrations at the automatic monitor in Appin Crescent had remained constant between 2012 and 2014 at 15 µg m^{-3}, however during 2015 the annual mean concentration increased slightly to 16 µg m^{-3}. Using the Bonnygate AQAP as a template, it is hoped that the Appin Crescent AQAP will achieve similar improvements in air quality.

Additional work carried out by Fife Council to improve air quality in its area has included the production of an Air Quality Strategy and a review and update of their Air Quality Action Plans for both Appin Crescent, Dunfermline and Bonnygate, Cupar. The Air Quality Strategy 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.

Fife Council has a duty to keep their action plans up to date (LAQM.PG(S) 16). The obligation to keep air quality action plans up to date provides the opportunity for local authorities to periodically review the progress that has been made in implementing the air quality action plan, and assess the significance of improvements in air quality that have been observed since the adoption of the plan. Furthermore, where appropriate, the review and update of the action plan provides the opportunity for the local authority to identify new or additional measures to help to work towards attainment of the air quality objectives. The updated action plans have been published and have incorporated further measures that will carried out in order to improve air quality within the designated AQMA's.

Following the review of all available 2015 data, it is recommended that Fife Council carry out the following actions:

1. Submit the next Air Quality Progress Report in June 2017.
2. Maintain and enhance (where appropriate) the current monitoring programme.
3. Implement updated AQAP's for both Appin Crescent, Dunfermline and Bonnygate, Cupar.

Actions to Improve Air Quality

Measures outlined in the AQAP for Bonnygate, Cupar and Appin Crescent, Dunfermline have been implemented to reduce NO_2 and PM_{10} concentrations. The installation of the traffic management system within Cupar has been implemented and is now completed. The traffic management system included a new pedestrian crossing linked at St Catherine Street. The twin mini roundabout system has been implemented at St Catherine Street/East Bridge to ease the flow of traffic through Cupar, reducing congestion.

In 2015 an air quality modelling assessment was conducted for the potential Cupar North Development Zone and Relief Road. The assessment aimed to quantify the potential air quality impact within the Bonnygate AQMA from future traffic associated with the Cupar North development zone. The conclusions of the report are that when compared with the future 2030 baseline, small improvements in NO_2 and PM_{10} concentrations are predicted with the completed development and the relief road in place in 2030. The executive summary for this report can be found in Appendix F of this report.

In 2015 Fife Council commissioned Ricardo Energy & Environment to conduct a modelling study for the Dunfermline Northern Link Road. This study will be used to inform future decision making on planning applications submitted for the proposed Dunfermline North development associated relief road.

Within the Appin Crescent AQMA, revised lane markings and signage were introduced in March 2013. These measures have resulted in a reduction in NO_2 concentrations on the south side of Appin Crescent.

Local Priorities and Challenges

Fife Council has obtained grant funding from the Scottish Government for 2016 – 2017. 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 Cupar and Dunfermline:

Bonnygate Cupar:

Fife Council will continue to implement the measures set out in the Bonnygate AQAP during 2016. Fife Council's priorities within the designated AQMA over the forthcoming year include:

- Continue to monitor the progress of the traffic signalling changes made to Bonnygate, Cupar.
- Continue the implementation of Fife Council's travel plan including encouraging walking and cycling infrastructure and initiatives
- Evaluate parking management within the Bonnygate AQMA.
- The Cupar Northern Link Road study will be used to inform decision making on planning applications submitted for the proposed development
- Fife ECO Stars scheme will continue to operate and encourage and promote 'clean fleet operators'
- Seek to install an automatic monitor for $PM_{2.5}$ in the Bonnygate in 2016-17 as part of assessing the effectiveness of AQAP measures.

Appin Crescent, Dunfermline:

Fife Council will continue to implement the measures set out in the Appin Crescent AQAP during 2016. Fife Council's priorities within the designated AQMA over the forthcoming year include:

- Further feasibility studies are to be conducted to look at traffic signalling and parking restrictions within Appin Crescent.
- Continue the implementation of Fife Council's travel plan including encouraging walking and cycling infrastructure and initiatives
- Following the conclusion of the feasibility study for an Appin Crescent bypass, other traffic measures will be considered to achieve the same concentration reductions whist being more cost effectives, practicable and feasible.
- Seek to install an automatic monitor for $PM_{2.5}$ in Appin Crescent in 2016-17 as part of assessing the effectiveness of AQAP measures.

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 Council during 2015. 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 during 2015.

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

Since the 2nd round of Review and Assessment commenced the following reports have been submitted by Fife Council:

- Updating and Screening Assessment (2003)[1]
- Progress Report (2004)[2]
- Progress Report (2005)[3]
- Updating and Screening Assessment (2006)[4]
- Progress Report (2007)[5]
- Progress Report (2008)[6]
- Detailed Assessment (2009) Appin Crescent, Dunfermline [7]
- Detailed Assessment (2009) Admiralty Road, Rosyth [8]
- Further Assessment (2010) Bonnygate, Cupar [9]
- Progress Report (2010) [10]
- 2nd Detailed Assessment (2011) Appin Crescent, Dunfermline [11]
- Progress Report (2011)[12]
- Further Assessment (2012) Appin Crescent Dunfermline[13]
- Updating and Screening Assessment (2012)[14]
- 2nd Detailed Assessment for Admiralty Road, Rosyth, Fife (2012)[15]
- Detailed Assessment for Detailed Assessment for St Clair Street, Kirkcaldy, Fife (2012)[16]
- Fife Council, Bonnygate Air Quality Action Plan [17]
- Fife Council: Air Quality Action Plan for Appin Crescent, Dunfermline[18]
- Progress Report (2013)[19]
- Appin Crescent Traffic Management Options Appraisal: Scenario Modelling (Phase 2) [20]

[1] Air Quality Updating and Screening Assessment for Fife Council 2003. AEAT/ENV/R/1494. August 2003

[2] Air Quality Review and Assessment Progress Report for Fife Council 2004. AEAT/ENV/R/1678 Issue 2. July 2004

[3] Air Quality Review and Assessment Progress Report for Fife Council -2004/2005. AEAT/ENV/R/1955 Issue 2. Jun 2005

[4] Air Quality Updating and Screening Assessment for Fife Council 2006. AEAT/ENV/R/2237 Issue 2, July 2006

[5] Air Quality Review and Assessment Progress Report for Fife Council 2006/7. AEAT/ENV/R/2452 May 2007

[6] Air Quality Review and Assessment Progress Report for Fife Council 2007/8. AEAT/ENV/R/2597 March 2008

[7] Air Quality Detailed Assessment for Fife Council 2008: Appin Crescent, Dunfermline. AEAT/ENV/R/2705, January 2009

[8] Air Quality Detailed Assessment for Fife Council 2008: Admiralty Road, Rosyth, AEAT/ENV/R/2761, April 2009

[9] Air Quality Review and Assessment, Further Assessment, Bonnygate, Cupar 2010

[10] 2010 Air Quality Progress Report for Fife Council, AEAT/ENV/R/2977, July 2010

[11] Detailed Assessment of Air Quality: Appin Crescent, Dunfermline, AEA/ENV/R/3096 Issue 3, January 2011

[12] Air Quality Review and Assessment Progress Report for Fife Council 2011. AEA/ENV/R/3179 Issue 2. May 2011

[13] Air Quality Further Assessment (2012) Appin Crescent Dunfermline, AEA/R/ED56439. Issue 1, March 2012

[14] 2012 Air Quality Updating and Screening Assessment for Fife Council, AEAT/ENV/R/3293, July 2012

[15] Air Quality Detailed Assessment for Admiralty Road, Rosyth, Fife, AEAT/ENV/R/3321, September 2012

[16] Detailed Assessment of Air Quality 2011 Saint Clair Street, Kirkcaldy, Fife, AEA/ENV/R/3332

[17] Fife Council, Bonnygate Air Quality Action Plan, 2010, AEAT/ENV/R/ED05550006

[18] Fife Council: Air Quality Action Plan for Appin Crescent, Dunfermline, Fife, ED56439- Issue Number 1

[19] Air Quality Review and Assessment Progress Report for Fife Council 2011, Ricardo-AEA/R/3367/, Issue 2, July 2013

[20] The Appin Crescent Traffic Management Options Appraisal: Scenario modelling assessment (Phase 2), Ricardo-AEA/R/ED56439013, Issue 3, Jan 2014

- Cupar Streetscene Air Quality Modelling Assessment[21]
- Progress Report (2014)[22]
- Cupar North Development Zone and Relief Road: Air quality modelling assessment[23]
- Appin Crescent Traffic Management Options Appraisal (Phase 3) AQ Impact Assessment[24]
- Fife Council Appin Crescent Updated Air Quality Action Plan (AQAP) 2015[25]
- Fife Council Bonnygate Updated Air Quality Action Plan (AQAP) 2015[26]
- Fife Council Air Quality USA Report 2015[27]

The second round of Review and Assessment reports (2003 Updating and Screening Assessment (USA) and 2004 & 2005 Progress reports) concluded that the Air Quality Objectives for sulphur dioxide (SO_2), carbon monoxide (CO), 1,3-butadiene, benzene and lead are unlikely to be exceeded.

The 2003 USA identified that high NO_2 concentrations were recorded at kerbside locations in North Approach Road in Kincardine, Carnegie Drive in Dunfermline and Admiralty Road in Rosyth. As this was based on kerbside data it was recommended that further diffusion tube monitoring be undertaken at the façade of the buildings in order to improve the assessment of potential exposure.

The 2005 Progress Report recommended that automatic monitoring of NO_2 be undertaken at Admiralty Road, Rosyth and Bonnygate, Cupar. Additionally, it was recommended that automatic monitoring continue at North Approach Road, Kincardine. PM_{10} monitoring also commenced at Admiralty Road, Rosyth and Bonnygate, Cupar.

The 2006 USA recommended that monitoring of NO_2 and PM_{10} continue at Bonnygate, Cupar and recommence at Admiralty Road, Rosyth to better assess concentrations of each pollutant. Automatic monitoring of NO_2 was discontinued at North Approach Road, Kincardine in May 2007 as the relevant Air Quality Objectives were met at this location. As a result of a new bridge crossing and northern bypass road further reductions of NO_2 have been realised at this location.

Monitoring data for 2006 and 2007 (automatic and diffusion tubes) indicated that it was likely the NO_2 and PM_{10} Air Quality Objectives would not be met in Bonnygate, Cupar. The 2007 Progress Report concluded that a Detailed Assessment should be carried out at this location. Additionally, the 2008 Progress Report concluded that a Detailed Assessment should be carried out for Appin Crescent, Dunfermline (NO_2) and Admiralty Road, Rosyth (PM_{10}).

The Detailed Assessment (2007/2008) for Bonnygate, Cupar considered NO_2 and PM_{10}. The report concluded that an AQMA should be declared for both NO_2 and PM_{10}. The Detailed Assessment (2008) for Appin Crescent, Dunfermline advised that increased monitoring of NO_2 should be carried out to enable improved characterisation of ambient NO_2 concentrations before any further decisions are made. The Detailed Assessment (2009) for Admiralty Road, Rosyth considered PM_{10} concentrations in the area and concluded that no further action was required.

The Further Assessment (2010) for Bonnygate, Cupar concluded that the AQMA was still required and that its boundary was appropriate (see Figure 2.1). The source apportionment found that heavy and light goods vehicles contributed broadly similar oxides of nitrogen (NOx) emissions and that action planning should therefore focus on both vehicle types. An Air Quality Action Plan has been implemented for Bonnygate, Cupar by Fife Council. Progress on measures contained within the Bonnygate, Cupar Air Quality Action Plan are reported in Section 2.2.

[21] Cupar Streetscene Air quality modelling assessment, Ricardo-AEA/R/ED56439014, Issue 3, March 2014

[22] Air Quality Review and Assessment Progress Report for Fife Council 2014, Ricardo-AEA/ENV/PR2014, May 2014

[23] Cupar North Development Zone And Relief Road: Air Quality Modelling Assessment, Ricardo-AEA/R/ED56439015 Issue Number 2, February 2015

[24] Appin Crescent Traffic Management Options Appraisal (Phase 3) Air Quality Impact Assessment, ED56439019- Issue Number 1, February 2015

[25] Fife Council Appin Crescent Updated AQAP, 2015, ED56439, Version 3, April 2015

[26] Fife Council Bonnygate Updated AQAP, 2015, ED56439, Version 2, April 2015

[27] Fife Council Air Quality USA Report, 2015, ED60521- Version 3, Issue 2, August 2015

The 2010 Progress report concluded that for NO_2 and PM_{10} monitoring, no further action was required over and above that already in progress by Fife Council. It was concluded that if NO_2 concentrations within the Appin Crescent area exceed the annual mean objective when 12 months diffusion tube data was available then Fife Council should proceed immediately to a Detailed Assessment.

At the end of 2010, a Detailed Assessment was carried out at Appin Crescent, Dunfermline. This Detailed Assessment considered NO_2 concentrations and concluded that Fife Council should consider declaring an Air Quality Management Area (AQMA) at Appin Crescent. Fife Council should therefore proceed with a Further Assessment and work towards preparing an Air Quality Action Plan. Due to the NO_2 concentrations measured at Appin Crescent the Detailed Assessment recommended that automatic measurement of PM_{10} should be carried out.

The 2011 Progress Report concluded that monitoring of NO_2 at the three automatic sites in Fife showed that concentrations at Appin Crescent, Dunfermline; Bonnygate, Cupar and Admiralty Road, Rosyth, were below the annual mean objective. However, NO_2 and PM_{10} concentrations have increased since 2009 in Admiralty Road. Fife Council concluded that to further investigate NO_2 concentrations, diffusion tube monitoring should be increased incorporating more locations of relevant exposure to the general public. If measured concentrations of NO_2 exceed the annual mean objective after 12 months from sites of relevant exposure, then in accordance with the Technical Guidance LAQM. TG (09), Fife Council should proceed with a Detailed Assessment for Admiralty Road.

Local bias adjusted diffusion tube data at 3 locations within Fife exceeded the NO_2 annual mean objective of 40 µg m^{-3} in 2010. These locations were: Appin Crescent, Dunfermline; Admiralty Road, Rosyth; St Clair Street, Kirkcaldy.

For 2010, all diffusion tubes sites (2,3,5 and 6) within Appin Crescent that exceeded the objective were located on the south side of Appin Crescent between Park Lane and Couston Street. Diffusion tubes within this area have consistently shown elevated concentrations contrary to those seen at the automatic monitoring site. Data from the 2011 Progress Report supported the conclusion made in the 2011 Detailed Assessment for Appin Crescent. It is concluded that Fife Council should consider declaring an AQMA at Appin Crescent, encompassing as a minimum all residential properties which lie between Park Lane and Couston Street. It also concluded that Fife Council should consider declaring an area larger than that stated to account for any uncertainties in monitoring and modelling carried out. Figure 2.2 shows the AQMA boundary encompassing residential properties located on Appin Crescent, Dunfermline.

For 2010, diffusion tube data at Bonnygate Cupar did not exceed the 40µg m^{-3} objective when using the locally derived bias adjustment factor (0.71). However, when using the National derived bias adjustment factor (0.78) concentrations at one Bonnygate location exceeded the objective with a borderline concentration of 41 µg m^{-3}. Data showed that NO_2 diffusion tube concentrations have reduced since the introduction of traffic management measures in 2009. In 2008 Fife Council declared Bonnygate, Cupar as an AQMA for NO_2 and PM_{10} and has since adopted an Air Quality Action Plan in 2010 to address the air quality issues. St Clair Street, Kirkcaldy diffusion tubes sites (1 and 2) have consistently measured concentrations around the 40 µg m^{-3} objective, with concentrations exceeding the objective in 2008 and 2010. As a result of this, Fife Council have installed an automatic monitoring station (monitoring NO_2 and PM_{10}) at St Clair Street to further investigate concentrations in this area, which commenced in February 2011.

PM_{10} data collected for 2010 showed that both the Bonnygate and Admiralty Road sites exceeded the annual mean objective with concentrations of 19 µg m^{-3}. Bonnygate Cupar has been declared an AQMA for PM_{10} since 2008 and an Action Plan has been adopted since 2010. Figure 2.1 shows the AQMA boundary encompassing Cupar Town Centre.

It was concluded that Fife Council should continue monitoring PM_{10} at Admiralty Road for another year before moving on to a Detailed Assessment. This conclusion was reached due to:

- The annual concentration (19 µg m^{-3}) being a borderline exceedance of the objective.
- 2010 being the first year concentrations exceeded the objective in the area.

• Unusual weather conditions for the year may have contributed to the increase in concentrations.

Results for SO_2 monitoring in Fife in 2010 indicated that AQS objectives for SO_2 were unlikely to be exceeded. There were no new industrial processes, road or other developments that required detailed assessment with respect to this pollutant. Hence, new information in 2009 confirmed the conclusion of previous reports that a Detailed Assessment is not required for SO_2.

Previous Review and Assessment reports have concluded that concentrations of lead, 1,3-butadiene and benzene are well below their respective objective at all locations in Fife. There has been no change in sources of these pollutants so they are not considered further in this report.

The Further Assessment (2012) for Appin Crescent concluded that there were continued current exceedances of the NO_2 annual mean objective in Appin Crescent, Dunfermline. The spatial extent of the exceedances remained quite small and the current AQMA boundary was adequate for NO_2 (Figure 2.2). The assessment also indicated that were are exceedances of the Scottish annual mean PM_{10} objective within the Appin Crescent AQMA and as this pollutant is not currently included in the AQMA order for the location, it was recommended that the order is amended accordingly. The results of the source apportionment indicated that for PM_{10}, existing background concentrations are thought to be predominant in the overall concentrations at all locations in Appin Crescent. For NOx/NO_2 the contribution from road traffic is dominant overall. The contribution from moving and queuing vehicles was also assessed: the contribution from moving traffic is thought to predominate between the two, although emissions from queuing vehicles are also important, though perhaps more so for NOx than PM_{10}. Of the vehicle classes assessed, cars and HGVs are the most significant sources of vehicular NOx, whilst cars and LGVs have been identified as the most significant sources of vehicular PM_{10}. Buses are also an important source of both pollutants.

An AQAP has been implemented for Appin Crescent, Dunfermline by Fife Council. The report on the finalised AQAP was approved in May 2013 and progress on the implemented measures are reported in Section 2.2.

The Updating and Screening Assessment (2012) concluded that no further action is required with respect to pollutants carbon Monoxide, benzene, 1,3-butadiene, lead and sulphur dioxide. The assessment also indicated that the 2011 nitrogen dioxide (NO_2) and particulate matter (PM_{10}) monitoring data supports the requirement for Air Quality Management Areas in Bonnygate, Cupar and Appin Crescent, Dunfermline due to exceedances of the annual mean objectives for both pollutants. PM_{10} concentrations at Admiralty Road, Rosyth have increased above the annual mean objective of 18 µg m^{-3} and it was therefore recommended that Fife Council carry out a further Detailed Assessment to assess PM_{10} concentrations in the area. The Cupar 2011 monitoring data indicated an overall downward trend in NO_2 concentrations since the introduction of the traffic queue relocation system in the Bonnygate. PM_{10} concentrations had also decreased relative to 2007 PM_{10} levels and the exceedance is currently marginal.

The annual mean NO_2 objective of 40 µg m^{-3} was exceeded at 6 diffusion tube sites located in three areas of Fife (Appin Crescent, Dunfermline, St Clair Street, Kirkcaldy and Bonnygate Cupar) during 2011. All 6 diffusion tube sites are considered to be locations of relevant exposure. Both Appin Crescent, Dunfermline and Bonnygate, Cupar are included within existing Air Quality Management Areas (AQMAs). St Clair Street, Kirkcaldy is not currently included within any existing AQMAs and it is therefore recommended that Fife Council carry out a Detailed Assessment for nitrogen dioxide in the area of St Clair Street, Kirkcaldy.

The Detailed Assessment of St Clair Street, Kirkcaldy (2012) was undertaken to investigate the potential scale and extent of exceedances of Air Quality Objectives in the study area. The modelling study, which used the most recent traffic data, NO_2 measurements and meteorological data indicated that it was unlikely that exceedances of the NO_2 annual mean objective had occurred at locations with relevant exposure in 2011. The annual mean objective exceedances occurred at ground level locations within the study area close to main junctions on St Clair Street where traffic congestion is known to occur. These are not however locations of relevant exposure as the properties are used for commercial purposes. NO_2 concentrations in excess of the annual mean objective were not observed and are not occurring where ground level or first floor residential properties are present within the

study area. In light of this Detailed Assessment of Air Quality, Fife Council is not required to declare an Air Quality Management Area at this time. It was recommended that Fife Council continue to monitor NO_2 and PM_{10} concentrations at this location and may wish to locate diffusion tube monitoring sites closer to the locations where ground floor residential properties are present on St Clair Street.

The Detailed Assessment of Admiralty Road, Rosyth, Fife (2012) was undertaken to investigate the potential scale and extent of exceedances of Air Quality Objectives in the study area. Dispersion modelling indicates that exceedances of the PM_{10} annual mean objective of 18 µg m^{-3} may have occurred at two receptors. It is also likely that the annual mean objective has been equalled at a further 41 receptors throughout the study area. However, the modelling also indicates that the daily mean objective has not been exceeded at any location on Admiralty Road. In light of this Detailed Assessment it is recommended that Fife Council should consider either declaring an Air Quality Management Area (AQMA) for the PM_{10} annual mean objective, which should encompass the study area detailed in this report.

Fife Council currently monitors PM_{10} using a Tapered Element Oscillating Microbalance-Filter Dynamic Measurement System (TEOM-FDMS) at one location on Admiralty Road. An analysis of FDMS data from the UK Automatic and Urban Network (AURN) identified baseline offsets in some FDMS analysers. As a result of this study a baseline check of the Rosyth FDMS was carried out, which consisted of running particle-free air through the analyser for 3 days. The results from this check indicated that there may be a positive offset in the 2012 Rosyth FDMS data; and as a consequence measured PM_{10} concentrations might have been over-estimated. Furthermore, the offset may also exist in the 2011 data; however, this cannot be confirmed as a baseline check was not carried out during 2011. It was therefore recommended that Fife Council change the drier unit to the FDMS analyser at Admiralty Road and to defer any AQMA declaration for a further year following the FDMS drier change in order to confirm the exceedance of the PM_{10} annual mean objective. Following discussions with the Scottish Government, it was agreed that Fife Council should defer its decision as to whether or not to declare an AQMA at Admiralty Road, Rosyth until at least six months monitoring data is available using a new FDMS drier in PM_{10} monitoring equipment.

The 2013 Progress Report concluded that Fife Council should maintain its current monitoring programme and confirmed that Fife Council is not required to declare an AQMA at Admiralty Road, Rosyth at that time.

The Appin Crescent Traffic Management Options Appraisal: Scenario modelling assessment (2014) considered the possible effects that a change in traffic management will have on the NO_2 and PM_{10} concentrations in 2015. Using modelling software and monitoring data, the report explains the predicted outcomes of possible traffic management scenarios in Appin Crescent, Dunfermline. The report concludes that none of the proposed traffic management scenarios made a significant difference to concentrations of NO_2 and PM_{10} at locations of relevant exposure. Whilst outcomes of dispersion modelling of the proposed Appin Crescent bypass option reveal that this may reduce concentrations of NO_2 and PM_{10} on Appin Crescent to below the relevant air quality objectives, it is still considered prudent to explore other traffic management measures that may deliver more cost effective and feasible solutions to addressing air quality issues in Appin Crescent.

The Cupar Streetscene Dispersion Modelling Report 2014 used atmospheric dispersion modelling to assess the potential air quality impacts that proposed traffic management changes in Cupar may have on the NO_2 and PM_{10} concentrations in 2017. The report concludes that both modelled Design Options 1 (includes introduction of mini-roundabouts at the East Bridge/St Catherine Street junction as well as the East Bridge/East Burnside junctions on the A91) and 2 (includes reconfiguration of the junctions at East Bridge/St Catherine Street and East Bridge/East Burnside junctions on the A91) will lead to a general reduction in NO_2 and PM_{10} emissions when compared to the 2017 baseline. Based on modelling predictions Option 1 provides greater air quality benefits than Option 2 for the Bonnygate AQMA. Both of these options were implemented in 2014.

The 2014 Progress Report concluded that Fife Council should maintain its current monitoring programme and there was no requirement to declare any new AQMAs. It also identified the successful reduction of both NO_2 and PM_{10} concentrations below the objectives within the Bonnygate AQMA. It concluded that the reductions were principally a result of traffic signalling and road layout improvements.

The Cupar North Development Zone and Relief Road: Air Quality Modelling Assessment 2015 aimed to quantify the potential air quality impact within the Bonnygate AQMA of future traffic associated with the Cupar North development zone. Future air quality impacts were assessed assuming that completion of different zones of the development are phased over time up to 2030, and that completion of the relief road may not occur until all of the residential and commercial developments are completed in 2030. This approach was used as projected vehicle pollutant emission rates and background concentrations are available until 2030 only. The report concludes that the results for each approach are very similar and indicate that there will be no exceedances of the NO_2 annual mean objective at the receptor locations in any of the future years assessed. However when emissions from the additional traffic from the development rollout phases are included the results indicate that exceedances of the 18 µg m^{-3} Scottish PM_{10} annual mean objective will occur at the same receptor locations where exceedances are predicted for the future baseline years. These receptor locations are at 1st floor height within the Bonnygate. When compared with the future 2030 baseline, small improvements in NO_2 and PM_{10} concentrations are predicted with the completed development and the relief road in place in 2030. The report also recommends that when considering the cumulative impact of the development without the relief road in place, that air quality and potential mitigation measures to counteract the impact of the additional development traffic are considered in the planning process.

Appin Crescent Traffic Management Options Appraisal (Phase 3) Air Quality Impact Assessment (2015) investigated the potential impact of traffic management scenarios which aim to improve traffic flow though Appin Crescent and hence reduce vehicle emissions and improve local air quality. Using modelling software and monitoring data, the report explains the predicted outcomes of these scenarios in Appin Crescent, Dunfermline. The report concludes that Test Option 1 (Optimisation of Holyrood Place / Appin Crescent signals (also linked to Sinclair Gardens roundabout)) does not appear to provide any air quality benefits and may lead to an increase in annual mean NO_2 concentrations. Test Options 2 (Reconfigure Appin Crescent / Garvock Hill mini roundabout to signalised junction (right turn storage allowed but runs opposed)) and test option 3 (Removal of bus stops on Appin Crescent) will provide improvements in both NO_2 and PM_{10} concentrations but neither of these options offer the opportunity to reduce concentrations of NO_2 and PM_{10} on Appin Crescent to below the respective air quality objectives. Test Option 3 investigated the removal of the bus stops on Appin Crescent. The report suggests that a cost-benefit analysis of this option may be beneficial as it could be relatively inexpensive to implement and will provide improvements in NO_2 and PM_{10} concentrations.

1.1.2 2015 Updating and Screening Assessment

The 2015 Updating and Screening Assessment assessed the monitoring data carried out in 2014. The review of all other local developments within the local authority did not identify any locations where there may be a risk of the air quality objectives being exceeded and so no additional air quality assessment was required.

The Air Quality Action Plan (AQAP) for the Bonnygate, Cupar AQMA has been successful in reducing both NO_2 and PM_{10} concentrations within the Bonnygate. The reductions have principally been a result of the traffic signalling and road layout improvements carried out during 2009. No exceedances of the NO_2 or PM_{10} AQS objectives were measured within the Bonnygate AQMA during 2014.
The Air Quality Action Plan for Appin Crescent, Dunfermline was finalised in May 2013 and aims to reduce NO_2 and PM_{10} concentrations within Appin Crescent. Initially an AQMA was declared in October 2011 for NO_2 only, however this was amended in August 2012 to include PM_{10}. In 2014 only 1 diffusion tube location in Appin Crescent was found to be marginally exceeding (40.3 µg m^{-3}) the annual mean objective. The annual mean NO_2 concentration at the automatic monitoring site in Appin Crescent was 27 µg m^{-3}.

1.1.3 Cost Benefit Analysis for Traffic Management Measures at the Appin Crescent AQMA Report 2016

The cost bene-fit analysis of traffic management measures for Appin Crescent[28] considered two traffic management options as follows:

1. Reconfiguration of the Appin Crescent/Garvock Hill mini roundabout
2. Removal of the bus stops on Appin Crescent.

In summary, this economic assessment supported the implementation of these two traffic options.

When assessed individually, either could deliver significant air pollutant and greenhouse gas (GHG) emission, fuel and travel time savings which outweigh the costs of the measures.

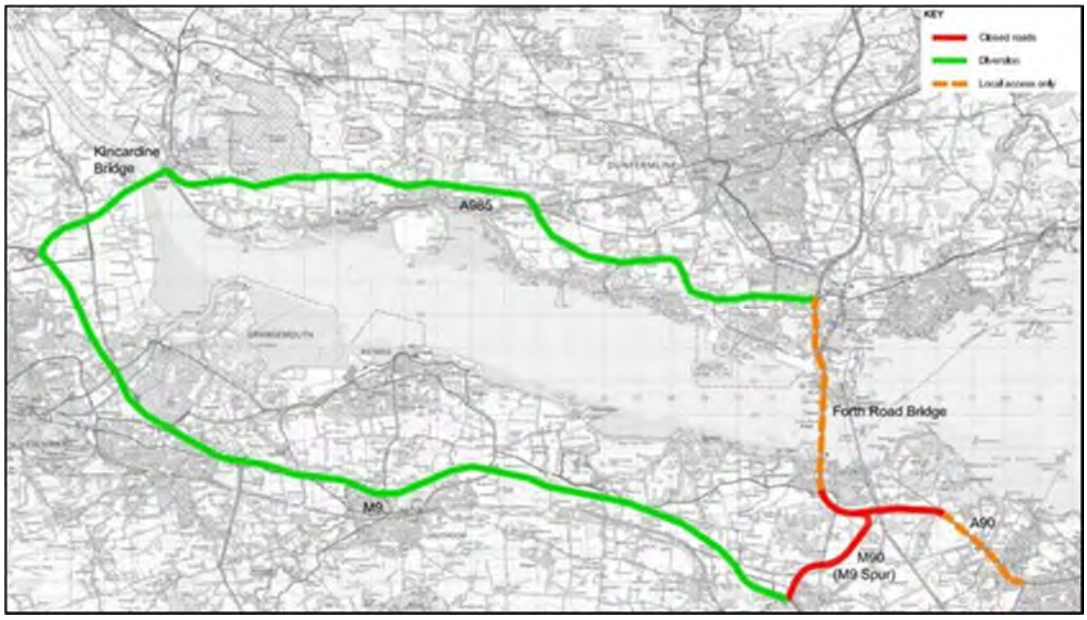
This is based on the assumptions and impacts covered in this assessment, and on the underlying emissions modelling.

These measures are currently being considered by the Council's Air Quality Steering Group in terms of their feasibility and acceptability to the local community.

1.1.4 Forth Road Bridge Closure Report 2016

Fife Council commissioned Forth Road Bridge Closure Report[29] to review and assess West Fife's automatic monitoring and diffusion tube data before, during and after the Forth Road Bridge closure from December 2015 to February 2016. In doing so, the report assesses if there was an impact on local air quality in West Fife caused by the bridge closure. The detour route map during the Forth Road Bridge closure is shown in Figure 1.1.

Figure 1.1 Map of detour route due to the Forth Road Bridge Closure



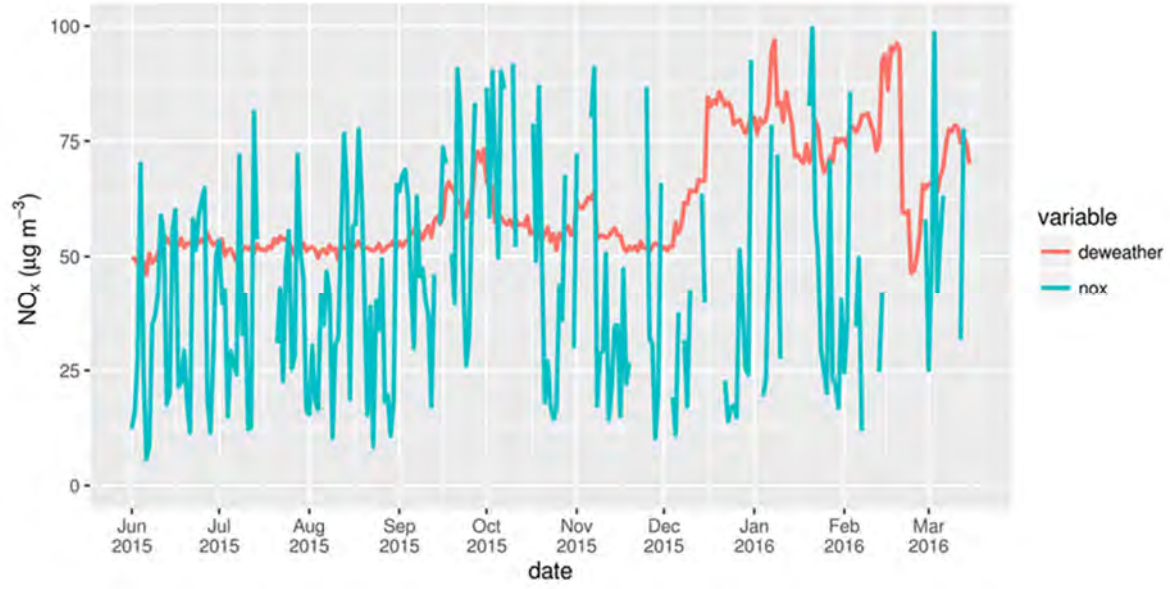
This report uses comparison plots of data from both automatic and non-automatic monitoring sites across Fife and the rest of the Scotland to assess the impact the closure had on the West Fife region. Additional analysis was also carried out using the Openair analysis tool. Pollutants considered within this report were NO_2, PM_{10} and $PM_{2.5}$.

[28] Cost- benefit analysis for traffic management measures at the Appin Crescent AQMA, January 2016, Ricardo Energy & Environment, ED60521, Issue Number 1.
[29] Forth Road Bridge Closure Air Quality Report, May 2016, Ricardo Energy & Environment, ED60521, Issue Number 1.

Analysis carried out for NO_2 (Automatic and Non-automatic), PM_{10} and $PM_{2.5}$ data during the bridge closure indicates that concentrations were comparable with historic data, other regional sites, and the average across the rest of the Scottish Air Quality database sites. This in turn shows that pollution concentrations were not significantly affected by the increase of traffic cause by the detouring of traffic through West Fife locations.

An explanation for these findings can be attributed to the wet and windy weather conditions experienced during the period in question. This is highlighted by the numerous named storms observed from December 2015 to February 2016. To identify how much of an effect the meteorology had on this monitoring period during the bridge closure automatic NOx data at Rosyth was modelled to show de-weathered adjusted NOx data, this is presented in Figure 1.2. The modelled NOx data provides evidence of increased concentrations over the bridge closure period at Rosyth however the exact timing of changes is difficult to identify due to limited data capture.

Figure 1.2 Daily average monitored NOx plotted against modelled de-weather adjusted daily NOx



1.1.5 Dunfermline Northern Link Road Modelling Study 2016

Fife Council commissioned Ricardo Energy & Environment to conduct the Dunfermline Northern Link Road Modelling study[30] in 2015-16. A number of zones within Dunfermline have been allocated for residential and other urban land use developments. The additional vehicle trips generated by these developments are likely to have an impact on road traffic emissions within the Appin Crescent AQMA. A measure that will likely help reduce traffic numbers and hence vehicle emissions in Appin Crescent is the construction of the Northern Link Road which will initially link Pilmuir Street and Whitefield Road in the area of Dunfermline to the North of Appin Crescent. Completion of the Northern link road will link Pilmur Street with the main road network at the east of Dunfermline. This will provide an alternative route for traffic that would otherwise use the Halbeath corridor and Appin Crescent to travel in and out of Dunfermline from the east.

The 2011 Dunfermline Strategic Land Allocation (SLA) Transport Assessment concluded that for effective operation of the road network, and in addition to a number of other upgrades to the road infrastructure, the link road will likely be required at some point between 2021 and 2029 depending on the rollout of residential and commercial developments in the SLA area. Comparison of the predicted pollutant concentrations for each scenario modelled indicate that neither the NO_2 or PM_{10} annual mean objectives are expected to be exceeded in 2029. Annual mean PM_{10} concentrations are still predicted to be close to the 18 µg m^{-3} objective in 2029 at the Appin Crescent 2 and Appin Crescent 3

[30] Dunfermline Northern Link Road: Air Quality assessment of potential impacts at the Appin Crescent AQMA, April 2016, Ricardo Energy & Environment, ED60521008, Issue Number 1.

receptor locations. The study area comprised of the Appin Crescent AQMA, the road links modelled are presented in Figure 1.3.

The findings of this study are to be incorporated with the Council's decision making process in terms of ensuring proposed new development does not compromise the achievement of statutory air quality objectives.

Figure 1.3 Northern Link Road Modelling Study Area

N

Key:

Road modelled

AQMA boundary

1.1.6 Bright Green Hydrogen / Levenmouth Community Energy Project

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[31], a collaborative initiative which is being 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 (up to 25 vehicles), some of which will be operated by Fife Council. The fleet includes 10 electric-powered Renault Kangoo vans with H_2 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 10 Ford Transit vehicles that are converted to run on a diesel and hydrogen mixture as well as two refuse collection vehicles (RCVs), as such, 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 businesses, allowing them to improve their green credentials by operating a vehicle that runs on green energy.

In early 2016, the importance of the Levenmouth development was recognised after the Scottish Government awarded £4million from its Local Energy Challenge Fund to help kick start the project while in May 2016, the scheme marked a major milestone after Fife Council awarded local company, Heil Farid, a contract worth around £1.5 million for the supply of nine RCVs, two of which are earmarked for the Levenmouth project. The project partners anticipate that the vehicles will start becoming available for lease in early 2016 and are also looking into the possibility of introducing other hydrogen powered vehicles.

Along with Bright Green Hydrogen, Fife Council and Toshiba, the partners behind the Levenmouth initiative also comprise Leven Valley Development Trust, Fife College, BOC (for hydrogen transport), Green Business Fife, Community Energy Scotland and the Scottish Hydrogen and Fuel Cell Association (SHFCA). For Toshiba, the scheme is the most complex hydrogen project outside Japan to date that the company has become involved with. The company will implement the on-site hydrogen energy management scheme by providing the overarching control system that will oversee all the scheme's hydrogen and renewable assets. Businesses will also be able to refuel the vehicles with hydrogen at the Hydrogen Office or Fife Council's Bankhead depot in Glenrothes with both locations having hydrogen refuelling stations installed as part of the project.

Fife's leading the way in clean energy with our new hydrogen & diesel refuse collection vehicle, May 2016

[31] Further information available at: http://brightgreenhydrogen.org.uk/home/levenmouth-community-energy-project-2/levenmouth-community-energy-project/

2 Actions to Improve Air Quality

2.1 Air Quality Management Areas

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

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 meetings regularly to discuss the progress of the action plan measures outlined in the AQAP.

Figure 2.1 Bonnygate, Cupar AQMA Boundary

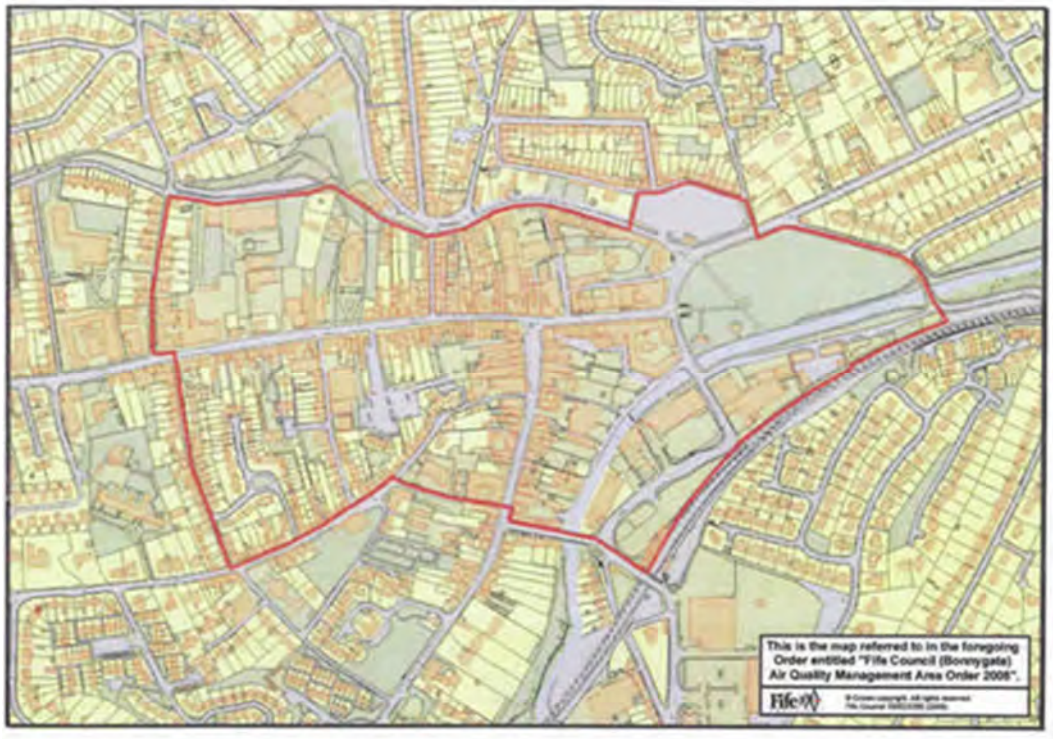
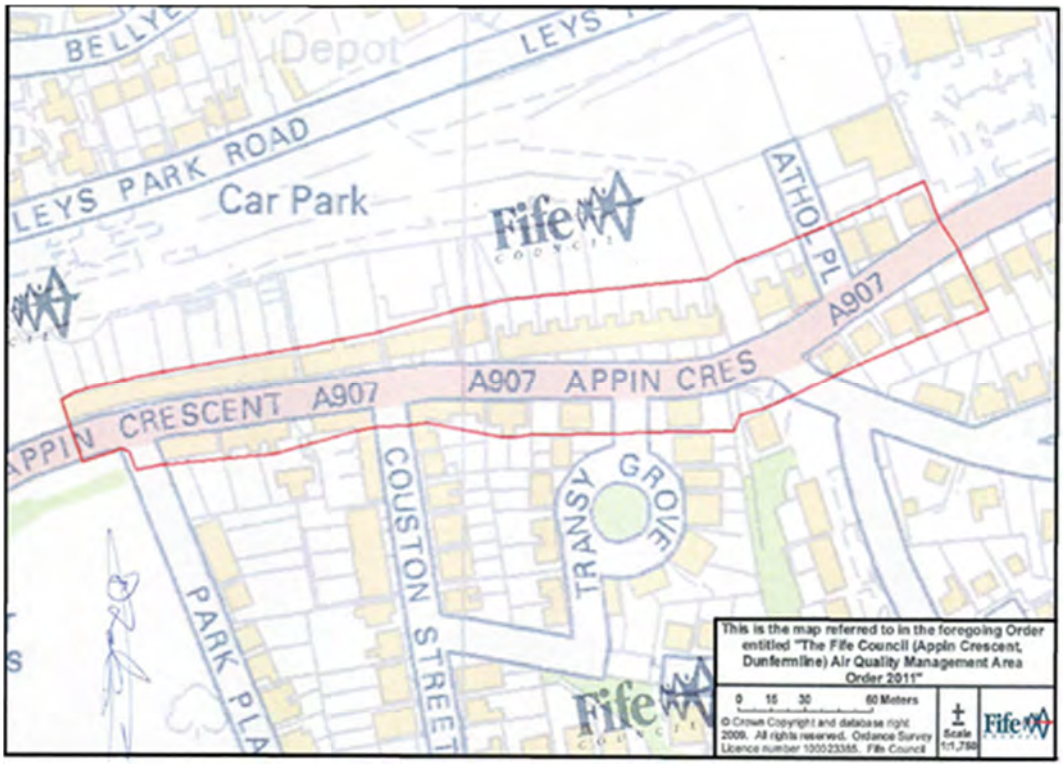


Figure 2.2 Appin Crescent, Dunfermline AQMA Boundary



2.1.1 Bonnygate, Cupar AQMA

The Bonnygate AQAP aims to work towards reducing transport emissions of NOx and PM_{10} 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.PG16). 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.

NO_2 concentrations within Bonnygate Cupar have remained consistent between 2013 and 2015. The initial drop in NO_2 concentrations between 2011 and 2012 are related to previous action plan measures implemented to alter the traffic signalling and pedestrian crossing within Bonnygate, Cupar. PM_{10} concentrations have steadily declined between 2011 and 2015, with concentrations dropping below the AQS annual mean objective of 18 µg m^{-3}.The automatic monitoring results for NO_2 and PM_{10} over the past five years are shown in Figure 2.3 and Figure 2.4 respectively.

Figure 2.3 NO_2 Monitoring Results 2011-2015-Bonnygate, Cupar

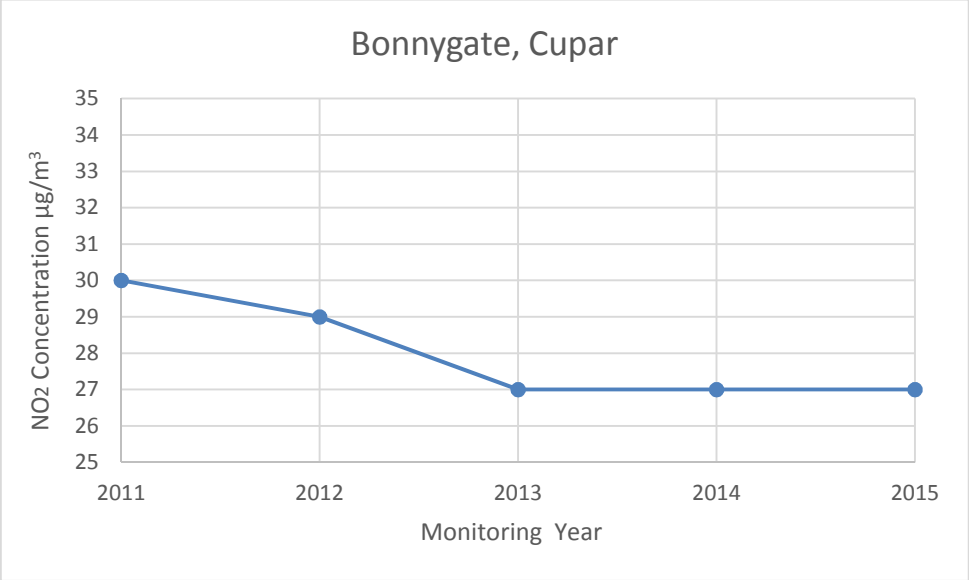
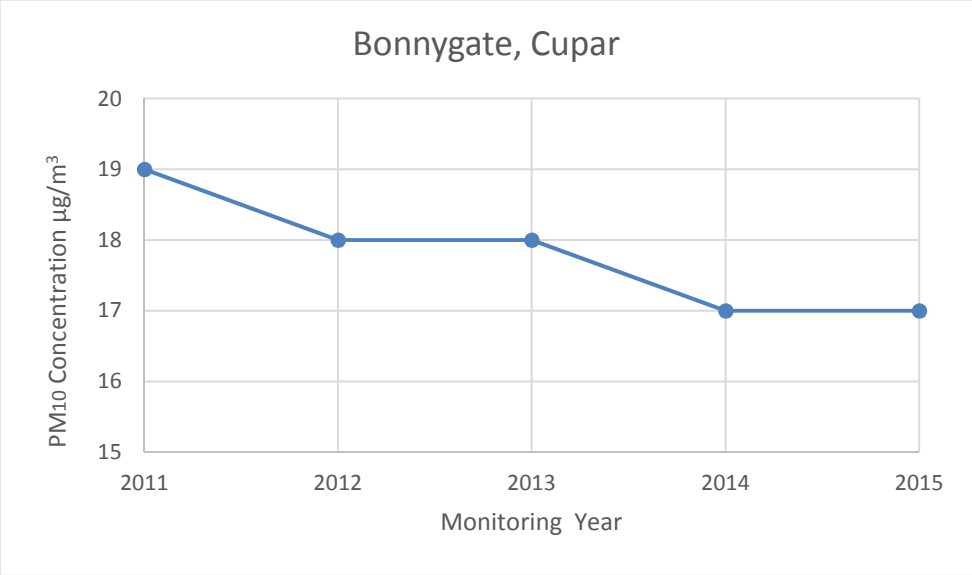


Figure 2.4 PM_{10} Monitoring Results 2011-2015- Bonnygate, Cupar



2.1.2 Appin Crescent AQMA

The Appin Crescent AQAP aims to work towards reducing transport emissions of NOx and PM_{10} 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.

Over the past five years NO_2 concentrations within Appin Crescent have decreased since 2011 as a result of the Action Plan measures being implemented. PM_{10} concentrations remained consistent between 2011-2015,with annual mean concentrations ranging between 15 µg $m^{-3}$and 16 µg m^{-3}. The automatic monitoring results for NO_2 and PM_{10} over the past five years are shown in Figure 2.5 and Figure 2.6 respectively.

Figure 2.5 NO_2 Monitoring Results 2011-2015- Appin Crescent, Dunfermline

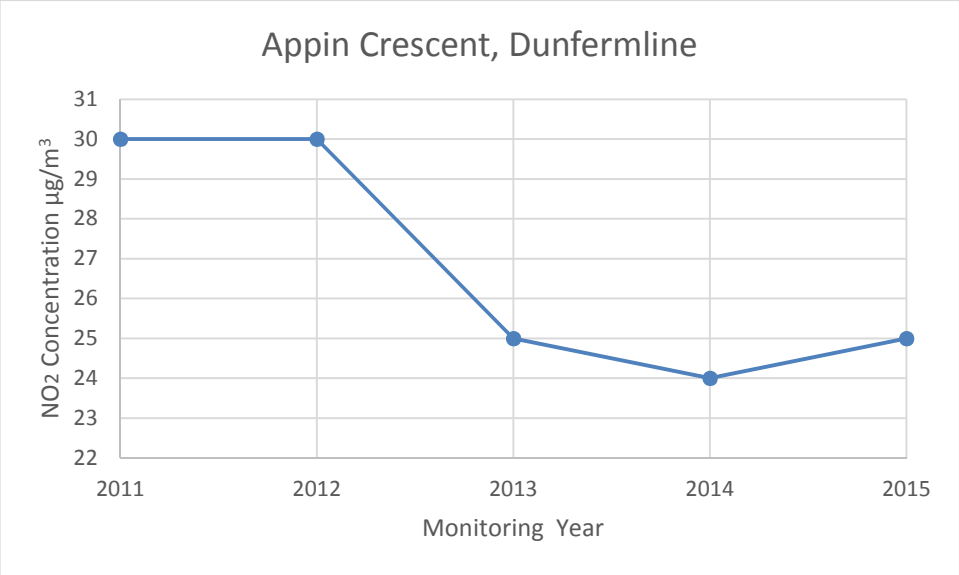


Figure 2.6 PM_{10} Monitoring Results 2011-2015- Appin Crescent, Dunfermline

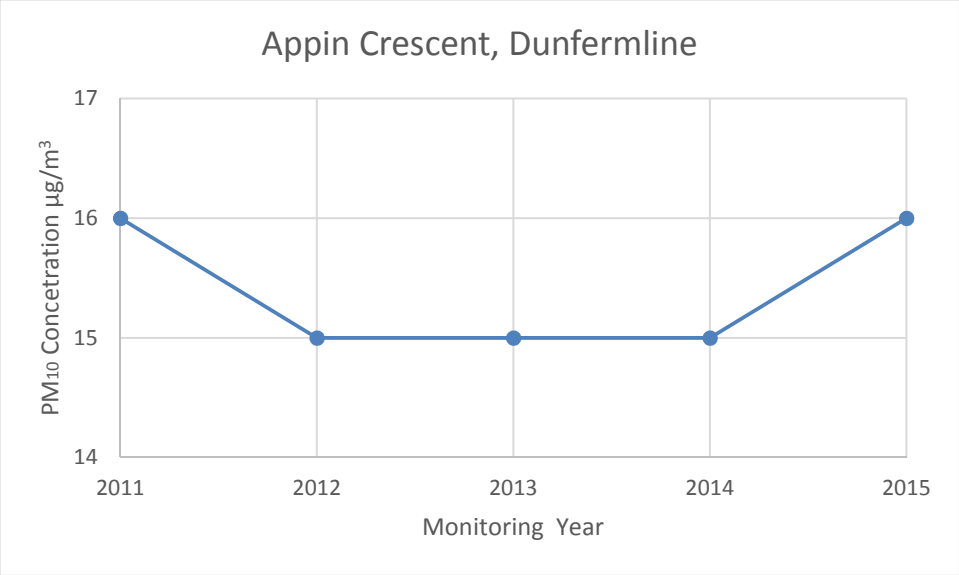


Table 2.1 Declared Air Quality Management Areas

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 at1st floor height above commercial properties.	Bonnygate Cupar, AQAP. Can be accessed at: http://publications.1fife.org.uk/uploadfiles/publications/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 1st floor height.	Appin Crescent, AQAP. Can be accessed at: http://publications.1fife.org.uk/uploadfiles/publications/c64_FifeCouncilAppinCrescentAQAPUpdate20151.pdf

2.2 Progress and Impact of Action Plan Measures

The obligation to keep air quality action plans up to date provides the opportunity for Fife Council to periodically review the progress that has been made in implementing the air quality action plan and assess the significance of improvements in air quality that have been observed since the adoption of the action plan measures. Furthermore, the review and update of the action plan provides the opportunity for Fife Council to identify new or additional measures to help to work towards attainment of the air quality objectives within the designated AQMAs.

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 are provided in the tables below. Further details of the AQAP's and their progress are detailed in Table 2.4 and Table 2.5.

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

The Fife ECO Stars programme was successfully launched by Fife Council in October 2014 and was extended to include Fife ECO Stars Taxi in December 2015. Since its launch two workshop events were held for local fleet operators (March 2015 and March 2016). Further details and pictures from these events are shown in Appendix E. At the workshop event a variety of topics were discussed related to improving fleet efficiency. Currently there are 83 HGV & Bus fleet members and 15 Taxi and private hire members already signed up to the scheme which seeks to improve air quality in the Fife area. Fife Council intends to continue with the scheme recruitment process, as well as hosting future workshops and exploring how best to evaluate the impact of this scheme through the use of both qualitative and quantitative performance indicators.

2.2.2 Regional Road Source Dispersion Model 2016

2.2.2.1 Background

As part of their action planning efforts Fife Council commissioned Ricardo Energy and Environment to prepare a regional scale dispersion model which would be primarily focussed on emissions from road traffic. The scope of the work involved modelling concentrations of NO_2 and PM_{10} in Cupar and Dunfermline using a novel GIS modelling framework developed by Ricardo. The model has now been successfully applied in cities in Saudi Arabia, China and the UK. Thus the Ricardo model has now been applied in city scale analyses for urban centres with a total population of about 15 million people.

2.2.2.2 Modelling framework and methods

The Ricardo modelling framework is called RapidAir, which has a component sub-model for street canyons called RapidStreet. The base dispersion modelling methodology in RapidAir is based on mandatory regulatory guidance from the US, with the formulations in street canyons based on the USEPA work on the topic in the 1980s[32]. The canyon model was empirically derived and found to work very well by the USEPA on validation testing in wind tunnels. The RapidStreet canyon shares very similar functionality to the well-known AirViro model which uses the same underlying equations. Ricardo's modelling framework runs within the ArcGIS environment and utilises custom Python[33] scripting which was locally tuned for this project. The underlying model is the same regardless of the location it is applied but it does need local tuning through a process of iterative model runs and model validation steps. Emissions for the model are computed in the usual manner in the UK Emissions Factors Toolkit (though the model can accept emissions from any such emissions model) before importing into the RapidAir model for further computation. The Python programming performs a series of calculations that can be summarised thus:

1) Assign emission rates associated with traffic in Fife to small area sources as per a methodology described by the USEPA in their road traffic dispersion modelling guidance[34]. This guidance offers advice on setting model parameters like release height and initial plume size for the area sources. This process creates a mapped emissions surface for the whole Kingdom
2) Using a series of dispersion kernels prepared in the USEPA model AERMOD, compute pollution surfaces and combine the results of near field and far field kernels to give total road contributions. The dispersion kernels are computed using emission rates set to unity so the python code scale the concentration by the ratio of the emissions in the cell to the idealised emission rate.
3) Concentrations are extracted from the 3 sub models, i.e. background concentrations (from the Scottish Government), modelled road contributions from RapidAir, and finally contributions from RapidStreet which are computed for the appropriate locations affected by street canyons.
4) Model tuning functions are applied before raster maps and contour plotting is carried out. Values for any cell/receptor in the Kingdom can be extracted using an extraction script during post-processing.

2.2.2.3 Model outputs

The initial ambition was to model the towns at high resolutions of between 5 to 8m depending mainly on computation time. A Road and Motorways would be modelled at 50m thereby localizing pollution gradients from these important sources and their contribution to concentrations in the town. During the project Ricardo were able to develop a regional model but at much higher resolution and with more sophistication than originally planned. As a result of the approach Ricardo took, and the significant upscaling in sophistication in the models, Fife Council has acquired the following outputs:

1) 3m resolution dispersion model of all road sources and towns in Fife. There are more than 300 million discrete predictions in the model which can be easily extracted to yield new receptor concentrations e.g. for a new development where relevant exposure may be introduced
2) Continuous concentration surfaces for all regions in Fife
3) Road traffic emissions inventory model based on a synthesis of Fife Council's significant database of traffic counts and fleet splits (over 200 sites)
4) Ability to update the model with scenarios via Ricardo- this was a key outcome of the work and it can be used to add new flows in areas that may be affected by development pressure.

During the project, and via the usual model verification procedures it became clear that a street canyon model was required to improve model agreement in the most urbanised locations in Fife. Whilst Ricardo were able to quite accurately reflect canyons in Cupar, Dunfermline and to a lesser extent Rosyth and Kirkcaldy, a key development in the modelling framework would be a more thorough analysis of canyon effects in other parts of Fife.

The NO_2 and PM_{10} model agreement was very good for the locations that were the main focus of the work- Cupar and Dunfermline. Other locations also had good agreement but our analysis of these

[32] USEPA Office of Mobile Source Air Pollution Control (1981)., Estimating Mobile Source Pollutants in Micro-Exposure Situations
[33] https://www.python.org/
[34] https://www3.epa.gov/otaq/stateresources/transconf/projectlevel-hotspot.htm

areas was necessarily constrained by available resources on the project. Some select model inputs and outputs from this initial modelling are shown in the image series below.

Figure 7 Spatial overview of the model domain (note all roads shown are not included in the model)

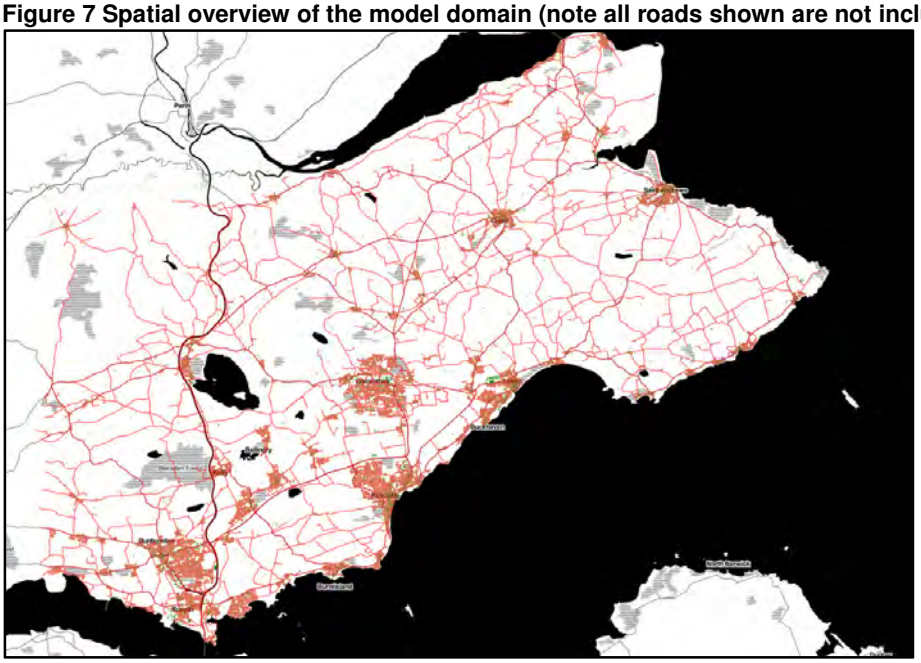
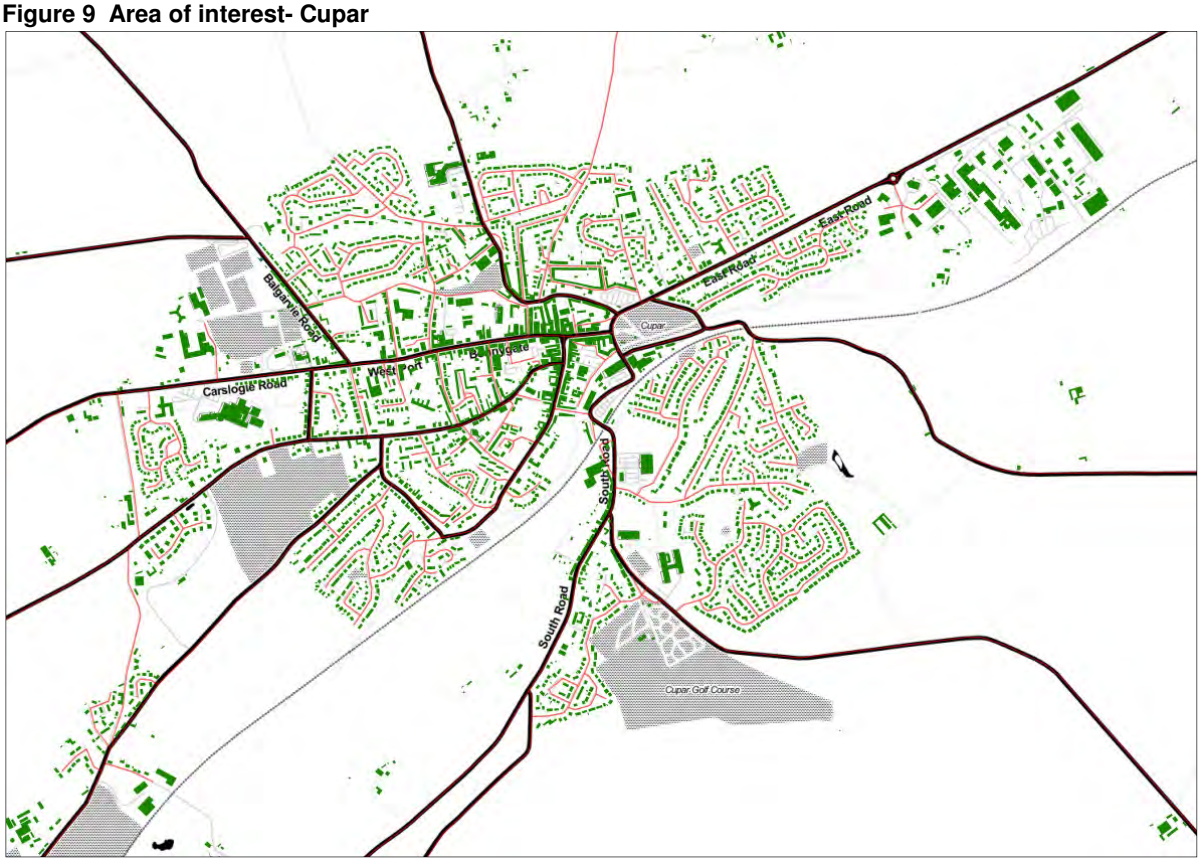


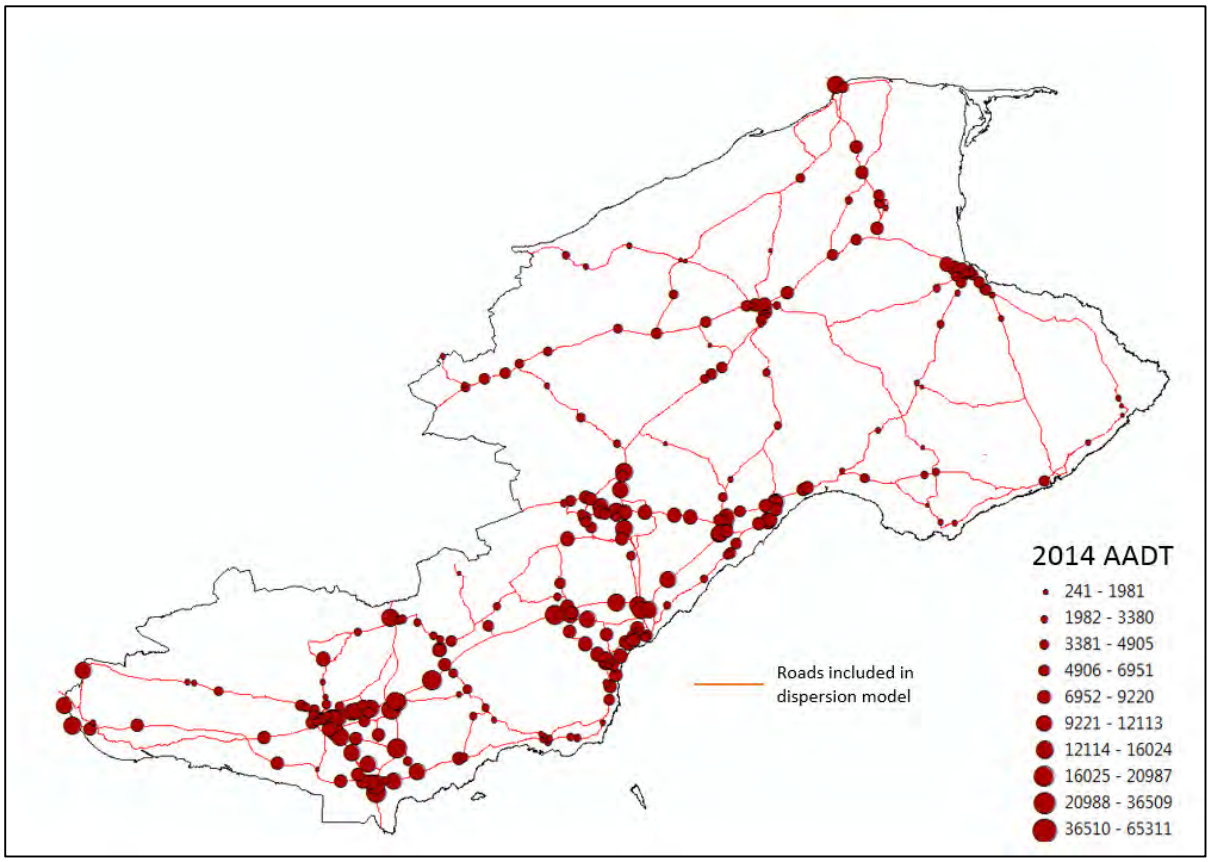
Figure 8 Area of interest- Dunfermline

Figure 9 Area of interest- Cupar



Contains OS data © Crown copyright and database right (2016)

Figure 10 Road network included in the model with AADT flows after screening of roads with no activity data



Contains OS data © Crown copyright and database right (2016)

Figure 11 Background NOx in Fife for 2014

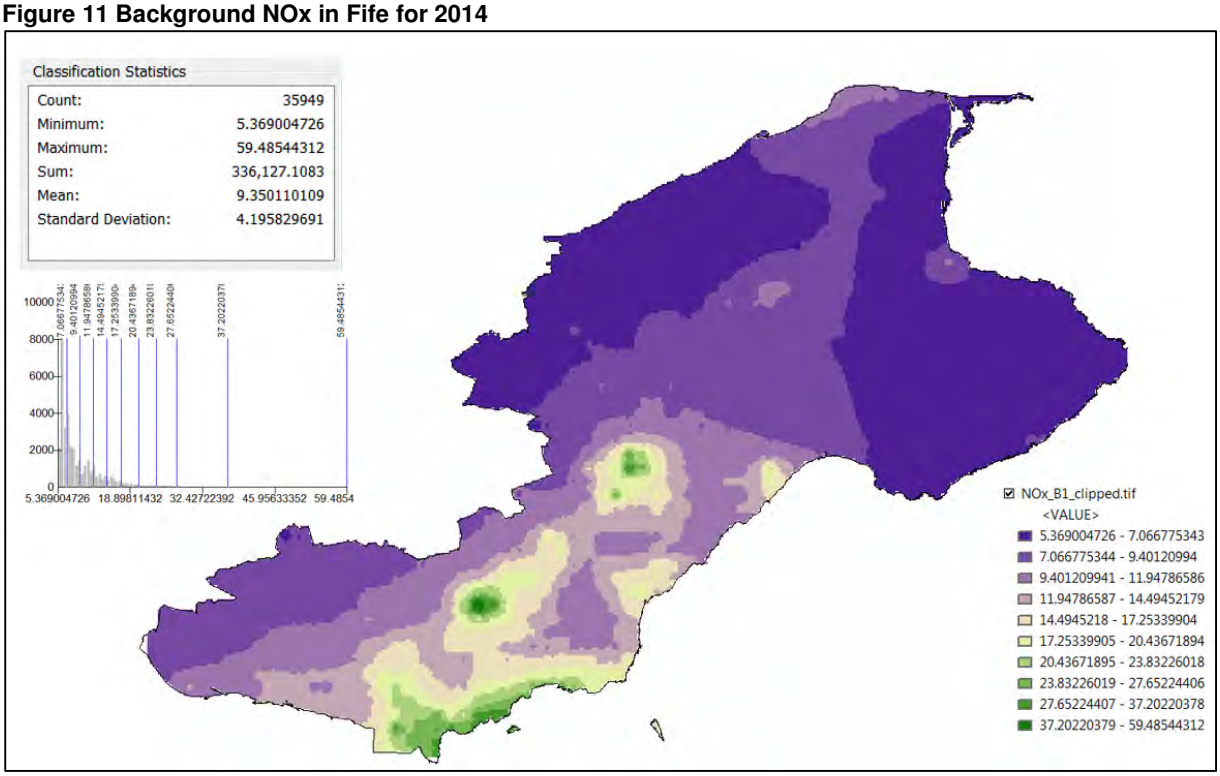


Figure 12 Background PM10 in Fife for 2014

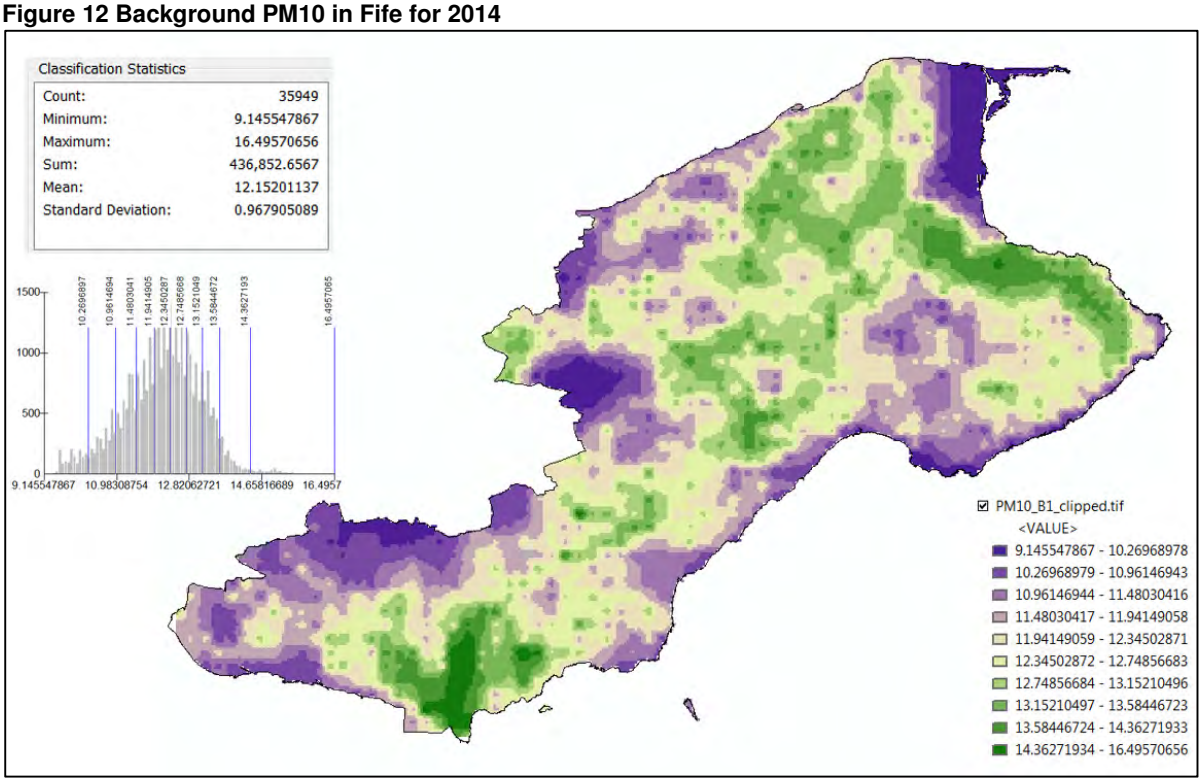


Figure 13 Draft RapidAir modelled NOx, 2014 all sources- 3m resolution, model contains >300 million receptor locations which can be used to extract values anywhere in Fife at 3m resolution

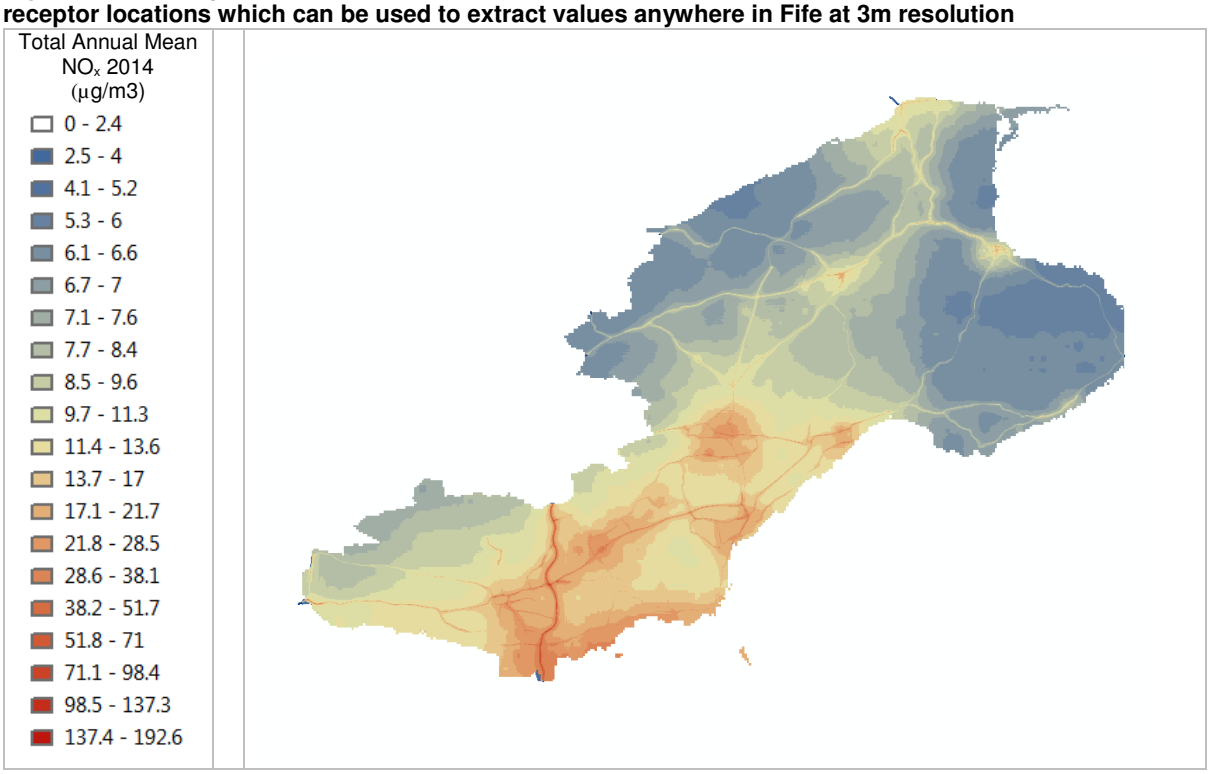


Figure 14 Draft model NOx in Cupar, 2014 all sources

Figure 15 NO_2 Model validation, Cupar

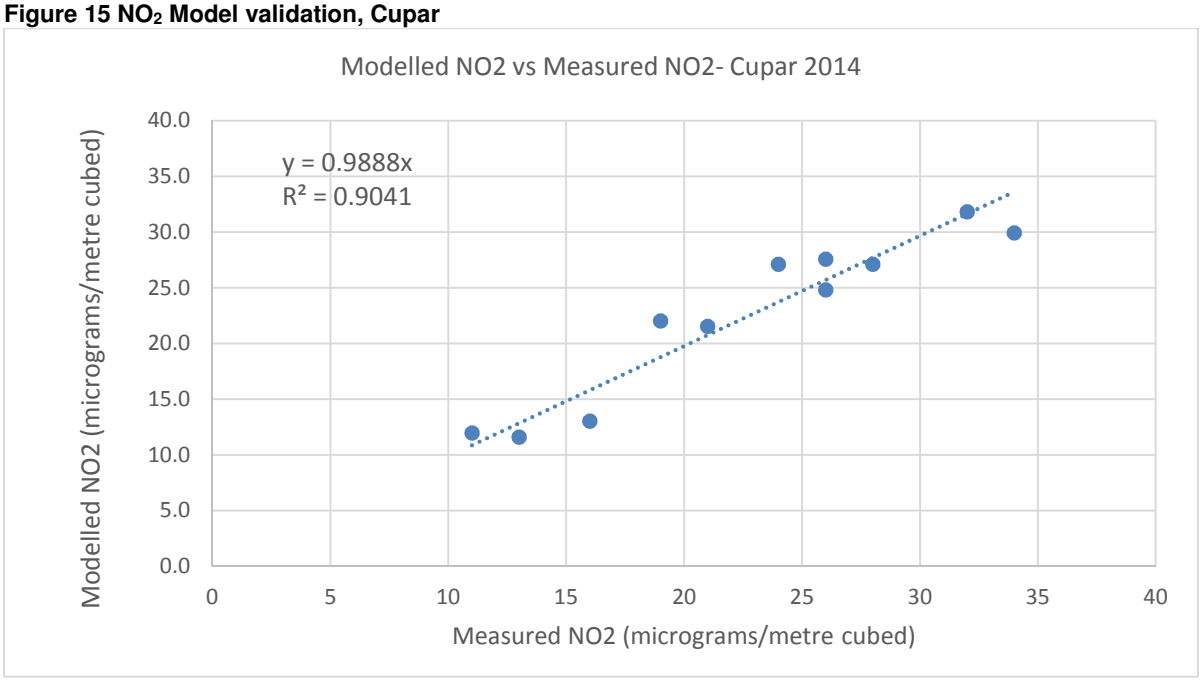


Figure 16 Draft model NOx in Dunfermline, 2014 all sources

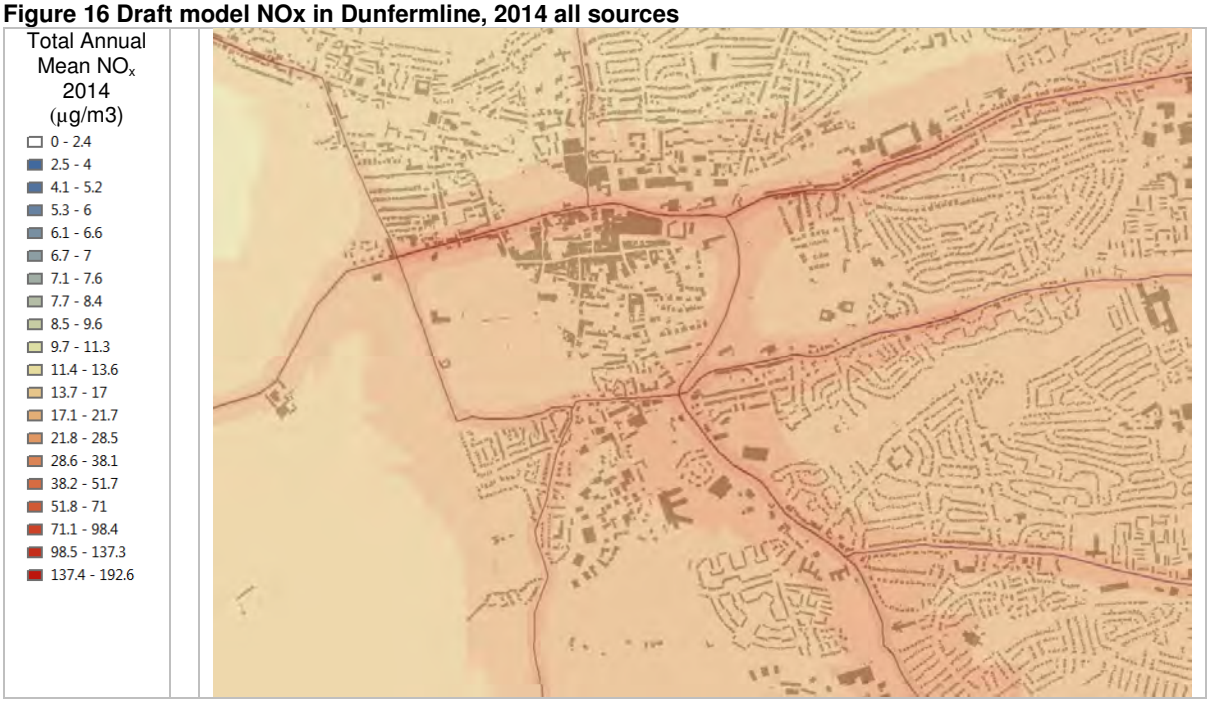
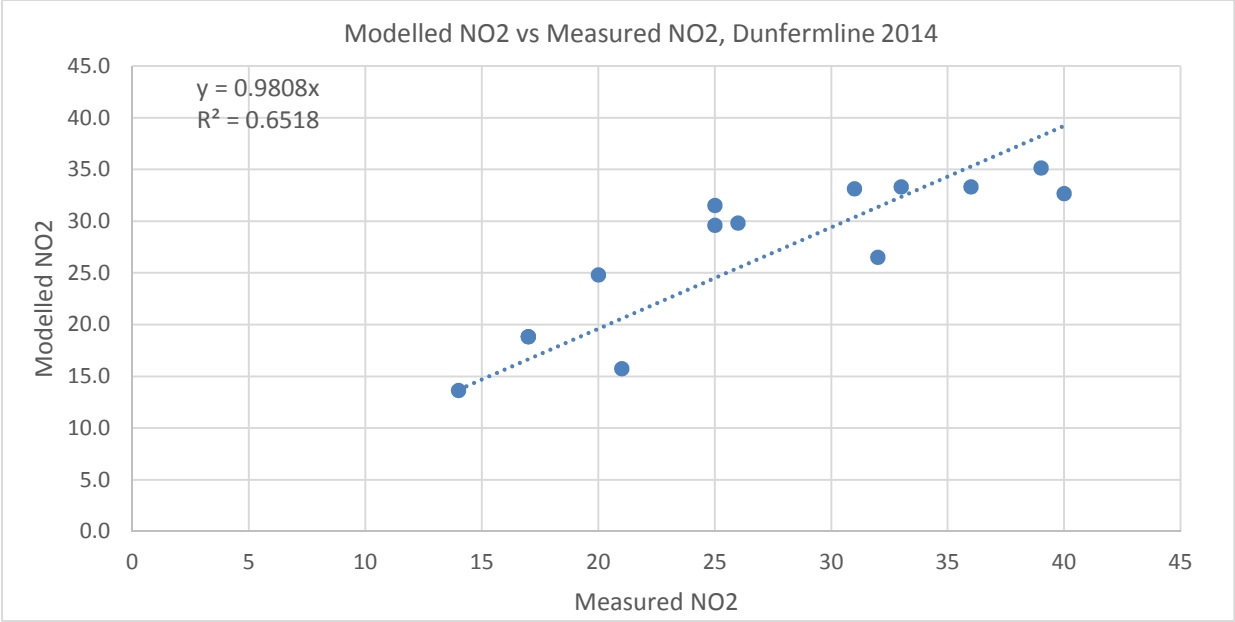


Figure 17 NO_2 Model validation, Dunfermline



Model verification and adjustment is done in the usual manner with the statistical methods derived from the LAQM Technical Guidance 2016. Primarily Ricardo used the r^2 and RMSE values to assess model performance but also included an analysis of the mean bias, coefficient of efficiency, and index of agreement. The statistics are computed as per guidance prepared to support the modStats function of the OpenAir tool which is developed and maintained by Ricardo Energy and Environment.
As part of the final outputs of the project Ricardo are preparing final NO_2 and PM_{10} surface maps and completing the model validation in the other major towns (Rosyth, St Andrews, Glenrothes, Kirkcaldy, Cowdenbeath etc) in the Fife area.

2.2.3 Completed Measures

Fife Council has taken forward a number of measures during the current reporting year of 2015 in pursuit of improving local air quality. Details of all measures completed, in progress or planned are set out in Table 2.4. for Bonnygate, Cupar and Table 2.5 for Appin Crescent, Dunfermline. 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 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.

In 2015 Fife Council commissioned Ricardo Energy & Environment to conduct a modelling study for the Cupar Northern Link Road. This study will be used to inform future decision making on planning applications submitted for the proposed Cupar North development associated relief road.

Within the Appin Crescent AQMA, revised lane markings and signage were introduced in March 2013. These measures have resulted in a reduction in NO_2 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 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.

A feasibility study was carried out on the possibility for creating a cycle route between Cupar and Guardbridge along the A91 to encourage the use of sustainable transport by local residents. However due to land access issues, it will not be practicable for this measure to go ahead.

Table 2.4 Progress on Measures to Improve Air Quality- Bonnygate Cupar

Measure No.	Measure	Category	Focus	Lead Authority	Planning Phase	Implementation Phase	Key Performance Indicator	Target Pollution Reduction in the AQMA	Progress to Date	Estimated Completion Date
1	Improving links with Local Transport Strategy/ Area Transport Plan	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	Ongoing	Reference to Bonnygate AQMA and measures included in Air Quality Action Plan. Integration of plan with Local Transport Strategy.	Low	To be reviewed as part of the Air Quality Strategy for Fife.	2020
2	Improving Air Quality Links with local Planning and Development Framework	Policy guidance and development control	Local planning considerations aim to mitigate the cumulative negative air quality impacts of new development	Fife Council	As outlined in the aims and objectives of Council's Air Quality Strategy 2015-20	Short-Term	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 supplementary planning guidance is currently under development and will hopefully be available for review in June 2016. A full public consultation will be undertaken June-August. SEPA have been consulted.	1-2 years
3	Integrate AQ with other Council Strategies	Policy guidance and development control	Encourage opportunity for contributions towards improving local air quality and minimising	Fife Council	As outlined in the aims and objectives of Council's Air Quality	Medium Term	Continue and enhance joint working between Council Services & other Partnership Organisations to	Low	Submission of AQ grant application to fund AQ work for 2016-2017.	2020

Measure No.	Measure	Category	Focus	Lead Authority	Planning Phase	Implementation Phase	Key Performance Indicator	Target Pollution Reduction in the AQMA	Progress to Date	Estimated Completion Date
			negative impacts from existing and future Council strategies. Planning obligations are set out in the Planning Obligations framework Guidance – this is to be reviewed in the near future. Increase awareness of local air quality		Strategy 2015-20		encourage potential air quality implications of existing and future Council strategies.			
4	Implementation of new Urban Traffic Management and Control system and changes to pedestrian crossings	Policy guidance and development control	Improve efficiency of transit through Cupar Town Centre and reduce emissions from road traffic sources within the Bonnygate street canyon.	Fife Council	2009	Completed	Pollutant reduction in AQMA	High Decline in NO_2 and PM_{10} concentrations within Bonnygate, monitoring to continue until trend has emerged. Pollutant concentrations can vary annually due to	The modelling study for the Cupar Northern Link Road has been conducted. Transport included in the grant application for traffic counters to inform future surveys. New pedestrian crossing linked	Completed, monitoring ongoing

Measure No.	Measure	Category	Focus	Lead Authority	Planning Phase	Implementation Phase	Key Performance Indicator	Target Pollution Reduction in the AQMA	Progress to Date	Estimated Completion Date
			Installation of traffic management system.			Completed	AQ monitor will continue to confirm the effectiveness of the measures.	meteorological influences.	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.	
5	Travel Plans for Large Institutions and Businesses	Promoting travel alternatives	To encourage a shift to more sustainable forms of travel, or reducing the need for travel.	Fife Council	2009-2015	Medium term	Results of Council Travel surveys	Low	To be reviewed as part of the Air Quality Strategy for Fife. Travel plans implemented and promoted in schools. Continue the implementation of Fife Council's travel plan.	Ongoing
6	Promotion of Travel Choices	Promoting travel alternatives	Discourage long stay commuter parking as part of the Fife Council's	Fife Council	As outlined in the aims and objectives of Councils Air Quality	Short-term	To improve integration between cycling, walking and public transport.	Low	Grant submission for traffic counters, to be able to inform future study.	Ongoing

Measure No.	Measure	Category	Focus	Lead Authority	Planning Phase	Implementation Phase	Key Performance Indicator	Target Pollution Reduction in the AQMA	Progress to Date	Estimated Completion Date
			Parking Strategy. To increase awareness of travel choices and encourage changes in behaviour that will contribute to improving local air quality.		Strategy 2015-20				.	
7	Target reduced localised emissions from freight.	Freight and delivery management	Improve efficiency of transit through the AQMA and facilitate reduce emissions.	Fife Council	As outlined in the aims and objectives of Councils Air Quality Strategy 2015-20	Short-Term	Continue to make information relating to local air quality management available through the Council website	Medium .	The modelling study for the Cupar Northern Link Road has been conducted. This will be used to inform future decision making on planning applications submitted for the proposed Cupar North development and associated Relief Road.	2020
8	AQMA Awareness Signs	Public information	To increase awareness of the Bonnygate AQMA and encourage behavioural change.	Fife Council	N/A	N/A	N/A	Low	Measure has been discounted based on the grounds of cost effectivess, practicability	N/A

Measure No.	Measure	Category	Focus	Lead Authority	Planning Phase	Implementation Phase	Key Performance Indicator	Target Pollution Reduction in the AQMA	Progress to Date	Estimated Completion Date
									feasibilityand acceptability to members of the public.	
9	Provision of Information relating to Air Quality	Public information	To increase awareness of local air quality issues and encourage changes in behaviour that will contribute to improving local air quality.	Fife Council	As outlined in the aims and objectives of Council's Air Quality Strategy 2015-20	Ongoing	Production of booklet- travel pack Publication for LAQM reports Continue to make information relating to local air quality management available through the Council website.	Low	Presentations to NHS, FPH and Green Fleet Scotland and STEP. Reports available of Fife direct for AQAP and Annual LAQM reports.	Ongoing
10	Parking Management and Control	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	Short-Medium Term	Pollutant reduction in AQMA	Low	The council has received parking control grant funding from the Scottish Government. Continue to evaluate parking management within the Bonnygate AQMA	2020

Measure No.	Measure	Category	Focus	Lead Authority	Planning Phase	Implementation Phase	Key Performance Indicator	Target Pollution Reduction in the AQMA	Progress to Date	Estimated Completion Date
11	Promotion pf Cycling and Walking	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	Ongoing	Medium Term	Number/length of cycling and walking routes developed.	Low	A feasibility study was carried out on the possibility for creating a cycle route between Cupar and Guardbridge along the A91. However due to land complexity this will not go ahead.	Ongoing
12	Review and support proposed infrastructure changes that will contribute to delivering improvements in local air quality	Transport planning and infrastructure	Support Council proposals for infrastructure changes that will facilitate improvements in vehicle movements within Cupar.	Fife Council	Ongoing	Long Term	Pollutant Reduction in AQMA	High	The modelling study for the Cupar Northern Link Road has been conducted. This will be used to inform future decision making on planning applications submitted for the proposed Cupar North development and associated Relief Road.	Ongoing
13	Target reductions in emissions from the Council fleet and contract vehicles (including driver training)	Vehicle fleet efficiency	Target reduced emissions from Council fleet vehicles and Council contract fleet vehicles operating	Fife Council	As outlined in the aims and objectives of Council's Air Quality Strategy 2015-20	Ongoing	Fife Council tender specification outlines that all new vehicles must have exhaust trap and filtration systems.	Medium	Fleet replacement programme, the fleet has been reduced by 300 vehicles. Each vehicle will be assessed at the end of its 7 year	Ongoing

Measure No.	Measure	Category	Focus	Lead Authority	Planning Phase	Implementation Phase	Key Performance Indicator	Target Pollution Reduction in the AQMA	Progress to Date	Estimated Completion Date
			within the Cupar AQMA.						life (5 years RCV's) Hydrogen RCV project is ongoing and will be launched at the APSE Scotland Fleet, Waste and Ground Seminar, 2016. This new technology has converted existing RCV vehicles to run on hydrogen and diesel. As well as the two bin lorries Fife's hydrogen fleet will also include: •5 Ford Transit Vans: Dual fuel Diesel and Hydrogen. •10 Renault HyKangoo Vans: Hybrid Electric and Hydrogen Fuel Cell.	
14	Target reductions in emissions from buses	Vehicle fleet efficiency	Target reduced emissions from buses operating	Fife Council	As outlined in the aims and objectives of Council's	Short-Term	Establish a bus quality partnership	Medium	Reviewed and discussed with other local authorities the approach to Bus	Ongoing

Measure No.	Measure	Category	Focus	Lead Authority	Planning Phase	Implementation Phase	Key Performance Indicator	Target Pollution Reduction in the AQMA	Progress to Date	Estimated Completion Date
			within the Bonnygate AQMA.		Air Quality Strategy 2015-20		Increase in fleet using alternative fuels		Quality Partnerships. To be reviewed as part of the Air Quality Strategy for Fife. ECO Stars scheme may facilitate such agreements as Stagecoach joined ECO Stars in 2015.	
15	Fife ECO Stars	Vehicle fleet efficiency	Encourage operators of buses, coaches, HGVs and LDVs to sign up to voluntary scheme which encourages and promotes 'clean operators'	Fife Council	As outlined in the aims and objectives of Council's Air Quality Strategy 2015-20	Ongoing	Number of ECO Stars members	Medium	Fife ECO Stars HGV and Bus Fleet Scheme has 83 members (4807 vehicles) Fife ECO Stars Taxi Scheme has 15 members (92 vehicles) Fife Council launched its Fife ECO Stars Taxi Scheme in December 2015 at Town	Ongoing

Measure No.	Measure	Category	Focus	Lead Authority	Planning Phase	Implementation Phase	Key Performance Indicator	Target Pollution Reduction in the AQMA	Progress to Date	Estimated Completion Date
									House in Kirkcaldy. Fife Council held ECO Stars Workshop in March 2016 with local fleet operators to evaluate the experience of local operators one year on and also to inform future strategic direction. Fife Council has submitted Scottish Government air quality grant application for pilot study to assess impacts of ECO Stars scheme .	
16	Air Quality and Planning Toolkit	Policy guidance and development control	Facilitate the consideration of the potential air quality impacts of developments across Fife, but notably near existing AQMAs	Fife Council	As outlined in the aims and objectives of Council's Air Quality Strategy 2015-20	Phase 1 Study Completed	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	Medium	Phase 1 Study Completed. Grant submission for Phase 2 study for 2016-17	2020

Measure No.	Measure	Category	Focus	Lead Authority	Planning Phase	Implementation Phase	Key Performance Indicator	Target Pollution Reduction in the AQMA	Progress to Date	Estimated Completion Date
							management process.			
17	Air Quality Strategy 2015-2020	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	Ongoing	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.	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.	See measures 1-16 These are considered to be consistent with aims/objectives of Scottish Government Cleaner Air Quality Strategy for Scotland 2015 including the List of Actions in Chapter 14 of this document. Partnership working has been demonstrated through action planning initiatives. This includes traffic management , Fife ECO Stars, detailed JHHP 2016-18 and behavioural change initiatives.	2020

Table 2.5 Progress on measures to Improve Air Quality- Appin Crescent Dunfermline

Measure No.	Measure	Category	Focus	Lead Authority	Planning Phase	Implementation Phase	Key Performance Indicator	Target Pollution Reduction in the AQMA	Progress to Date	Estimated Completion Date
1	Liaise with Scottish Government to encourage the consideration of national measures	Policy guidance and development control	Increase focus on background concentrations of PM and encourage national action	Fife Council	As outlined in the aims and objectives of Council's Air Quality Strategy 2015-20	Ongoing	Maintain contact with the Scottish Government regarding the adoption of national air quality measures	Low KPis to be developed in liaison with Scottish Government	Local Authority provided comments on latest policy & technical guidance circulated by the Scottish Government. Local authority keen to arrange training to cover policy, technical guidance and modelling. This has been included within the grant funding application for 2016-17.	Ongoing
2	Feasibility study	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	Fife Council	As outlined in the aims and objectives of Council's Air Quality Strategy 2015-20	Medium Term	Undertake a feasibility study to assess the potential impact of local infrastructure developments and traffic management optimisation on air quality in Appin Crescent	High	Feasibility study reports (2014 onwards) Feasibility studies have been carried out on four local infrastructure developments and traffic management optimisation options.	2020

Measure No.	Measure	Category	Focus	Lead Authority	Planning Phase	Implementation Phase	Key Performance Indicator	Target Pollution Reduction in the AQMA	Progress to Date	Estimated Completion Date
			management measures.						Further feasibility studies are to be carried out to look at traffic signalling and parking restrictions within Appin Crescent.	
3	Improving links with Local Transport Strategy/ Area Transport Plan	Transport planning and infrastructure	Measures to ensure the current poor air quality in the AQMA is improved where possible and to avoid future problems are implemented via the Local Transport Strategy.	Fife Council	As outlined in the aims and objectives of Council's Air Quality Strategy 2015-20	Ongoing	Reference to Appin Crescent AQMA and measures included in Air Quality Action Plan. Integration of plan with Local Transport Strategy.	Low	To be reviewed as part of the Air Quality Strategy for Fife.	2020
4	Improving Air Quality links with Local Planning and Development Framework	Policy guidance and development control	Local planning considerations aim to mitigate the cumulative negative air quality impacts of new development	Fife Council	As outlined in the aims and objectives of Council's Air Quality Strategy 2015-20	Short-Term	Integration of Appin Crescent AQAP with future versions of Local Plan. Maintain and make available - air quality guidance note for developers.	Medium	Low carbon supplementary planning guidance (including AQ Impact Assessment) is currently under development, it is hoped it will be available for review in June 2016.	1-2 Years
5	Integrate AQ with other Council Strategies	Policy guidance and	Encourage opportunity for	Fife Council	As outlined in the aims and objectives	Medium Term	Continue and enhance joint working between Council	Low	Submission of AQ grant application to fund AQ work for 2016-2017.	2020

Measure No.	Measure	Category	Focus	Lead Authority	Planning Phase	Implementation Phase	Key Performance Indicator	Target Pollution Reduction in the AQMA	Progress to Date	Estimated Completion Date
		development control	contributions towards improving local air quality and minimising negative impacts from existing and future Council strategies. Planning obligations are set out in the Planning Obligations framework Guidance – this is to be reviewed in the near future. Increase awareness of local air quality.		of Council's Air Quality Strategy 2015-20		Services & other Partnership Organisations to encourage potential air quality implications of existing and future Council strategies			
6	Traffic Management optimization (dependant on feasibility study)	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	Medium Term	Optimisation of the traffic management system at Appin Crescent and the surrounding network. Progress of this action is dependent on	High	Transport included in the grant application for traffic counters to inform future surveys. AQ issues raised during the closure of the FRB. Ricardo have	2020

Measure No.	Measure	Category	Focus	Lead Authority	Planning Phase	Implementation Phase	Key Performance Indicator	Target Pollution Reduction in the AQMA	Progress to Date	Estimated Completion Date
							the conclusions of the feasibility study.		produced a report following review of data recorded before, during and after the closure. Initial review of data shows no exceedances. The study was finalised in 2015 and also considered the optimisation of traffic light sequencing in Sinclair Gardens roundabout and relocation of bus stops. Revised lane markings and signage were introduced in March 2013 and have resulted in a decrease in NO_2 concentrations on the South side of Appin Crescent.	
7	Travel Plans for large Institutions and Businesses	Transport planning and infrastructure	To encourage a shift to more sustainable forms of travel, or reducing the need for travel.	Fife Council	As outlined in the aims and objectives of Council's Air Quality	Medium Term	Continue the implementation of Fife Council's travel plan	Low	To be reviewed as part of the Air Quality Strategy for Fife. Travel plans implemented and promoted in schools.	Ongoing

Measure No.	Measure	Category	Focus	Lead Authority	Planning Phase	Implementation Phase	Key Performance Indicator	Target Pollution Reduction in the AQMA	Progress to Date	Estimated Completion Date
					Strategy 2015-20		Undertake Council travel surveys		Continue the implementation of Fife Council's travel plan.	
8	Provision of Information and promotion of travel options	Promoting travel alternatives	To increase awareness of travel choices and encourage changes in behaviour that will contribute to improving local air quality.	Fife Council	As outlined in the aims and objectives of Council's Air Quality Strategy 2015-20	Ongoing	To improve integration between cycling, walking and public transport. Produce Travel Choices facility for Dunfermline. Undertaking Travel Marketing in Dunfermline.	Low	Grant submission for traffic counters, to be able to inform future study. Report commissioned as a result of the FRB closure. AQ issues were raised as a concern. Initial findings of report suggests no exceedances.	Ongoing
9	Provision of information relating to Air Quality	Public information	To increase awareness of local air quality issues and encourage changes in behaviour that will contribute to improving local air quality.	Fife Council	As outlined in the aims and objectives of Council's Air Quality Strategy 2015-20	Ongoing	Continue to make information relating to local air quality management available through the Council website.	Low	Presentations to NHS, FPH and Green Fleet Scotland and STEP. Reports available of Fife direct for AQAP and Annual LAQM reports. Currently reviewing air	Ongoing

Measure No.	Measure	Category	Focus	Lead Authority	Planning Phase	Implementation Phase	Key Performance Indicator	Target Pollution Reduction in the AQMA	Progress to Date	Estimated Completion Date
									quality web pages to include latest legislation ($PM_{2.5}$) and policy/technical guidance. Further detailed information on how fife Council and NHS Fife are working together is provided in the latest version of the JHPP for 2016-18	
10	Target reductions in emissions from the Council fleet and contract vehicles (including driver training)	Vehicle fleet efficiency	Target reduced emissions from Council fleet vehicles and Council contract fleet vehicles.	Fife Council	As outlined in the aims and objectives of Council's Air Quality Strategy 2015-20	Ongoing	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 Emission's or an equivalent emission reduction system.	Medium	Fleet replacement programme, the fleet has been reduced by 300 vehicles. Each vehicle will be assessed at the end of its 7 year life (5 years RCV's) Hydrogen RCV project is ongoing and will be launched at the APSE Scotland Fleet, Waste and Ground Seminar, 2016. This new technology has converted existing	Ongoing

Measure No.	Measure	Category	Focus	Lead Authority	Planning Phase	Implementation Phase	Key Performance Indicator	Target Pollution Reduction in the AQMA	Progress to Date	Estimated Completion Date
									RCV vehicles to run on hydrogen and diesel. As well as the two bin lorries Fife's hydrogen fleet will also include: •5 Ford Transit Vans: Dual fuel Diesel and Hydrogen. •10 Renault HyKangoo Vans: Hybrid Electric and Hydrogen Fuel Cell. Over 500 Council staff now have Professional Driver CPC Training certification. All FC vehicles will eventually have telematics systems fitted for operational efficiencies/ management (over 1000 already fitted with TomTom)	
11	Investigate the potential for establishing	Promoting travel alternatives	Target reduced emissions from buses	Fife Council	As outlined in the aims and objectives	Ongoing	Liaise with bus operators regarding emissions from	Medium	To be reviewed as part of the Air Quality Strategy for Fife.	Ongoing

Measure No.	Measure	Category	Focus	Lead Authority	Planning Phase	Implementation Phase	Key Performance Indicator	Target Pollution Reduction in the AQMA	Progress to Date	Estimated Completion Date
	voluntary bus agreements		operating within the Appin Crescent AQMA.		of Council's Air Quality Strategy 2015-20		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. ECO stars scheme may facilitate such agreements as Stagecoach joined ECO Stars in 2015.		Stagecoach have already joined the Fife ECO Stars scheme and attended workshop in March 2016.	
12	Consideration of development of Appin Crescent bypass (Dependent upon feasibility study)	Transport planning and infrastructure n	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	Fife Council	As outlined in the aims and objectives of Council's Air Quality Strategy 2015-20	Ongoing	Development of an Appin Crescent bypass	High but is not considered cost effective, practicable and feasible in relation to other traffic management measures that are currently being considered including the proposed Dunfermline	The feasibility study suggests that the proposed bypass would appear to achieve the achievement of the Air Quality objectives, however no funding is currently available. Local authority to consider other traffic	Not being progressed on the grounds of cost effectiveness, practicability and feasibility relative to other traffic management options.

Measure No.	Measure	Category	Focus	Lead Authority	Planning Phase	Implementation Phase	Key Performance Indicator	Target Pollution Reduction in the AQMA	Progress to Date	Estimated Completion Date
			consequently contribute to lower emissions.					Northern Link Road.	management to achieve the same outcome whilst being more cost-effective, practicable and feasible.	
13	Fife ECO Stars	Vehicle Fleet Efficiency in HGV & 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	Ongoing	Number of ECO Stars members	Medium	Fife ECO Stars HGV and Bus Fleet Scheme has 83 members (4807 vehicles) Fife ECO Stars Taxi Scheme has 15 members (92 vehicles) Fife Council launched its Fife ECO Stars Taxi Scheme in December 2015 at Town House in Kirkcaldy. Fife Council held ECO Stars Workshop in March 2016 with local fleet operators to evaluate the experience of local operators	Ongoing

Measure No.	Measure	Category	Focus	Lead Authority	Planning Phase	Implementation Phase	Key Performance Indicator	Target Pollution Reduction in the AQMA	Progress to Date	Estimated Completion Date
									one year on and also to inform future strategic direction. Fife Council has submitted Scottish Government air quality grant application for pilot study to assess impacts of ECO Stars scheme in terms of air quality improvements.	
14	Air Dispersion modelling Study of the potential Dunfermline Northern Link Road	Traffic Management	Estimate the impact of the proposed northern link road and the proposed Dunfermline strategic land allocation (SLA) zones	Fife Council	As outlined in the aims and objectives of Council's Air Quality Strategy 2015-20	Long Term. Report indicates that that neither the NO_2 or PM_{10} annual mean objectives are expected to be exceeded in 2029 with the North Link Road being fully operational.	Carry out Air Quality dispersion modelling to quantify the impacts of the proposed Northern Link.	High	North Link Road AQ modelling study has been completed.	Ongoing

Measure No.	Measure	Category	Focus	Lead Authority	Planning Phase	Implementation Phase	Key Performance Indicator	Target Pollution Reduction in the AQMA	Progress to Date	Estimated Completion Date
15	Air Quality and Planning Toolkit	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	Phase 1 Study Completed	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	Phase 1 Study Completed. Grant submission for Phase 2 study for 2016-17	2020
16	Cost-benefit analysis of traffic management options to improve air quality within Appin Crescent	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	Completed	CBA analysis Outcomes of two traffic management options	High	Considering feasibility of traffic signalling and car parking restrictions following CBA report outcomes	2020
17	Air Quality Strategy for Fife	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	Ongoing	Pollutant reduction in AQMAs KPIs are currently being developed by the Scottish Government as outlined in the Cleaner Air	High	See measures 1-16 These are considered to be consistent with aims/objectives of Scottish Government Cleaner Air Quality Strategy	2020

Measure No.	Measure	Category	Focus	Lead Authority	Planning Phase	Implementation Phase	Key Performance Indicator	Target Pollution Reduction in the AQMA	Progress to Date	Estimated Completion Date
							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.		for Scotland 2015 including the List of Actions in Chapter 14 of this document. Partnership working has been demonstrated through action planning initiatives. This includes traffic management , Fife ECO Stars, detailed JHHP 2016-18 and behavioural change initiatives.	

3 Air Quality Monitoring Data and Comparison with Air Quality Objectives

3.1 Summary of Monitoring Undertaken

3.1.1 Automatic Monitoring Sites

This section sets out what monitoring has taken place and how local concentrations of the main air pollutants compare with the relevant objectives. Fife Council undertook automatic (continuous) monitoring at 4 sites during 2015. NO_2 and PM_{10} concentrations are measured at each site. PM_{10} measured at Cupar, Dunfermline and Kirkcaldy measured using Tapered Element Oscillating Microbalance - Filter Dynamics Measurement System (TEOM-FDMS) instruments. TEOM-FDMS analysers have been assessed as equivalent to the EU reference method without any adjustment to the data and therefore no adjustment has been applied. Rosyth measures PM_{10} and $PM_{2.5}$ using a FIDAS instrument which has been certified as equivalence, previously Rosyth monitored PM_{10} using TEOM-FDMS until July 2015. As of April 2016 Kirkcaldy now monitors PM_{10} and $PM_{2.5}$ using a FIDAS instrument which has been certified as equivalence, and this $PM_{2.5}$ monitoring data will be reported in future progress reports. The latest FIDAS technology is being trialled at the Kirkcaldy and Rosyth locations with a view to confirming the technology is suitable for monitoring at the two existing AQMA locations in Cupar and Dunfermline. Table A.1 in Appendix A shows the details of the sites. National monitoring results are available at: http://www.scottishairquality.co.uk/data/data-selector.

Maps showing the location of the monitoring sites in 2015 are provided in Figures 3.1-3.4. Further details on the QA/QC of the automatic monitoring sites are included in Appendix C. Automatic SO_2 data are available from Scottish Power Generation Ltd from a monitoring site close to Longannet Power Station and is provided in their Annual Air Quality Impact Report[35]. The station's PPC permit from SEPA requires that air quality impacts around Longannet Power Station be assessed with respect to the Air Quality Strategy (AQS) objectives. The monitoring location is at Blair Mains (Grid Reference NS972864) to the north east of the power station. This location is in the area identified by modelling as likely to experience the maximum impact of the power station plume.

Short-period CO monitoring has also been undertaken by Fife Council's Transportation Department. A summary of the INEOS Grangemouth oil refinery in their Annual Community Air Monitoring Report[36] for 2015 is also provided in this report. The report assesses concentrations of 1,3 butadiene, benzene, nitrogen dioxide and sulphur dioxide.

3.1.2 Non-Automatic Monitoring Sites

Fife Council operates an extensive NO_2 diffusion tube monitoring survey with sites in East, West and Central Fife. In total there are 48 NO_2 diffusion tube 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, Kirkcaldy, Rosyth and Dunfermline. In January 2015, two new diffusion tube monitoring sites were added at Pilmuir Street and Mill Street in Dunfermline. Table A.2 in Appendix A shows the details of the sites.

Maps showing the location of the monitoring sites are provided in Figures 3.1-3.4. Further details on Quality Assurance/Quality Control (QA/QC) and bias adjustment for the diffusion tubes are included in Appendix C.

NPL on behalf of BP Exploration North Sea Region monitored hydrocarbon levels on the Forth coastline during 2015 (29/12/2014-29/12/2015). Samples were collected over 2 week periods using passive samplers at 12 locations between the Forth Bridges and West Wemyss, including 4 locations between Dalgety Bay and Burntisland. Samples were analysed for iso-butane, n-butane, iso-pentane, n-pentane, nhexane, n-heptane, benzene, toluene, xylene and total hydrocarbons (C4-C19). These hydrocarbons are emitted from a variety of sources around the Forth including the operations at Hound Point but also traffic and other industrial sites such as the operations of ExxonMobil and Shell

[35] Review of Annual Air Quality around Longannet Power Station Compared to Air Quality Strategy Objectives- 2015, Iberdrola, March 2016.
[36] Community Air Quality Monitoring Report, Ambient Atmospheric Survey in the Vicinity of Grangemouth – 2015, INEOS March 2016

at Braefoot Bay and Mossmorran. The results of this monitoring indicate that concentrations of benzene over the 12 month period were low (annual means range from 0.2-0.4 ppb) and well within the air quality standard. Concentrations of other hydrocarbons were also low, but there are no air quality standards for these substances. The substance present in the greatest concentrations at most locations, as in 2014, was n-butane for which annual mean concentrations ranged from 1.4 ppb to 11.1 ppb. Annual mean concentrations of other individual substances ranged from <0.3 ppb to 2.16 ppb. Annual mean concentrations of total hydrocarbons at different locations ranged from 8-33 ppb. BP have commissioned monitoring along the Fife coastline for many years and there has been an overall reduction in the levels of hydrocarbons, including benzene, present in air over the last decade. Concentrations at any one locality are highly dependent on the weather. The measurements made in 2015 indicate that concentrations of most of the monitored substances were lower than 2014 at most locations.

Figure 3.1 Monitoring Locations- Cupar

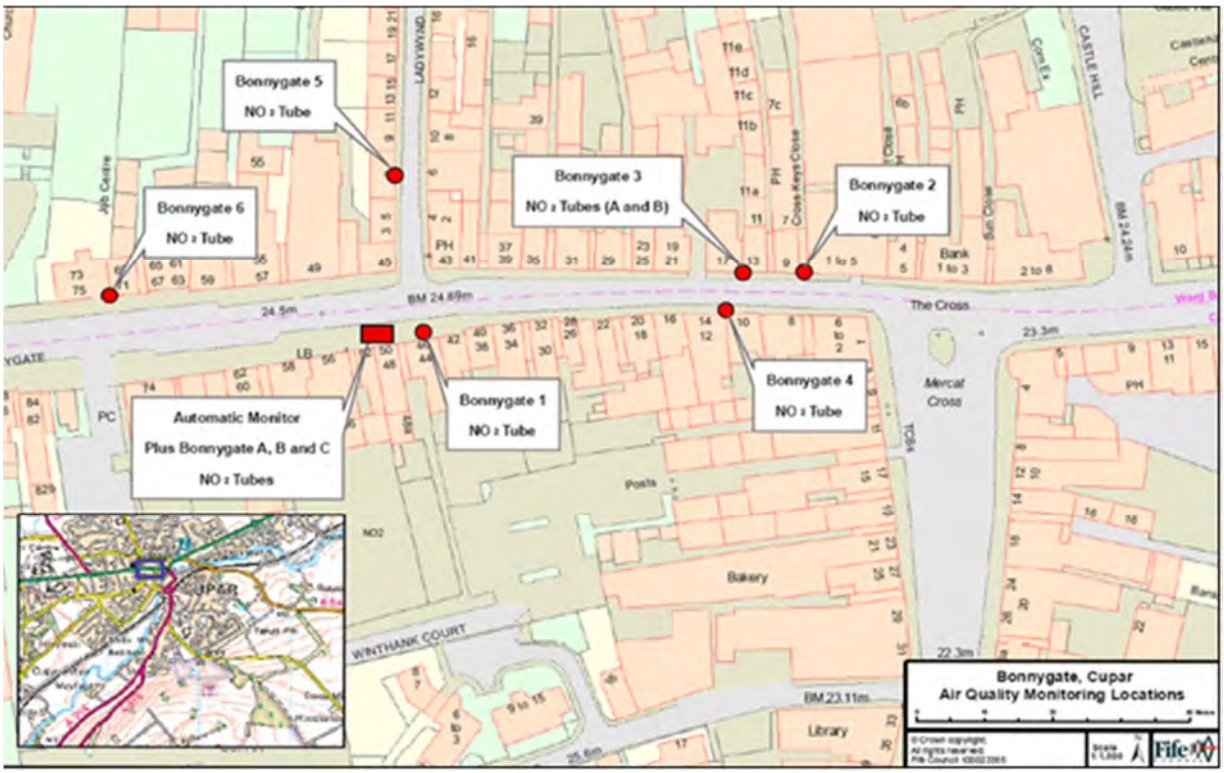
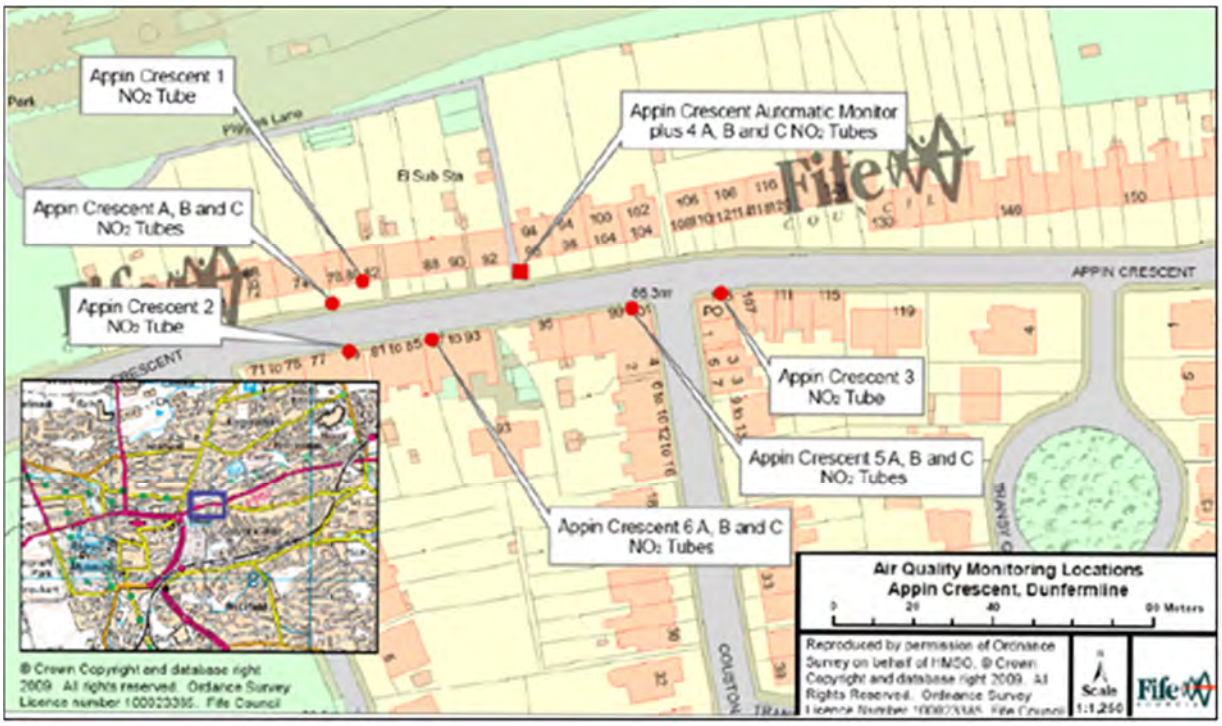
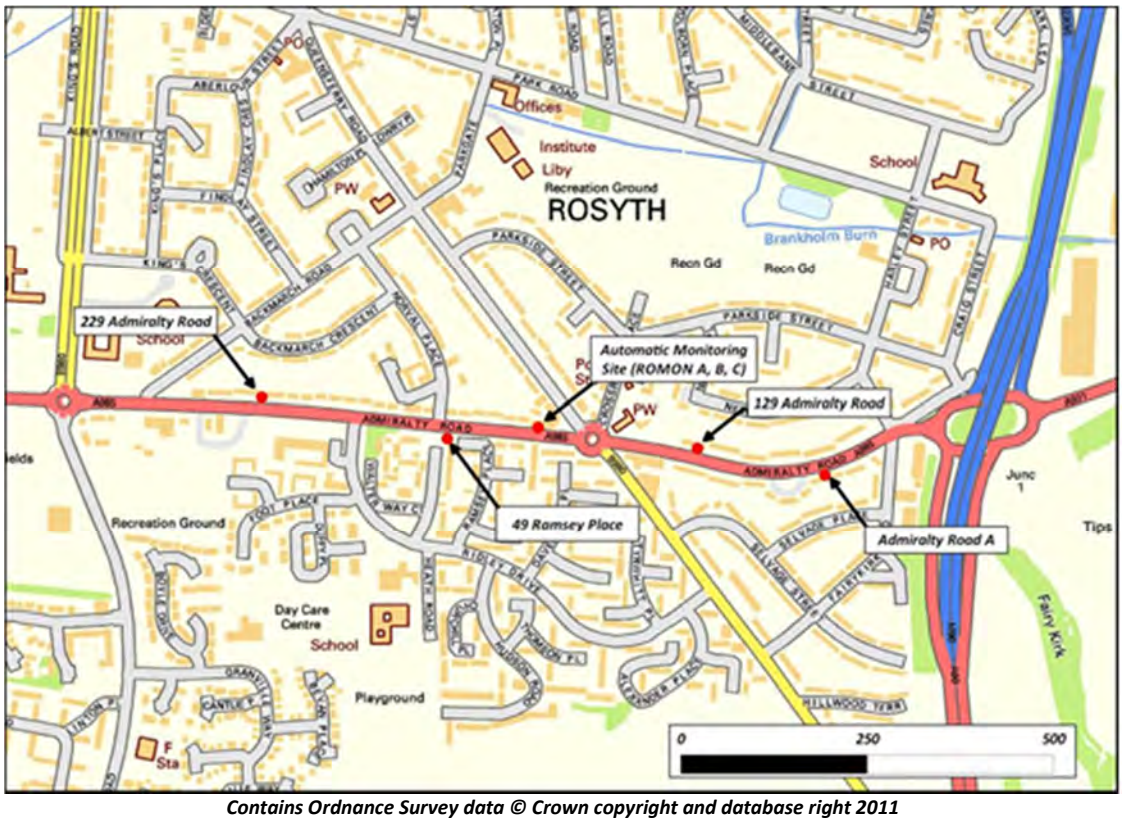


Figure 3.2 Monitoring Locations- Appin Crescent, Dunfermline



Crown Copyright and database right 2011. All rights reserved. Ordnance Survey Licence number 00023385.

Figure 3.3 Monitoring Locations- Rosyth



Contains Ordnance Survey data © Crown copyright and database right 2011

Figure 3.4 Monitoring Locations – Kirkcaldy

Contains Ordnance Survey data © Crown copyright and database right 2011

3.2 Individual Pollutants

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

3.2.1 Nitrogen Dioxide (NO_2)

Automatic Monitoring Data

Appendix A presents the monitoring results for 2015. The automatic sites at Cupar, Kirkcaldy, Rosyth and Dunfermline did not record any exceedances of the AQS NO_2 annual mean (Table A.3) or 1- hour mean objectives (Table A.5) during 2015.

The trend of decreasing concentrations seen at Bonnygate, Cupar, suggests that the traffic management measures introduced in mid-July 2009 is likely to be reducing levels of NO_2 in this area. These measures include a new Urban Traffic Management and Control System and changes to the pedestrian crossings.

The annual mean NO_2 concentrations from 2011-2015 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 NO_2 concentrations are generally declining in both AQMAs and provides evidence of the effectiveness of the action plans.

Diffusion Tube Monitoring Data

The annual diffusion tube data is presented in Appendix A, Table A.4. The Data has been bias corrected using both the national adjustment factor of 0.77 and the average of the local adjustment factors (0.75). The following local bias adjustment were calculated - further details are provided in Appendix C:

- Kirkcaldy = 0.72
- Cupar = 0.77
- Rosyth = 0.77
- Dunfermline = 0.75

The combined factor of the local and national bias adjustment of 0.76 was applied to all diffusion tubes for consistency. The full 2015 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 2011 to 2015 are presented in Appendix A, Table A.4. The 2015 diffusion tube results indicate that marginal exceedance of the AQS annual mean objective was measured at two locations within Dunfermline:

- Appin Crescent (2), Dunfermline (40 µg m^{-3})
- Appin Crescent (6), (A), (B), (C), Dunfermline (43 µg m^{-3})

Both locations are within the current Appin Crescent AQMA and are considered to be locations of relevant exposure.

NO_2 monitoring data are presented for INEOS Grangemouth oil refinery as part of their annual monitoring report for 2015 report[37]. Annual average concentrations for NO_2 are lower than the set air quality limit of 31 µg m^{-3} (16 ppb).

3.2.2 Particulate Matter (PM_{10})

Table A.6 in Appendix A compares the ratified and adjusted monitored PM_{10} annual mean concentrations for the past 5 years with the air quality objective of 18µg/m^3. Table A.7, Appendix A compares the ratified continuous monitored PM_{10} daily mean concentrations for the past 5 years with the air quality objective of 50µg/m^3, not to be exceeded more than 7 times per year.

[37] Community Air Quality Monitoring Report, Ambient Atmospheric Survey in the Vicinity of Grangemouth – 2015, INEOS March 2016

PM_{10} 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 2015 shows that all the Fife monitoring sites meet the annual mean objective with concentrations lower than 18 µg m^{-3}:

- Admiralty Road, Rosyth - 14 µg m^{-3}
- Appin Crescent in Dunfermline - 16 µg m^{-3}
- Bonnygate, Cupar - 17 µg m^{-3}
- St Clair Street, Kirkcaldy -13 µg m^{-3}

A summary of the number of exceedances of the PM_{10} daily-mean objective of 50 µg m^{-3} between 2011 and 2015 are presented in Appendix A, Table A.7. The 2015 monitoring results indicate that the daily-mean objective of 50 µg m^{-3} (not to be exceeded more than 7 times in a year) was not exceeded at any of the PM_{10} monitoring sites in Fife. The Kirkcaldy, Cupar and Dunfermline sites each recorded 2 instances of daily mean over the 50 µg m^{-3}. Rosyth recorded 3 instances of daily mean greater than 50 µg m^{-3}.

PM_{10} concentrations within the Bonnygate, Cupar AQMA for PM_{10} have steadily decreased from 19 µg m^{-3} in 2011 to 17 µg m^{-3} in 2015. It is believed that the decrease in PM_{10} 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 2015 annual mean PM_{10} concentration at Admiralty Road, Rosyth (14 µg m^{-3}) was below the annual mean PM_{10} objective, showing a slight decrease from 2014 (15 µg m^{-3}). Appendix A, Figure A.2 shows the change in PM_{10} concentrations at Bonnygate, Cupar and Appin Crescent, Dunfermline from 2011 to 2015 and highlights that action plans can be effective in reducing concentrations of pollutants in AQMA's.

In 2012 a Detailed Assessment was carried out at Admiralty Road, Rosyth as PM_{10} concentrations were exceeding the AQS annual mean objective. It was concluded that Fife Council should defer its decision to declare an AQMA until at least 6 months of monitoring data was made available using a new FDMS drier. The new drier was installed in September 2012. Using mean data up to the 31st March 2013 (15 µg m^{-3}) the 2012 Progress Report concluded that Fife Council was not required to declare an Air Quality Management Area at Admiralty Road, Rosyth. The 2013, 2014 and 2015 annual mean PM_{10} concentrations support this conclusion.

The annual mean PM_{10} concentration at Appin Crescent, Dunfermline (16 µg m-3) was below the AQS annual mean PM_{10} objective, with a slight increase from the 15 µg m^{-3} measured in 2014. The Appin Crescent, Dunfermline site's data capture was 87%. The Further Assessment of Air Quality in Appin Crescent (2012) indicated that the relevant PM_{10} objectives 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 PM_{10} in November 2012.

The annual mean PM_{10} concentration for St Clair Street, Kirkcaldy in 2015 continued to be below the PM_{10} annual mean objective with a measured concentration of 13 µg m^{-3}. The data capture for 2015 at this site was 100%. As shown in Table A.2, Appendix A, the PM_{10} concentrations at St Clair Street Kirkcaldy have been consistently well below the air quality objective.

3.2.3 Particulate Matter ($PM_{2.5}$)

During 2015 $PM_{2.5}$ was measured at the Admiralty Road, Rosyth air quality site starting July 2015. As the monitoring commenced in the latter half of 2015, results have been annualised in accordance with TG16 and are presented in Appendix A.

Table A.8 in Appendix A compares the ratified and adjusted monitored $PM_{2.5}$ monthly mean concentrations between July 2015 and December 2015. This gives an annual data capture of 50% Therefore the concentrations for 2015 have been annualised in accordance with TG(16) for

comparison with the AQS Annual Mean objective of 10 µg m^{-3}. Further details of the annualisation is available in Appendix D.

3.2.4 Sulphur Dioxide (SO_2)

Fife Council does not undertake any SO_2 monitoring, however, SO_2 concentrations are measured on behalf of Longannet Power Station.

3.2.4.1 SO_2 Automatic Monitoring

SO_2 monitoring is undertaken on behalf of Longannet Power Station at Blair Mains, Fife (Grid Reference NS972864) to the north east of the power station. In 2015 Longannet operated with an average load factor of 38.9% (48.1% in 2014, 49.9% in 2013, 47.9% in 2012, 46.1% in 2011, 49.6% in 2010 and/ 41% in 2009).

The station emitted 12.3 kT of SO_2 during 2014 (17.9 kT in 2014, 25.8 kT in 2013, 34.8kT in 2012, 37.7kT in 2011, 45.2kT in 2010 and ~32.2kT in 2009). Emissions were well below the short-term authorisation limit for SO2 of 2000 mg/m^3 at all times. Results for 2015 for this site are provided along with 2006 to 2015 data, are summarised in Table 3.1:

Table 3.1 SO_2 Monitoring - Longannet Power Station

Period	Valid Data Capture%	Max 15 Minute Mean (µg m^{-3})	Max 1 Hour Mean (µg m^{-3})	Max 24 Hour Mean (µg m^{-3})
2006	N/A	166	88	N/A
2007	N/A	138	N/A	N/A
2008	N/A	423	N/A	N/A
2009	99.9	150 (0)	70 (0)	N/A (0)
2010	99.8	238.6 (0)	164.7 (0)	22.9 (0)
2011	96.6	247.6 (0)	152 (0)	37.5 (0)
2012	97.4	201.1 (0)	92.6 (0)	17.3 (0)
2013	97.6	178.3 (0)	133.3 (0)	20.7 (0)
2014	97.8	192.3 (0)	151.8 (0)	35.5 (0)
2015	97.6	166.8 (0)	76.6 (0)	22.9 (0)

As detailed in the Longannet Power Station Report[38] the measured concentrations at Blair Mains automatic monitor indicate that there were no exceedances of the 15-minute mean objective. Measured concentrations also indicated that there were no exceedances of the hourly or the daily SO_2 thresholds. Although maximum 24-hour mean data are not available, the 99.18th percentile daily value was 13.9 µg m^{-3} (compliance value 125 µg m^{-3}) (23.6 µg m^{-3} in 2014,15.7 µg m^{-3} in 2013, 15.2 µg m^{-3} in 2012 and 29.9 µg m^{-3} in 2011), and the 99.73th percentile was 48.8 µg m^{-3} (compliance value 350 µg m^{-3}) (56.5 µg m^{-3} in 2014, 57.7 µg m^{-3} in 2013, 48.5 µg m^{-3} in 2012 and 74.6 µg m^{-3} in 2011). The period-mean for 2014 was 3.1 µg m^{-3}.

The measurements therefore indicate that the area around Longannet Power Station was in compliance with all relevant SO_2 objectives during 2015.

The SEPA Stirling Team have advised Fife Council that: *"Scottish Power PPC Permit PPC/A/1008873 for the operation of the coal-fired power station is likely to be formally surrendered before the end of 2016 although this is still to be confirmed because the site need to undertake a period of decommissioning and site investigation first to support their surrender application. However, emissions to air from the Power Station ceased on 24 March 2016 at 12:00 midday."*

[38] Review of Annual Air Quality around Longannet Power Station Compared to Air Quality Strategy Objectives- 2015, Iberdrola, March 2016

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 INEOS Grangemouth oil refinery in their annual monitoring report for 2015[39]. 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

NPL on the behalf of BP Exploration North Sea Region monitored hydrocarbon levels on the Forth coastline during 2015 (29/12/2014-29/12/2015). Samples were collected over 2 week periods using passive samplers at 12 locations between the Forth Bridges and West Wemyss including 4 locations between Dalgety Bay and Burntisland. Samples were analysed for iso-butane, n-butane, iso-pentane, n-pentane, nhexane, n-heptane, benzene, toluene, xylene and total hydrocarbons (C4-C19). These hydrocarbons are emitted from a variety of sources around the Forth including the operations at Hound Point but also 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 concentrations of benzene over the 12 month period were low (annual means range from 0.2-0.4 ppb) and well within the air quality standard. Concentrations of other hydrocarbons were also low, but there are no air quality standards for these substances. The substance present in the greatest concentrations at most locations, as in 2014, was n-butane for which annual mean concentrations ranged from 1.4 ppb to 11.1 ppb. Annual mean concentrations of other individual substances ranged from <0.3 ppb to 2.16 ppb. Annual mean concentrations of total hydrocarbons at different locations ranged from 8-33 ppb.

BP have commissioned monitoring along the Fife coastline for many years and there has been an overall reduction in the levels of hydrocarbons, including benzene, present in air over the last decade. Concentrations at any one locality are highly dependent on the weather. The measurements made in 2015 indicate that concentrations of most of the monitored substances were lower than 2014 at most 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 3.2. The results have been converted from ppm into mass units at 20℃ and 1 atmosphere.

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

Table 3.2 CO Monitoring Fife Transportation Services

Site Number/Location	Monitoring Period	Max 8-Hour Concentration (mg m^{-3})
Dunfermline, Bothwell Gardens	15/4/16-21/4/15	0.2
	8/7/15-14/7/15	1.05
	7/10/15-13/10/15	0.71
Dunfermline, Carnegie Drive/Pilmuir Street	15/4/15-21/4/15	0.2
	8/7/15-14/7/15	0.66
	7/10/15-13/10/15	0.86
Dunfermline, Appin Crescent	15/4/15-21/4/15	0.64
	8/7/15-14/7/15	0.26
	7/10/15-13/10/15	0.58
	14/5/15-20/5/15	0.25

[39] Community Air Quality Monitoring Report, Ambient Atmospheric Survey in the Vicinity of Grangemouth – 2015, INEOS March 2016

Site Number/Location	Monitoring Period	Max 8-Hour Concentration (mg m^{-3})
Leven, Glenlyon Road/ Windygates Road	20/8/15-26/8/15	1.7
	10/2/16-16/2/16	0.35
Cupar, Bonnygate	14/5/15-20/5/15	0.53
	20/8/15-26/8/15	0.56
	10/2/16-16/2/16	0.84
Kirkcaldy, Dunnikier Road/Victoria Road	4/6/15-10/6/15	0.36
	3/9/15-9/9/15	0.8
	1/3/16/7/3/16	0.79
Kirkcaldy, St Clair Street/Junction Road	4/6/15-10/6/15	0.68
	3/9/15-9/9/15	0.29
	1/3/16-7/3/16	0.24
Rosyth, Admiralty Road/Queensferry Road	4/6/15-10/6/15	0.71
	4/9/15-10/9/15	0.83
	1/3/16-7/3/16	2.01
A909 Mossmorran	25/4/15-1/5/15	0.65
	17/7/15-23/7/15	0.64
	22/10/15-28/10/15	0.1

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 at both the INEOS Grangemouth oil refinery and BP Production and Exploration as part of their annual reporting for 2015[40]. Annual average concentrations are low, but there are no air quality standards for these substances. The INEOS Grangemouth annual community air monitoring report for 2015 states that there were no significant changes in the annual average concentrations for all hydrocarbon components across all locations, when compared with historical data.

As summary of the monitoring data from BP Production and Exploration, Houndpoint, 2015 states that concentrations of most of the monitored substances in 2015 were lower than 2014 at most locations. BP have commissioned monitoring along the Fife coastline for many years and there has been an overall reduction in the levels of hydrocarbons, including benzene, present in air over the last decade. Concentrations at any one locality are highly dependent on meteorological influences.

The Mossmorran & Braefoot Bay Independent Air Quality Monitoring Review Group 2015 Annual Report (April 2016)[41] states that emissions from regulated sources within the Shell and ExxonMobil Plants in 2015 remained well within the limit values set by SEPA for the protection of public health and the environment. The report concluded that emissions from the Shell and ExxonMobil Plants at Mossmorran and Braefoot Bay continue to pose no significant risk to the health of members of the local community.

3.2.7 Summary of Compliance with AQS Objectives

New monitoring data measured in 2015 identified exceedances of the AQS annual mean objective for NO_2 in Appin Crescent, Dunfermline at two diffusion tube location (Appin Crescent 2 and Appin Crescent 6 (A, B, C)). No other air quality issues concerning NO_2 were highlighted by the 2015 data. All the automatic monitoring sites in Fife measured PM_{10} concentrations below the annual and daily mean objectives during 2015. Bonnygate, Cupar and Appin Crescent, Dunfermline have both already

[40] Community Air Quality Monitoring Report, Ambient Atmospheric Survey in the Vicinity of Grangemouth – 2015, INEOS March 2016
[41] Mossmorran & Braefoot BayAir Quality Review Group, 2015 Annual report, April 2016

been declared AQMAs for NO_2 and PM_{10}. Fife Council are currently in the process of implementing their Air Quality Action Plans for these areas.

Fife Council has examined the results from monitoring in the Fife Council Area. Concentrations within the Appin Crescent, Dunfermline AQMA are within the air quality objectives with the exception of marginal annual mean exceedances of NO_2 concentrations at two diffusion tube locations. As a result, the AQMA should remain. Concentrations within the Bonnygate, Cupar AQMA are within the annual mean objectives for PM_{10} however monitoring during 2015 indicated a slight rise in PM_{10} concentrations at Appin Crescent, Dunfermline. Both AQMA's have PM_{10} annual means close to the annual mean objective, therefore these two AQMAs for PM_{10} should remain and the measures detailed in the AQAPs should continue to be implemented. Concentrations of all AQS pollutants outside of the AQMAs are all below the objectives at relevant locations, therefore there is no need to proceed to a Detailed Assessment.

4 New Local Developments

4.1 Road Traffic Sources

Fife Council confirms that there are no new/newly identified congested streets with a flow above 5,000 vehicles per day and residential properties close to the kerb, that have not been adequately considered in previous rounds of Review and Assessment.

4.2 Other Transport Sources

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

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

4.5 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 2015:

Part A Sites
The following Part A installations have made amendments during 2015:

• Levenmouth WWTW sludge drying increased stack heights in 2 odour treatment systems from 15m to 30m July 2015.
• Tullis Russell Papermakers stopped operating in 2015
• Thornton animal feed mill & Quaker Oats (Cupar) although existing sites came into PPC in 2015 under PPC 2012 activities.
• James Donaldson timber Ltd – existing site but timber treatment operations came into PPC through PPC 2012.
• Scottish Power PPC Permit PPC/A/1008873 for the operation of the coal-fired power station is likely to be formally surrendered before the end of 2016 although this is still to be confirmed because the site need to undertake a period of decommissioning and site investigation first to support their surrender application. However, emissions to air from the Power Station ceased on 24 March 2016 at 12:00 midday. ScotAsh intend to remain operational.

Part B Sites
The following Part B installations have made amendments during 2015:

• Collier Quarrying & Recycling – a new cement batching/concrete block manufacturing site at Goathill Quarry, Cowdenbeath.
• Burntisland Fabrications Methil Facility has been in Care and Maintenance

Forth Replacement Crossing

During the construction of the Forth Replacement Crossing and associated road network, air quality monitoring has been undertaken by the Forth Crossing Bridge Constructors (FCBC)[42]. Air quality is being monitored using automatic light scatter dust meters and Frisbee gauge dust deposition monitoring. Seven automatic light scatter meters were installed at various sensitive locations to measure real time particulate matter (PM_{10}) concentrations and the Total Suspended Particle (TSP) concentrations. Thirteen Frisbee gauges were also set up at sensitive locations across the site to measure dust deposition rates. Of all the sites currently monitored by FCBC, only the Whinny Hill light scatter meter and dust deposition Frisbee are within the Fife local authority area.

Additionally, a daily dust log for both the North and South sites was kept by the FCBC Environmental Department. This daily dust inspection was used to identify any dust occurring as a result of construction works and any actions that were required. Also included in this log was a visual record of weather conditions which included conditions that may have affected readings, such as fog.

The 2015 monitoring results for Whinny Hill indicated that there were a few elevated readings throughout the year (*exceedances of the thresholds set out in the FRC air quality management plan)*, which were mostly explained by regional events rather than construction related as elevated levels were seen at automatic monitoring sites within the region. Within in the monitoring reports created the majority of PM_{10} exceedances were attributed to foggy weather conditions.

All the Forth Replacement Crossing air quality monitoring reports are publically available at the project website:
www.transport.gov.scot/road/forth-replacement-crossing/frc-air-quality-documents

[42] Forth Replacement Crossing: Air Quality Monitoring Report March 2016, Forth Crossing Bridge Constructors

5 Planning Applications

5.1 Applications

The following planning applications were submitted during 2015, they were required to demonstrate that the AQS objectives would not be exceeded:

1. **Planning Ref. 15/02703/FULL** Erection of food store (Class 1), petrol filling station with car wash and ATM, car parking, access, landscaping and associated works (demolish existing retail unit) (Section 42 application for variation of condition 10 to allow extended delivery hours), Wm Morrison Supermarket Plc, 439 Esplanade, Kirkcaldy, Fife, KY1 1SL . Requested Air Quality Impact Assessment

2. **Planning Ref. 15/01442/FULL** Installation of flue | 35 Claybraes, St Andrews, Fif,e KY16 8RS. Information submitted acceptable.

3. **Planning Ref. 15/00937/FULL** Condition 21, 15/04166/FULL, 15/01244/NBH Kirkland Works. Awaiting report.

4. **Planning Ref. 14/00726/SCO, 14/01907/SCR, 14/02334/EIA, 15/03458/EIA, 14/01933/PPP** Guardbridge Paper Mill Site (includes biomass boiler). Information submitted acceptable.

5. **Planning Ref. 11/03696/DPN, 11/04948/PPP, 14/00685/ARC, 14/00809/FULL 15/01159/ARC** Freescale Halbeath. AQ Impact assessment findings accepted.

6. **Planning Ref. 15/02176/PAN** Percival Buckhaven. PAN notice only.

7. **Planning Ref. 15/03760/PREAPP**, 15/04159/SCR Pleasance Halbeath. Awaiting report.

8. **Planning Ref. 15/03726/PREAPP** Reliance Eastfield. Awaiting report

9. **Planning Ref. 14/00637/FULL** Wormiston Biomass. Information submitted acceptable.

10. **Planning Ref. 16/00127/FULL** Erection of new golf course clubhouse (incorporating restaurant, 41 accommodation rooms and shop), change of use of and alterations to farmhouse to form associated spa facilities, landscaping and renewable energy plant, and demolition of the farm steading with car park re-modelling at Feddinch Mains, Feddinch, St Andrews. Plans submitted indicate that the renewable energy plant will include a biomass boiler. The applicant has been advised to complete the Biomass Information Request Form.

11. **Planning Ref. 15/01147/PPP** Proposed residential development at Land at Spencerfield, The Avenue, Inverkeithing. Advised AQ impact assessment required.

12. **Planning Ref. 15/00971/FULL** Erection of replacement secondary school (Class 10) with integrated community facilities, parking, associated landscaping and demolition of existing post Victorian School buildings at Waid Academy, St Andrews Road, Anstruther. Awaiting results of modelling exercise.

13. **Planning Ref. 15/01222/FULL** Erection of 137 dwelling houses, formation of new vehicular access with open space, landscaping and other associated engineering options at land to north of B925 and east of Curling Knowes, Crossgates. Information submitted generally satisfactory.

14. **Planning Ref. 15/01278/PREAPP** Pre-application for proposed landfill site and waste recovery at Old Landfill Site, Balbie Farm, Orrock, Auchtertool. Advised that further AQ information would be required to ensure developed in accordance with PAN 51.

15. **Planning Ref. 15/02449/FULL** Erection of biomass building (demolition of existing garages) at Falkland House School, West Port, Falkland. Information submitted generally satisfactory.

16. **Planning Ref. 15/02889/FULL** Installation of combined heat and power unit, cabin, associated flue and palisade fencing at Levenmouth Swimming Pool. Further AQ information requested, unclear if proposed CHP to include biomass.

17. **Planning Ref. 15/03093/FULL** Erection of boiler house with enclosed waste wood burning equipment and external silo at East Dock, Harbour Place, Burntisland. Information submitted generally satisfactory.

18. **Planning Ref. 15/03461/FULL** Erection of a 2MW anaerobic digestion plant and ancillary works including erection of office building at Inchdairnie, Kinglassie Road, Glenrothes. Information submitted generally satisfactory, however additional information may be required by Development Management following an objection to the development.

19. Planning Ref. 15/03735/PREAPP Pre-application for proposed mixed use development of major brownfield site (including employment, office, retail, leisure, residential, food and drink, hotel, tourism, community and institutional development) and associated works at Oil Fuel Depot, Castle Quay, Dundas Road, Port of Rosyth. Advised AQ impact assessment required.

20. **Planning Ref. 15/03791/FULL** Erection of biomass boiler shed with plant and storage at Pitcairlie House, Pitcairlie, Newburgh. Information submitted generally satisfactory.

21. **Planning Ref. 15/04287/PREAPP** Pre-application for erection of 160 detached and semi-detached houses with 48 flats (4 blocks) at land to east of Old Duloch House, Aberdour Road, Dunfermline. Advised AQ impact assessment may be required.

22. **Planning Ref. 15/01846/PREAPP** – Pre-application for residential development with associated landscaping, roads and drainage system at Lynebank Hospital, Halbeath Road, Dunfermline, KY11 4UW. Advised that an air quality impact assessment may be required due to the proximity to Appin Crescent AQMA.
23. **Planning Ref. 15/01030/FULL** – Erection of biomass boiler and associated building at Strathtyrum House, St Andrews, Fife. Advised that information satisfactory in terms of 199kW biomass boiler.

24. **Planning Ref. 15/01570/FULL** – Erection of new stone wall and gates, installation of biomass boiler (retrospective) at Bendameer Lodge, Newbigging, Burntlisland, Fife, KY3 0AG. Advised that information satisfactory in terms of 28kW biomass boiler.

25. **Planning Ref. 15/02888/FULL** – Installation of combined heat and power unit, cabin, flod barrier fence and associated flue at Beacon Leisure Centre, Lammerlaws Road, Burntisland, Fife, KY3 9BS. Advised that additional info required as it was not specified if a biomass boiler was to be installed. Thus far no additional info has been received.

26. **Planning Ref. 15/03652/CON** – Marine (Scotland) Act 2010, Part 4 Marine Licensing for waterproofing of viaduct spans (including bridge deck concrete repairs, spraying of a waterproof membrane, resurfacing and expansion joint replacement), concrete repairs to the swing span portals, installation of deck level marine navigation lights, special inspections to various areas of the bridge, including the piers (scour assessment), in accessible cell (below the concrete portals and underdeck areas) at Kincardine Bridge. Advised that assurances would be required that achievement of statutory AQ objectives will not be jeopardised. Thus far no additional info has been received.

27. **Planning Ref. Westfield 16/00793/SCO** – Request for scoping opinion for restoration and development of former opencast site including power generation/storage, waste recovery/recycling, employment uses and ancillary operations at Westfield. Information currently being reviewed.

28. **Planning Ref. 16/00859/SCO** Request for scoping opinion for residential-led master planning proposal on land at the Levenmouth Strategic Development Area at Land to East and West of Methilhaven Road, Buckhaven. Air quality assessment requested.

29. **Planning Ref. 16/00662/PREAPP** Pre-application for mixed use development

Comprising residential, employment, open space, education and community facilities with associated roads and services infrastructure. Site: Strategic Land Allocation to Southwest of Dunfermline (as indicated in Dunfermline and West Fife Local Plan 2012). Air quality assessment requested.

5.2 Consultations

The following air quality consultations were carried out in 2015:

April 2015

15/00778/FULL Extension to retail park of 7 No. Units (6 No. Class 1 and 1 No. Class 3 (with take away function and drive through facility)), car parking, servicing, landscaping and ancillary works including retention and regrading works with new substation, Land To The North Of Halbeath Retail Park Dunfermline Fife.
Further AQ Information Requested

July 2015

14/01578/PREAPP Preapplication for erection of 130 dwellinghouses with associated roads and sewers, Land At Former Lochside Works Grangehill Kinghorn Fife.
Further AQ Information Requested as part of any future application.

August 2015

06/03707/CARM Reserved matters application for erection of 199 dwelling houses (104 houses, 95 flats) (28 affordable units) including construction of roads, car parks, new junctions, landscaping and open space, Dunnikier Maltings Kidd Street Kirkcaldy Fife KY1 2EF
Further AQ Information Requested

November 2015

15/00778/FULL Extension to retail park of 7 No. Units (6 No. Class 1 and 1 No. Class 3 (with take away function and drive through facility)), car parking, servicing, landscaping and ancillary works including retention and regrading works with new substation, Land to the north of Halbeath Retail Park Dunfermline Fife
Submitted AQ Assessment Satisfactory – No Further Comment.

15/03814/PREAPP Pre application for proposed 20MW gas powered peaking power plant, Land to west of Whitworth Road Glenrothes Fife

& **15/03815/SCR** EIA screening request for proposed 20MW gas-powered peaking plant at Land to West of Whitworth Road, Glenrothes.
Air Quality Impact Assessment Received in May 2016 and currently being reviewed

March 2016 -

16/00591/PREAPP Pre application for proposed 19.8 MW gas powered peaking power plant, PLOT 10, DUNNIKIER BUSINESS PARK, KIRKCALDY
Advised Submission of Air Quality Impact Assessment as part of any future EIA/ES.

15/04279/EIA Application for Planning Permission in Principle for a Mixed Use Development (Major) Comprising 1480 Residential Units (of which 20% are Affordable Units); Commercial (Bulky Goods Retail, Business, Hotel, Restaurant and Associated Hot Food Takeaway, Petrol Filling Station and Leisure Uses); Primary School; Green Network and Associated Open Space/ Recreational Land/Sports Pitches; a Relief Road and Associated Road Infrastructure, Cupar North Cupar Fife
Further Information Requested regarding submitted AQIA and peer review.

6 Conclusions and Proposed Actions

6.1 Conclusions from New Monitoring data

Nitrogen Dioxide

The 2016 APR has considered the available monitoring data measured during 2015. During 2015 non-automatic, diffusion tube monitoring was undertaken at 48 locations within Fife. The new monitoring data highlighted exceedances of the AQS annual mean objective at two diffusion tube locations at:

- Appin Crescent (2), Dunfermline (40 µg m^{-3})
- Appin Crescent (6), (A), (B), (C), Dunfermline (43 µg m^{-3})

The exceedances of the annual mean NO_2 objective was measured at two location within Appin Crescent, Dunfermline, which has been declared an Air Quality Management Area (AQMA). Fife Council's Air Quality Action Plan (AQAP) for Appin Crescent intends to addresses these exceedances through the implementation of appropriate measures.

Particulate Matter

PM_{10} concentrations are measured at four locations in Fife at Bonnygate, Cupar; Appin Crescent, Dunfermline; Admiralty Road, Rosyth and St Clair Street, Kirkcaldy. Measured 2015 concentrations were below the PM_{10} annual mean objective with no exceedances of the annual mean or daily mean objective at all sites.

$PM_{2.5}$ concentrations have been measured at Rosyth since July 2015. The concentrations measured have been annualised in accordance with TG (16) resulting in an annual mean for 2015 of 6.8 µg m^{-3}.

Sulphur Dioxide

The 2015 results for SO_2 monitoring in Fife indicate that AQS objectives for SO_2 are unlikely to be exceeded. There are no new industrial processes, road or other developments that require detailed assessment with respect to this pollutant. SO_2 monitoring is not undertaken by Fife Council directly, it is undertaken on behalf of Longannet Power Station at Blair Mains, Fife.

Carbon Monoxide

Short-term monitoring undertaken by Fife Council's Transportation Services department during 2015 indicates that the AQS objective for CO is unlikely to have been exceeded during 2015. There are no new industrial processes, roads or other developments that require detailed assessment with respect to this pollutant.

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 Air Quality Strategy objective for these pollutants have been exceeded within the Fife Council boundary.

6.2 Conclusions Relating to New Developments

Fife Council have not identified any New Local Developments 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.

6.3 Proposed Actions

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

1. Submit the next Air Quality Progress Report in June 2017.

2. Maintain the current monitoring programme.

3. Continue to implement the measures outlined in the action plans for Appin Crescent, Dunfermline and Bonnygate, Cupar.

Appendices

Appendix A: Monitoring Results
Appendix B: Full Monthly Diffusion Tube Results for 2015
Appendix C: Supporting Technical Information/ Data QA/QC
Appendix D: Annualisation of Diffusion Tube Data
Appendix E: ECO Stars Scheme
Appendix F: CBA for traffic management measures at Appin Crescent AQMA 2016
Appendix G: Appin Crescent – Northern Link Road: Air Quality Modelling Assessment 2016
Appendix H: Technical Specification of Automatic Monitoring Equipment

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)
Bonnygate, Cupar	Kerbside	337406	714574	NO_2, PM_{10}	Y	NO_x Analyser (Chemiluminescence), TEOM-FDMS	N (1m)	<0.5m
Appin Crescent, Dunfermline	Roadside	309926	687722	NO_2, PM_{10}	Y	NO_x Analyser (Chemiluminescence), TEOM-FDMS	Y (1m)	4m
Admiralty Road, Rosyth	Roadside	311755	683503	NO_2, PM_{10}	N	NO_x Analyser (Chemiluminescence) TEOM-FDMS (until July 2015), FIDAS (since July 2015)	Y (1.5m)	6m
St Clair Street, Kirkcaldy	Roadside	329143	692986	NO_2, PM_{10}	N	NO_x Analyser (Chemiluminescence), TEOM-FDMS	N (10m)	5m

Table A. 2 - 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?
West Area								
St Leonards Primary School, Dunfermline	R(F)	309770	686895	NO_2	N	Y	10.6	N
Carnegie Drive (A,B,C), Dunfermline*	R(F)	309019	687632	NO_2*	N	Y	2.3	N
Rumblingwell, Dunfermline (5N)	R	307866	688231	NO_2	N	N (6.3)	1.7	N
Appin Crescent (A)(B)(C), Dunfermline (9N)*	R	309897	687713	NO_2	Y	N (5.1)	1.6	N
Appin Crescent (1) Dunfermline	R(F)	309891	687716	NO_2	Y	Y	6.5	N
Appin Crescent (2) Dunfermline	R(F)	309975	687716	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

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?
Appin Crescent 5(A)(B)(C)*	R(F)	309974	687716	NO_2	Y	Y	1.5	N
Appin Crescent 6(A)(B)(C)*	R(F)	309904	687704	NO_2	Y	Y	1.5	N
High Street, Cowdenbeath	K	316523	691740	NO_2	N	N (3.5)	0.5	N
North Approach Road (A, B) Kincardine	K	293182	687549	NO_2	N	N (11.0)	0.5	N
Pittencrieff St, Dunfermline	R(F)	308743	687549	NO_2	N	Y	0.5	N
11 Halbeath RD1, Dunfermline	R (F)	310245	687784	NO_2	N	Y	14	N
57 Halbeath RD2, Dunfermline	R (F)	310488	6987873	NO_2	N	Y	6	N
Admiralty Road A, Rosyth	R(F)	312140	683439	NO_2	N	Y	9	N
Admiralty Road (A,B,C) ROMON*	R(F)	311755	683503	NO_2^*	N	Y	6.5	Y
229 Admiralty Road, Rosyth	R (F)	311384	683543	NO_2	N	Y	11	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?
49 Ramsay Place, Rosyth	R (F)	311633	683688	NO_2	N	Y	14	N
129 Admiralty Road, Rosyth	R (F)	311693	683477	NO_2	N	Y	12	N
Pilmuir Road, Dunfermline	R	309412	687777	NO_2	N	Y	1.5	N
Mill Street, Dunfermline	R	308894	687964	NO_2	N	Y	1.5	N
Central Area								
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), Kirkcaldy	R(F)	329174	693069	NO_2	N	Y	2	N
St Clair Street ROMON (A,B,C,)* Kirkcaldy	R	329143	692986	NO_2	N	N(10.0m)	5	Y
Dunnikier Rd, Kirkcaldy	R(F)	328152	692350	NO_2	N	Y	3.4	N
Victoria Rd, Kirkcaldy	R(F)	328152	692325	NO_2	N	Y	2.5	N
Glenlyon Road, Levenmouth	K	337357	701318	NO_2	N	N (26.8)	1	N
Leslie High St	R(F)	325111	701806	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?
Queensway, Glenrothes	K	327849	701114	NO_2	N	N (17.0)	1	N
Adsa Roundabout, Kirkcaldy	K	328735	694053	NO_2	N	N (28.0)	1	N
125 St Clair Street, Kirkcaldy	R(F)	329208	693170	NO_2	N	Y	1.5	N
179A St Clair Street, Kirkcaldy	R(F)	329301	693315	NO_2	N	Y	1.5	N
3A Junction Road, Kirkcaldy	R(F)	329121	693036	NO_2	N	Y	1.5	N
24 St Clair Street, Kirkcaldy	R(F)	329091	692691	NO_2	N	Y	1.5	N
East Area								
City Road (1,2), St Andrews	R	350586	716580	NO_2	N	N (1.0)	1.5	Y
Bell Street (1,), St Andrews	R(F)	350708	716716	NO_2	N	Y	1.6	Y
Bell Street (2) St Andrews	R(F)	350716	716669	NO_2	N	Y	2.1	Y
Crossgate, Cupar	K	337536	714537	NO_2	Y	N (3.0)	0.5	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?
South Road, Cupar	R	337513	713616	NO_2	N	N (17.0)	1.8	Y
Cupar Road, Auchtermuchty	R(F)	324186	711801	NO_2	N	Y	1.8	Y
Bonnygate, Cupar (1N), Bonnygate 1	R(F)	337409	714570	NO_2	Y	Y	5.3	Y
Bonnygate, Cupar, Bonnygate 2	R(F)	337493	714586	NO_2	Y	Y	1.7	Y
Bonnygate, Cupar, Bonnygate 3 (A, B)	R(F)	337480	714586	NO_2	Y	Y	1.6	Y
Bonnygate, Cupar, Bonnygate B4	R(F)	337471	714575	NO_2	Y	Y	1.9	Y
Ladywynd, Cupar, Ladywynd B5	R(F)	337405	714596	NO_2	Y	Y	1	Y
Bonnygate West, Cupar, Bonnygate B6	R(F)	337342	714579	NO_2	Y	Y	3.2	Y
Bonnygate, Cupar, Monitor BA, BB, BC *	K	337406	714574	NO_2^*	Y	N (4.8)	0.6	Y
4 East Road, Cupar	R(F)	337915	714721	NO_2	Y	Y	14	Y

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. 3- Annual Mean NO_2 Monitoring Results (µg/m^3)

Site Name	Site Type	Valid Data Capture 2015 (%) (2)	2011	2012	2013	2014	2015
Appin Crescent, Dunfermline	Roadside	99	30	30	25	24	25
Bonnygate, Cupar	Kerbside	97	30	29	27	27	27
Admiralty Road, Rosyth	Roadside	93	28	28	25	25	23
St Clair Street, Kirkcaldy	Roadside	100	19*	32	20	18	18

Notes: Exceedances of the NO_2 annual mean objective of 40µg/m^3 are shown in bold.
NO_2 annual means exceeding 60µg/m^3, indicating a potential exceedance of the NO_2 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%).
* St Clair Street, Kirkcaldy started monitoring February 2011

NO_2 Annual Mean concentrations are presented in Figure A.1. Over the past 5 years NO_2 concentrations have declined and have generally stabilised between 2014 and 2015. The decline in concentrations could be a result of the current AQAP measures that have been implemented.

Figure A. 1 NO_2 annual mean 2011-2015 (µg/m^3)

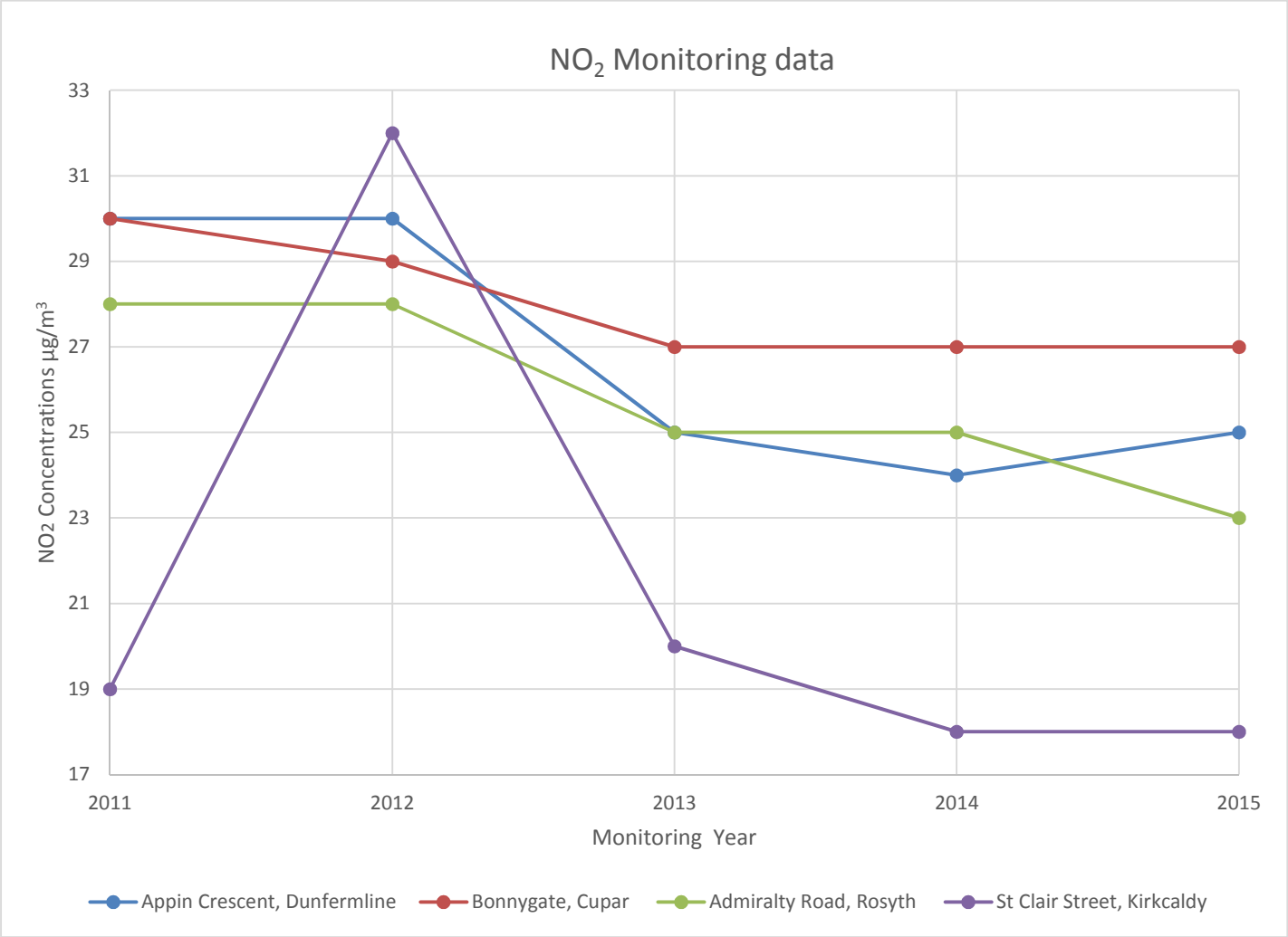


Table A. 4 - Annual mean NO_2 Monitoring Results- Non-Automatic sites (µg/m^3)

Site Name	Site Type	Valid Data Capture for Monitoring Period (%) [1]	Valid Data Capture 2015 (%) [2]	2011	2012	2013	2014	2015
Diffusion Tubes- West Area								
St Leonards Primary School, Dunfermline	R(F)	N/A	100	21 (20)	17	14	14	14
Carnegie Drive (A,B,C), Dunfermline	R(F)	N/A	100	38 (35)	35	31	32	30
Rumblingwell, Dunfermline (5N)	R	N/A	100	27 (21)	25	21	21	22
Appin Crescent (A)(B)(C), Dunfermline (9N)	R	N/A	100	36 (34)	34	31	31	32
Appin Crescent (1) Dunfermline	R(F)	N/A	100	29 (28)	27	25	26	27
Appin Crescent (2) Dunfermline	R(F)	N/A	100	**46 (44)**	**41**	39	39	**40**
Appin Crescent (3) Dunfermline	R(F)	N/A	100	**41 (39)**	39	33	33	35
Appin Crescent 4(A)(B)(C) Dunfermline	R(F)	N/A	100	32 (30)	28	25	25	25
Appin Crescent 5(A)(B)(C)	R(F)	N/A	100	**46 (43)**	**42**	36	36	39

Appin Crescent 6(A)(B)(C)	R(F)	N/A	100	**56 (47)**	**46**	**40**	**40**	**43**
High Street, Cowdenbeath	K	N/A	100	22	24	21	22	19
North Approach Road (A, B) Kincardine	K	N/A	100	19	19	17	16	16
Pittencrieff St, Dunfermline	R(F)	N/A	92	24 (22)	19	18	26	20
11 Halbeath RD1, Dunfermline	R (F)	N/A	100	22* (20*)	21	18	17	18
57 Halbeath RD2, Dunfermline	R (F)	N/A	100	26* (25*)	20	18	17	18
Admiralty Road A, Rosyth	R(F)	N/A	100	36 (31)	33	32	31	28
Admiralty Road (A,B,C) ROMON	R(F)	N/A	97	29** (25**)	28	26	25	23
229 Admiralty Road, Rosyth	R (F)	N/A	100	24	24	22	22^	20
49 Ramsay Place, Rosyth	R (F)	N/A	100	17	19	18	17	14.6
129 Admiralty Road, Rosyth	R (F)	N/A	100	27** (23.5**)	27	25	24	22
Pilmuir Road, Dunfermline	R	100	75	N/A	N/A	N/A	N/A	24
Mill Street, Dunfermline	R	100	75	N/A	N/A	N/A	N/A	28
Diffusion Tubes – Central Area								
St Clair Street (1) , Kirkcaldy	R(F)	N/A	100	**42 (40)**	**45**	34	35	31
St Clair Street (2) , Kirkcaldy	R(F)	N/A	100	36 (35)	**41**	36	36	37

St Clair Street (3), Kirkcaldy	R(F)	N/A	100	32 (31)	34	30	31	27
St Clair Street ROMON (A,B,C,)Kirkcaldy	R	N/A	100	19 (19)	25	20	18	19
Dunnikier Rd, Kirkcaldy	R(F)	N/A	100	30 (29)	32	27	27	25
Victoria Rd, Kirkcaldy	R(F)	N/A	100	32 (31)	34	29	29	26
Glenlyon Road, Levenmouth	K	N/A	100	27	28	24	26	25
Leslie High St	R(F)	N/A	100	22	25	21	20	19
Queensway, Glenrothes	K	N/A	100	22	25	20	20	18
Adsa Roundabout, Kirkcaldy	K	N/A	100	34 (33)	33	30	28	26
125 St Clair Street, Kirkcaldy	R(F)	N/A	100	-	N/A	31	31	32
179A St Clair Street, Kirkcaldy	R(F)	N/A	100	-	N/A	27	26	27
3A Junction Road, Kirkcaldy	R(F)	N/A	100	-	N/A	27	27	26
24 St Clair Street, Kirkcaldy	R(F)	N/A	83	-	N/A	19	20	20
Diffusion Tubes - East Area								
City Road (1,2), St Andrews	R	N/A	92	36	30	27	25	23
Bell Street (1,), St Andrews	R(F)	N/A	92	36	39	35	32	32
Bell Street (2) St Andrews	R(F)	N/A	67	39	36	25	28	21^^

Crossgate, Cupar	K	N/A	100	22 (24)	24	26	21	21
South Road, Cupar	R	N/A	83	12 (12)	14	12	11	12
Cupar Road, Auchtermuchty	R(F)	N/A	100	24	28	25	22	22
Bonnygate, Cupar (1N), Bonnygate 1	R(F)	N/A	83	28 (30)	29	22***	26	27
Bonnygate, Cupar, Bonnygate 2	R(F)	N/A	92	35 (38)	36	32	26	29
Bonnygate, Cupar, Bonnygate 3 (A, B)	R(F)	N/A	96	36 (39) ((41))	37	31	34	39
Bonnygate, Cupar, Bonnygate B4	R(F)	N/A	100	31 (33)	34	35	32	36
Ladywynd, Cupar, Ladywynd B5	R(F)	N/A	100	18 (19)	18	18	16	16
Bonnygate West, Cupar, Bonnygate B6	R(F)	N/A	100	19 (20)	21	19	19	18
Bonnygate, Cupar, Monitor BA, BB, BC	K	N/A	100	30 (32)	30	30	28	27
4 East Road, Cupar	R(F)	N/A	100	13 (14)	14	15	13	12

Notes: Exceedances of the NO_2 annual mean objective of 40µg/m^3 are shown in **bold**.

NO_2 annual means exceeding 60µg/m^3, indicating a potential exceedance of the NO_2 1-hour mean objective are shown in **bold and underlined.**

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

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

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

* 2011 data has been Period Mean Adjustment of 1.21 applied to non bias corrected data to compensate for January to September missing data
** 2011 data has been Period Mean Adjustment of 1.06 applied to non bias corrected data to compensate for January to April missing data
*** Data capture <75%
^ 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)
( ) Highest concentrations using highest bias correction factor.

Table A. 5 - 1-Hour Mean NO_2 Monitoring Results (NO_2 1-Hour Means > 200µg/m^3)

Site Name	Monitoring Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2015 (%) (2)	2011(3)	2012(3)	2013(3)	2014(3)	2015(3)
Appin Crescent, Dunfermline	Automatic	n/a	99	0	0	0	0	0
Bonnygate, Cupar	Automatic	n/a	97	0 (120)	0	0 (117)	0 (115)	0
Admiralty Road, Rosyth	Automatic	n/a	93	0	0	0	0 (105)	0

St Clair Street, Kirkcaldy	Automatic	n/a	100	0 (71)*	0	0	0	0

Notes: Exceedances of the NO_2 1-hour mean objective (200µg/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.

*St Clair Street, Kirkcaldy started monitoring February 2011

Table A. 6- Annual Mean PM_{10} Monitoring Results (µg/m^3)

Site Name	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2015 (%) (2)	2011(3)	2012(3)	2013(3)	2014(3)	2015(3)
Appin Crescent, Dunfermline	n/a	87	(16) 16*	15	15	15	16
Bonnygate, Cupar	n/a	80	19	18	(18) 18	17	17
Admiralty Road, Rosyth	n/a	90	20	17	14	15	14
St Clair Street, Kirkcaldy	n/a	100	13**	11	12	11	13

Notes: Exceedances of the PM_{10} annual mean objective of 18µg/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), valid data capture for the full calendar year is less than 75%. See Appendix C for details

* Appin Crescent, Dunfermline started monitoring PM10 March 2011, Period Mean Adjustment of 1.03 applied.

**St Clair Street, Kirkcaldy started monitoring February 2011

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

PM_{10} Annual Mean concentrations are presented in Figure A.2. Over the past 5 years NO_2 concentrations have declined and have generally stabilised between 2014 and 2015. The decline in concentrations could be a result of the current AQAP measures that have been implemented.

Figure A. 2 PM10 Annual Mean Concentrations 2011-2015 (µg/m^3)

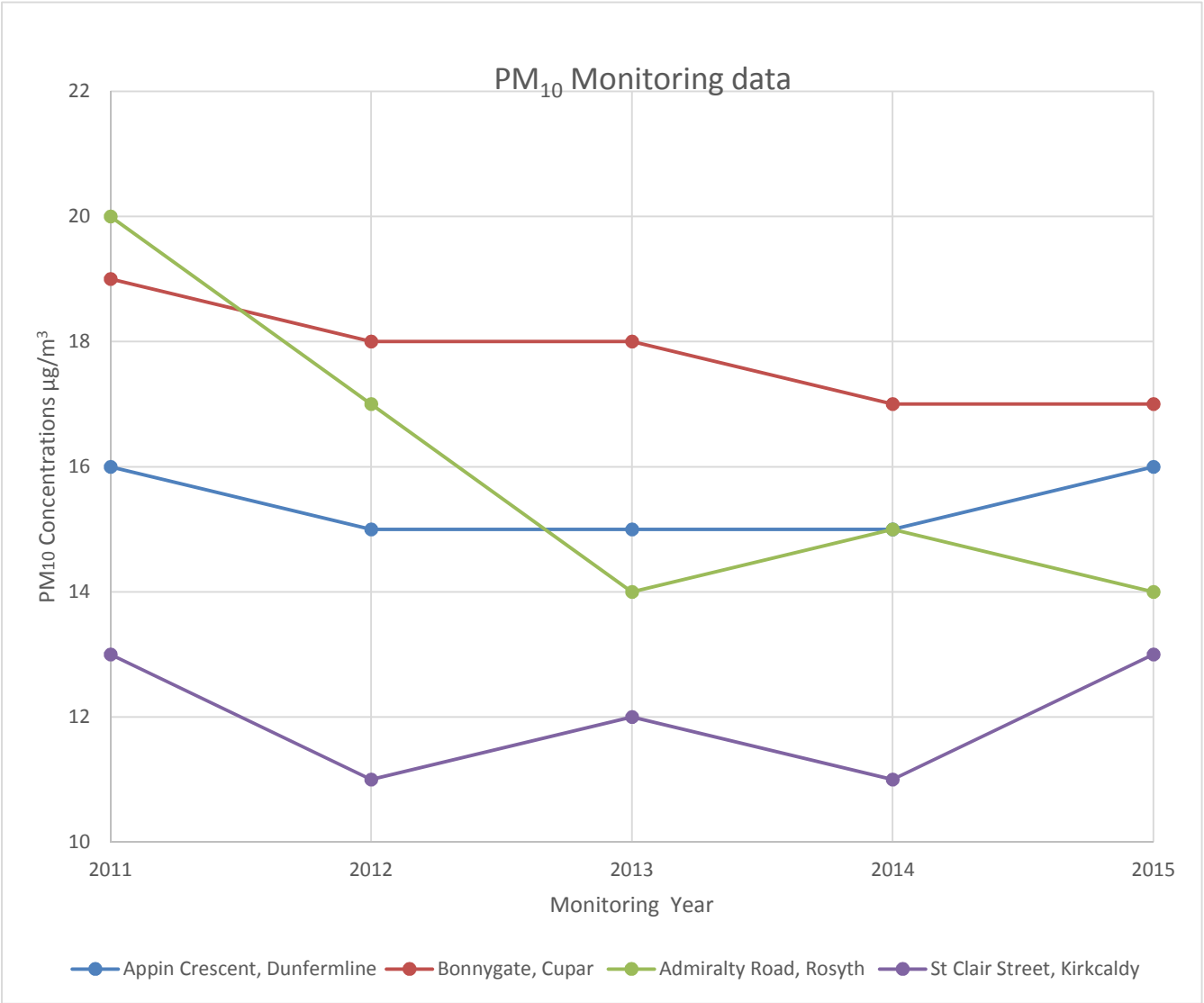

PM10 Monitoring data
22
20
18
16
14
12
10
PM10 Concentrations µg/m3
2011
2012
2013
2014
2015
Monitoring Year
Appin Crescent, Dunfermline
Bonnygate, Cupar
Admiralty Road, Rosyth
St Clair Street, Kirkcaldy

Table A. 7- 24- Hour Mean PM_{10} Monitoring Results (PM_{10} 24-Hour Means > 50µg/m^3)

Site Name	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2015 (%) (2)	2011(3)	2012(3)	2013(3)	2014(3)	2015(3)
Appin Crescent, Dunfermline	n/a	87	0 (38)*	4	2	0	2 (25)
Bonnygate, Cupar	n/a	80	0 (44)	4	4 (45)	0 (39)	2 (27)
Admiralty Road, Rosyth	n/a	90	3	1	2	0 (37)	3 (24)
St Clair Street, Kirkcaldy	n/a	100	0 (33)**	1	1	1 (25)	2

Notes: Exceedances of the PM_{10} 24-hour mean objective (50µg/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.

* Appin Crescent, Dunfermline started monitoring PM_{10} March 2011, Period Mean Adjustment of 1.03 applied.

**St Clair Street, Kirkcaldy started monitoring February 2011

Table A. 8- Annual Mean $PM_{2.5}$ Monitoring Results ($\mu g/m^3$)

Site Name	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2015 (%) (2)	2011(3)	2012(3)	2013(3)	2014(3)	2015(3)
	Admiralty Road, Rosyth	50%	n/a	n/a	n/a	n/a	7^^

Notes: Exceedances of the PM_{10} annual mean objective of 10 $\mu g/m^3$ 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), valid data capture for the full calendar year is less than 75%. See Appendix D for details.

^^ Data annualised as detailed in Appendix D, using Ratio factor of 1.105.

Appendix B - Full Monthly Diffusion Tube Results for 2015

Table B. 1- NO_2 Monthly Diffusion Tube Results for 2015 (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)
Diffusion Tubes-West Area														
St Leonards Primary School, Dunfermline	22.8	22	20.9	17.1	14	15.3	12.7	14	19.4	22.8	23.4	16.9	18.4	14
Carnegie Drive (A), Dunfermline	36.2	42.6	42.2	41.5	36.9	38.4	40.2	41.6	43.0	47.1	42.6	37.7	39.9	30
Carnegie Drive (B), Dunfermline	36.7	44.0	36.8	35.9	35.4	38.2	37.3	40.8	40.2	42.2	33.7	38.6		
Carnegie Drive (C), Dunfermline	39.4	41.7	42.5	38.2	40.0	37.1	40.6	41.7	42.0	44.9	37.6	40.6		
Rumblingwell, Dunfermline (5N)	33.6	32.4	32.7	27.5	23.8	27.4	23	26.8	29.2	34.2	33	30.2	29.5	22
Appin Crescent (A), Dunfermline (9N)	55.3	47.9	48.3	38.5	34.9	35.6	32.0	34.7	43.2	48.2	50.8	45.4	42.1	32
Appin Crescent (B), Dunfermline (9N)	47.1	41.7	45.2	42.1	37.5	40.7	32.4	35.4	42.2	43.1	53.2	45.2		
Appin Crescent (C), Dunfermline (9N)	50.4	53.5	45.4	41.9	38.1	36.9	34.3	32.4	39.1	44.4	38.2	41.1		
Appin Crescent (1) Dunfermline	43.2	41	39.4	33.9	30.7	30.4	26.3	29.1	35.1	37.1	35.8	35.9	34.8	27
Appin Crescent (2) Dunfermline	55.5	59.8	55.3	50.8	45	48.1	42.9	48.6	55.8	49.7	61.7	60	52.8	**40**
Appin Crescent (3) Dunfermline	57.2	54.6	46.4	44.1	37.6	40.9	37.8	38.7	41.7	51.5	57.5	46.1	46.2	35
Appin Crescent 4(A) Dunfermline	38.8	40.5	23.8	31.9	29.6	29.9	25.4	27.6	31.2	36.7	31.7	35.7	32.9	25
Appin Crescent 4(B) Dunfermline	44.0	34.3	36.6	30.5	27.0	30.2	25.0	28.9	33.3	36.5	36.3	36.4		
Appin Crescent 4(C) Dunfermline	38.4	41.3	37.9	31.2	29.3	29.9	25.6	28.5	31.8	37.6	36.7	33.9		
Appin Crescent 5(A)	60.4	58.7	56.7	51.2	47.0	45.5	42.5	44.0	45.3	51.3	56.8	51.5	51	39
Appin Crescent 5 (B)	58.9	59.2	54.0	46.1	44.9	48.6	40.0	44.0	48.6	53.3	63.5	60.7		
Appin Crescent 5(C)	62.2	64.6	57.3	50.9	42.2	45.6	39.0	44.4	45.0	49.7	52.0	50.1		

Appin Crescent 6(A)	61.7	69.3	57.2	50.5	46.9	51.9	46.4	53.6	58.4	55.2	67.4	62.1	56.7	**43**
Appin Crescent 6(B)	57.2	65.3	62.3	58.1	52.4	54.3	47.0	52.5	57.5	60.3	59.3	63.2		
Appin Crescent 6(C)	63.7	69.5	58.1	52.8	46.2	47.8	46.6	49.8	56.5	53.3	64.7	61.4		
High Street, Cowdenbeath	0.4	53.4	22.2	21.6	21.6	18.9	23.4	25.7	26.6	34.5	24	25.5	24.8	19
North Approach Road (A) Kincardine	30.1	29.5	22.4	16.4	16.3	16.1	15.8	17.4	20.2	26.1	29.3	21.9	21.5	16
North Approach Road (B) Kincardine	28.2	28.3	5.4**	18.6	13.6	16.9	14.8	17.2	21.5	23.6	28.6	21.7		
Pittencrieff St, Dunfermline	29.8	30.7	27.6	23.8	22.2	21	20.7	23.7	24.6	31.2	29.9	-	25.9	20
11 Halbeath RD1, Dunfermline	30.5	30	23.5	21.1	16	19.5	16.6	18.2	22.8	24.5	30.1	26	23.2	18
57 Halbeath RD2, Dunfermline	30.1	29.6	25.6	23.8	17.2	21.2	17.2	17.6	21.5	24.5	29	24.6	23.5	18
Admiralty Road A, Rosyth	40.7	37.2	40.8	35.1	32	32.7	32.4	33.7	35.3	43.8	41.3	39.1	37	28
Admiralty Road (A) ROMON	33.1	31.8	30.5	30.6	21.7	25.8	24.4	31.3	31.8	38.9	28.9	30.2	29.9	23
Admiralty Road (B) ROMON	33.6	31.3	30.1	29.1	22.9	26.3	26.1	30.0	33.1	36.2	35.1	28.2		
Admiralty Road (C) ROMON	31.4	31.1	32.4	30.8	23.6	25.1	26.1	26.9	32.3	38.7	tube lost	28.4		
229 Admiralty Road, Rosyth	31.9	28	30.3	26	21	24	16.2	23.6	25.1	30.9	32.1	28.7	26.5	20
49 Ramsay Place, Rosyth	20.6	21	19.7	19.5	14.7	14.6	16.4	18	20.7	23.9	22.2	19.4	19.2	15
129 Admiralty Road, Rosyth	28.6	29.7	33.2	28.9	22.7	23.6	25.9	26.8	30	37.3	33.1	29.3	29.1	22
Pilmuir Road, Dunfermline	-	-	-	36.6	29	29.5	26.7	31.4	32.3	33.4	38.6	29.3	31.9	24
Mill Street, Dunfermline	-	-	-	36.8	30.6	32.8	31.2	34.1	40.1	46.4	45.4	33.2	36.7	28
Diffusion Tubes- Central Area														
St Clair Street (1) , Kirkcaldy	46.6	34.4	43.3	**40.4**	**36.7**	38.2	41.3	38.5	39.7	48.5	41	37.9	40.5	31
St Clair Street (2) , Kirkcaldy	56.5	52.9	53.3	46	**48.5**	44.8	40.9	49.2	51	48.9	55.8	42.5	49.2	37
St Clair Street (3), Kirkcaldy	34.9	32.4	39.7	37.5	30.6	34.5	36	37.2	36.9	45.4	28.2	34.8	35.7	27

St Clair Street ROMON (A)Kirkcaldy	46.6	34.4	43.3	40.4	36.7	38.2	41.3	38.5	39.7	48.5	41.0	37.9	25.4	19
St Clair Street ROMON (B) Kirkcaldy	56.5	52.9	53.3	46.0	48.5	44.8	40.9	49.2	51.0	48.9	55.8	42.5		
St Clair Street ROMON (C) Kirkcaldy	34.9	32.4	39.7	37.5	30.6	34.5	36.0	37.2	36.9	45.4	28.2	34.8		
Dunnikier Rd, Kirkcaldy	31.7	32.1	34.5	32.9	26	31	31.4	33.5	35.3	41.4	35.6	30.9	33	25
Victoria Rd, Kirkcaldy	34.1	38	30.4	32.3	26.9	29.1	32.5	34.5	34.8	39.4	48.3	30.5	34.2	26
Glenlyon Road, Levenmouth	35.4	33.8	31.9	31.3	28.1	27.6	31.6	35	34.1	37.6	40.4	29.1	33	25
Leslie High St	27.6	30.7	28.7	22.7	20.1	21.7	18.3	21.8	26.1	31.1	25.6	22	24.7	19
Queensway, Glenrothes	24.7	27.8	24.8	22.6	17.5	19.9	19.7	20.5	25.9	31.3	26.3	26.1	23.9	18
Adsa Roundabout, Kirkcaldy	36.4	29.5	37	30.7	25.9	34.6	32.5	34.3	33.6	41	40.1	36.9	34.4	26
125 St Clair Street, Kirkcaldy	42.5	50	43.1	38.7	34.6	36.6	34	40.8	43.9	41	53.8	40.4	30	32
179A St Clair Street, Kirkcaldy	42.2	42.7	33	30.6	26.6	26.8	25	34.5	36.7	45.4	45.3	31.5	25.2	27
3A Junction Road, Kirkcaldy	28.9	37.7	34	33.2	29.3	32	31.2	34.3	33.8	41.2	38.2	31.2	33.8	26
24 St Clair Street, Kirkcaldy	26.3	30.5	24.4	24.3	18.1	-	-	24.9	25.8	33.3	32.2	26.1	19.1	20
Diffusion Tube – East Area														
City Road (1), St Andrews	Tube lost	15.2	52.0	18.0	19.1	41.7	21.2	27.7	36.3	40.4	27.9	25.3	29.7	23
City Road (2), St Andrews	Tube lost	12.6	49.9	17.7	19.9	42.5	19.7	29.3	37.2	40.7	31.8	26.7		
Bell Street (1,), St Andrews	61.7	23.7	71.4	29.3	25	54.6	-	37	41.6	42	34.1	34.5	41.4	32
Bell Street (2) St Andrews	50.6	-	-	-	22	-	19	32.3	40	45.3	36.8	33.4	34.9	26^^
Crossgate, Cupar	45.1	16.4	40.3	29.4	16.8	36.3	17.5	21.4	25.5	28.5	25.7	26.2	27.4	21
South Road, Cupar	26.9	9.4	17.6	14	6.6	18.3	-	-	15.9	18.8	13.3	18.6	15.9	12
Cupar Road, Auchtermuchty	44.9	18.4	38	28.4	18.5	40.2	16.6	28.7	35.8	23	27.5	24.7	28.7	22

Bonnygate, Cupar (1N), Bonnygate 1	56.1	18.1	44.9	32.2	17.6	40.4	-	-	37.5	40.7	36.5	34.2	35.8	27
Bonnygate, Cupar, Bonnygate 2	52.3	19	38.3	30.1	18.1	44.9	25	-	39.4	57.9	47.5	39.3	37.4	29
Bonnygate, Cupar, Bonnygate 3 (A)	78.6	21.9	56.2	37.0	26.1	54.8	Tube lost	45.2	67.9	94.1	87.2	56.8	51.5	39
Bonnygate, Cupar, Bonnygate 3 (B)	101.1	27.0	58.1	52.5	27.5	59.3	28.3	37.8	45.8	40.9	38.0	36.3		
Bonnygate, Cupar, Bonnygate B4	65.2	17.6	52.6	47	24.6	57	26.1	52.1	61.5	41.3	71	45.3	46.8	35.6
Ladywynd, Cupar, Ladywynd B5	38.2	11.4	26.7	20.8	10.7	22.6	8.8	18	20.4	24.3	26.4	23.4	21	16
Bonnygate West, Cupar, Bonnygate B6	40.4	12.6	31.7	25.2	13.3	30	13.7	18.8	24.8	27.3	23.5	22.2	23.6	18
Bonnygate, Cupar, Monitor BA	61.1	20.1	47.9	33.1	21.5	47.8	21.4	30.9	35.5	35.1	41.4	34.9	35.2	27
Bonnygate, Cupar, Monitor BB	58.1	18.5	41.6	39.1	20.3	48.2	21.4	33.3	39.0	34.2	41.6	31.5		
Bonnygate, Cupar, Monitor BC	56.9	16.7	37.4	35.1	19.1	45.1	20.3	30.7	37.0	40.9	38.7	32.3		
4 East Road, Cupar	34.1	11.1	21.1	14.8	9	1.4	2.4	12.7	17.2	18.8	22.3	18.6	15.3	12

(1) See Appendix C for details on bias adjustment

(2) ^^2015 data annualised, adjustment factor of 0.99 to calculate annual mean from period mean concentrations as described in TG(16)

(3) Exceedances of the NO_2 annual mean objective of 40µg/m^3 are shown in bold.

(4) ** North Approach Road (B) Kincardine March concentration (5.4) discarded as sampling error due to low concentration, average concentration recalculated.

Appendix C - Supporting Technical Information/ Data QA/QC

Diffusion Tube Bias Adjustment Factors

Diffusion tubes may over or under predict NO_2 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 or this. Results are adjusted using a calculated bias adjustment factor.

The diffusion tubes deployed by Fife Council are supplied and analysed by Tayside Scientific Services using a preparation mixture of 20% triethanolamine (TEA) in water. The bias adjustment factor of 0.77 reported in the national diffusion tube bias adjustment factor spreadsheet (version 03/16), conducted using diffusion tubes prepared and analysed by Tayside Scientific Services during 2015.

The National Spreadsheet of Bias Adjustment Factors (version 03/16) is shown below in Figure C.1 and Figures C2 – C5 show the locally derived adjustment factors. Overall the locally derived adjustment factor was 0.75, with a combined factor of 0.76 using both local and national adjustment. The combined adjustment factor of 0.76 has been used to bias correct the diffusion tube results within this report.

Figure C. 1 National Bias Adjustment Factor Spreadsheet

National Diffusion Tube Bias Adjustment Factor Spreadsheet — Spreadsheet Version Number: 03/16

Follow the steps below in the correct order to show the results of relevant co-location studies
Data only apply to tubes exposed monthly and are not suitable for correcting individual short-term monitoring periods
Whenever presenting adjusted data, you should state the adjustment factor used and the version of the spreadsheet
This spreadsheet will be updated every few months: the factors may therefore be subject to change. This should not discourage their immediate use.

This spreadsheet will be updated at the end of June 2016

The LAQM Helpdesk is operated on behalf of Defra and the Devolved Administrations by Bureau Veritas, in conjunction with contract partners AECOM and the National Physical Laboratory.

Spreadsheet maintained by the National Physical Laboratory. Original compiled by Air Quality Consultants Ltd.

Step 1: Select the Laboratory that Analyses Your Tubes from the Drop-Down List

Step 2: Select a Preparation Method from the Drop-Down List

Step 3: Select a Year from the Drop-Down List

Step 4: Where there is only one study for a chosen combination, you should use the adjustment factor shown with caution. Where there is more than one study, use the overall factor* shown in blue at the foot of the final column.

If you have your own co-location study then see footnote*. If uncertain what to do then contact the Local Air Quality Management Helpdesk at LAQMHelpdesk@uk.bureauveritas.com or 0800 0327953

Analysed By*	Method	Year*	Site Type	Local Authority	Length of Study (months)	Diffusion Tube Mean Conc. (Dm) (µg/m³)	Automatic Monitor Mean Conc. (Cm) (µg/m³)	Bias (B)	Tube Precision*	Bias Adjustment Factor (A) (Cm/Dm)
Tayside Scientific Services	20% TEA in water	2015	KS	Marylebone Road Intercomparison	12	107	81	31.5%	G	0.76
Tayside Scientific Services	20% TEA in water	2015	R	Fife Council	11	30	23	32.4%	G	0.76
Tayside Scientific Services	20% TEA in water	2015	R	Fife Council	12	25	19	34.3%	G	0.74
Tayside Scientific Services	20% TEA in water	2015	R	Fife Council	12	33	25	29.8%	G	0.77
Tayside Scientific Services	20% TEA in water	2015	R	Fife Council	12	35	28	25.4%	G	0.80
Tayside Scientific Services	20% TEA in water	2015		Overall Factor* (5 studies)				Use		0.77

Figure C. 2 Local Bias adjustment spreadsheet- Cupar

Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

Diffusion Tubes Measurements

Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 µgm^{-3}	Tube 2 µgm^{-3}	Tube 3 µgm^{-3}	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean
1	09/01/2015	04/02/2015	61.1	58.1	56.9	59	2.2	4	5.4
2	04/02/2015	04/03/2015	20.1	18.5	16.7	18	1.7	9	4.2
3	06/03/2015	03/04/2015	47.9	41.6	37.4	42	5.3	12	13.1
4	03/04/2015	01/05/2015	33.1	39.1	35.1	36	3.1	9	7.6
5	01/05/2015	29/05/2015	21.5	20.3	19.1	20	1.2	6	3.0
6	29/05/2015	03/07/2015	47.8	48.2	45.1	47	1.7	4	4.2
7	03/07/2015	29/07/2015	21.4	21.4	20.3	21	0.6	3	1.6
8	29/07/2015	27/08/2015	30.9	33.3	30.7	32	1.4	5	3.6
9	27/08/2015	01/10/2015	35.5	39.0	37.0	37	1.8	5	4.4
10	01/10/2015	27/10/2015	35.1	34.2	40.9	37	3.6	10	9.0
11	27/10/2015	30/11/2015	41.4	41.6	38.7	41	1.6	4	4.0
12	30/11/2015	06/01/2016	34.9	31.5	32.3	33	1.8	5	4.4
13									

Automatic Method		Data Quality Check	
Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
38	92	Good	Good
37	96	Good	Good
27	100	Good	Good
24	99	Good	Good
21	86	Good	Good
21	98	Good	Good
21	94	Good	Good
22	100	Good	Good
27	100	Good	Good
30	99	Good	Good
31	100	Good	Good
28	100	Good	Good
Overall survey -->		Good precision	Good Overall

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

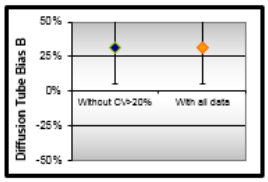
(Check average CV & DC from Accuracy calculations)

Site Name/ ID:	Bonnygate/Cupar

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

Accuracy (with 95% confidence interval) without periods with CV larger than 20%	
Bias calculated using 12 periods of data	
Bias factor A	0.77 (0.64 - 0.98)
Bias B	29% (3% - 56%)
Diffusion Tubes Mean:	35 µgm^{-3}
Mean CV (Precision):	6
Automatic Mean:	27 µgm^{-3}
Data Capture for periods used:	97%
Adjusted Tubes Mean:	27 (23 - 35) µgm^{-3}

Accuracy (with 95% confidence interval) WITH ALL DATA	
Bias calculated using 12 periods of data	
Bias factor A	0.77 (0.64 - 0.98)
Bias B	29% (3% - 56%)
Diffusion Tubes Mean:	35 µgm^{-3}
Mean CV (Precision):	6
Automatic Mean:	27 µgm^{-3}
Data Capture for periods used:	97%
Adjusted Tubes Mean:	27 (23 - 35) µgm^{-3}



Jaume Targa, for AEA
Version 04 - February 2011

Figure C. 3 Local Bias Adjustment Factor spreadsheet- Dunfermline

Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

Diffusion Tubes Measurements

Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 µgm^{-3}	Tube 2 µgm^{-3}	Tube 3 µgm^{-3}	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean
1	06/01/2015	04/02/2015	38.8	44.0	38.4	40	3.1	8	7.8
2	04/02/2015	04/03/2015	40.5	34.3	41.3	39	3.8	10	9.5
3	04/03/2015	31/03/2015	23.8	36.6	37.9	33	7.8	24	19.4
4	31/03/2015	28/04/2015	31.9	30.5	31.2	31	0.7	2	1.7
5	28/04/2015	25/05/2015	29.6	27.0	29.3	29	1.4	5	3.5
6	25/05/2015	29/06/2015	29.9	30.2	29.9	30	0.2	1	0.4
7	29/06/2015	27/07/2015	25.4	25.0	25.6	25	0.3	1	0.8
8	27/07/2015	26/08/2015	27.6	28.9	28.5	28	0.7	2	1.7
9	26/08/2015	30/09/2015	31.2	33.3	31.8	32	1.1	3	2.7
10	30/09/2015	26/10/2015	36.7	36.5	37.6	37	0.6	2	1.5
11	26/10/2015	03/12/2015	31.7	36.3	36.7	35	2.8	8	6.9
12	03/12/2015	04/01/2016	35.7	36.4	33.9	35	1.3	4	3.2
13									

Automatic Method		Data Quality Check	
Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
31	100	Good	Good
34	99	Good	Good
27	100	Poor Precision	Good
24	99	Good	Good
18	99	Good	Good
19	98	Good	Good
17	100	Good	Good
19	100	Good	Good
25	98	Good	Good
29	99	Good	Good
30	99	Good	Good
26	100	Good	Good
Overall survey -->		Good precision	Good Overall

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

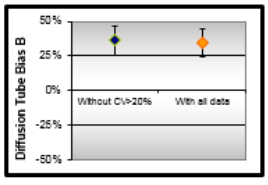
(Check average CV & DC from Accuracy calculations)

Site Name/ ID:	Appin Crescent-Dunfermline

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

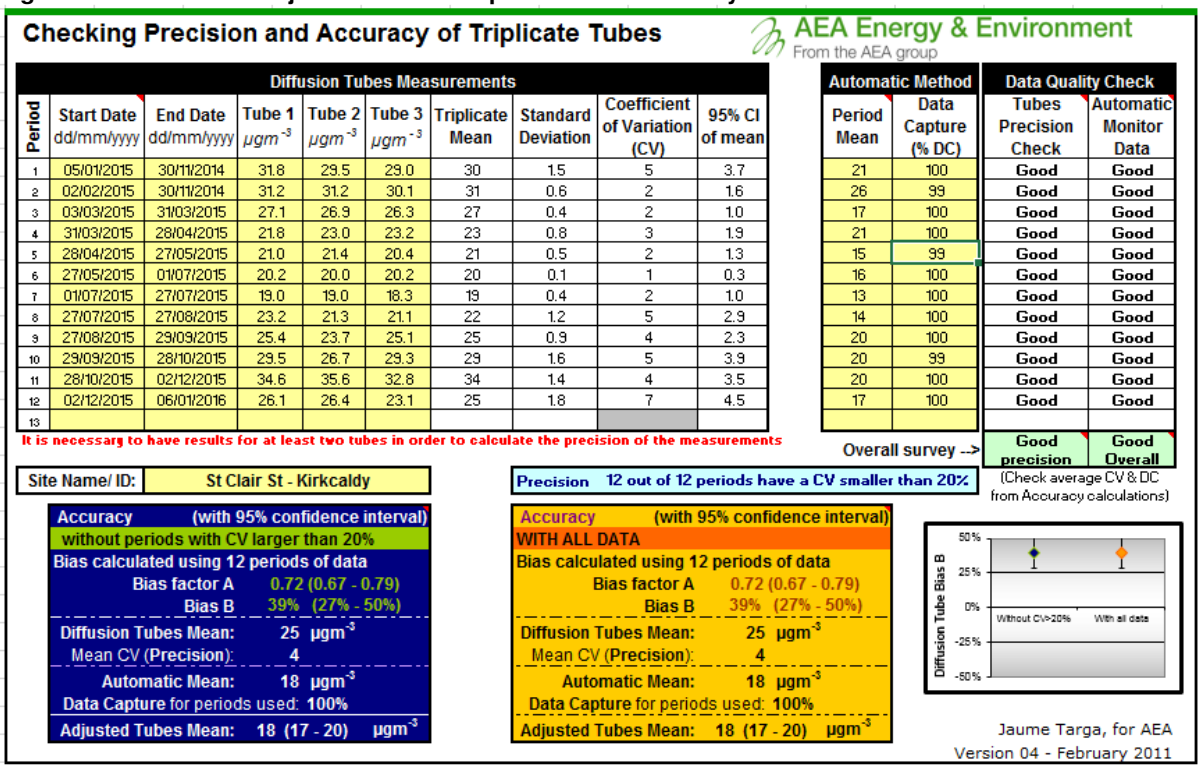
Accuracy (with 95% confidence interval) without periods with CV larger than 20%	
Bias calculated using 11 periods of data	
Bias factor A	0.75 (0.7 - 0.82)
Bias B	33% (23% - 44%)
Diffusion Tubes Mean:	33 µgm^{-3}
Mean CV (Precision):	4
Automatic Mean:	25 µgm^{-3}
Data Capture for periods used:	99%
Adjusted Tubes Mean:	25 (23 - 27) µgm^{-3}

Accuracy (with 95% confidence interval) WITH ALL DATA	
Bias calculated using 12 periods of data	
Bias factor A	0.76 (0.7 - 0.82)
Bias B	32% (22% - 42%)
Diffusion Tubes Mean:	33 µgm^{-3}
Mean CV (Precision):	6
Automatic Mean:	25 µgm^{-3}
Data Capture for periods used:	99%
Adjusted Tubes Mean:	25 (23 - 27) µgm^{-3}



Jaume Targa, for AEA
Version 04 - February 2011

Figure C. 4 Local Bias Adjustment Factor spreadsheet- Kirkcaldy



Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

Diffusion Tubes Measurements

Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 µgm^{-3}	Tube 2 µgm^{-3}	Tube 3 µgm^{-3}	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean
1	05/01/2015	30/11/2014	31.8	29.5	29.0	30	1.5	5	3.7
2	02/02/2015	30/11/2014	31.2	31.2	30.1	31	0.6	2	1.6
3	03/03/2015	31/03/2015	27.1	26.9	26.3	27	0.4	2	1.0
4	31/03/2015	28/04/2015	21.8	23.0	23.2	23	0.8	3	1.9
5	28/04/2015	27/05/2015	21.0	21.4	20.4	21	0.5	2	1.3
6	27/05/2015	01/07/2015	20.2	20.0	20.2	20	0.1	1	0.3
7	01/07/2015	27/07/2015	19.0	19.0	18.3	19	0.4	2	1.0
8	27/07/2015	27/08/2015	23.2	21.3	21.1	22	1.2	5	2.9
9	27/08/2015	29/09/2015	25.4	23.7	25.1	25	0.9	4	2.3
10	29/09/2015	28/10/2015	29.5	26.7	29.3	29	1.6	5	3.9
11	28/10/2015	02/12/2015	34.6	35.6	32.8	34	1.4	4	3.5
12	02/12/2015	06/01/2016	26.1	26.4	23.1	25	1.8	7	4.5
13									

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

Automatic Method		Data Quality Check	
Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
21	100	Good	Good
26	99	Good	Good
17	100	Good	Good
21	100	Good	Good
15	99	Good	Good
16	100	Good	Good
13	100	Good	Good
14	100	Good	Good
20	100	Good	Good
20	99	Good	Good
20	100	Good	Good
17	100	Good	Good
Overall survey -->		Good precision	Good Overall

(Check average CV & DC from Accuracy calculations)

Site Name/ ID: St Clair St - Kirkcaldy

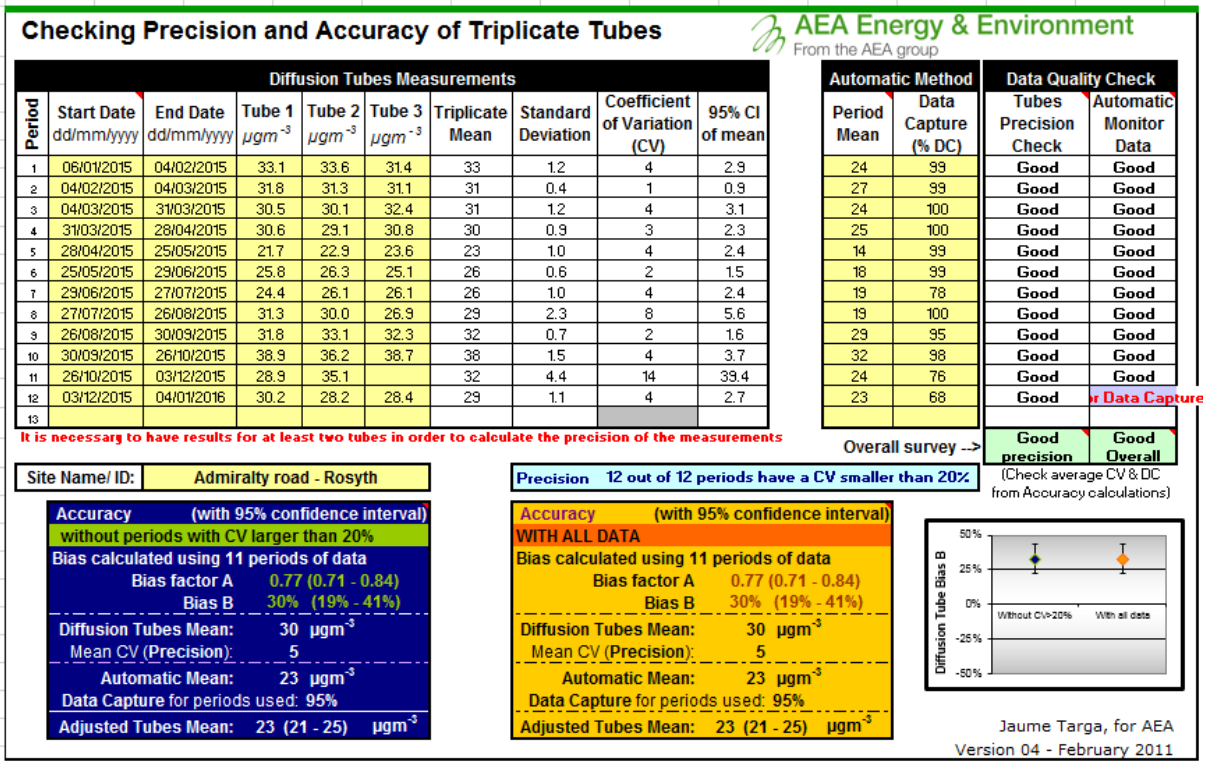
Precision 12 out of 12 periods have a CV smaller than 20%

Accuracy (with 95% confidence interval)
without periods with CV larger than 20%
Bias calculated using 12 periods of data
Bias factor A 0.72 (0.67 - 0.79)
Bias B 39% (27% - 50%)
Diffusion Tubes Mean: 25 µgm^{-3}
Mean CV (Precision): 4
Automatic Mean: 18 µgm^{-3}
Data Capture for periods used: 100%
Adjusted Tubes Mean: 18 (17 - 20) µgm^{-3}

Accuracy (with 95% confidence interval)
WITH ALL DATA
Bias calculated using 12 periods of data
Bias factor A 0.72 (0.67 - 0.79)
Bias B 39% (27% - 50%)
Diffusion Tubes Mean: 25 µgm^{-3}
Mean CV (Precision): 4
Automatic Mean: 18 µgm^{-3}
Data Capture for periods used: 100%
Adjusted Tubes Mean: 18 (17 - 20) µgm^{-3}

Jaume Targa, for AEA
Version 04 - February 2011

Figure C. 5 Local Bias Adjustment Factor Spreadsheet – Rosyth



Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

Diffusion Tubes Measurements

Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 µgm^{-3}	Tube 2 µgm^{-3}	Tube 3 µgm^{-3}	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean
1	06/01/2015	04/02/2015	33.1	33.6	31.4	33	1.2	4	2.9
2	04/02/2015	04/03/2015	31.8	31.3	31.1	31	0.4	1	0.9
3	04/03/2015	31/03/2015	30.5	30.1	32.4	31	1.2	4	3.1
4	31/03/2015	28/04/2015	30.6	29.1	30.8	30	0.9	3	2.3
5	28/04/2015	25/05/2015	21.7	22.9	23.6	23	1.0	4	2.4
6	25/05/2015	29/06/2015	25.8	26.3	25.1	26	0.6	2	1.5
7	29/06/2015	27/07/2015	24.4	26.1	26.1	26	1.0	4	2.4
8	27/07/2015	26/08/2015	31.3	30.0	26.9	29	2.3	8	5.6
9	26/08/2015	30/09/2015	31.8	33.1	32.3	32	0.7	2	1.6
10	30/09/2015	26/10/2015	38.9	36.2	38.7	38	1.5	4	3.7
11	26/10/2015	03/12/2015	28.9	35.1		32	4.4	14	39.4
12	03/12/2015	04/01/2016	30.2	28.2	28.4	29	1.1	4	2.7
13									

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

Automatic Method		Data Quality Check	
Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
24	99	Good	Good
27	99	Good	Good
24	100	Good	Good
25	100	Good	Good
14	99	Good	Good
18	99	Good	Good
19	78	Good	Good
19	100	Good	Good
29	95	Good	Good
32	98	Good	Good
24	76	Good	Good
23	68	Good	r Data Capture
Overall survey -->		Good precision	Good Overall

(Check average CV & DC from Accuracy calculations)

Site Name/ ID: Admiralty road - Rosyth

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

Accuracy (with 95% confidence interval)
without periods with CV larger than 20%
Bias calculated using 11 periods of data
Bias factor A 0.77 (0.71 - 0.84)
Bias B 30% (19% - 41%)
Diffusion Tubes Mean: 30 µgm^{-3}
Mean CV (Precision): 5
Automatic Mean: 23 µgm^{-3}
Data Capture for periods used: 95%
Adjusted Tubes Mean: 23 (21 - 25) µgm^{-3}

Accuracy (with 95% confidence interval)
WITH ALL DATA
Bias calculated using 11 periods of data
Bias factor A 0.77 (0.71 - 0.84)
Bias B 30% (19% - 41%)
Diffusion Tubes Mean: 30 µgm^{-3}
Mean CV (Precision): 5
Automatic Mean: 23 µgm^{-3}
Data Capture for periods used: 95%
Adjusted Tubes Mean: 23 (21 - 25) µgm^{-3}

Jaume Targa, for AEA
Version 04 - February 2011

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 level 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 outlined in the Technical Guidance (TG.16), the following QA/QC procedures were implemented:

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

Calibrations of the NOx analyser were carried out using certified compressed gas standards (ISO17025). This ensured that the calibration gas was traceable to national and international standards. In addition to the calibration, sample filters were changed for NOx and TEOM FDMS analysers and any faults were identified thus minimising data loss.

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 collated 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 supplied and analysed by Tayside Scientific Services (formerly Dundee City Council Scientific Services). The laboratory participates in three schemes which ensure that the NO_2 tube results meet acceptable standards:

1. The WASP scheme is run by the Health and Safety Laboratory. Each month one tube is sent for testing. Results are compared with other participating labs and feedback on performance provided.

2. Every three months three tubes and a blank (for analysis) are supplied for exposure at an intercomparison site operated as part of the Support to Local Authorities for Air Quality Management contract funded by the Scottish Government, Defra and the other Devolved Authorities. Again, results are compared with other participating labs and feedback on performance provided.

3. Each month a QC NO_2 solution is also provided via this contract. This solution is run as an internal check for NO2 tubes in the laboratory. The solution is tested after every 21 NO_2 tube samples.

Tayside Scientific Services also use in-house quality assurance standards. The tube preparation method is 20% TEA in water.

Bias Correction for Diffusion Tubes
Diffusion tube samplers are a simple and cost effective method of measuring NO_2. However, they are classed as an indicative method and are known to have a systematic bias compared to more accurate results obtained from calibrated automatic analysers.

The degree of systematic bias depends on the laboratory preparing and analysing the tubes, and also includes the methodology employed for that analysis. Therefore, it is necessary to methodology determine a bias adjustment factor appropriate for the particular diffusion tubes used in Fife. For determining the appropriate bias adjustment factor is outlined in LAQM TG (16); and several online tools are also available to assist with this process.

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 calculation spreadsheets are shown in Figure C2-5 above.

The average of the bias adjustment factors from Appin Crescent, Bonnygate, Admiralty Road and St Clair Street is 0.79. The nationally derived bias adjustment factor was calculated as 0.77; however, this has been calculated using only one study from the up-to-date National Bias Adjustment Factor Spreadsheet (version number 03/16). A further bias adjustment factor has been calculated by combining both the locally and nationally derived factors.

For this report, in order to keep results comparable, the combined bias correction factor has been applied to all diffusion tubes.TG16 outlines that a combined approach should be used when:

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

As Cupar is situated in a street canyon the combined Local and national bias adjusted factors have been applied across the entire dataset.

Table C. 1 Local BIAS adjustment factors

Source	Bias Adjustment Factors 2015
Appin Crescent, Dunfermline	0.75
Bonnygate, Cupar	0.77
Admiralty Road, Rosyth	0.77
St Clair Street, Kirkcaldy	0.72
Nationally Derived	0.77
Combined Bias factor (national and local)	**0.76**

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. Monitoring of PM2.5 commenced at Rosyth in July 2015.

Table D. 1 - Annualisation of Rosyth $PM_{2.5}$

Background Site	Annual mean 2015 (Am)	Period Mean 2015 (Pm)	Ratio (Am/Pm)
Edinburgh St Leonards	6	6.5	0.923
Auchencorth Moss	3	2.3	1.288
Average (Ra)			1.105
Rosyth Period Mean (µg/m^3)			6.16
Rosyth Annual Mean (µg/m^3)			**6.8**

Table D. 2 Annualisation of Diffusion Tubes

Diffusion Tubes	Annual mean 2015 (Am)	Period Mean 2015 (Pm) (July to December)	Ratio (Am/Pm)
Bush Estate	6	6.25	0.96
St Leonards	26	25.49	1.02
Average (Ra)			0.99
Bell Street 2- St Andrews Period Mean (µg/m^3)			34.5
Bell Street 2- St Andrews Annual Mean (µg/m^3)			34.1
Bell Street 2- St Andrews Annual Mean (µg/m^3) – BIAS Adjusted			25.9

Appendix E- Fife ECO Stars Scheme

Fife Council launched its ECO Stars scheme for taxis and private hire vehicles on 19th December 2015 at Town House in Kirkcaldy. The event was well attended and attendees heard a number of talks on air quality and transport related issues. Certificates were presented to new ECO Stars Taxi members.

Fife Council also held its second ECO Stars workshop to help Fife fleet operators become more efficient and improve local air quality on 15th March 2016 at City Chambers, Dunfermline.

Workshop attendees heard presentations on a range of topics including air quality and driver training, took part in lively discussions relating to fuel efficiency, fleet management and cultural change in organisations, and shared their experiences of the scheme.

Again the event was well attended and outcomes of this workshop will be used to influence future strategic discussion on these issues.

Appendix F - Cost Benefit Analysis for traffic management measures at Appin Crescent AQMA 2016

One of the measures out in the Appin Crescent AQAP was to investigate optimisation of the traffic management system within the AQMA and the surround network in Dunfermline.A number of traffic management measures have now been investigated using a combined of micro simulation traffic modelling and atmospheric dispersion modelling.

The Phase 3 air quality assessment[43] investigated three options. The modelling study indicated that two of these options would result in in reductions of NO_2 and PM_{10} concentrations within Appin Crescent.

- Test Option 2- Investigated the reconfiguration of the Appin Crescent/ Garvock Hill mini roundabout. The dispersion modelling results indicated that annual mean NO_2 concentrations would reduce at some receptor locations by up to 2.6 µg/m^3. It was also predicted that the NO_2 annual mean at some receptor locations may increase by 0.6 µg/m^3 compared to the 2015 baseline.
- Test Option 3- investigated the removal of bus stops on Appin Crescent. The traffic modelling concluded that there were benefits in terms of reduced traffic queuing on Appin Crescent during both AM and PM peak traffic periods. The dispersion modelling predictions indicated a reduction of up to 2.5 µg/m^3 for NO_2 annual mean concentrations. For PM_{10} the predicted reduction in annual mean concentration was very small with reductions of up to 0.1 µg/m^3 along Appin Crescent.

The study concluded that although Test Option 2 and Test Option 3 do result in reductions of PM_{10} and NO_2 annual mean concentrations, neither of these options offer the opportunity to reduce concentrations below the AQS objectives for NO_2 or PM_{10} in the future year modelled.

The report also concluded that as Test option 3 may be relatively inexpensive to implement, it may be beneficial to conduct an economic assessment for this scheme considering the net change in emissions that could be achieved as a result. Ricardo Energy & Environment were subsequently commissioned to undertake this work.

[43] Ricardo Energy & Environment (2015): Appin Crescent Traffic Management Options Appraisal (Phase 3): Air Quality Impact Assessment, report provided to Fife Council.

Appendix G Appin Crescent – Northern Link Road: Air Quality Modelling Assessment 2016

A number of zones within Dunfermline have been allocated for residential and other urban land use developments. The additional vehicle trips generated by these developments are likely to have an impact on road traffic emissions within the Appin Crescent AQMA. A measure that will likely help reduce traffic numbers and hence vehicle emissions in Appin Crescent is the construction of the Northern Link Road which will initially link Pilmuir Street and Whitefield Road in the area of Dunfermline to the North of Appin Crescent. Completion of the Northern link road will link Pilmur Street with the main road network at the east of Dunfermline. This will provide an alternative route for traffic that would otherwise use the Halbeath corridor and Appin Crescent to travel in and out of Dunfermline from the east.

The 2011 Dunfermline Strategic Land Allocation (SLA) Transport Assessment concluded that for effective operation of the road network, and in addition to a number of other upgrades to the road infrastructure, the link road will likely be required at some point between 2021 and 2029 depending on the rollout of residential and commercial developments in the SLA area. Comparison of the predicted pollutant concentrations for each scenario modelled indicate that neither the NO_2 or PM_{10} annual mean objectives are expected to be exceeded in 2029. Annual mean PM_{10} concentrations are still predicted to be close to the 18 µg m^{-3} objective in 2029 at the Appin Crescent 2 and Appin Crescent 3 receptor locations. The study area comprised of the Appin Crescent AQMA.

The findings of this study are to be incorporated with the Council's decision making process in terms of ensuring proposed new development does not compromise the achievement of statutory air quality objectives.

Appendix H Technical Specification of Automatic Monitoring Equipment

Appin Crescent Dunfermline

Station Name:	Appin Crescent, Dunfermline
Site Owner/operator:	Fife Council
Easting:	309926
Northing:	687722
Distance to kerb and road name/number	3m + (A907)
Zone/agglomeration:	
Site Classification:	Roadside
Manifold type and height:	Single Teflon tube, inlet height 1.7m
Network affiliation:	Scottish Air Quality Database
Quality control procedures:	UKAS calibration by Ricardo with Air Liquide gas cylinder
Pollutants measured on site:	NO_x, NO NO_2, PM_{10}
Instrument manufacturer:	FDMS Thermo i-series
Calibration procedure and frequency:	3-weekly manual calibration
Site service arrangements:	6-monthly service by air monitors
Co-located passive sampler	Triplicate NO_2 tubes installed

Bonnygate Cupar

Station Name:	Bonnygate, Cupar
Site Owner/operator:	Fife Council
Easting:	337406
Northing:	714574
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 1.7m
Network affiliation:	Scottish Air Quality Database
Quality control procedures:	UKAS calibration by Ricardo with Air Liquide gas cylinder
Pollutants measured on site:	PM_{10} (TEOM) NOx, NO, NO_2
Instrument manufacturer:	FDMS NOx – 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

Admiralty Road, Rosyth

Station Name:	Admiralty Road, Rosyth
Site Owner/operator:	Fife Council
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 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}, $PM_{2.5}$, NOx, NO, NO_2,
Instrument manufacturer:	FIDAS 200 NOx – Thermo 42i
Calibration procedure and frequency:	3-weekly manual calibration and autocalibration every 3 days.
Site service arrangements:	6-monthly service by air monitors
Co-located passive sampler	Triplicate NO_2 tubes installed

St Clair Street, Kirkcaldy

Station Name:	St Clair Street , Kirkcaldy
Site Owner/operator:	Fife Council
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 2.5m
Network affiliation:	Scottish Air Quality Database
Quality control procedures:	UKAS calibration by Ricardo with Air Liquide gas cylinder
Pollutants measured on site:	$PM_{10,}$ $PM_{2.5}$, NOx, NO, NO_2
Instrument manufacturer:	FIDAS 200 NOx – Thermo 42i
Calibration procedure and frequency:	3-weekly manual calibration
Site service arrangements:	6-monthly service by air monitors
Co-located passive sampler	Triplicate NO_2 tubes installed

Glossary of Terms

Abbreviation	Description
AQAP	Air Quality Action Plan - A detailed description of measures, outcomes, achievement dates and implementation methods, showing how the LA intends to achieve air quality limit values'
AQMA	Air Quality Management Area – An area where air pollutant concentrations exceed / are likely to exceed the relevant air quality objectives. AQMAs are declared for specific pollutants and objectives
APR	Air quality Annual Progress Report
AURN	Automatic Urban and Rural Network (UK air quality monitoring network)
Defra	Department for Environment, Food and Rural Affairs
DMRB	Design Manual for Roads and Bridges – Air quality screening tool produced by Highways England
FDMS	Filter Dynamics Measurement System
LAQM	Local Air Quality Management
NO_2	Nitrogen Dioxide
NO_x	Nitrogen Oxides
PM_{10}	Airborne particulate matter with an aerodynamic diameter of 10µm (micrometres or microns) or less
$PM_{2.5}$	Airborne particulate matter with an aerodynamic diameter of 2.5µm or less
QA/QC	Quality Assurance and Quality Control
SO_2	Sulphur Dioxide

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