Exeter City Council

2017 Air Quality Annual Status Report (ASR)

In fulfilment of Part IV of the
Environment Act 1995
Local Air Quality Management

May 2017

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Report Reference number	ASR 2016
Date	May 2017

Executive Summary: Air Quality in Our Area

Air Quality in Exeter

Air pollution is associated with a number of adverse health impacts. It is recognised as a contributing factor in the onset of heart disease and cancer. Additionally, air pollution particularly affects the most vulnerable in society: children and older people, and those with heart and lung conditions. There is also often a strong correlation with equalities issues, because areas with poor air quality are also often the less affluent areas[1,2].

The annual health cost to society of the impacts of particulate matter alone in the UK is estimated to be around £16 billion[3].

Air Quality in Exeter

Air quality in Exeter is mainly good, with just a small number of hot spots where levels of nitrogen dioxide are above government objectives. These are at Livery Dole junction, East Wonford Hill, Honiton Road, Alphington Street and the Blackboy Road/Pinhoe Road junction. All these are included within Exeter's Air Quality Management Area, an area where the Council will bring forward and facilitate actions to improve air quality. Further details of the Air Quality Management Area, and the Council's Action Plan are available online at https://exeter.gov.uk/airpollution/. During 2017 the Council will be consulting on an updated Air Quality Action Plan, commencing in September.

The monitoring that the Council has done shows that concentrations of nitrogen dioxide have been falling throughout the city since around 2009, despite significant housing and commercial development over the same period. There were no exceedences of the hourly objective proxy in 2015 or 2016 and the long-term reduction in concentrations means that the Council is able to remove exceedance of the hourly objective from the AQMA order. No new sources of pollution have been identified that are likely to cause new areas to exceed the objective levels for any form of air pollution.

[1] Environmental equity, air quality, socioeconomic status and respiratory health, 2010
[2] Air quality and social deprivation in the UK: an environmental inequalities analysis, 2006
[3] Defra. Abatement cost guidance for valuing changes in air quality, May 2013

Actions to Improve Air Quality

Exeter City Council took forward a number of measures during 2015 in pursuit of improving local air quality. Key completed measures are:

- The establishment of new alliances across disciplines between Exeter City Council, Devon County Council, Mid Devon District Council, East Devon District Council, Teignbridge District Council, Royal Devon and Exeter Healthcare Trust and Exeter University to work on joint projects such as the new AQAP, the Greater Exeter Strategic Plan, and applications for grant funding for new electric vehicles and charge points. Three applications have been made for significant funding, including two to DEFRA (although these two were unsuccessful).
- Bridge Road widening, and improved cycle path.
- Expansion of the City Council's electric pool vehicle fleet, to replace use of grey fleet.
- Establishment of policies to curb emissions from hackney carriages have resulted in 5% of the fleet converting to ULEV. This proportion is expected to rise significantly in the next 2 years.
- Establishment of the UK's first on-street electric bike hire scheme.
- Devon County Council was successful in an application for funding to support their Access Fund program. This will run for the next three years and will include work with schools and businesses in Exeter to support modal shift, sustainable and active travel.
- Exeter City Council has approved funding to replace the automatic monitoring sites in the city.

Exeter City Council also expects the following measures to be completed over the course of the next reporting year:

- Consultation on the draft new AQAP.
- At least 6 new electric vehicles to enter the Council's fleet, and continued high usage of the electric pool cars (further replacing use of the grey fleet).
- Construction of Marsh Barton railway station.

- Projects to increase electric vehicles and charge points across Greater Exeter, (subject to successful applications for funding).

Conclusions and Priorities

Exeter City Council's priorities for the coming year are consultation on a new AQAP, publication of the final document and to seek funding for electric vehicles, charging points and solar PV panels. If applications for funding are successful, it will be a key priority to implement these programmes. Further information on this will be provided in the new AQAP.

The principal challenges and barriers to implementation that Exeter City Council anticipates facing are the scale of local growth in housing, and finding sources of funding for measures such as EV charging points.

Progress on publication of the new AQAP has been slower than expected due to the fact that considerable work has taken place to align the new plan with those for the neighbouring authorities. Officers at Exeter have also spent time making applications to fund action plan measures, and this has reduced the amount of officer time available for the Action Plan itself.

During 2017 Exeter City Council will also remove the hourly objective for NO_2 from the Exeter AQMA order.

Local Engagement and How to get Involved

Everyone in Exeter can take action on a personal level to improve our air quality. Some examples are shown below.

Walk or cycle

Replacing a car journey by walking or cycling helps reduce traffic and traffic emissions. It has proven health and mental health benefits too.

Take public transport or carshare

For longer journeys, why not use public transport or car share?

And if you have to use your car…

Make sure your tyre pressure is correct (low tyre pressure increases fuel use, fuel costs and emissions).

Think about whether you need to use the air conditioning. Using it increases fuel consumption by 30%; driving with windows open only increases it by 5%.

Using a roof rack on your car can increase fuel consumption by 20 to 30%. Bicycles are better attached to the back of the car.

If you need to buy a car, check its fuel economy. With an ultra-low emission vehicle (ULEV) you will use less fuel and produce less exhaust fumes.

Go for local produce!

Transporting goods a long way creates more air pollution than transporting them short distances. Try to buy locally produced goods and eat local foods that are in season: transporting and producing them doesn't generate as much air pollution.

Tell us what you think

Consultation on the new AQAP will also take place from September 2017, which will give individuals the opportunity to comment on and direct future actions to improve air quality. Information will be made available online at https://exeter.gov.uk/airpollution/ and in local media.

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1 Local Air Quality Management

This report provides an overview of air quality in Exeter during 2016. 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 Status Report (ASR) is an annual requirement showing the strategies employed by Exeter City Council to improve air quality and any progress that has been made.

The statutory air quality objectives applicable to LAQM in England can be found in Table E.1 in Appendix E.

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 12-18 months setting out measures it intends to put in place in pursuit of compliance with the objectives.

A summary of AQMAs declared by Exeter City 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 https://exeter.gov.uk/airpollution/

We propose to remove the exceedance of the hourly objective for NO_2 from the Exeter AQMA during 2017 (see monitoring section).

Table 2.1 – Declared Air Quality Management Areas

AQMA Name	Date of Declaration	Pollutants and Air Quality Objectives	City / Town	One Line Description	Is air quality in the AQMA influenced by roads controlled by Highways England?	Level of Exceedance (maximum monitored/modelled concentration at a location of relevant exposure)		Action Plan (inc. date of publication)
						At Declaration	Now	
Exeter AQMA	Declared 2007, Amended 2011	NO2 Annual Mean	Exeter	An area encompassing the radial routes into the city and other major routes	NO	70 µg/m^3 (2007)	58 µg/m^3	Exeter AQAP www.exeter.gov.uk/airpollution
Exeter AQMA	Declared 2007, Amended 2011	NO2 1 Hour Mean	Exeter	An area encompassing the radial routes into the city and other major routes	NO	65 µg/m^3 (annual average as proxy) (2011)	58 µg/m^3 (annual average as proxy)	Exeter AQAP www.exeter.gov.uk/airpollution

☒ **Exeter City Council confirm the information on UK-Air regarding their AQMA(s) is up to date**

2.2 Progress and Impact of Measures to address Air Quality in Exeter

Defra's appraisal of last year's ASR concluded that the report was well structured, detailed, and provides the information specified in the Guidance. It welcomed the review of the AQAP currently underway and recommended that this consider the following:

1. As the new Action Plan is developed, it will be important to consider the relationships between local traffic management and positions of air pollution hotspots. It is likely that there will be a significant relationship between traffic congestion and hotspot locations.
2. On this basis, the action plan needs to reconsider the prioritisation of measures that can significantly impact on reducing pollution below objective levels on a clear understanding of current and future transport management within the city.
3. It will also be beneficial to review the level of further emissions reductions required to achieve the air quality objectives, in order to inform the development of the measures within the new AQAP.

These will all be considered in the new AQAP, which will be published for consultation in September 2017.

Exeter City Council has taken forward a number of direct measures during the current reporting year of 2016 in pursuit of improving local air quality. Details of all measures completed, in progress or planned are set out in Table 2.2.

More detail on these measures can be found in their respective Action Plans, shown at the web links in the table. Key completed measures are:

- The establishment of new alliances across disciplines between Exeter City Council, Devon County Council, Mid Devon District Council, East Devon District Council, Teignbridge District Council, Royal Devon and Exeter Healthcare Trust and Exeter University to work on joint projects such as the new AQAP, the Greater Exeter Strategic Plan, and applications for grant funding for new electric vehicles and charge points. Three applications have been made for significant funding, including two to DEFRA (although these two were unsuccessful).

- Bridge Road widening, and improved cycle path.
- Expansion of the City Council's electric pool vehicle fleet, to replace use of grey fleet.
- Establishment of policies to curb emissions from hackney carriages have resulted in 5% of the fleet converting to ULEV. This proportion is expected to rise significantly in the next 2 years.
- Establishment of the UK's first on-street electric bike hire scheme.
- Devon County Council was successful in an application for funding to support their Access Fund program. This will run for the next three years and will include work with schools and businesses in Exeter to support modal shift, sustainable and active travel.
- Exeter City Council has approved funding to replace the automatic monitoring sites in the city.

Exeter City Council's priorities for the coming year are consultation on a new AQAP, publication of the final document and to seek funding for electric vehicles, charging points and solar PV panels. If applications for funding are successful, it will be a key priority to implement these programmes. Further information on this will be provided in the new AQAP.

Exeter City Council also expects the following measures to be completed over the course of the next reporting year:

- Consultation on the draft new AQAP.
- At least 6 new electric vehicles to enter the Council's fleet, and continued high usage of the electric pool cars (further replacing use of the grey fleet).
- Construction of Marsh Barton railway station.
- Projects to increase electric vehicles and charge points across Greater Exeter, (subject to successful applications for funding).

The principal challenges and barriers to implementation that Exeter City Council anticipates facing are the scale of local growth in housing, and finding sources of funding for measures such as EV charging points.

Progress on publication of the new AQAP has been slower than expected due to the fact that considerable work has taken place to align the new plan with those for the neighbouring authorities. Officers at Exeter have also spent time making applications for funding for action plan measures, and this has reduced the amount of officer time available for the Action Plan itself.

Whilst the measures stated above and in Table 2.2 will help to contribute towards compliance, Exeter City Council expects to bring forward further measures in 2017/2018 in the next AQAP which will work towards compliance and enable the future revocation of the Exeter AQMA. Action by the UK government using powers not available to Exeter City Council could also be effective in reducing vehicle emissions within the city.

Table 2.2 – Progress on Measures to Improve Air Quality

Measure No.	Measure	EU Category	EU Classification	Organisations involved and Funding Source	Planning Phase	Implementation Phase	Key Performance Indicator	Reduction in Pollutant / Emission from Measure	Progress to Date	Estimated / Actual Completion Date	Comments / Barriers to implementation
1	Public health and community awareness	Public Information	Other	ECC	Complete	2017	Work with Sustrans to provide education on air quality in 3 schools	N/A	Education delivered in one school	Dec-17	The aim is to encourage and support behavioural change on an individual level
2	ECC vehicle fleet	Promoting Low Emission Transport	Public Vehicle Procurement - Prioritising uptake of low emission vehicles	ECC	Complete	2016-2018	At least 6 new electric vehicles in 2017	Unquantified because of difficulty in estimating contribution of emissions from ECC vehicles	Five electric pool cars and 7% reduction in waste fleet fuel use due to new technology	Rolling program to be reviewed in 2018	Application for funding made for further electric vehicles
3	ECC parking strategy	Traffic Management	Other	ECC	2015	2016 - 2026	Implement Action Plan. Impact on congestion (traffic volumes and speeds at peak hours) will be monitored	No target set	New strategy adopted March 2016	2026	http://committees.exeter.gov.uk/documents/s50631/ECC%20Parking%20Strategy%20Draft%20Feb%2016%20Final.pdf
4	Highways works, reduce congestion, new junctions etc	Transport Planning and Infrastructure	Other	DCC	Ongoing	2011-2026 (LTP3 period)	· Improvements to Alphington Corridor · Use of real-time technology and signage · Bridge Road widening and cycle path	1% reduction in emissions in AQMA based upon measures contained in 'LES lite'	Tithebarn link completed and Bridge Road works nearly completed	2026	https://exeter.gov.uk/airpollution/
5	Travel planning support, car clubs (inc bikes) and Park & Change	Alternatives to private vehicle use	Car & lift sharing schemes	DCC	Ongoing	2011-2026 (LTP3 period)	· Developers to contribute towards establishment of car clubs · Expansion of Co-Bikes bike hire scheme · Provide travel planning support service where funding available	1% reduction in emissions in AQMA based upon measures contained in 'LES lite'	· Car Clubs established at Newcourt and Rougemont Park and on street electric bike hire scheme set up (Co-Bikes) · Devon County Council Access Fund to support sustainable transport	2026	https://exeter.gov.uk/airpollution/

Measure No.	Measure	EU Category	EU Classification	Organisations involved and Funding Source	Planning Phase	Implementation Phase	Key Performance Indicator	Reduction in Pollutant / Emission from Measure	Progress to Date	Estimated / Actual Completion Date	Comments / Barriers to implementation
									education and publicity · Contributions received from developers for travel plans at 8 housing sites in the city		
6	Electric vehicle charging	Promoting Low Emission Transport	Procuring alternative Refuelling infrastructure to promote Low Emission Vehicles, EV recharging, Gas fuel recharging	ECC	Complete	2014-2019	Implement Electric Vehicle Strategy	1% reduction in emissions in AQMA based upon measures contained in 'LES lite'	Charging points installed in 6 car parks and application made for funding for significant further expansion of this network	2019	https://exeter.gov.uk/media/1616/ehod-electric-vehicle-strategy-final.pdf
7	Park and Ride	Alternatives to private vehicle use	Bus based Park & Ride	DCC	Ongoing	2011-2026 (LTP3 period)	· Expand electric vehicle charging at P&R sites, potentially incorporated with solar panels · Maintain and expand existing P&R schemes where possible	1% reduction in emissions in AQMA based upon measures contained in 'LES lite'	Application made for funding for charging points and solar PV	2026	https://exeter.gov.uk/airpollution/
8	Bus, smart ticketing, RTI, new services	Alternatives to private vehicle use	Other	DCC	Ongoing	2011-2026 (LTP3 period)	· Introduce real-time information · Investigate options for smart ticketing · New and extended services to major areas of development	1% reduction in emissions in AQMA based upon measures contained in 'LES lite'	Real-time information apps operating, with displays at selected stops and Newcourt services operating	2026	https://exeter.gov.uk/airpollution/
9	Bus links and bus priority	Transport Planning and Infrastructure	Bus route improvements	DCC	Ongoing	2011-2026 (LTP3 period)	· Topsham Road bus priority works · Continue to identify options for bus priority improvements	1% reduction in emissions in AQMA based upon measures contained in 'LES lite'	London Inn Square bus priority works complete	2026	https://exeter.gov.uk/airpollution/
10	Walking and cycling infrastructure	Promoting Travel Alternatives	Promotion of walking & Promotion of cycling	DCC	Complete	2010-2020	· 20% of journeys to work by bike · 20% of journeys to primary school by bike	Not quantified	Exeter Cycle Strategy and Exeter Walking Strategy published and	2020	http://www.devon.gov.uk/eldf-exeter-cycle-strategy.pdf and http://www.devon.go

Measure No.	Measure	EU Category	EU Classification	Organisations involved and Funding Source	Planning Phase	Implementation Phase	Key Performance Indicator	Reduction in Pollutant / Emission from Measure	Progress to Date	Estimated / Actual Completion Date	Comments / Barriers to implementation
							· 30% of journeys to secondary school by bike		developer contributions towards key infrastructure improvements		v.uk/exeter-walking-strategy-august-2012.pdf
11	Devon Metro	Alternatives to private vehicle use	Rail based Park & Ride	DCC	Ongoing	2011-2026 (LTP3 period initially)	Marsh Barton station open	1% reduction in emissions in AQMA based upon measures contained in 'LES lite'	Cranbrook and Newcourt Stations complete	ongoing	https://exeter.gov.uk/airpollution/ and http://www.devon.gov.uk/devon_metro_briefing.pdf
12	Taxi licensing	Promoting Low Emission Transport	Taxi Licensing conditions	ECC	Complete	2015-2020	At least 50% of hackney carriage fleet to be ULEV or ZEV	1% reduction in emissions in AQMA based upon measures contained in 'LES lite'	Emissions standard set in policy and application made for funding for EV charge points at ranks	2020	https://exeter.gov.uk/media/1428/taxi-policy-2015.pdf
13	Wider Exeter travel to work area	Policy Guidance and Development Control	Regional Groups Co-ordinating programmes to develop Area wide Strategies to reduce emissions and improve air quality	ECC	2016	2017-2022	Adoption of Greater Exeter Strategic Plan	To be determined during Strategic Environmental Assessment of plan	Working group set up and initial consultation undertaken	2022	Working more closely with neighbouring authorities to integrate actions,
14	Freight Quality partnership (FQP), Ecostars	Vehicle Fleet Efficiency	Fleet efficiency and recognition schemes	ECC / DCC	2015	2016	Further businesses within Exeter to sign up to EcoStars when funding available	Unknown	Ten fleets committed to sign up to scheme across Devon in addition to existing members	2016	FQP is a DCC responsibility to take forward, if funding available
15	Wider projects, including Exeter City Futures (ECF) and Low Carbon Task Force (LCTF)	Policy Guidance and Development Control	Other policy	ECC	ongoing	ongoing	To lobby for local air quality to be considered in wider projects to improve the sustainability of the city and the greater Exeter region	Unknown	· Officers meeting regularly with Exeter City Futures and the LCTF, submission of significant grant funding application to enhance ULEV uptake across	ongoing	http://www.exeterandeastdevon.gov.uk/Low-Carbon-Task-Force%20 and http://exetercityfutures.com/

Measure No.	Measure	EU Category	EU Classification	Organisations involved and Funding Source	Planning Phase	Implementation Phase	Key Performance Indicator	Reduction in Pollutant / Emission from Measure	Progress to Date	Estimated / Actual Completion Date	Comments / Barriers to implementation
									Greater Exeter plus seeking other opportunities · 100 volunteers to trial 'Lightfoot' technology in private cars (ECF project)		

2.3 $PM_{2.5}$ – Local Authority Approach to Reducing Emissions and/or Concentrations

As detailed in Policy Guidance LAQM.PG16 (Chapter 7), local authorities are expected to work towards reducing emissions and/or concentrations of $PM_{2.5}$ (particulate matter with an aerodynamic diameter of 2.5µm or less). There is clear evidence that $PM_{2.5}$ has a significant impact on human health, including premature mortality, allergic reactions, and cardiovascular diseases.

There is no direct monitoring of $PM_{2.5}$ in Exeter. However it is possible to estimate concentrations based upon local PM_{10} data using the correction factor in TG(16). This method suggests that $PM_{2.5}$ concentrations at both Exeter RAMM and Alphington Street are 10.5 $\mu g/m^3$. The annual average EU limit value for $PM_{2.5}$ is 25 $\mu g/m^3$ so there is no suggestion that this level is being exceeded in Exeter. However the council still has a duty to reduce emissions of and exposure to this pollutant.

During 2017, Exeter City Council will be taking the measures described in Table 2.2 that will address $PM_{2.5}$ as well as NO_2. The measures expected to have the most significant effect on $PM_{2.5}$ are those which encourage modal shift, or uptake of ULEVs such as measures 1, 2, 4, 6, 10, 11, 12, 14 and 15. During the year the Council will also be working on an updated AQAP that will include explicit reference to $PM_{2.5}$, and set out the actions that will be taken to reduce $PM_{2.5}$ during the next five years. This will involve close partnership working with public health professionals, which is reflected in the make-up of the steering group (Appendix C.3).

Approximately 60% of Exeter is designated as Smoke Control Areas. Controls on solid fuel combustion appliances and fuels are likely to have restricted $PM_{2.5}$ emissions in these areas.

During 2017 the City Council will also be replacing its two PM_{10} analysers at Exeter Roadside (RAMM) and Alphington Street. Subject to a tender process, it is hoped that the new equipment will provide the capacity to measure $PM_{2.5}$ at at least one of these sites.

3 Air Quality Monitoring Data and Comparison with Air Quality Objectives and National Compliance

3.1 Summary of Monitoring Undertaken

3.1.1 Automatic Monitoring Sites

This section sets out what monitoring has taken place and how it compares with objectives.

Exeter City Council undertook automatic (continuous) monitoring at two sites during 2016. Table A.1 in Appendix A shows the details of the sites. National monitoring results are available at https://uk-air.defra.gov.uk/. At the start of 2015, Exeter City Council ceased monitoring CO and SO_2 on the grounds that the concentrations of these pollutants were substantially below the objective levels, and had been so since monitoring began. There was no evidence of a trend of increasing concentrations of either pollutant (Exeter City Council 2015).

Maps showing the location of the monitoring sites are provided in Appendix D. Further details on how the monitors are calibrated and how the data has been adjusted are included in Appendix C.

3.1.2 Non-Automatic Monitoring Sites

Exeter City Council undertook non- automatic (passive) monitoring of NO_2 at 65 sites during 2016. Table A.2 in Appendix A shows the details of the sites. Three sites were added to the monitoring network in 2016.

Maps showing the location of the monitoring sites are provided in Appendix D. Further details on Quality Assurance/Quality Control (QA/QC) for the diffusion tubes, including bias adjustments and any other adjustments applied (e.g. “annualisation” and/or distance correction), are included in Appendix C.

3.2 Individual Pollutants

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

3.2.1 Nitrogen Dioxide (NO_2)

Table A.3 in Appendix A compares the ratified and adjusted monitored NO_2 annual mean concentrations for the past 5 years with the air quality objective of 40µg/m^3.

For diffusion tubes, the full 2016 dataset of monthly mean values is provided in Appendix B.

Table A.4 in Appendix A compares the ratified continuous monitored NO_2 hourly mean concentrations for the past 5 years with the air quality objective of 200µg/m^3, not to be exceeded more than 18 times per year. Figure A.1 shows the longer-term trend in annual mean concentrations at 6 sites with the longest continuous data record.

The data shows that six locations measured an exceedence of the annual objective in 2016. Four of these are at relevant locations (DT19 Alphington Street, DT40 Pinhoe Road (Polsloe Road), DT50 Livery Dole and DT55 East Wonford Hill). The other two (DT56 Honiton Road and DT52 Salutary Mount) are not at relevant receptors. When corrected for the distance to the nearest receptor the objective is not exceeded at the façade of the nearest houses (Appendix B). For DT56 there is also a tube located at the nearest property (DT57 Honiton Road façade); this tube does not show an exceedence.

All six locations that exceeded the objective are within the AQMA. The extent of the exceedence of the objectives ranges from 0.3 µg/m^3 at Alphington Street to 18 µg/m^3 at East Wonford Hill. No annual average level was over a level of 60µg/m^3, which would indicate that an exceedance of the 1-hour mean objective is also unlikely at these sites. DEFRA's appraisal of the 2015 Annual Status Report said that:

> There are no exceedences of the hourly objective, suggesting that the AQMA can be revoked for this objective once this has been maintained for a further year. The current monitoring strategy should be reviewed with the aim of identifying any hotspots and providing confidence in relation to future decisions on revoking the current AQMA.

As there were no exceedences of the hourly objective in 2016, Exeter City Council will seek to revoke the hourly objective part of the AQMA during 2017. Exeter City Council has always chosen to monitor at expected hot spots and relevant worst-case

locations and so no further revision to the rationale for the monitoring network is required.

The levels measured from diffusion tubes in 2016 increased at most locations when compared to last year (46 of 62 locations). This is considered to be part of the normal inter-annual variation although trends will continue to be monitored. The largest increase was at the location of DT52 Salutary Mount, with an increase from 35.5 µg/m^3 in 2015 to 49.7 µg/m^3 in 2016. The reason for this increase is that in January the tube was moved from the front of a house to a nearby sign post on the pavement closer to the road. The tube location was moved because the homeowner was no longer willing to have the tube located at his property. As stated above, when distance corrected to the nearest receptor the objective is not exceeded.

The general trend in the diffusion tube data for the last 5 years shown in Table A.3 is downward, as was predicted by the Low Emission Strategy modelling. There has been a corresponding reduction in the number of sites which exceed the objective. However, Exeter City Council has no current plans to amend the AQMA and reduce the area included. The AQMA boundary was originally drawn to include a larger area than just the strict areas of exceedence (Exeter City Council 2011). The rationale for this boundary remains sound.

Figue A.1 shows that this downward trend seems to have existed since around 2009, and is evident at background sites as well as roadside ones. This is a welcome trend, especially in the context of significant local housing and commercial development. However it has not been possible to link this trend directly to any specific national or local intervention and some element of inter-annual variability caused by weather conditions will be included.

3.2.2 Particulate Matter (PM_{10})

Table A.5 in Appendix A compares the ratified and adjusted monitored PM_{10} annual mean concentrations for the past 5 years with the air quality objective of 40µg/m^3.

Table A.6 in 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 35 times per year.

Figure A.3 shows the longer-term trends in annual mean PM10 concentrations.

There were no measured exceedences of the PM_{10} air quality objectives in Exeter in 2016. Annual average concentrations have reduced since 2015, and there were no exceedences of an hourly mean of 50µg/m^3. The long-term trend in annual concentrations is a decline since 2005 or 2006. Data capture at Alphington Street in 2016 was low at just 80%. This was caused by a pump fault from late May to early July, which took some time to repair. The current TEOM equipment is being replaced in 2017, so data capture issues should be resolved.

Appendix A: Monitoring Results

Table A.1 – Details of Automatic Monitoring Sites

Site ID	Site Name	Site Type	X OS Grid Ref	Y OS Grid Ref	Pollutants Monitored	In AQMA?	Monitoring Technique	Distance to Relevant Exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Inlet Height (m)
CM1	Exeter Roadside	Kerbside	291939	92830	NO2; O3; PM10	YES	Chemiluminescent; UVA; TEOM	0	1	1.7
CM2	Alphington Street	Roadside	291670	91773	PM10	NO	TEOM	12	3	1.7

Notes:

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

(2) N/A if not applicable.

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

Site ID	Site Name	Site Type	X OS Grid Ref	Y OS Grid Ref	Pollutants Monitored	In AQMA?	Distance to Relevant Exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Tube collocated with a Continuous Analyser?	Height (m)
DT1	High Street /Castle Street	Kerbside	292199	92814	NO2	YES	50	0.5	NO	2
DT2	Longbrook Street	Kerbside	292315	93016	NO2	NO	0	1	NO	1.7
DT3	New North Road	Kerbside	292185	93049	NO2	YES	0	1	NO	2
DT4	Queen Street	Kerbside	291779	93011	NO2	YES	0	1.5	NO	2
DT5	RAMM 1	Kerbside	291944	92826	NO2	YES	0	1	YES	1.7
DT6	RAMM 2	Kerbside	291944	92826	NO2	YES	0	1	YES	1.7
DT7	High Street Guildhall	Roadside	291984	92626	NO2	YES	0	2	NO	2
DT8	North Street	Kerbside	291895	92569	NO2	YES	0	1	NO	1.7
DT9	South Street	Roadside	291943	92511	NO2	YES	3	1.5	NO	2
DT10	Market Street	Kerbside	291833	92433	NO2	YES	0	1	NO	1.7
DT11	Magdalen Street	Kerbside	292291	92292	NO2	YES	8	1	NO	1.7
DT12	Magdalen Street façade	Kerbside	292422	92320	NO2	YES	0	1	NO	1.7
DT13	Archibald Road	Roadside	292590	92743	NO2	NO	0	1.5	NO	1.7
DT14	Heavitree Road inbound	Roadside	292832	92731	NO2	YES	0	10	NO	2
DT15	Heavitree Road outbound	Kerbside	292703	92807	NO2	YES	0	1	NO	1.7
DT16	Holloway Street	Kerbside	292378	92039	NO2	YES	0	1	NO	1.7

Site ID	Site Name	Site Type	X OS Grid Ref	Y OS Grid Ref	Pollutants Monitored	In AQMA?	Distance to Relevant Exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Tube collocated with a Continuous Analyser?	Height (m)
DT17	Carder's Court, Shilhay	Roadside	291699	92091	NO2	NO	0	15	NO	1.7
DT18	Rear of Gervase Avenue	Roadside	291657	91973	NO2	YES	5	5	NO	2
DT19	Alphington Street	Kerbside	291669	91812	NO2	YES	0	1	NO	2
DT20	Alphington Road inbound	Roadside	291532	91349	NO2	YES	0	2	NO	1.7
DT21	Queen's Road	Urban Background	291460	91390	NO2	NO	8	2	NO	1.7
DT22	Alphington Road outbound	Roadside	291509	91151	NO2	YES	0	8	NO	1.7
DT23	Alphington Road outer	Roadside	291518	90813	NO2	YES	15	2	NO	1.7
DT24	Church Road Alphington	Roadside	291691	90425	NO2	YES	0	1.5	NO	1.7
DT25	Church Road II	Kerbside	291767	90160	NO2	YES	0	1	NO	1.7
DT26	Cowick Street (Cowick Lane)	Kerbside	290864	91725	NO2	YES	0	1	NO	1.7
DT27	Cowick Street (inbound)	Roadside	291249	91874	NO2	YES	0	4	NO	1.7
DT28	Cowick Street (outbound)	Roadside	291376	91944	NO2	YES	0	1.5	NO	1.7
DT29	Cowick Street (Exe Bridges)	Roadside	291500	92055	NO2	YES	0	2	NO	1.7
DT30	Okehampton Street	Roadside	291351	92169	NO2	YES	0	4	NO	1.7

Site ID	Site Name	Site Type	X OS Grid Ref	Y OS Grid Ref	Pollutants Monitored	In AQMA?	Distance to Relevant Exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Tube collocated with a Continuous Analyser?	Height (m)
DT31	Bonhay Road (St Clements Lane)	Roadside	291253	93299	NO2	YES	0	2	NO	2
DT32	Red Cow Village	Kerbside	291242	93483	NO2	YES	0	1	NO	1.7
DT33	Red Cow II	Kerbside	291272	93468	NO2	YES	0	1	NO	1.7
DT34	Cowley Bridge Road	Roadside	291054	94399	NO2	YES	0	4	NO	1.7
DT35	Pennsylvania Road	Roadside	292391	93291	NO2	NO	0	1	NO	1.7
DT36	York Road School	Roadside	292469	93245	NO2	NO	3.5	2.5	NO	1.7
DT37	York Road	Kerbside	292579	93146	NO2	NO	1.5	0	NO	1.7
DT38	Union Road	Roadside	293047	93877	NO2	NO	0	1	NO	1.7
DT39	Pinhoe Road inbound	Roadside	293405	93395	NO2	YES	0	3	NO	1.7
DT40	Pinhoe Road (Polsloe Road)	Kerbside	293251	93375	NO2	YES	0	1	NO	1.7
DT41	Blackboy Road (Polsloe Road)	Roadside	293227	93356	NO2	YES	0	2	NO	1.7
DT42	Beacon Heath	Kerbside	295068	94487	NO2	NO	10	1	NO	1.7
DT43	Venny Bridge	Kerbside	295888	94101	NO2	NO	10	0.2	NO	1.7
DT44	Pinhoe	Kerbside	296418	94470	NO2	NO	1	0	NO	1.7
DT45	Langaton Lane	Urban Background	296984	94327	NO2	NO	20	0	NO	1.7
DT46	Pinn Lane	Roadside	296494	93782	NO2	NO	10	1.5	NO	2
DT47	Pinhoe Road (Fairfield Avenue)	Roadside	295413	93689	NO2	YES	0	5	NO	1.7

Site ID	Site Name	Site Type	X OS Grid Ref	Y OS Grid Ref	Pollutants Monitored	In AQMA?	Distance to Relevant Exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Tube collocated with a Continuous Analyser?	Height (m)
DT48	East John Walk	Urban Background	293091	92825	NO2	NO	1.5	N/A	NO	1.7
DT49	Magdalen Road (Barrack Road)	Kerbside	293448	92419	NO2	YES	0	1	NO	1.7
DT50	Livery Dole	Roadside	293418	92497	NO2	YES	0	1.5	NO	1.7
DT51	Rowancroft	Kerbside	293533	92473	NO2	YES	0	0.2	NO	2
DT52	Salutary Mount	Roadside	293738	92396	NO2	YES	1.5	4.5	NO	1.7
DT53	Fore Street Heavitree outbound	Roadside	293781	92409	NO2	YES	8	4	NO	1.7
DT54	Fore Street Heavitree inbound	Roadside	294043	92359	NO2	YES	0	2	NO	1.7
DT55	East Wonford Hill	Roadside	294410	92310	NO2	YES	0	2	NO	1.7
DT56	Honiton Road	Roadside	295203	92378	NO2	YES	13	1.5	NO	1.7
DT57	Honiton Road façade	Roadside	295191	92395	NO2	NO	0	15	NO	1.7
DT58	Sidmouth Road lamp post	Roadside	295466	92365	NO2	YES	6	1.5	NO	2
DT59	Sidmouth Road Middlemoor	Roadside	295636	92232	NO2	YES	0	10	NO	1.7
DT60	Newcourt Way	Roadside	295710	90571	NO2	NO	20	1.5	NO	2
DT61	Topsham Road	Roadside	294694	90001	NO2	YES	0	5	NO	2
	(Countess Wear)									
	Bridge Road									

Site ID	Site Name	Site Type	X OS Grid Ref	Y OS Grid Ref	Pollutants Monitored	In AQMA?	Distance to Relevant Exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Tube collocated with a Continuous Analyser?	Height (m)
DT62	(Countess Wear)	Roadside	294652	89974	NO2	NO	0	15	NO	1.7
DT63	High Street Topsham	Kerbside	296415	88477	NO2	NO	0	1	NO	1.7
DT64	Topsham Road (Tollards Road)	Roadside	294227	90435	NO2	YES	0	1.5	NO	1.7
DT65	Topsham Road (Barrack Road)	Roadside	293213	91245	NO2	YES	0	10	NO	1.7

Notes:

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

(2) N/A if not applicable.

Table A.3 – Annual Mean NO_2 Monitoring Results

Site ID	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) [1]	Valid Data Capture 2016 (%) [2]	NO_2 Annual Mean Concentration (µg/m^3) [3]				
					2012	2013	2014	2015	2016
CM1	Kerbside	Automatic		95%	33	32	31	28	30.5
DT1	Kerbside	Diffusion Tube		100.0%	31.5	28.7	29.9	25	26.8
DT2	Kerbside	Diffusion Tube		100.0%				24.8	25.5
DT3	Kerbside	Diffusion Tube		91.7%	32.8	30	28.1	26.5	26.3
DT4	Kerbside	Diffusion Tube		100.0%	29.5	27.2	26	21.6	23.2
DT5	Kerbside	Diffusion Tube		83.3%	33.5	32.5	30.6	29.6	29.6
DT6	Kerbside	Diffusion Tube		83.3%	32.5	32.7	31.1	28.9	29.5
DT7	Roadside	Diffusion Tube		100.0%	28.9	27.3	29.2	25	25.2
DT8	Kerbside	Diffusion Tube		100.0%	**45.1**	**40**	39.8	34.8	33.4
DT9	Roadside	Diffusion Tube		100.0%	38.1	34.8	33.6	30.6	31.1
DT10	Kerbside	Diffusion Tube		100.0%	35.7	32.4	34.1	28.3	29.6
DT11	Kerbside	Diffusion Tube		91.7%	33.2	31.7	31.5	27.6	28.1
DT12	Kerbside	Diffusion Tube		100.0%	33.3	33.9	31.9	28	30.1
DT13	Roadside	Diffusion Tube		100.0%	25.1	24.8	22.1	20.5	22.5
DT14	Roadside	Diffusion Tube		100.0%	23.7	23.2	21.7	19.6	21.0
DT15	Kerbside	Diffusion Tube		100.0%	37.4	39.6	38.8	33.5	36.4
DT16	Kerbside	Diffusion Tube		100.0%	36.4	39.2	35.9	28.8	33.4
DT17	Roadside	Diffusion Tube		100.0%	25.9	24.1	23.5	20.5	22.4
DT18	Roadside	Diffusion Tube		100.0%	29.4	24.7	26.6	23.7	23.4
DT19	Kerbside	Diffusion Tube		100.0%	**42.4**	**45.8**	**44.4**	35.2	**40.3**
DT20	Roadside	Diffusion Tube		100.0%	35.9	35.7	36.3	32.5	32.9
DT21	Urban Background	Diffusion Tube		100.0%	15.4	15.3	15.2	12.8	14.2
DT22	Roadside	Diffusion Tube		100.0%	29.5	29.6	30.7	25.3	27.5

Site ID	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) [1]	Valid Data Capture 2016 (%) [2]	NO_2 Annual Mean Concentration ($\mu g/m^3$) [3]				
					2012	2013	2014	2015	2016
DT23	Roadside	Diffusion Tube		100.0%	28.1	31.2	28.6	22.3	24.8
DT24	Roadside	Diffusion Tube		100.0%	28.2	26	26.4	24.1	25.8
DT25	Kerbside	Diffusion Tube		100.0%	30.3	29.6	29.1	26.9	26.9
DT26	Kerbside	Diffusion Tube		91.7%	**50.4**	**47.7**	**45.4**	36.4	37.0
DT27	Roadside	Diffusion Tube		100.0%	24.5	24.7	24.6	20.5	23.0
DT28	Roadside	Diffusion Tube		100.0%	**41.9**	38.6	**40.8**	34	33.6
DT29	Roadside	Diffusion Tube		100.0%	37.8	35.6	35.7	32.4	31.7
DT30	Roadside	Diffusion Tube		100.0%	28.5	27.8	26.5	23.7	24.3
DT31	Roadside	Diffusion Tube		83.3%	33.1	32.6	31.5	27.2	29.4
DT32	Kerbside	Diffusion Tube		100.0%	**43.7**	**40.8**	**42.7**	36.1	37.7
DT33	Kerbside	Diffusion Tube		100.0%	37.1	34	36.8	32	31.7
DT34	Roadside	Diffusion Tube		100.0%	37.5	36.4	38.3	33.2	31.5
DT35	Roadside	Diffusion Tube		100.0%	30.5	31.2	31.3	25.6	28.0
DT36	Roadside	Diffusion Tube		100.0%				27.9	29.1
DT37	Kerbside	Diffusion Tube		100.0%	37.8	37.3	38.8	32	36.2
DT38	Roadside	Diffusion Tube		100.0%	32.5	31.2	32.1	22.3	26.4
DT39	Roadside	Diffusion Tube		100.0%	38	34.1	37.7	30.6	31.2
DT40	Kerbside	Diffusion Tube		100.0%	**55.4**	**48.4**	**48.3**	**42.1**	**42.1**
DT41	Roadside	Diffusion Tube		100.0%	34.3	32.9	33.4	29.2	30.9
DT42	Kerbside	Diffusion Tube		91.7%	19.8	17.3	19	17.5	19.7
DT43	Kerbside	Diffusion Tube		100.0%					18.8
DT44	Kerbside	Diffusion Tube		91.7%	28.8	35.9	38.4	24.9	27.4
DT45	Urban Background	Diffusion Tube		100.0%	18.4	17.7	18.7	16.7	18.1
DT46	Roadside	Diffusion Tube		100.0%	21.7	20.7	20.2	18.5	17.4
DT47	Roadside	Diffusion Tube		91.7%					19.7

Site ID	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) [1]	Valid Data Capture 2016 (%) [2]	NO_2 Annual Mean Concentration (µg/m^3) [3]				
					2012	2013	2014	2015	2016
DT48	Urban Background	Diffusion Tube		100.0%	17.1	15	15.7	13.9	15.3
DT49	Kerbside	Diffusion Tube		100.0%	**43.8**	**43.1**	**40.4**	37.2	36.9
DT50	Roadside	Diffusion Tube		100.0%	**51.8**	**49.3**	**52**	**48.8**	**46.8**
DT51	Kerbside	Diffusion Tube		100.0%	**46.7**	**41.6**	**42.5**	38.2	39.8
DT52	Roadside	Diffusion Tube		83.3%	**44.7**	39.3	39.5	35.5	**49.7**
DT53	Roadside	Diffusion Tube		100.0%	32.9	29.2	30.3	29.5	31.4
DT54	Roadside	Diffusion Tube		100.0%	**50.9**	**46.2**	**48.5**	38.6	38.5
DT55	Roadside	Diffusion Tube		100.0%	**70.6**	**60.8**	**64.2**	**59.2**	**57.9**
DT56	Roadside	Diffusion Tube		100.0%	**56.2**	**53.9**	**58.4**	**42.7**	**49.9**
DT57	Roadside	Diffusion Tube		100.0%	21.8	20.9	21.9	18.4	20.1
DT58	Roadside	Diffusion Tube		100.0%	36.9	34.6	35.3	31.4	35.0
DT59	Roadside	Diffusion Tube		100.0%	24.4	23.8	24	21.2	22.0
DT60	Roadside	Diffusion Tube		75.0%	27.9	27.3	29	26.3	17.8
DT61	Roadside	Diffusion Tube		100.0%	22.2	22.5	21.6	19.3	24.6
DT62	Roadside	Diffusion Tube		100.0%					20.5
DT63	Kerbside	Diffusion Tube		100.0%	28.5	26.6	26.1	21.6	24.3
DT64	Roadside	Diffusion Tube		100.0%	**42.6**	38.1	**40.2**	36.6	34.9
DT65	Roadside	Diffusion Tube		100.0%	27.5	26.9	27.6	24.1	25.0

☒ **Diffusion tube data has been bias corrected**

☒ **Annualisation has been conducted where data capture is <75%**

☒ **If applicable, all data has been distance corrected for relevant exposure (distance corrected data is shown in table B.1)**

Notes:

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

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 Boxes 7.9 and 7.10 in LAQM.TG16 if valid data capture for the full calendar year is less than 75%. See Appendix C for details.

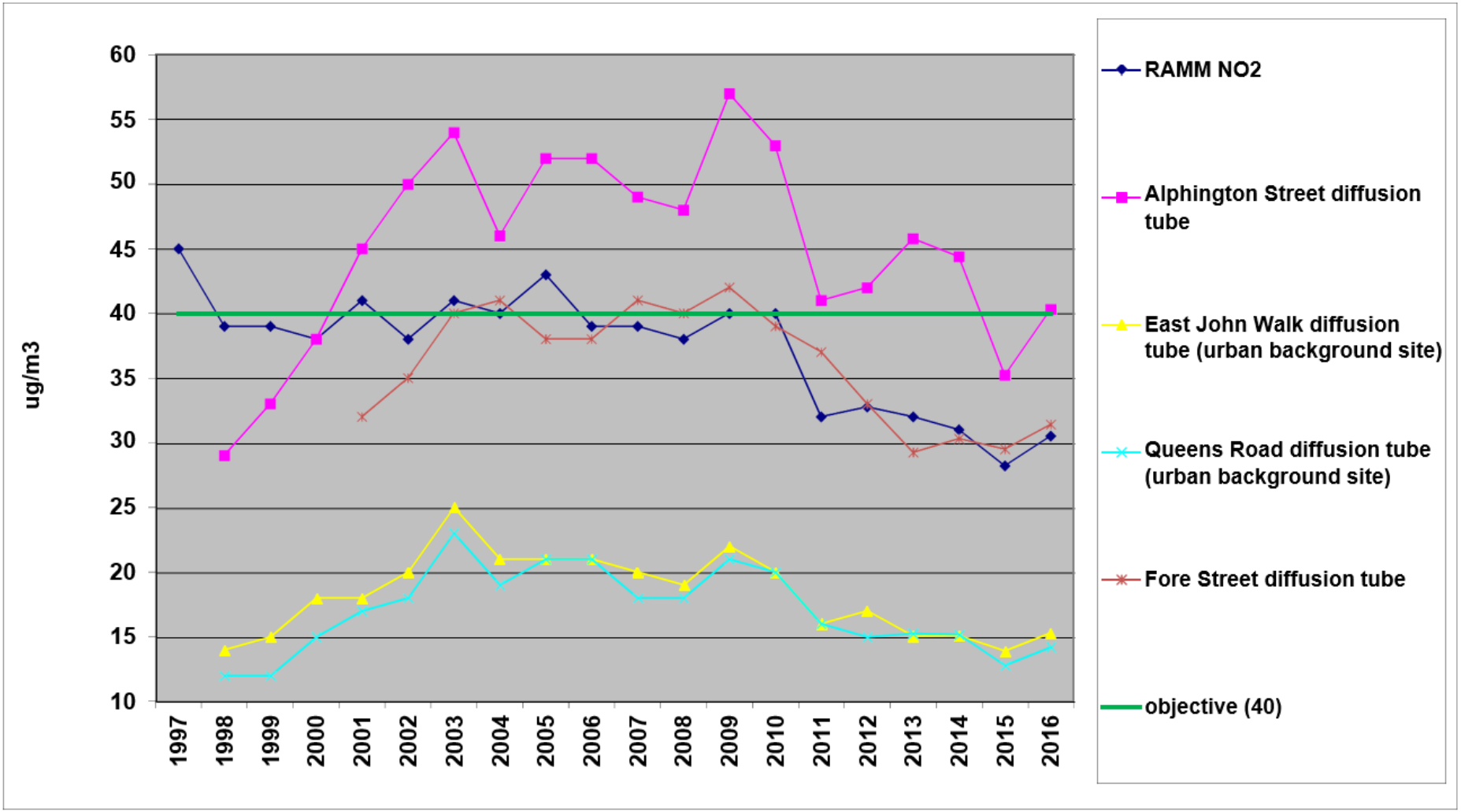


Figure A.1 – Trends in Annual Mean NO_2 Concentrations at 6 Long-Term Sites in Exeter

Table A.4 – 1-Hour Mean NO_2 Monitoring Results

Site ID	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2016 (%) (2)	NO_2 1 Hour Means > 200µg/m^3 (3)				
					2012	2013	2014	2015	2016
CM1	Kerbside	Automatic		95%	1	0	0 (109)	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 85%, the 99.8th percentile of 1-hour means is provided in brackets.

Table A.5 – Annual Mean PM_{10} Monitoring Results

Site ID	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2016 (%) (2)	PM_{10} Annual Mean Concentration ($\mu g/m^3$) (3)				
				2012	2013	2014	2015	2016
CM1	Kerbside		99%	16	22	20	19	15
CM2	Roadside		80%	19	21	20	19	15

☒ **Annualisation has been conducted where data capture is <75%**

Notes:

Exceedances of the PM_{10} annual mean objective of 40$\mu g/m^3$ 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 Boxes 7.9 and 7.10 in LAQM.TG16, valid data capture for the full calendar year is less than 75%. See Appendix C for details.

Figure A.2 – Trends in Annual Mean PM_{10} Concentrations

Table A.6 – 24-Hour Mean PM_{10} Monitoring Results

Site ID	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2016 (%) (2)	PM_{10} 24 Hour Means > 50µg/m^3 (3)				
				2012	2013	2014	2015	2016
CM1	Kerbside		99%	3	8	2	6	0
CM2	Roadside		80%	3	3	2	6 (29.5)	0 (23.7)

Notes:

Exceedances of the PM_{10} 24-hour mean objective (50µg/m^3 not to be exceeded more than 35 times/year) are shown in **bold.**

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

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

(3) If the period of valid data is less than 85%, the 90.4th percentile of 24-hour means is provided in brackets.

Appendix B: Full Monthly Diffusion Tube Results for 2016

Table B.1 – NO_2 Monthly Diffusion Tube Results - 2016

Site ID	NO_2 Mean Concentrations (µg/m^3)														
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Mean		
													Raw Data	Bias Adjusted (0.87) and Annualised (1)	Distance Corrected to Nearest Exposure (2)
DT1	34.90	33.02	31.35	30.13	27.08	25.88	23.07	24.66	26.28	36.74	36.56	39.65	30.78	26.78	17.1
DT2	33.92	34.48	28.50	28.34	27.50	24.10	24.19	24.76	26.80	29.33	35.52	33.95	29.28	25.48	n/a
DT3	33.19	35.52	28.29	28.24	30.59	26.78	26.89	27.53	29.32	30.56	35.04		30.18	26.25	n/a
DT4	25.55	30.02	25.38	23.27	25.33	23.40	20.38	19.62	27.31	29.99	33.28	36.73	26.69	23.22	n/a
DT5		35.94	34.21	32.99	33.49	31.07	25.98	29.59	33.64	37.45		45.83	34.02	29.60	n/a
DT6		37.83	34.07	33.33	33.62	31.85	25.80	29.30	34.00	40.91		38.67	33.94	29.53	n/a
DT7	32.43	31.19	31.03	28.90	28.93	21.91	21.81	22.88	25.88	30.79	35.51	36.18	28.96	25.19	n/a
DT8	38.54	39.50	35.91	37.43	38.92	34.36	34.49	37.07	39.76	35.07	45.55	44.75	38.45	33.45	n/a
DT9	37.40	37.46	35.00	32.34	32.92	31.38	29.71	31.66	36.68	35.77	43.63	44.61	35.71	31.07	27.3
DT10	34.74	35.33	31.74	33.17	33.77	27.06	28.32	28.47	34.40	35.02	41.29	45.41	34.06	29.63	n/a
DT11	35.99	36.70	31.37	30.76	27.34	26.06	24.06	26.42	32.82	39.65		43.92	32.28	28.08	22.4
DT12	36.00	39.34	34.74	32.25	29.58	29.56	24.87	27.77	32.23	39.50	54.01	35.89	34.64	30.14	n/a
DT13	28.12	27.05	25.60	23.12	22.05	16.30	15.89	18.36	24.02	30.65	33.24	45.37	25.81	22.46	n/a
DT14	25.82	29.21	25.22	23.25	21.02	18.87	12.91	16.88	22.84	28.23	32.67	32.53	24.12	20.98	n/a
DT15	40.39	43.45	40.71	42.16	42.01	38.60	30.51	33.90	38.90	45.84	53.09	53.18	41.89	36.45	n/a
DT16	36.58	39.10	35.06	38.30	37.90	31.02	28.30	32.11	36.24	44.74	53.93	47.42	38.39	33.40	n/a
DT17	27.60	31.29	25.27	22.15	20.72	18.55	20.54	21.55	23.26	27.84	36.15	34.15	25.76	22.41	n/a
DT18	30.88	30.44	27.07	25.56	24.09	21.23	20.66	22.51	26.43	27.58	32.99	32.71	26.85	23.36	21.7

Site ID	NO_2 Mean Concentrations (µg/m^3)														
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Mean		
													Raw Data	Bias Adjusted (0.87) and Annualised (1)	Distance Corrected to Nearest Exposure (2)
DT19	43.74	51.30	47.78	45.83	40.42	42.15	28.46	38.06	46.49	49.04	65.19	58.03	46.37	**40.35**	n/a
DT20	39.64	42.65	35.74	33.49	37.50	31.84	31.14	35.15	37.62	40.25	45.28	43.27	37.80	32.88	n/a
DT21	16.96	19.92	16.59	15.81	12.39	10.26	7.58	10.28	15.49	22.36	21.69	27.22	16.38	14.25	14.2
DT22	28.90	32.27	29.74	34.60	32.17	29.50	22.03	26.01	32.11	34.09	39.66	37.72	31.57	27.46	n/a
DT23	23.63	31.03	32.35	29.88	29.16	22.25	14.51	20.65	30.44	34.31	33.66	40.51	28.53	24.82	20.0
DT24	26.64	33.58	30.91	29.19	27.18	23.76	20.67	22.52	28.66	29.01	43.29	40.91	29.69	25.83	n/a
DT25	31.49	36.93	30.88	33.41	29.64	25.14	26.99	17.44	30.11	32.34	39.14	36.88	30.87	26.85	n/a
DT26	42.43	46.56	42.20	43.00		39.34	35.42	42.12	41.79	43.62	36.51	54.96	42.54	37.01	n/a
DT27	24.91	28.37	26.73	23.09	23.01	21.55	16.55	18.73	23.68	30.31	46.98	33.18	26.42	22.99	n/a
DT28	39.48	42.59	40.47	39.04	40.34	35.60	31.85	34.25	39.26	41.31	31.95	47.15	38.61	33.59	n/a
DT29	37.78	38.33	39.93	32.28	36.16	31.47	28.95	33.42	33.33	41.15	40.46	44.34	36.47	31.73	n/a
DT30	31.45	30.62	27.62	25.36	23.97	23.71	20.33	22.91	26.06	29.59	41.22	32.98	27.99	24.35	n/a
DT31	31.26	37.64		30.33	30.15	29.46	24.14		32.41	44.27	34.60	43.25	33.75	29.36	n/a
DT32	41.56	45.54	44.22	43.57	41.98	41.80	30.96	40.86	46.70	48.63	42.36	51.25	43.29	37.66	n/a
DT33	34.50	37.83	34.71	35.86	32.20	34.71	36.70	30.01	36.25	39.81	45.31	39.58	36.46	31.72	n/a
DT34	34.92	40.71	29.46	34.82	40.91	27.65	28.18	31.98	33.26	40.23	41.29	51.51	36.24	31.53	n/a
DT35	33.97	35.69	25.94	29.89	29.75	27.24	21.65	23.31	30.83	38.03	43.09	46.83	32.18	28.00	n/a
DT36	32.93	34.41	34.00	34.05	34.40	29.27	25.07	23.66	32.17	38.75	40.88	41.56	33.43	29.08	26.1
DT37	41.44	42.64	45.77	43.99	38.96	34.00	29.21	31.03	39.38	55.37	38.31	59.81	41.66	36.24	28.2
DT38	32.74	29.38	25.76	27.10	25.89	25.94	20.09	21.29	27.41	34.53	53.76	40.56	30.37	26.42	n/a
DT39	40.11	36.90	31.87	33.68	33.53	31.25	30.59	30.25	35.77	39.00	34.06	53.07	35.84	31.18	n/a
DT40	52.97	49.84	41.02	50.89	50.18	41.46	42.92	42.25	52.24	52.29	41.01	64.27	48.44	**42.15**	n/a
DT41	35.08	38.88	37.69	30.85	29.87	27.06	27.29	28.46	28.64	39.13	53.38	49.26	35.47	30.86	n/a

Site ID	NO_2 Mean Concentrations (µg/m^3)														
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Mean		
													Raw Data	Bias Adjusted (0.87) and Annualised (1)	Distance Corrected to Nearest Exposure (2)
DT42	23.44	22.97	21.06	19.22	18.40	17.29	18.32	14.85		25.67	36.44	31.43	22.64	19.70	17.6
DT43	26.97	25.84	21.03	20.71	17.39	15.97	15.93	16.08	20.22	23.05	23.82	32.13	21.59	18.79	16.7
DT44	33.03	34.02	25.49	25.04	23.88	22.52	23.28	23.98		39.49	26.73	68.63	31.46	27.37	23.6
DT45	22.66	22.64	21.21	16.62	16.88	15.47	12.50	13.25	17.87	21.70	41.18	27.23	20.77	18.07	16.4
DT46	22.44	20.71	20.24	18.87	17.29	15.57	15.24	13.34	17.61	21.55	21.95	34.83	19.97	17.37	16.5
DT47	25.52	25.06	23.87		19.77	18.22	15.00	14.25	18.92	29.11	25.44	34.48	22.69	19.74	n/a
DT48	21.57	20.48	16.92	15.47	12.62	9.06	10.38	10.51	15.42	18.68	29.93	30.31	17.61	15.32	n/a
DT49	41.39	47.96	50.32	50.21	43.55	42.57	28.04	36.60	28.03	54.12	25.82	59.82	42.37	36.86	n/a
DT50	60.98	54.80	57.74	56.30	52.63	50.00	51.49	27.82	55.90	57.16	51.73	68.66	53.77	**46.78**	n/a
DT51	47.23	43.79	43.38	42.73	32.18	38.36	37.86	39.70	41.19	57.72	62.68	61.55	45.70	39.76	n/a
DT52		52.35	44.72	59.07	56.65	53.17	53.36	53.74	62.08		69.77	66.39	57.13	**49.70**	39.2
DT53	37.20	32.49	35.33	35.23	34.05	31.11	26.19	27.28	33.49	43.78	55.63	41.58	36.11	31.42	26.5
DT54	49.58	45.98	45.59	42.13	37.31	39.65	40.80	40.42	43.17	46.13	40.48	59.64	44.24	38.49	n/a
DT55	76.07	61.39	65.02	72.75	65.08	67.42	56.52	68.76	66.18	72.57	42.16	84.23	66.51	**57.87**	n/a
DT56	57.51	52.84	56.14	52.89	51.86	53.89	54.00	51.91	57.64	58.27	68.10	73.05	57.34	**49.89**	32.7
DT57	25.73	23.76	21.37	21.85	20.00	19.86	17.26	17.16	22.93	27.88	27.56	31.46	23.07	20.07	n/a
DT58	31.27	35.99	40.58	37.96	42.55	31.88	32.56	30.99	41.33	48.63	51.48	56.98	40.18	34.96	28.0
DT59	27.08	27.24	22.15	23.62	23.61	20.82	21.26	18.74	26.76	27.70	28.48	36.08	25.29	22.01	n/a
DT60	24.60	24.93	20.74	19.44	17.66	15.75	14.80	15.96			29.83		20.41	17.76	16.3
DT61	33.80	32.06	25.82	27.14	29.49	24.85	14.70	24.66	25.08	30.55	35.09	35.47	28.23	24.56	n/a
DT62	22.88	24.00	22.71	22.66	20.17	17.10	27.34	15.38	21.09	28.59	30.46	30.48	23.57	20.51	n/a
DT63	27.77	28.97	25.68	29.90	25.96	24.32	20.23	20.18	25.49	32.32	35.49	39.39	27.97	24.34	n/a
DT64	44.37	38.65	35.50	38.84	40.02	32.08	38.00	35.45	38.17	41.99	44.45	53.54	40.09	34.88	n/a

Site ID	NO_2 Mean Concentrations (µg/m^3)														
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Mean		
													Raw Data	Bias Adjusted (0.87) and Annualised (1)	Distance Corrected to Nearest Exposure (2)
DT65	31.35	31.14	23.67	31.44	29.21	26.32	19.27	20.29	28.11	32.60	31.04	40.46	28.74	25.01	n/a

☒ **Local bias adjustment factor used**

☐ **National bias adjustment factor used**

☒ **Annualisation has been conducted where data capture is <75**

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) See Appendix C for details on bias adjustment and annualisation.

(2) Distance corrected to nearest relevant public exposure.

(3) Blank cells indicate data that is missing either because the diffusion tube went missing during the exposure period, or because the data has been deleted during the QA/QC process.

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

C.1 – Air Quality Strategy

Exeter City Council updated its Air Quality Strategy in 2015. The strategy is available online at https://exeter.gov.uk/airpollution/.

C.2 – Air Quality Action Plan Steering Group

Exeter City Council arranged a meeting in June 2016 for the following key organisations with an interest in air quality:

- Public Health England
- Public Health Devon
- European Centre for Environment and Health (Peninsular Medical School / Exeter University)
- Exeter City Futures
- Devon County Council Highways
- Exeter University (Greenpeace laboratories)
- Met Office
- Teignbridge District Council
- East Devon District Council
- Mid Devon District Council
- Exeter City Council – Communities
- Exeter City Council – Sustainable Transport and Economic Development
- Exeter City Council – Forward Planning
- Exeter City Council – Fleet
- Exeter City Council – Energy Manager
- Exeter Chamber of Commerce
- Low Carbon Task Force

At this meeting it was agreed that there was a clear need and desire to take forward innovative measures to reduce vehicle emissions and exposure to these. While it was extremely useful to have so many interested parties gathered together, it was evident that this group was too large to be anything other than a consultative body for a draft AQAP. Smaller, more focussed groups would be needed to take forward potential measures.

Action to reduce vehicle emissions relies on commitment by a coalition of organisations, both public and private sector. Therefore whilst the AQAP will be published by Exeter City Council, it should be seen instead as a collection of collaborative projects with other allies. These projects are independently run, by their own project boards and groups, and will be summarised in the AQAP. For this reason, there is no single AQAP steering group. Instead, the following groups are all actively involved in discussing and developing potential measures:

- Exeter Health and Wellbeing Board and Devon Health and Wellbeing Board
- Devon Tranquillity Group (DCC, ECC, landscape, planning and public health officers)
- Ad hoc discussions between DCC Highways and ECC Air Quality
- District Council Air Quality Officers (EDDC, MDDC, TDC and ECC)
- Greater Exeter Strategic Plan Board (DCC, ECC, MDDC, TDC, EDDC planners)
- Exeter City Council Licensing Committee
- Exeter taxi forum
- Devon Public Health Air Quality Board (all Devon district councils and Public Health Devon)
- Heavitree Congestion & Environment Group (ECC Environmental Health, ECC Communities, Exeter University, Heavitree residents representatives and Exeter City Futures)
- Ad hoc meetings with ECC Environmental Health and ECC fleet
- Ad hoc meetings with ECC forward planning officers
- Low Carbon Task Force – ULEV Group

These meetings are constructive and are helping to shape the actions that will be included in the AQAP. It reflects the local importance given to air quality and sustainability that many of the groups would have met and taken actions forward in the absence of the AQAP. However the AQAP gives an opportunity to co-ordinate such programs, introduce some others and focus on compliance with the air quality objectives. Consultation on the draft will start in September 2017.

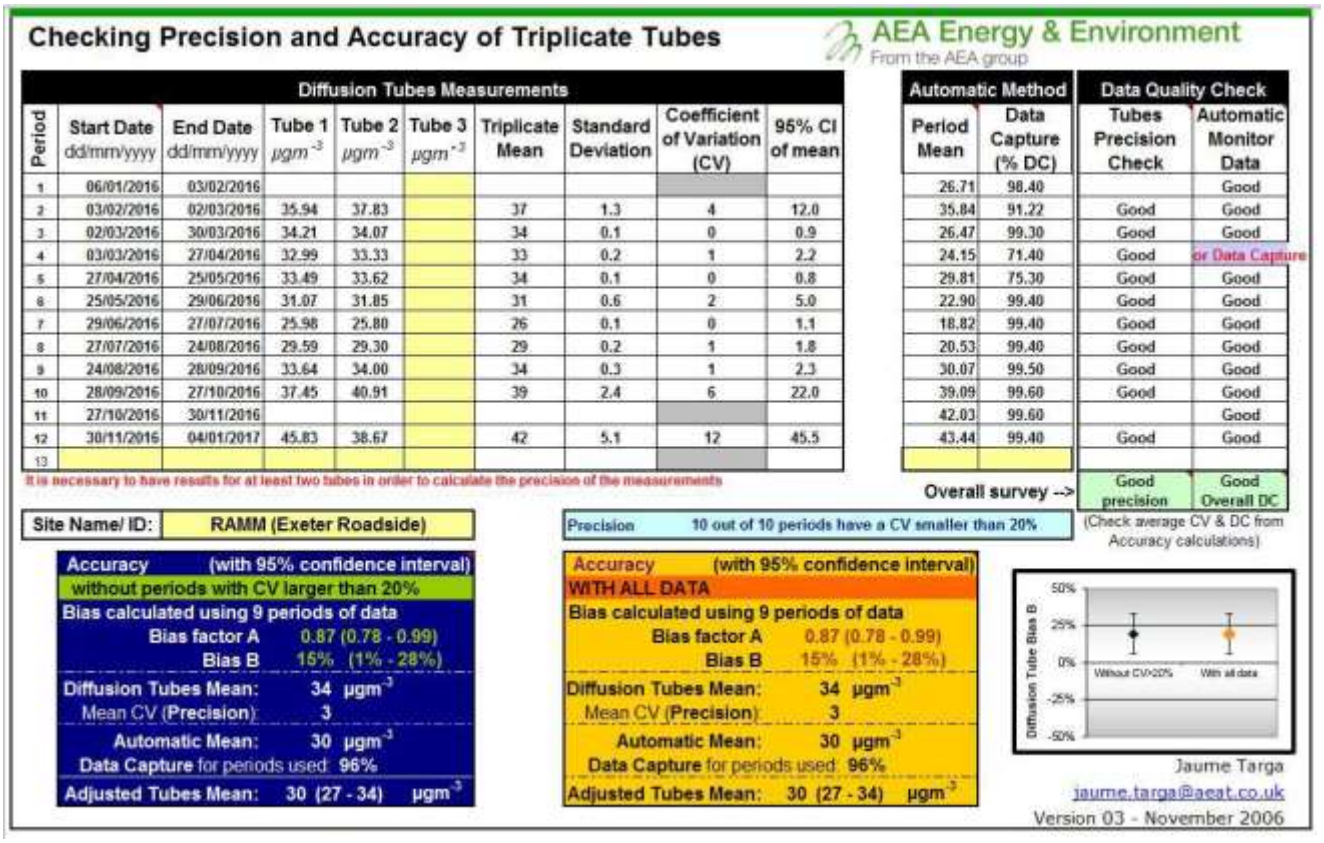
C.3 – Air Quality Monitoring Data QA/QC

Diffusion Tube Bias Adjustment Factors - National Factor

The national bias adjustment factor of 0.94 has been obtained from the spreadsheet version 02/17, for Gradko diffusion tubes (20% TEA in water).

Factor from Local Co-location Studies

The precision and local bias factor (0.87) for the co-located diffusion tubes at Exeter Roadside (RAMM Queen Street) has been calculated using the spreadsheet shown as Figure C.4.1 below.



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	06/01/2016	03/02/2016							
2	03/02/2016	02/03/2016	35.94	37.83		37	1.3	4	12.0
3	02/03/2016	30/03/2016	34.21	34.07		34	0.1	0	0.9
4	03/03/2016	27/04/2016	32.99	33.33		33	0.2	1	2.2
5	27/04/2016	25/05/2016	33.49	33.62		34	0.1	0	0.8
6	25/05/2016	29/06/2016	31.07	31.85		31	0.6	2	5.0
7	29/06/2016	27/07/2016	25.98	25.80		26	0.1	0	1.1
8	27/07/2016	24/08/2016	29.59	29.30		29	0.2	1	1.8
9	24/08/2016	28/09/2016	33.64	34.00		34	0.3	1	2.3
10	28/09/2016	27/10/2016	37.45	40.91		39	2.4	6	22.0
11	27/10/2016	30/11/2016							
12	30/11/2016	04/01/2017	45.83	38.67		42	5.1	12	45.5
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
26.71	98.40		Good
35.84	91.22	Good	Good
26.47	99.30	Good	Good
24.15	71.40	Good	or Data Capture
29.81	75.30	Good	Good
22.90	99.40	Good	Good
18.82	99.40	Good	Good
20.53	99.40	Good	Good
30.07	99.50	Good	Good
39.09	99.60	Good	Good
42.03	99.60		Good
43.44	99.40	Good	Good
Overall survey -->		Good precision	Good Overall DC

Site Name/ ID: RAMM (Exeter Roadside)

Precision: 10 out of 10 periods have a CV smaller than 20%

(Check average CV & DC from Accuracy calculations)

Accuracy (with 95% confidence interval)
without periods with CV larger than 20%
Bias calculated using 9 periods of data
Bias factor A 0.87 (0.78 - 0.99)
Bias B 15% (1% - 28%)
Diffusion Tubes Mean: 34 µgm^{-3}
Mean CV (Precision): 3
Automatic Mean: 30 µgm^{-3}
Data Capture for periods used: 96%
Adjusted Tubes Mean: 30 (27 - 34) µgm^{-3}

Accuracy (with 95% confidence interval)
WITH ALL DATA
Bias calculated using 9 periods of data
Bias factor A 0.87 (0.78 - 0.99)
Bias B 15% (1% - 28%)
Diffusion Tubes Mean: 34 µgm^{-3}
Mean CV (Precision): 3
Automatic Mean: 30 µgm^{-3}
Data Capture for periods used: 96%
Adjusted Tubes Mean: 30 (27 - 34) µgm^{-3}

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Version 03 - November 2006

Figure C.4.1 Diffusion Tube Precision and Accuracy

Discussion of Choice of Factor to Use

Data from the tubes are ratified and suspect data is rejected by Exeter City Council, following the procedure in the DEFRA practical guidance. Analysis of the data from the two tubes that are co-located with the continuous analyser shows that these have good precision and a bias factor of 0.87 (Figure C.4.1). This means that the Exeter diffusion tubes over-estimate actual concentrations when compared to the reference method. The nationally collated bias adjustment factor is similar, at 0.94.

Results calculated using the Exeter factor are used in this report because the data capture at Exeter RAMM is over 90%, and it is thought to be more representative of local conditions.

QA/QC of Automatic Monitoring

Neither of the two TEOMs are part of the national network, however recommended QA/QC procedures from the AURN Local Site Operator's manual are followed, including the filter change frequency and methodology. Horiba also service each analyser every six months. Data capture at the RAMM site was over 99% in 2016, but at the Alphington Street site it was 80%. The low data capture was caused by a pump fault which took some time to repair.

The PM_{10} data is collected, validated and ratified by Exeter City Council. Validation involves checking the data daily for instrumentation errors etc and then visually screening the data on a weekly basis to mark any obviously spurious or unusual measurements. The Council also undertakes data ratification on an approximately three monthly basis as well as following site services. This involves:

- Comparison of data with other pollutants and other appropriate AURN network sites (roadside sites and other sites in the south west),
- Final checking and deletion of data marked as possibly erroneous,
- Removal of data from unrepresentative periods of operation (e.g. road works in immediate vicinity of site etc where data is shown or believed to have been affected),
- Adjustment for issues identified during services etc.

Both the PM_{10} analysers are TEOMs. The TEOM method of measuring particulates has failed the EC equivalence test, however advice from DEFRA is that Local

Authorities do not need to replace TEOMs immediately unless PM_{10} concentrations are close to the objective level. In Exeter, previous reports have not found that the objective level for particulates is likely to be exceeded and therefore the two TEOMs are still being used. They are expected to be replaced in 2017 and care will be taken to ensure that any new equipment does meet the EC equivalence criteria. In the meantime, the data has been adjusted for volatiles using the online Volatile Correction Model tool from Kings College, London.

The NO_2 data from Exeter Roadside is collected and ratified by the AURN. Network data from the site can be found at http://uk-air.defra.gov.uk/data/. It is ratified every 3 months by NETCEN, and is reported in the QA / QC Data Ratification Report for the Automatic Urban Network. Data capture from the NO_2 analyser was 95% in 2016.

Plots of hourly average values for nitrogen dioxide and particulate matter are shown below in figures C.4.2 and C.4.3.

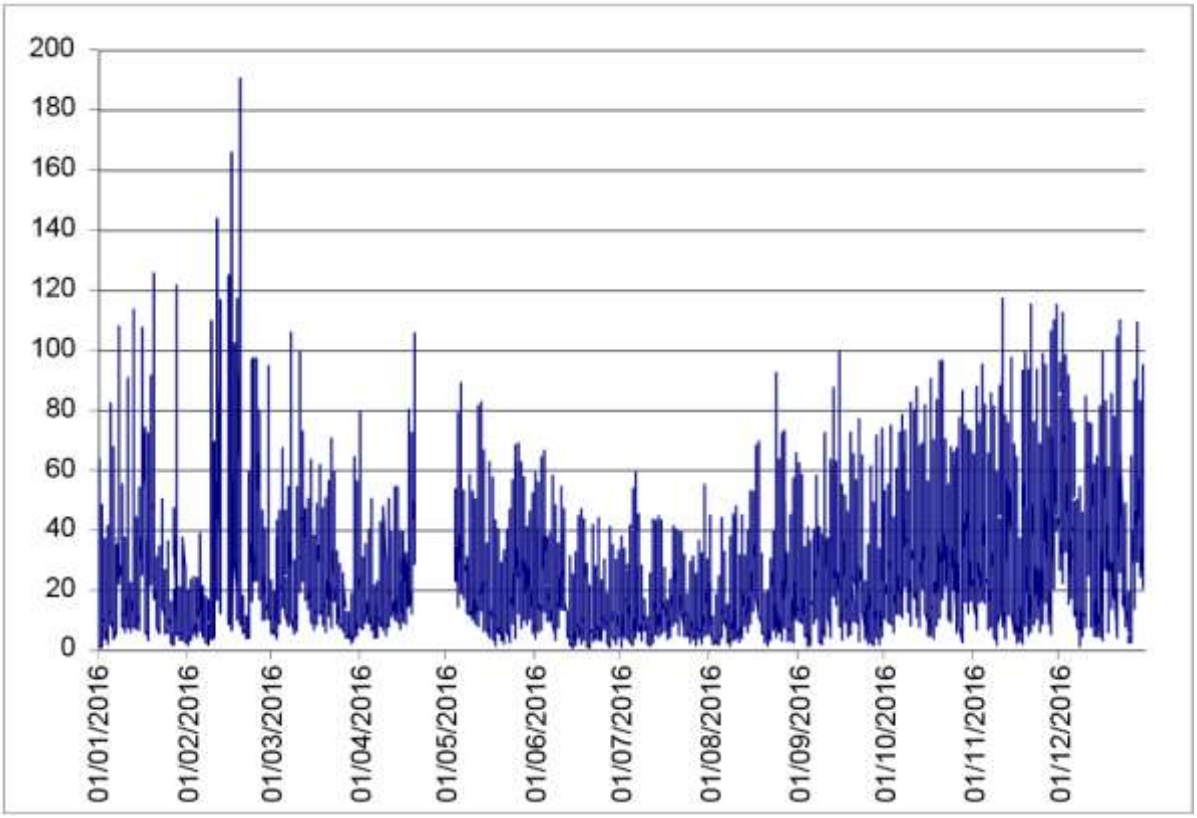

Figure C.4.2 Hourly NO_2 data from Exeter Roadside (RAMM) ($\mu g/m^3$)

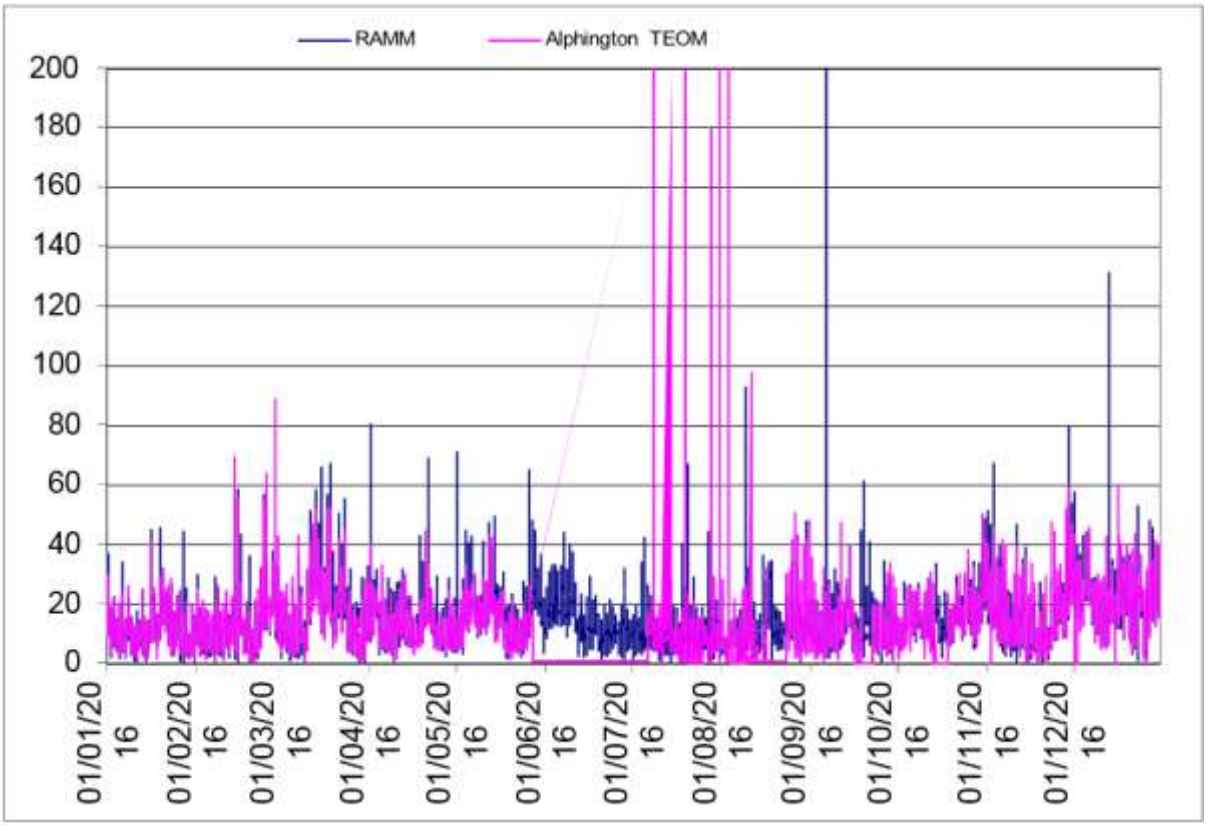

Figure C.4.3 Hourly PM_{10} data from Exeter Roadside (RAMM) and Alphington Street ($\mu g/m^3$)

QA/QC of Diffusion Tube Monitoring

The diffusion tubes are supplied by GRADKO[4] and are prepared using 20% TEA in water. The GRADKO lab follows the procedures set out in the Harmonisation Practical Guidance. The performance of laboratory is rated as satisfactory in the centralised AIR NO_2 PT scheme for quality assurance and quality control.

The tube exposure period used follows the timetable provided by the Air Quality Support Helpdesk, i.e. an exposure time of 4 or 5 weeks, with an allowed variation in exposure time of $\pm$ 2 days. The tubes are stored in a fridge before they are exposed. Location sites and fixings follow the recommendations in the DEFRA practical guidance on the use of diffusion tubes for NO_2 monitoring, published in 2008. Two tubes are collocated with the continuous analyser at the Royal Albert Memorial Museum (RAMM), Queen Street (Exeter Roadside).

Data from the tubes are ratified and suspect data rejected by Exeter City Council, following the procedure in the DEFRA practical guidance. Analysis of the data from

[4] GRADKO International Ltd., St. Martins House, 77 Wales Street, Winchester, Hants. SO23 0RH

the two tubes that are co-located with the continuous analyser shows that these have good precision.

The full monthly dataset is shown in Table B.1 above.

Appendix D: Map(s) of Monitoring Locations and AQMAs

This is included as a separate document

Appendix E: Summary of Air Quality Objectives in England

Table E.1 – Air Quality Objectives in England

Pollutant	Air Quality Objective[5]	
	Concentration	Measured as
	200 µg/m^3 not to be exceeded more than 18 times a year	1-hour mean
	40 µg/m^3	Annual mean
	50 µg/m^3, not to be exceeded more than 35 times a year	24-hour mean
	40 µg/m^3	Annual mean
	350 µg/m^3, not to be exceeded more than 24 times a year	1-hour mean
	125 µg/m^3, not to be exceeded more than 3 times a year	24-hour mean
	266 µg/m^3, not to be exceeded more than 35 times a year	15-minute mean

[5] The units are in microgrammes of pollutant per cubic metre of air (µg/m^3).

Glossary of Terms

Abbreviation	Description
AQAP	Air Quality Action Plan - A detailed description of measures, outcomes, achievement dates and implementation methods, showing how the local authority 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
ASR	Air quality Annual Status Report
Defra	Department for Environment, Food and Rural Affairs
DMRB	Design Manual for Roads and Bridges – Air quality screening tool produced by Highways England
EU	European Union
FDMS	Filter Dynamics Measurement System
LAQM	Local Air Quality Management
NO_2	Nitrogen Dioxide
NO_x	Nitrogen Oxides
PM_{10}	Airborne particulate matter with an aerodynamic diameter of 10µm (micrometres or microns) or less
$PM_{2.5}$	Airborne particulate matter with an aerodynamic diameter of 2.5µm or less
QA/QC	Quality Assurance and Quality Control
SO_2	Sulphur Dioxide

References

Exeter City Council 2011. Exeter Air Quality Action Plan 2011-2016. https://exeter.gov.uk/airpollution/

Exeter City Council 2016. Exeter Air Quality Annual Status Report. https://exeter.gov.uk/airpollution/

Local Air Quality Management Technical Guidance 2016 - LAQM.TG(16)

Diffusion Tubes for Ambient NO_2 Monitoring: Practical Guidance for Laboratories and Users 2008

National bias adjustment factor spreadsheet: http://laqm.defra.gov.uk/bias-adjustment-factors/national-bias.html

Tube precision spreadsheet: www.airquality.co.uk/archive/laqm/tools/AEA_DifTPAB_v03.xls

Volatile Correction Model website: http://www.volatile-correction-model.info/

Devon Local Transport Plans: http://www.devon.gov.uk/index/transportroads/devon_local_transport_plan.htm

DEFRA 2015. DEFRA National Statistics Release; Emissions of air pollutants in the UK, 1970 to 2014