

2018 Air Quality Annual Status Report (ASR)

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

June 2018

| Local Authority Officer | Tim Savage |
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| Department | Public Health & Protection |
| Address | Duke Street Chelmsford Essex CM1 1JE |
| Telephone | 01245 606264 |
| E-mail | tim.savage@chelmsford.gov.uk |
| Report Reference number | CHE/ASR2018 |
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| Written by | Tim Savage |
| Scientific Team Public Health & Protection Services Chelmsford City Council Duke Street Chelmsford Essex CM1 1JE | City Council |

Executive Summary: Air Quality in Our Area

This 2018 Annual Status Report is designed to provide the public with information relating to local air quality in Chelmsford, to fulfil Chelmsford City Council's statutory duty to review and assess air quality within its area, and to determine whether or not the air quality objectives are likely to be achieved.

In 2017, Air Quality Objectives were exceeded and the Council proposes to declare a new Air Quality Management Area (AQMA) in the village of Danbury.

Air Quality in Chelmsford

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 $\pounds 16$ billion³.

Chelmsford is located in mid Essex, thirty-one miles from London and has a population of over 168,310 (2011 census), largely living in the main urban areas of Chelmsford and South Woodham Ferrers. The City of Chelmsford comprises of a number of suburban areas surrounding the main urban areas and the larger rural villages of Danbury, East and West Hanningfield, Great Leighs, Little Waltham and Little Baddow.

The main source of air pollution in Chelmsford is road traffic emissions from major roads, notably the A12, A414, A138, A130 and B1016

Chelmsford City Council has declared one Air Quality Management Area (AQMA) at the Army and Navy roundabout and surrounding roads which is detailed in Table 2.1.

In 2017, the Council measured exceedances of the air quality objectives at relevant exposure inside and outside of the AQMA. Declaration of a new AQMA has been proposed in respect of the exceedances measured outside of the existing AQMA.

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

Chelmsford Growth Package

Roads in Chelmsford are operational at up to 90% capacity with the remaining 10% providing flexibility, resilience and reliability. As such, traffic often comes to a halt during rush hour. The road network operates at 96% capacity during peak times, so sheer volume of traffic can lead to delays. With only 4% space left, Essex County Council secured £15 million to deliver the range of transport improvement measures in the proposed Chelmsford Growth Package.



Figure i.1 - Chelmsford Growth Package Zones

https://www.essexhighways.org/highway-schemes-and-developments/major-schemes/chelmsford-future-transport-network.aspx

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A zonal approach has been proposed. The Outer Zone will target journeys from outside of Chelmsford and will focus on removing as much traffic as possible on the outskirts of the City by emphasising existing rail and Park & Ride routes and exploring potential for future services.

The Mid Zone will target sustainable alternatives to the private car and encouraging trips using public transport, cycling and on the pedestrian network.

The Central Zone focuses on improving the quality of the walking environment for residents and visitors, public realm improvements and managing traffic as efficiently as possible.

Consultation has been completed and construction is due to commence with March 2020 a target completion date. Notable proposals of the Baddow Road Bus Gate and the Broomfield Road: Hybrid Cycleway are discussed below.

Baddow Road Bus Gate

The Army and Navy roundabout is a key gateway to the city and is a key point on the network where five roads meet at the junction. The Baddow Road approach to the junction is a primarily residential access onto the junction and suffers severe congestion during peak periods.

The five-arm roundabout of the Army & Navy is challenging to mitigate congestion due to the proximity of the arms to each other. There is significant queuing on all arms during peak hours and delays throughout the day on the Baddow Road corridor.

The Army & Navy AQMA covers the junction, along Parkway and a short section of Baddow Road. Modelling studies were commissioned to develop improvement options for the junction with a one way, town centre bound closure to general traffic with a bus gate between the Army & Navy and Meadgate Avenue junctions was selected. In addition to benefits to traffic flow and congestion 5% improvements in NO₂ concentrations had been modelled.

Figure i.2 - Baddow Road Bus Gate



Chelmsford City Growth Package Volume 5 https://www.essexhighways.org/uploads/CCGP/CCGP_Vol5_Web.pdf

After the consultation process, the proposed operation times have been reduced to peak hours only (0700-1000 & 1600-1900) and to allow residents living between Meadgate Avenue and the Army & Navy to access the roundabout as they currently do. This scheme will be implemented for 18 months on a trial basis.

Figure i.3 - Broomfield Road: Hybrid Cycleway (Gyratory to Patching Hall Lane)

Broomfield Road benefits from standard cycle lanes on both sides. These are subject to substantial use throughout the day. A high-quality flagship cycle route is proposed to upgrade the cycle lanes by installation of hybrid cycle tracks.



Chelmsford Growth Package Volume 1 https://www.essexhighways.org/uploads/CCGP/CCGP Vol1 Web.pdf

Hybrid cycle tracks are at a slightly different level to both the footway and the road to provide defined segregation for people who cycle from traffic and pedestrians. These cycle tracks are proposed for Broomfield Road between Skerry Rise in the north and the gyratory with Parkway at the southern end and will provide links to the existing cycle network across the city.

Chelmsford City Council New Local Plan

To aid in development of the Local Plan, Chelmsford City Council has commissioned consultants to prepare an air quality impact assessment for Local Plan development to 2036.

The first stage of the modelling is to compile a baseline emissions inventory and carry out model verification to check that the model input data and assumptions are appropriate for the area. This includes:

- Traffic model data from Chelmsford's Strategic and Local Junction Modelling
- Emissions from industrial sources from previous modelling carried out in Chelmsford, and also from the National Atmospheric Emissions Inventory.
- Meteorological data.
- Results of continuous and diffusion tube monitoring for model verification.

Verification of the data is currently being completed. The next steps will be to use the verified model to predict any changes to 2036 accounting for proposed developments and increased traffic volumes. The full report is expected to be complete by the end of July 2018.

The Council has also undertaken a high-level <u>assessment</u> of proposed development sites allocated in the Local Plan using the Earth Sense postcode checker.

The preferred options document for the new Chelmsford Local Plan contains a number of policies for the improvement of air quality:

Policy MP3 includes the requirement for 'New dwellings and non-residential buildings shall provide convenient access to EV charging point infrastructure'.

Residential development should provide EV charging point infrastructure to encourage the use of ultra-low emission vehicles at the rate of 1 charging point perunit (for a dwelling with dedicated off-road parking) and/or 1 charging point per-10 spaces (where off-road parking is unallocated). Non-residential development should provide charging points equivalent to 5% of the total parking provision.

Policy PA2 prioritises securing air quality mitigation through development:

'For developments in or adjacent to an Air Quality Management Area, or where an air quality impact assessment has been provided, permission will only be granted where the Council is satisfied that after selection of appropriate mitigation the development will not have an unacceptable significant impact on air quality, health and wellbeing.'

Conclusions and Priorities

Army and Navy AQMA

One exceedance was measured within the existing AQMA at CB58 148 Baddow Road. This monitoring location is at relevant exposure and is a worst-case exposure location within Baddow Road. The measured concentration of nitrogen dioxide was $40.58\mu g/m^3$ which exceeds the Air Quality Objectives by $0.58\mu g/m^3$.

Following the review of air quality dispersion modelling, for 2018 two new air quality monitoring sites have been added on the eastbound side of Parkway near to the junction with High Bridge Road and Baddow Road.

The Army & Navy July 2008 Air Quality Action Plan will be reviewed in the forthcoming year with reference to the proposed Baddow Road Bus Gate and new monitoring locations on the north side of Parkway.

A414 Danbury Pollution Hotspot

The A414 Maldon Road is a busy road that connects Maldon and the Dengie area with the A12 and Chelmsford. At the pollution hotspot the road has narrow footways flanked by buildings on one or both sides.

In 2017, the Council measured exceedances of the air quality objectives at relevant exposure on the A414 Maldon Road in Danbury. A new AQMA is proposed to be declared and Air Quality Action Plan developed. More information can be found in Appendix F.

Springfield Road Pollution Hotspot

The crossroads junction of Springfield Road and Victoria Road is a congestion hotspot and the Council monitors air quality on all four road-links entering the junction.

A small section of Springfield Road west of the junction up to Trinity Road has buildings flanking the road creating a canyon-like environment. This 'street canyon' reduces the dispersion of pollution generated by traffic. Vehicles queue down to the traffic lights and monitoring has found that air quality in this section of road is borderline with the Air Quality Objectives.

Chelmsford Council will continue to monitor air quality at this location.

Summary of Chelmsford City Council Priority Actions

Chelmsford City Council will prioritise the following air quality actions for the forthcoming year:

- Declare an AQMA at A414 Maldon Road, Danbury
- Develop an AQAP for A414 Maldon Road, Danbury
- Review the AQAP for existing Army & Navy AQMA
- Develop an Air Quality Strategy for Chelmsford
- Develop a new workplace travel plan for Chelmsford City Council

Local Engagement and How to get Involved

Residents and visitors to Chelmsford are encouraged to <u>sign up</u> to *air*TEXT for free air quality alerts by SMS text message, email, <u>@airtext chelm</u> on twitter and voicemail. The service also provides 3-day forecasts of air quality, pollen, UV and temperature. It is possible to sign up by visiting <u>airTEXT.info/signup</u> or by texting airTEXT to 78070.

There is also a free *air*TEXT smart phone app that gives users forecasts for pollution, UV, grass pollen and temperature. This app is available for iPhones and Android smartphones.





Chelmsford City Council is a member of the Essex Air Quality consortium. The purpose of Essex Air is to promote improvements in air quality related issues.

The Essex Air <u>web site</u> provides a daily forecast of air pollution. Also, the <u>@EssexAir</u> twitter feed provides localised weekly air pollution forecasts.

Figure i.4 - Essex Air Twitter Air Quality Notifications

Essex Air @EssexAir
Moderate #airpollution forecast for Essex on Thursday and Friday ukair.defra.gov.uk/forecasting/?d...
For health advice see uk-air.defra.gov.uk/airpollution/...
3:33 PM - 4 May 2016

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Links to Defra recommended actions and health advice are provided when air pollution is likely to be moderate or higher. This will enable those with heart or lung conditions, or other breathing problems to make informed judgements about their levels of activity or exposure.

The Essex Air twitter also promotes the <u>DVSA service</u> for reporting smoky lorries or buses. Particulate matter is usually not visible but when poorly maintained diesel engines can produce visible particles, appearing as smoke. Fine particles have an adverse effect on human health, particularly among those with respiratory and cardiovascular problem.

Figure i.5 - Essex Air Reporting Smoky Vehicle Tweets



Essex County Council has worked closely with <u>Liftshare</u> to develop the Essex Car Share scheme. This operates across Chelmsford and provides commuters with a car sharing service which could cut congestion and air pollution whilst saving money.

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1 Local Air Quality Management

This report provides an overview of air quality in Chelmsford during 2017. 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 Chelmsford 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.2 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 the AQMAs declared by Chelmsford City Council can be found in Table 2.1. Further information related to declared or revoked AQMAs, including maps of AQMA boundaries are available <u>online</u>. Alternatively, see Appendix D: Map(s) of Monitoring Locations and AQMAs, which provides for a map of air quality monitoring locations in relation to the AQMA.

Chelmsford City Council proposes to declare a new AQMA in the village of Danbury on the A414, Maldon Road. For more information see Appendix F.

| AQMA Name | Date of Declaratio n | Pollut ants and Air Qualit | City / Town | One Line Descrip | Is air quality in the AQMA influenced by roads controlled | Level of Exceedance (maximum monitored/modelled concentration at a location of relevant exposure) | | | | Action Plan | | | |
|------------------------|--|--|----------------|---|--|--|---------------|-------|-------|--|------------------------|--|--|
| | | y Object ives | | uon | by Highways England? | Decla | At aration | N | ow | Name | Date of Publication | Link | |
| Army & Navy AQMA | Declared 01/12/2005 , Amended 1/10/2012 | NO2 Annual Mean | Chelmsford | Army & Navy Rounda bout and surroun ding roads | NO | 51 | µg/m³ | 40.58 | µg/m³ | Air Quality Action Plan Army & Navy July 2008 | 2008 | https://uk- air.defra.gov.uk/asse ts/documents/no2te n/Local zone29 Che Imsford AQActionpl an 1.pdf | |

Table 2.1 – Declared Air Quality Management Areas

☑ Chelmsford City Council confirms the information on UK-Air regarding their AQMA(s) is up to date

2.2 Measures to address Air Quality in Chelmsford

Details of all measures completed, in progress or planned are set out in Table 2.2.

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 | Chelmsfor d Growth Package - Outer Zone | Transport Planning and Infrastruct ure | Other | Essex County Council / South East LEP | 2010-2017 | 2018 | Reduced Congestion | Baddow Road Bus Gate 5% improvement in NO2 concentrations | Funding secured & public consultation completed | 2020 | Bus Priority Measures. Focus on removing as much traffic as possible on the outskirts of the City by emphasising existing rail and Park & Ride routes and exploring potential for future services. |
| 2 | Chelmsfor d Growth Package - Mid Zone | Transport Planning and Infrastruct ure | Cycle network | Essex County Council / South East LEP | 2017 | 2018 | Increased Cycle Use | Not quantified | Funding secured & public consultation completed | 2020 | Sustainable alternatives to the private car use and encouraging trips using public transport, cycling and on the pedestrian network |
| 3 | Chelmsfor d Growth Package - Inner Zone | Promoting Travel Alternativ es | Promotion of walking | Essex County Council / South East LEP | 2017 | 2018 | Increased Pedestrian Access | Not quantified | Funding secured & public consultation completed | 2020 | Public Real Improvements - Improving the quality of the walking environment |
| 4 | Chelmsfor d Air Quality Modelling for Local Plan Developm ent | Policy Guidance and Developm ent Control | Other policy | Chelmsford City Council | 2017 | 2018 | Adoption of Policy | Not quantified | Model Verification | 2018 | Identifying that proposed development is suitable on the basis of air quality |

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| 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 |
|----------------|---|---|---|--|-------------------|-------------------------|---|---|------------------|---|--|
| 5 | Chelmsfor d Air Quality Strategy | Policy Guidance and Developm ent Control | Low Emissions Strategy | Chelmsford City Council | 2018 | 2019 | Adoption of Policy | Not quantified | N/A | 2019 | |
| 6 | Essex Liftshare | Alternativ es to private vehicle use | Car & lift sharing schemes | Essex County Council | N/A | 2014 | Number of Users | Not quantified | Ongoing | Ongoing Measure | |
| 7 | Member of Essex Air | Policy Guidance and Developm ent Control | Regional Groups Co- ordinating programmes to develop Area wide Strategies to reduce emissions and improve air quality | Essex Air | N/A | N/A | N/A | N/A | Ongoing | Ongoing Measure | |
| 8 | Environm ental Permit Inspection & Enforcem ent | Environm ental Permits | Measures to reduce pollution through IPPC Permits going beyond BAT | Chelmsford City Council | N/A | N/A | Operator compliance with Environmental Permit | N/A | Ongoing | N/A | |

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.

Chelmsford City Council does not monitor $PM_{2.5}$ concentrations however monitors PM_{10} at three locations. A <u>report</u> on the UK-AIR websites suggests that an approximate ratio of $PM_{2.5}$: PM_{10} concentrations to be 0.67.

The Springfield Road (Chelmsford Prison) site routinely measures the highest PM_{10} in the monitoring network. This location is sited next to a busy road and junction along with an adjacent bus stop. Particulate matter is likely to be present at relatively high concentrations due to tyre / brake wear and from dust resuspension as well as diesel vehicle emissions.

In 2017 the Springfield Road (Chelmsford Prison) site measured an annual mean PM_{10} value of 28.80µg/m³. Using the 0.67 ratio would suggest that the concentration of $PM_{2.5}$ at this busy junction would be 19.30µg/m³ well below the National Air Quality objective of 25µg/m³. It should be noted that this is a worst-case scenario and not necessarily representative of average exposure across the urban area. Also, all three PM_{10} monitors in Chelmsford are trending downwards suggesting that $PM_{2.5}$ concentrations may also be reducing. This can be seen in Figure A.10 in Appendix A.

Chelmsford City Council notes the Public Health Outcomes Framework indicator 3.01 – Fraction of mortality attributable to particulate (PM_{2.5}) air pollution which for 2016 gave a value of 5.6% which is slightly above average for the region (5.4%).

Chelmsford City Council is taking the following measures to address PM_{2.5}:

- Use of Essex Air twitter to encourage the reporting of smoky vehicles through the DVSA reporting service. It is possible to report either heavy goods vehicles or public service vehicles (buses).
- Regular inspections of permitted industry where combustion and noncombustion processes could lead to anthropogenic emissions of PM_{2.5}
- Working with Essex County Council (highway authority) and Highways England to deliver major transport improvement schemes to alleviate traffic and congestion. In addition to reduced exhaust emissions, these schemes will reduce non-exhaust particulate emissions from brake and tyre wear by making traffic flows smoother.

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

3.1 Summary of Monitoring Undertaken

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

3.1.1 Automatic Monitoring Sites

Chelmsford City Council undertook automatic (continuous) monitoring at 4 sites during 2017. Table A.1 in Appendix A shows the details of the sites.

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

Chelmsford City Council undertook non-automatic (passive) monitoring of NO₂ at 57 sites during 2017. Table A.2 in Appendix A shows the details of the sites.

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 (NO₂)

At the end of 2016, the diffusion tube monitoring locations were audited and three locations were removed:

- CB37 30 Victoria Crescent. Urban site that didn't provide any actionable information.
- CB41 Hill Road South. Background location which was only to be retained for one year after replacement of the Chelmer viaduct.

• CB42 Wharf Road. Removed to make way for development works.

During 2017, two diffusion tube monitoring locations were removed:

- CB19 92 Maldon Road. Removed after property sale.
- CB88 147 Baddow Road. Removed during renovation work. There is nearby coverage by the CM4 automatic monitoring site and CB84/85/86 diffusion tubes.

Six diffusion tubes CB91/CB92/CB93/CB94/CB95/CB96 were added in and around the Danbury air pollution hotspot.

Chelmsford City Council measured exceedances at nine of its diffusion tube monitoring locations:

- CB58 148 Baddow Road. This location is within the Army & Navy AQMA. The measured concentration of Nitrogen Dioxide was 40.58µg/m³ at relevant exposure.
- CB76/76B/76C 5/7 Maldon Road, Danbury. This location is not within an AQMA. This is a triplicate monitoring site. All three diffusion tubes measured exceedances and the averaged measured concentration of Nitrogen Dioxide was 41.82µg/m³ at relevant exposure.
- CM83B 134-136 Springfield Road. This location is not within an AQMA. This is a triplicate monitoring site. Only CB83B measured an exceedance and the averaged measured concentration for the site was 39.35µg/m³ at relevant exposure which is not an exceedance of the Air Quality objectives.
- CB89 135 Springfield Road. This location is not within an AQMA. The measured concentration was 41.67µg/m³ however this is a roadside. monitoring site. At relevant exposure, it is estimated that the concentration would be 34.80µg/m³.
- CB91/92/93 26 Maldon Road, Danbury. This location is not within an AQMA. This is a triplicate monitoring site. All three diffusion tubes measured exceedances and the averaged measured concentration of Nitrogen Dioxide was 47.31µg/m³ at relevant exposure.

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 $40\mu g/m^3$.

For diffusion tubes, the full 2017 dataset of monthly mean values is provided in Appendix B.

Table A.4 in Appendix A compares the ratified continuous monitored NO₂ hourly mean concentrations for the past 5 years with the air quality objective of $200\mu g/m^3$, not to be exceeded more than 18 times per year.

Chelmsford City Council has not monitored any exceedances of the 1-hour mean objective. Also, no diffusion tubes have exceeded $60\mu g/m^3$ which indicates that there has been no exceedance of the 1-hour mean objective at these sites either.

3.2.1 Particulate Matter (PM₁₀)

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 $40\mu g/m^3$.

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 $50\mu g/m^3$, not to be exceeded more than 35 times per year.

Chelmsford City Council have measured no exceedances of the Air Quality Objective for PM₁₀.

3.2.2 Ozone (O₃)

Table A.7 in Appendix A provides the results of Ozone monitoring from 2011 to 2017.

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 | Chignal St James | Rural | 566463 | 210830 | NO, NO _x , NO ₂ , PM ₁₀ , O ₃ | NO | Chemiluminescent / Unheated BAM / UV Photometry | 40 | 43 | 4 |
| CM2 | Springfield Road (Prison) | Roadside | 571640 | 207179 | NO, NOx, NO2, PM10 | NO | Chemiluminescent / Unheated BAM | 29.2 | 2.8 | 2.5 |
| CM3 | Rainsford Lane (Fire Station) | Roadside | 569912 | 206881 | NO, NOx, NO2, PM10 | NO | Chemiluminescent / Unheated BAM | 20 | 2.5 | 2.5 |
| CM4 | Baddow Road | Roadside | 571654 | 205798 | NO, NO _x , NO ₂ | NO | Chemiluminescent | 12 | 5.1 | 1.5 |

Notes:

(1) Om 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.

| 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) |
|---------|------------------------|---------------------|------------------|------------------|-------------------------|-------------|---|--|---|---------------|
| CB01 | 12 Van Diemans Road | Roadside | 571421 | 205963 | NO2 | NO | 0 | 12 | No | 2.5 |
| CB02 | 3 Moulsham Chase | Roadside | 571388 | 205725 | NO2 | NO | 9.3 | 2.5 | No | 2.5 |
| CB04 | 28 Cleves Ct. | Urban Background | 575266 | 210080 | NO2 | NO | 0 | 5 | No | 2.5 |
| CB08 | 109 Balmoral Ct. | Roadside | 571383 | 206926 | NO2 | NO | 3 | 3 | No | 2.5 |
| CB11 | 20 Brooklands Walk | Urban Background | 570065 | 205468 | NO2 | NO | 0 | 19 | No | 2.5 |
| CB13 | 60 Roxwell Road | Roadside | 569077 | 207528 | NO2 | NO | 0 | 16 | No | 2.5 |
| CB18 | 180 Maldon Rd | Roadside | 573846 | 205362 | NO2 | NO | 0 | 17 | No | 2.5 |
| CB19 | 92 Maldon Road | Roadside | 573408 | 205317 | NO2 | NO | 0 | 16 | No | 2.5 |
| CB20 | Lyster Avenue | Urban Background | 573095 | 205245 | NO2 | NO | 0 | 4 | No | 2.5 |
| CB22 | 95 Baddow Road | Roadside | 571505 | 205968 | NO2 | YES | 0 | 8 | No | 2.5 |
| CB22B | 95 Baddow Road | Roadside | 571505 | 205968 | NO2 | YES | 0 | 8 | No | 2.5 |
| CB22C | 95 Baddow Road | Roadside | 571505 | 205968 | NO2 | YES | 0 | 8 | No | 2.5 |
| CB25 | 20 Allen Way | Suburban | 573992 | 207985 | NO2 | NO | 4 | 0.1 | No | 2.5 |

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

| CB26 | 214 Baddow Road | Roadside | 571614 | 205812 | NO2 | NO | 0 | 5 | No | 2.5 |
|-------|---------------------------------|---------------------|--------|--------|-----|----|----|----|-----|-----|
| CB26B | 214 Baddow Road | Roadside | 571614 | 205812 | NO2 | NO | 0 | 5 | No | 2.5 |
| CB26C | 214 Baddow Road | Roadside | 571614 | 205812 | NO2 | NO | 0 | 5 | No | 2.5 |
| CB27 | Howe Green Interchange | Roadside | 574080 | 203469 | NO2 | NO | 0 | 18 | No | 2.5 |
| CB27A | Howe Green Interchange | Roadside | 574080 | 203469 | NO2 | NO | 0 | 18 | No | 2.5 |
| CB27B | Howe Green Interchange | Roadside | 574080 | 203469 | NO2 | NO | 0 | 18 | No | 2.5 |
| CB30 | Colchester Road | Roadside | 573403 | 208650 | NO2 | NO | 0 | 5 | No | 2.5 |
| CB31 | Main Road, Boreham | Roadside | 575265 | 209975 | NO2 | NO | 0 | 5 | No | 2.5 |
| CB32 | 2 Abbots Place | Roadside | 571581 | 207144 | NO2 | NO | 0 | 5 | No | 2.5 |
| CB33 | Victoria Road | Roadside | 570974 | 207157 | NO2 | NO | 3 | 3 | No | 2.5 |
| CB35 | 129 Moulsham Street | Roadside | 570489 | 205981 | NO2 | NO | 4 | 1 | No | 2.5 |
| CB36 | 2 Rainsford Lane | Roadside | 570104 | 207247 | NO2 | NO | 2 | 1 | No | 2.5 |
| CB38 | Prison 1 | Roadside | 571640 | 207179 | NO2 | NO | 14 | 3 | Yes | 2.5 |
| CB39 | Prison 2 | Roadside | 571640 | 207179 | NO2 | NO | 14 | 3 | Yes | 2.5 |
| CB40 | Prison 3 | Roadside | 571640 | 207179 | NO2 | NO | 14 | 3 | Yes | 2.5 |
| CB44 | Atlantic Business Centres | Urban Background | 570422 | 207352 | NO2 | NO | 0 | 11 | No | 2.5 |
| CB45 | 32 Van Diemans Road | Urban Background | 571400 | 205911 | NO2 | NO | 0 | 11 | No | 2.5 |

| CB46 | 32 Rochford Road | Roadside | 571062 | 206281 | NO2 | NO | 2 | 3 | No | 2.5 |
|-------|---------------------------|----------|--------|--------|-----|-----|----|-----|-----|-----|
| CB48 | 1 Weight Road | Roadside | 571462 | 206950 | NO2 | NO | 3 | 1 | No | 2.5 |
| CB49 | 26 Rochford Road | Roadside | 571104 | 206262 | NO2 | NO | 0 | 5 | No | 2.5 |
| CB52 | Penpol, Victoria Road | Roadside | 571367 | 207014 | NO2 | NO | 0 | 3 | No | 2.5 |
| CB55 | 15 Cedar Avenue | Roadside | 570278 | 207309 | NO2 | NO | 0 | 8 | No | 2.5 |
| CB56 | 52 Goldlay Road | Roadside | 571177 | 206222 | NO2 | YES | 5 | 1 | No | 2.5 |
| CB57 | Goldlay House, Parkway | Roadside | 571359 | 206124 | NO2 | NO | 0 | 16 | No | 2.5 |
| CB58 | 148 Baddow Road | Roadside | 571476 | 205964 | NO2 | YES | 0 | 12 | No | 2.5 |
| CB61 | 10 Fraser Close | Roadside | 571445 | 205631 | NO2 | NO | 0 | 7 | No | 2.5 |
| CB62 | Chignal 1 | Roadside | 566463 | 210830 | NO2 | NO | 40 | 43 | Yes | 4 |
| CB63 | Chignal 2 | Suburban | 566463 | 210830 | NO2 | NO | 40 | 43 | Yes | 4 |
| CB64 | Chignal 3 | Rural | 566463 | 210830 | NO2 | NO | 40 | 43 | Yes | 4 |
| CB65 | Fire Station 1 | Rural | 569912 | 206881 | NO2 | NO | 20 | 2.5 | Yes | 2.5 |
| CB66 | Fire Station 2 | Rural | 569912 | 206881 | NO2 | NO | 20 | 2.5 | Yes | 2.5 |
| CB67 | Fire Station 3 | Roadside | 569912 | 206881 | NO2 | NO | 20 | 2.5 | Yes | 2.5 |
| CB68 | Goldlay Avenue 1 | Roadside | 571382 | 206092 | NO2 | NO | 0 | 12 | No | 2.5 |
| CB68B | Goldlay Avenue 2 | Roadside | 571382 | 206092 | NO2 | NO | 0 | 12 | No | 2.5 |
| CB68C | Goldlay Avenue 3 | Roadside | 571382 | 206092 | NO2 | NO | 0 | 12 | No | 2.5 |
| CB73 | Chelmer Road | Roadside | 572130 | 206507 | NO2 | NO | 0 | 18 | No | 2.5 |
| CB74 | South Primrose Hill | Roadside | 570074 | 207167 | NO2 | NO | 0 | 4 | No | 2.5 |

| CB75 | Main Road, Danbury | Roadside | 577921 | 205246 | NO2 | NO | 0 | 1 | No | 2.5 |
|-------|--------------------------------|----------|--------|--------|-----|----|----|-----|-----|-----|
| CB76 | 5/7 Maldon Road, Danbury | Roadside | 578506 | 205122 | NO2 | NO | 0 | 1 | No | 2.5 |
| CB76B | 5/7 Maldon Road, Danbury | Roadside | 578506 | 205122 | NO2 | NO | 0 | 1 | No | 2.5 |
| CB76C | 5/7 Maldon Road, Danbury | Roadside | 578506 | 205122 | NO2 | NO | 0 | 1 | No | 2.5 |
| CB77 | Meadgate Avenue | Suburban | 571653 | 205948 | NO2 | NO | 0 | 1 | No | 2.5 |
| CB79 | 10 Waterhouse Lane | Roadside | 569480 | 206008 | NO2 | NO | 2 | 1 | No | 2.5 |
| CB80 | 208 Springfield Road | Roadside | 571710 | 207246 | NO2 | NO | 0 | 3 | No | 2.5 |
| CB81 | 2/4 Arbour Lane | Roadside | 571674 | 207282 | NO2 | NO | 4 | 1 | No | 2.5 |
| CB82 | 122 Springfield Road | Roadside | 571438 | 206966 | NO2 | NO | 0 | 4 | No | 2.5 |
| CB83 | 134/136 Springfield Road | Roadside | 571462 | 206999 | NO2 | NO | 0 | 3 | No | 2.5 |
| CB83b | 134/136 Springfield Road | Roadside | 571462 | 206999 | NO2 | NO | 0 | 3 | No | 2.5 |
| CB83c | 134/136 Springfield Road | Roadside | 571462 | 206999 | NO2 | NO | 0 | 3 | No | 2.5 |
| CB84 | Baddow Road AQMS 1 | Roadside | 571653 | 205800 | NO2 | NO | 12 | 5.1 | Yes | 1.5 |
| CB85 | Baddow Road AQMS 2 | Roadside | 571653 | 205800 | NO2 | NO | 12 | 5.1 | Yes | 1.5 |
| CB86 | Baddow Road AQMS 3 | Roadside | 571653 | 205800 | NO2 | NO | 12 | 5.1 | Yes | 1.5 |

| CB87 | Bus Station | Other | 570444 | 207044 | NO2 | NO | 4 | 3 | No | 2.5 |
|------|--|----------|------------|-----------|-----|----|-------|------|----|-----|
| CB88 | 147 Baddow Road | Suburban | 571663 | 205811 | NO2 | NO | 0 | 22 | No | 2.5 |
| CB89 | 135 Springfield Road | Roadside | 571426 | 206979 | NO2 | NO | 2 | 0.5 | No | 2.5 |
| CB90 | 144 Springfield Road | Roadside | 571480 | 207019 | NO2 | NO | 2 | 2 | No | 2.5 |
| CB91 | 26 Maldon Road, Danbury | Roadside | 578538.827 | 205114 | NO2 | NO | 0.00 | 1.00 | No | 2.5 |
| CB92 | 26 Maldon Road, Danbury | Roadside | 578538.827 | 205114 | NO2 | NO | 0.00 | 1.00 | No | 2.5 |
| CB93 | 26 Maldon Road, Danbury | Roadside | 578538.827 | 205114 | NO2 | NO | 0.00 | 1.00 | No | 2.5 |
| CB94 | Copt Hill, Danbury | Roadside | 578570.903 | 205107.86 | NO2 | NO | -1.40 | 2.80 | No | 2.5 |
| CB95 | Eves Corner, Danbury | Roadside | 578408.67 | 205106 | NO2 | NO | 3.00 | 2.00 | No | 2.5 |
| CB96 | Heathcote School, Main Road, Danbury | Kerbside | 578363 | 205119.8 | NO2 | NO | 3.00 | 0.25 | No | 2.5 |

Notes:

(1) Om 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 NO2 Monitoring Results

| Site ID | Oite Turne | Monitoring | Valid Data Capture for | Valid Data | Ν | IO ₂ Annual M | ean Concentra | ation (µg/m³) ⁽ | 3) |
|--|---------------------|-------------------|---|--------------------|-------|--------------------------|---------------|----------------------------|-------|
| Site ID | Site Type | Туре | Monitoring Period (%) ⁽¹⁾ | (%) ⁽²⁾ | 2013 | 2014 | 2015 | 2016 | 2017 |
| CM1 | Rural | Automatic | 94.03 | 94.03 | 13.86 | 14.19 | 12.79 | 14.23 | 14.47 |
| CM2 | Roadside | Automatic | 85.35 | 85.35 | 31.38 | 28.09 | 28.11 | 28.89 | 28.00 |
| CM3 | Roadside | Automatic | 94.25 | 94.25 | 29.22 | N/A | 27.9 | 25.59 | 26.88 |
| CM4 | Roadside | Automatic | 99.12 | 99.12 | 43.52 | N/A | 25.8 | 29.57 | 29.46 |
| CB01 | Roadside | Diffusion Tube | 100.00 | 100.00 | 33.9 | 30.27 | 28.44 | 31.30 | 32.49 |
| CB02 | Roadside | Diffusion Tube | 100.00 | 100.00 | 25.17 | 21.5 | 20.15 | 20.53 | 22.59 |
| CB04 | Urban Background | Diffusion Tube | 100.00 | 100.00 | 29.7 | 22.3 | 21.65 | 22.00 | 25.34 |
| CB08 | Roadside | Diffusion Tube | 100.00 | 100.00 | 31.02 | 28.02 | 28.59 | 28.91 | 33.21 |
| CB11 | Urban Background | Diffusion Tube | 100.00 | 100.00 | 26.57 | 23.37 | 23.39 | 24.41 | 28.69 |
| CB13 | Roadside | Diffusion Tube | 100.00 | 100.00 | 20.16 | 18.59 | 16.26 | 18.09 | 20.07 |
| CB18 | Roadside | Diffusion Tube | 100.00 | 100.00 | 17.65 | 17.67 | 17.02 | 17.02 | 16.95 |
| CB19 | Roadside | Diffusion Tube | 100.00 | 33.33 | 23.74 | 19.65 | 18.56 | 19.61 | 20.27 |
| CB20 | Urban Background | Diffusion Tube | 91.67 | 91.67 | 19.9 | 17.23 | 15.65 | 17.87 | 19.08 |
| CB22/CB22B/CB22C (Triplicate Results Averaged) | Roadside | Diffusion Tube | 83.33 | 83.33 | 36.07 | 32.39 | 30.34 | 32.37 | 32.32 |

| CB25 | Suburban | Diffusion Tube | 100.00 | 100.00 | 23.64 | 20.91 | 19.81 | 20.64 | 17.01 |
|--|---|-------------------|--------|--------|-------|-------|-------|-------|-------|
| CB26/CB26B/CB26C (Triplicate Results Averaged) | Roadside | Diffusion Tube | 100.00 | 100.00 | 35.78 | 30.7 | 28.07 | 29.29 | 31.21 |
| CB27/CB27A/CB27B | Roadside | Diffusion Tube | 100.00 | 100.00 | 40.3 | 39.33 | 36.64 | 35.04 | 36.35 |
| CB30 | Roadside | Diffusion Tube | 100.00 | 100.00 | 32.71 | 31.28 | 28.2 | 29.12 | 31.02 |
| CB31 | Roadside | Diffusion Tube | 100.00 | 100.00 | 29.15 | 26.49 | 24.78 | 26.69 | 26.01 |
| CB32 | Roadside | Diffusion Tube | 100.00 | 100.00 | 37.83 | 32.64 | 31.6 | 31.88 | 33.30 |
| CB33 | Roadside | Diffusion Tube | 83.33 | 83.33 | 37.29 | 31.44 | 31.08 | 28.82 | 31.97 |
| CB35 | Roadside | Diffusion Tube | 91.67 | 91.67 | 27.48 | 24.33 | 23.23 | 25.46 | 23.93 |
| CB36 | Roadside | Diffusion Tube | 100.00 | 100.00 | 31.21 | 29.89 | 25.84 | 27.95 | 26.19 |
| CB38/CB39/CB40 (Triplicate Results Averaged) | CB36 Roadside B/CB39/CB40 licate Results weraged) Roadside | | 100.00 | 100.00 | 31.81 | 28.01 | 28.29 | 28.3 | 30.27 |
| CB44 | Roadside | Diffusion Tube | 100.00 | 100.00 | 33.16 | 31.12 | 29.96 | 31.09 | 32.41 |
| CB45 | Roadside | Diffusion Tube | 100.00 | 100.00 | 30.76 | 29.11 | 23.99 | 28.78 | 28.07 |
| CB46 | Roadside | Diffusion Tube | 100.00 | 100.00 | 30.3 | 25.52 | 25.15 | 25.22 | 28.79 |
| CB48 | Roadside | Diffusion Tube | 100.00 | 100.00 | 26.93 | 24.32 | 23.88 | 21.58 | 26.76 |
| CB49 | Roadside | Diffusion Tube | 100.00 | 100.00 | 25.22 | 22.27 | 21.37 | 22.74 | 23.07 |

| CB52 | Roadside | Diffusion Tube | 100.00 | 100.00 | 36.54 | 31.77 | 30.79 | 30.35 | 34.30 |
|--|----------|-------------------|--------|--------|-------|-------|-------|-------|-------|
| CB55 | Roadside | Diffusion Tube | 100.00 | 100.00 | 27.33 | 25.49 | 24.85 | 25.28 | 27.30 |
| CB56 | Roadside | Diffusion Tube | 91.67 | 91.67 | 27.33 | 23.65 | 21.13 | 24.15 | 24.49 |
| CB57 | Roadside | Diffusion Tube | 100.00 | 100.00 | 30.78 | 27.35 | 26.45 | 28.25 | 30.59 |
| CB58 | Roadside | Diffusion Tube | 100.00 | 100.00 | 45.94 | 36.75 | 35.77 | 36.59 | 40.58 |
| CB61 | Suburban | Diffusion Tube | 100.00 | 100.00 | 18.83 | 16.31 | 15.29 | 15.98 | 17.29 |
| CB62/CB63/CB64 (Triplicate Results Averaged) | Rural | Diffusion Tube | 100.00 | 100.00 | 13.78 | 12.37 | 11.15 | 12.22 | 13.52 |
| CB65/CB66/CB67 (Triplicate Results Averaged) | Roadside | Diffusion Tube | 100.00 | 100.00 | 26.46 | 23.37 | 22.44 | 23.1 | 24.07 |
| CB68/CB68B/CB68C (Triplicate Results Averaged) | Roadside | Diffusion Tube | 100.00 | 100.00 | 33.89 | 40.78 | 28.70 | 29.85 | 31.85 |
| CB73 | Roadside | Diffusion Tube | 100.00 | 100.00 | 25.1 | 22.77 | 23.07 | 21.89 | 23.49 |
| CB74 | Roadside | Diffusion Tube | 91.67 | 91.67 | N/A | N/A | 25.52 | 31.00 | 27.97 |
| CB75 | Roadside | Diffusion Tube | 100.00 | 100.00 | N/A | N/A | 30.55 | 34.27 | 36.00 |
| CB76/CB76B/CB76C (Triplicate Results Averaged) | Roadside | Diffusion Tube | 100.00 | 100.00 | N/A | N/A | 33.43 | 39.36 | 41.82 |
| CB77 | Suburban | Diffusion Tube | 100.00 | 100.00 | N/A | N/A | 24.34 | 25.02 | 27.77 |

| CB79 | Roadside | Diffusion Tube | 91.67 | 91.67 | N/A | N/A | 28.2 | 35.22 | 39.46 |
|--|----------|-------------------|--------|--------|-----|-----|-------|-------|-------|
| CB80 | Roadside | Diffusion Tube | 100.00 | 100.00 | N/A | N/A | 25.34 | 25.29 | 27.52 |
| CB81 | Roadside | Diffusion Tube | 100.00 | 100.00 | N/A | N/A | 25.96 | 29.16 | 32.54 |
| CB82 | Roadside | Diffusion Tube | 100.00 | 100.00 | N/A | N/A | 32.83 | 31.90 | 34.64 |
| CB83/CB83B/CB83C (Triplicate Results Averaged) | Roadside | Diffusion Tube | 91.67 | 91.67 | N/A | N/A | 39.05 | 38.02 | 39.35 |
| CB84/CB85/CB86 (Triplicate Results Averaged) | Roadside | Diffusion Tube | 100.00 | 100.00 | N/A | N/A | 24.28 | 27.48 | 29.82 |
| CB87 | Other | Diffusion Tube | 100.00 | 100.00 | N/A | N/A | 39.92 | 35.81 | 36.97 |
| CB88 | Suburban | Diffusion Tube | 100.00 | 33.33 | N/A | N/A | 19.82 | 21.84 | 22.26 |
| CB89 | Roadside | Diffusion Tube | 91.67 | 91.67 | N/A | N/A | N/A | 37.37 | 41.67 |
| CB90 | Roadside | Diffusion Tube | 91.67 | 91.67 | N/A | N/A | N/A | 30.48 | 29.55 |
| CB91/92/93 (Triplicate Results Averaged) | Roadside | Diffusion Tube | 96.70 | 80.56 | N/A | N/A | N/A | N/A | 47.31 |
| CB94 | Roadside | Diffusion Tube | 100.00 | 83.33 | N/A | N/A | N/A | N/A | 31.37 |
| CB95 | Roadside | Diffusion Tube | 90.00 | 75.00 | N/A | N/A | N/A | N/A | 26.93 |
| CB96 | Kerbside | Diffusion Tube | 90.00 | 75.00 | N/A | N/A | N/A | N/A | 24.57 |

☑ Diffusion tube data has been bias corrected

☑ Annualisation has been conducted where data capture is <75%

Notes:

Exceedances of the NO₂ annual mean objective of $40\mu g/m^3$ are shown in **bold**.

NO₂ annual means exceeding 60µg/m³, indicating a potential exceedance of the NO₂ 1-hour mean objective are shown in bold and underlined.

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

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

(3) Means for diffusion tubes have been corrected for bias. All means have been "annualised" as per 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 – Nitrogen Dioxide (Automatic Monitor) Trend Data 2009-2017

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Table A.4 – 1-Hour Mean NO₂ Monitoring Results

| Site ID | Sito Tupo | Monitoring | Valid Data Capture for | Valid Data | N | O₂ 1-Houi | · Means > 2 | 200µg/m³ | (3) |
|---------|-----------|------------|------------------------|------------|------|-----------|-------------|----------|------|
| Sile ib | Site Type | Туре | (1) | | 2013 | 2014 | 2015 | 2016 | 2017 |
| CM1 | Rural | Automatic | 94.03 | 94.03 | 0 | 0 | 0(63.08) | 0 | 0 |
| CM2 | Roadside | Automatic | 85.35 | 85.35 | 2 | 0 | 0 | 0 | 0 |
| CM3 | Roadside | Automatic | 94.25 | 94.25 | 0 | N/A | 0(98.51) | 0 | 0 |
| CM4 | Roadside | Automatic | 99.12 | 99.12 | 0 | N/A | 0(82.10) | 0 | 0 |

Notes:

Exceedances of the NO₂ 1-hour mean objective (200µg/m³ 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.

Figure A.3 – CM1 Chignal St James NO₂ Automatic Data Plot



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Figure A.4 – CM2 Springfield Road NO₂ Automatic Data Plot





Figure A.6 – CM4 Baddow Road NO₂ Automatic Data Plot



Valid Data Capture PM₁₀ Annual Mean Concentration (µg/m³) ⁽³⁾ Valid Data Capture Site ID Site Type for Monitoring Period 2017 (%) (2) (%) ⁽¹⁾ 2013 2014 2015 2016 2017 CM1 Rural 90.14 90.14 17.97 17.44 20.49 17.07 16.19 CM2 Roadside 85.48 85.48 30.92 29.15 27.21 28.42 28.80 CM3 90.41 90.41 23.06 22.2 20.97 20.83 Roadside 19.97

Table A.5 – Annual Mean PM₁₀ Monitoring Results

Notes:

Exceedances of the PM₁₀ 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.

Chelmsford City Council Figure A.7 – CM1 Chignal St James PM₁₀ Automatic Data Plot



Figure A.8 – CM2 Springfield Road PM₁₀ Automatic Data Plot



Figure A.9 – CM3 Rainsford Lane PM₁₀ Automatic Data Plot





Figure A.10 – Trends in Annual Mean PM₁₀ Concentrations

| Site ID | Site Turne | Valid Data Capture for | Valid Data Capture | PN | I ₁₀ 24-Hour | Means > | 50µg/m³ ⁽³ | |
|---------|------------|--------------------------------------|-------------------------|-----------|---------------------|---------|-----------------------|------|
| Sile iD | Sile Type | Monitoring Period (%) ⁽¹⁾ | 2017 (%) ⁽²⁾ | 2013 | 2014 | 2015 | 2016 | 2017 |
| CM1 | Rural | 91.53 | 91.53 | 1 | 5 | 3 | 1 | 5 |
| CM2 | Roadside | 90.71 | 90.71 | 20(45.56) | 21(43.09) | 7 | 8 | 15 |
| CM3 | Roadside | 93.99 | 93.99 | 9(39.74) | 9(35.55) | 4 | 5 | 5 |

Table A.6 – 24-Hour Mean PM₁₀ Monitoring Results

Notes:

Exceedances of the PM₁₀ 24-hour mean objective (50µg/m³ 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.

Table A.7 – Ozone (O₃) Monitoring Results 2011-2017

| Site | Site Type | Valid Data Capture | Valid Data | | | O 3 | Annual Me | an | | |
|------|-----------|--------------------|--------------------|------|-------|------------|-----------|------|-------|-------|
| ID | Site Type | (%) ⁽¹⁾ | (%) ⁽²⁾ | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
| CM1 | Rural | | | 38.2 | 26.78 | 43.26 | 48.94 | 53.4 | 47.89 | 47.73 |



Figure A.11 – Measured Ozone (O₃) Concentrations 2017





Appendix B: Full Monthly Diffusion Tube Results for 2017

 Table B.1 – NO2 Monthly Diffusion Tube Results - 2017

| | | | | | | | NO | 2 Mean Concer | ntrations (µg/m | 1 ³) | | | | | |
|---------|-------|---------|---------|-------|--------------|--------------|--------------|---------------|-----------------|------------------|--------------|--------------|-------------|--|---|
| | | | | | | | | | | | | | | Annual Mea | n |
| Site ID | Jan | Feb | Mar | Apr | Мау | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Raw Data | Bias Adjusted (0.77) and Annualised ⁽¹⁾ | Distance Corrected to Nearest Exposure (2) |
| CB01 | 62.50 | 48.00 | 37.10 | 41.30 | 40.10 | 38.40 | 32.10 | 47.90 | 39.60 | 40.40 | 43.90 | 35.10 | 42.2 | 32.49 | 32.49 |
| CB02 | 48.10 | 36.70 | 27.20 | 23.40 | 19.10 | 16.60 | 19.10 | 29.00 | 24.00 | 29.50 | 39.60 | 39.70 | 29.3 | 22.59 | 19.38 |
| CB04 | 49.20 | 38.00 | 32.30 | 31.50 | 23.40 | 21.60 | 22.10 | 25.40 | 27.90 | 35.90 | 44.90 | 42.70 | 32.9 | 25.34 | 25.34 |
| CB08 | 59.10 | 44.30 | 42.80 | 40.50 | 37.10 | 37.00 | 34.70 | 36.10 | 38.80 | 47.50 | 53.30 | 46.30 | 43.1 | 33.21 | 30.40 |
| CB11 | 51.20 | 44.30 | 39.20 | 31.30 | 18.80 | 27.80 | 27.80 | 35.90 | 35.30 | 41.80 | 49.90 | 43.80 | 37.3 | 28.69 | 28.69 |
| CB13 | 36.50 | 31.10 | 30.60 | 21.50 | 18.50 | 19.70 | 18.20 | 23.70 | 23.80 | 26.60 | 30.90 | 31.70 | 26.1 | 20.07 | 20.07 |
| CB18 | 39.40 | 25.30 | 20.10 | 20.20 | 16.00 | 16.70 | 15.20 | 20.80 | 21.00 | 13.20 | 26.80 | 29.50 | 22.0 | 16.95 | 16.95 |
| CB19 | 45.50 | 29.40 | 30.30 | 24.80 | Discontinued | Discontinued | Discontinued | Discontinued | Discontinued | Discontinued | Discontinued | Discontinued | 32.5 | 20.27 | 20.27 |
| CB20 | 46.40 | 28.20 | 26.00 | 19.10 | 19.70 | 16.30 | 15.40 | 23.40 | 20.10 | Missing | 29.90 | 28.00 | 24.8 | 19.08 | 19.08 |
| CB22 | 60.40 | 43.90 | 46.20 | 43.50 | 40.90 | 33.10 | 33.20 | 40.00 | 40.50 | Missing | 51.80 | 31.90 | 42.3 | 32.58 | 32.58 |
| CB22B | 58.70 | Missing | 48.60 | 42.10 | 42.40 | 27.80 | 32.60 | 41.40 | 31.80 | Missing | 54.30 | 44.50 | 42.4 | 32.66 | 32.66 |
| CB22C | 53.40 | 46.30 | Missing | 43.10 | Missing | 32.80 | 34.10 | 39.70 | 35.40 | Missing | 51.30 | 34.50 | 41.2 | 31.71 | 31.71 |
| CB25 | 43.00 | 25.50 | 37.10 | 22.90 | 24.20 | 17.90 | 20.60 | 30.00 | 20.80 | 27.90 | 31.30 | 30.90 | 27.7 | 21.31 | 17.01 |
| CB26 | 60.20 | 44.50 | 27.20 | 41.00 | 35.90 | 34.10 | 31.80 | 38.40 | 37.10 | 42.20 | 41.20 | 39.70 | 39.4 | 30.37 | 30.37 |
| CB26B | 62.00 | 46.90 | 32.30 | 39.70 | 34.60 | 32.80 | 34.70 | 39.40 | 38.20 | 42.60 | 46.00 | 37.10 | 40.5 | 31.20 | 31.20 |

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| CB26C | 60.00 | 43.70 | 42.80 | 41.10 | 36.60 | 34.40 | 34.00 | 41.30 | 40.50 | 39.90 | 41.80 | 43.30 | 41.6 | 32.04 | 32.04 |
|-------|-------|-------|-------|-------|---------|-------|---------|-------|-----------|-------|-------|-------|------|-------|-------|
| CB27 | 35.20 | 57.20 | 39.20 | 49.10 | 37.50 | 41.30 | 42.10 | 44.10 | 49.40 | 60.30 | 51.20 | 60.60 | 47.3 | 36.40 | 36.40 |
| CB27A | 56.60 | 60.60 | 30.60 | 46.60 | 38.30 | 36.60 | 45.60 | 40.00 | 46.10 | 53.70 | 47.50 | 56.20 | 46.5 | 35.83 | 35.83 |
| CB27B | 56.40 | 61.70 | 20.10 | 50.30 | 38.80 | 38.10 | 45.00 | 43.80 | 47.70 | 59.10 | 58.30 | 54.60 | 47.8 | 36.83 | 36.83 |
| CB30 | 63.50 | 48.70 | 30.30 | 32.20 | 32.40 | 31.20 | 32.30 | 39.60 | 40.30 | 46.90 | 40.60 | 45.50 | 40.3 | 31.02 | 31.02 |
| CB31 | 61.70 | 45.80 | 26.00 | 29.40 | 27.00 | 27.60 | 21.50 | 32.60 | 32.40 | 19.30 | 44.40 | 37.70 | 33.8 | 26.01 | 26.01 |
| CB32 | 63.70 | 51.90 | 46.20 | 36.30 | 37.10 | 35.80 | 29.70 | 33.60 | 38.40 | 43.20 | 55.20 | 47.90 | 43.3 | 33.30 | 33.30 |
| CB33 | 59.20 | 48.10 | 48.60 | 46.60 | Missing | 23.60 | Missing | 40.10 | 14.20 | 48.90 | 69.50 | 57.30 | 45.6 | 35.12 | 31.97 |
| CB35 | | | | | Tube | | | | | | | | 36.4 | 27 99 | 23 93 |
| 0200 | 53.40 | 42.40 | 37.10 | 29.50 | damaged | 23.60 | 25.00 | 28.70 | 33.30 | 38.80 | 46.40 | 41.70 | 00.1 | 21.00 | 20.00 |
| CB36 | 60.90 | 43.80 | 43.60 | 25.20 | 37.50 | 28.80 | 26.30 | 33.20 | 37.80 | 37.80 | 43.00 | 37.30 | 37.9 | 29.21 | 26.19 |
| CB38 | 57.60 | 43.50 | 43.00 | 35.00 | 31.20 | 30.30 | 28.40 | 34.30 | 34.90 | 43.40 | 46.70 | 45.40 | 39.5 | 30.40 | 23.68 |
| CB39 | 56.90 | 49.00 | 45.60 | 33.50 | 30.60 | 31.20 | 28.90 | 32.00 | 35.50 | 48.30 | 49.20 | 39.50 | 40.0 | 30.81 | 23.91 |
| CB40 | 57.00 | 47.50 | 33.50 | 33.70 | 32.20 | 25.60 | 26.60 | 34.90 | 38.10 | 39.30 | 49.00 | 43.70 | 38.4 | 29.59 | 23.24 |
| CB44 | 43.40 | 52.20 | 48.30 | 37.00 | 37.80 | 35.50 | 34.20 | 40.00 | 41.00 | 51.50 | 47.20 | 37.00 | 42.1 | 32.41 | 32.41 |
| CB45 | 56.70 | 44.90 | 34.20 | 38.20 | 26.60 | 30.20 | 30.00 | 32.90 | 34.40 | 33.70 | 45.50 | 30.10 | 36.5 | 28.07 | 28.07 |
| CB46 | 61.40 | 41.10 | 35.20 | 31.90 | 30.80 | 22.60 | 25.20 | 31.80 | 36.30 | 58.00 | 39.50 | 34.80 | 37.4 | 28.79 | 26.86 |
| CB48 | 41.70 | 33.80 | 40.20 | 31.10 | 27.40 | 23.70 | 24.40 | 30.50 | 35.60 | 39.00 | 47.60 | 42.10 | 34.8 | 26.76 | 24.19 |
| CB49 | 47.40 | 33.30 | 28.40 | 28.60 | 25.80 | 22.10 | 21.40 | 24.90 | 29.30 | 32.10 | 30.20 | 36.10 | 30.0 | 23.07 | 23.07 |
| CB52 | 51.50 | 51.50 | 50.70 | 38.10 | 41.60 | 37.80 | 33.50 | 38.40 | 45.00 | 35.50 | 57.90 | 53.00 | 44.5 | 34.30 | 34.30 |
| CB55 | 56.90 | 39.90 | 39.30 | 31.50 | 34.60 | 27.20 | 21.70 | 30.60 | 34.70 | 33.70 | 36.10 | 39.20 | 35.5 | 27.30 | 27.30 |
| CB56 | | | | | | | | | Collected | | | | 31.8 | 24 49 | 20.78 |
| 0000 | 50.80 | 34.20 | 32.60 | 29.10 | 27.10 | 24.10 | 18.90 | 28.20 | at Lab | 32.80 | 40.20 | 31.90 | 51.0 | 24.45 | 20.70 |
| CB57 | 53.70 | 43.20 | 42.20 | 37.70 | 34.60 | 36.20 | 32.20 | 40.00 | 40.00 | 36.60 | 44.60 | 35.80 | 39.7 | 30.59 | 30.59 |
| CB58 | 67.60 | 56.90 | 55.60 | 50.30 | 49.20 | 44.90 | 41.10 | 54.70 | 47.00 | 52.90 | 57.10 | 55.10 | 52.7 | 40.58 | 40.58 |
| CB61 | 40.70 | 27.30 | 24.40 | 16.40 | 15.40 | 13.60 | 12.80 | 17.50 | 20.60 | 20.50 | 32.30 | 27.90 | 22.5 | 17.29 | 17.29 |

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| CB62 | 32.30 | 22.90 | 20.00 | 12.00 | 11.20 | 9.30 | 9.00 | 13.20 | 16.10 | 20.30 | 21.10 | 26.00 | 17.8 | 13.69 | 10.66 |
|-------|---------|---------|-------|-------|-------|-------|---------|-------|---------|-------|-------|---------|------|-------|-------|
| CB63 | 30.60 | 21.90 | 18.60 | 10.70 | 12.90 | 9.10 | 10.30 | 13.40 | 15.40 | 18.90 | 22.40 | 24.50 | 17.4 | 13.39 | 10.52 |
| CB64 | 28.20 | 22.10 | 18.30 | 12.30 | 12.20 | 9.70 | 10.70 | 13.50 | 15.20 | 19.90 | 22.00 | 25.80 | 17.5 | 13.47 | 10.56 |
| CB65 | 48.20 | 41.50 | 29.70 | 25.80 | 27.80 | 21.00 | 22.70 | 25.80 | 28.10 | 33.60 | 36.50 | 30.60 | 30.9 | 23.83 | 19.35 |
| CB66 | 45.80 | 42.70 | 33.00 | 26.60 | 26.50 | 21.60 | 23.10 | 24.70 | 28.60 | 33.90 | 36.20 | 27.80 | 30.9 | 23.77 | 19.33 |
| CB67 | 46.40 | 38.90 | 36.10 | 29.00 | 22.20 | 23.60 | 22.30 | 23.70 | 30.80 | 33.30 | 40.20 | 37.00 | 32.0 | 24.61 | 19.71 |
| CB68 | 69.00 | 50.50 | 45.60 | 31.40 | 40.60 | 31.60 | 28.90 | 44.20 | 39.80 | 35.80 | 45.20 | 41.50 | 42.0 | 32.35 | 32.35 |
| CB68B | 62.90 | 44.90 | 45.20 | 35.10 | 45.40 | 28.90 | 31.40 | 39.90 | 39.50 | 38.40 | 34.50 | 39.80 | 40.5 | 31.18 | 31.18 |
| CB68C | 55.50 | 46.80 | 42.60 | 35.80 | 42.30 | 35.50 | 30.80 | 49.70 | 41.60 | 31.60 | 44.20 | 42.60 | 41.6 | 32.02 | 32.02 |
| CB73 | 49.90 | 40.70 | 32.60 | 24.80 | 20.60 | 21.30 | 21.00 | 28.20 | 28.50 | 32.50 | 35.00 | 30.90 | 30.5 | 23.49 | 23.49 |
| CB74 | 63.10 | Missing | 41.90 | 29.00 | 38.00 | 27.80 | 26.80 | 37.70 | 33.50 | 32.00 | 35.30 | 34.50 | 36.3 | 27.97 | 27.97 |
| CB75 | 66.30 | 53.40 | 50.10 | 41.80 | 42.80 | 46.30 | 35.10 | 49.20 | 45.30 | 36.50 | 49.60 | 44.70 | 46.8 | 36.00 | 36.00 |
| CB76 | 72.00 | 55.50 | 58.60 | 52.40 | 46.10 | 43.50 | 42.30 | 49.00 | 48.00 | 56.30 | 68.40 | 47.20 | 53.3 | 41.02 | 41.02 |
| CB76B | 70.50 | 58.70 | 52.70 | 52.40 | 46.80 | 46.70 | 45.80 | 55.30 | 41.40 | 57.40 | 64.80 | 62.40 | 54.6 | 42.02 | 42.02 |
| CB76C | 77.00 | 58.90 | 58.10 | 55.50 | 45.90 | 47.40 | 43.20 | 49.10 | 44.40 | 55.00 | 68.90 | 57.60 | 55.1 | 42.41 | 42.41 |
| CB77 | 58.00 | 38.80 | 37.80 | 32.80 | 30.00 | 26.60 | 23.70 | 31.80 | 33.40 | 36.50 | 40.80 | 42.60 | 36.1 | 27.77 | 27.77 |
| CB79 | Missing | 67.90 | 60.70 | 45.90 | 54.50 | 39.90 | 44.30 | 51.10 | 45.60 | 55.60 | 50.50 | 47.70 | 51.2 | 39.46 | 33.25 |
| CB80 | 51.60 | 40.70 | 39.20 | 29.80 | 31.80 | 29.30 | 25.30 | 34.70 | 33.00 | 38.40 | 40.80 | 34.30 | 35.7 | 27.52 | 27.52 |
| CB81 | 58.30 | 50.10 | 47.10 | 34.40 | 39.40 | 30.00 | 31.10 | 39.80 | 41.80 | 40.40 | 46.80 | 47.90 | 42.3 | 32.54 | 27.00 |
| CB82 | 62.80 | 47.20 | 51.90 | 40.00 | 39.80 | 38.30 | 36.60 | 45.00 | 45.20 | 41.90 | 48.60 | 42.60 | 45.0 | 34.64 | 34.64 |
| CB83 | 66.20 | 56.80 | 49.80 | 44.70 | 45.80 | 41.20 | 46.40 | 46.40 | Missing | 53.00 | 53.60 | 47.00 | 50.1 | 38.56 | 38.56 |
| CB83b | 68.20 | 53.70 | 52.10 | 47.50 | 43.90 | 45.40 | Missing | 52.90 | 52.30 | 55.10 | 52.10 | Missing | 52.3 | 40.29 | 40.29 |
| CB83c | 66.70 | 56.20 | 54.60 | 45.20 | 51.30 | 42.90 | 42.50 | 49.40 | 47.10 | 51.80 | 57.60 | 45.50 | 50.9 | 39.19 | 39.19 |
| CB84 | 59.00 | 42.00 | 40.20 | 28.90 | 28.90 | 26.70 | 24.70 | 37.00 | 32.40 | 33.80 | 44.70 | 42.90 | 36.8 | 28.31 | 23.13 |
| CB85 | 49.90 | 40.20 | 50.00 | 32.50 | 30.80 | 38.80 | 34.40 | 31.60 | 36.20 | 36.40 | 47.40 | 40.50 | 39.1 | 30.07 | 24.25 |
| CB86 | | 40.70 | 27.90 | 26.00 | 22.20 | 28 70 | 17.20 | 31 10 | 39 30 | 44 70 | 59.60 | 52 50 | 40.4 | 31.08 | 24.89 |

| CB87 | 63.60 | 54.10 | 47.90 | 43.00 | 37.00 | 45.30 | 41.00 | 50.20 | 46.70 | 48.50 | 45.90 | 52.90 | 48.0 | 36.97 | 32.28 |
|------|-------|-------|-------|-------|--------------|--------------|--------------|------------------------------------|--------------|--------------|--------------|--------------|------|-------|-------|
| CB88 | 48.40 | 35.10 | 32.40 | 25.10 | Discontinued | Discontinued | Discontinued | Discontinued | Discontinued | Discontinued | Discontinued | Discontinued | 35.3 | 22.26 | 22.26 |
| CB89 | 70.70 | 59.90 | 60.70 | 59.10 | 42.10 | 47.20 | 44.00 | 50.70 | 50.50 | 55.40 | Missing | 55.00 | 54.1 | 41.67 | 34.80 |
| CB90 | 60.40 | 47.10 | 40.00 | 34.40 | 31.20 | 29.30 | 29.00 | 33.50 | 35.60 | 38.70 | 43.00 | Missing | 38.4 | 29.55 | 27.60 |
| CB91 | N/A | N/A | 70.80 | 63.50 | 50.20 | 55.90 | 64.10 | Erroneous Data Point Removed | 66.90 | 73.50 | 69.70 | 55.30 | 63.3 | 48.76 | 48.76 |
| CB92 | N/A | N/A | 52.30 | 57.60 | 58.50 | 48.90 | 48.20 | 63.50 | 69.00 | 66.50 | 72.50 | 65.70 | 60.3 | 46.41 | 46.41 |
| CB93 | N/A | N/A | 53.70 | 54.60 | 49.50 | 60.30 | 49.80 | 76.10 | 65.10 | 67.60 | 66.70 | 63.90 | 60.7 | 46.76 | 46.76 |
| CB94 | N/A | N/A | 24.80 | 37.60 | 36.10 | 30.60 | 29.00 | 40.30 | 32.20 | 39.70 | 47.30 | 46.40 | 36.4 | 28.03 | 31.37 |
| CB95 | N/A | N/A | 35.40 | 39.90 | 49.80 | 30.40 | 31.90 | 45.00 | 42.60 | Missing | 49.50 | 46.50 | 41.2 | 31.74 | 26.93 |
| CB96 | N/A | N/A | 33.10 | 47.10 | Missing | 39.90 | 38.40 | 42.40 | 41.00 | 58.50 | 61.30 | 46.30 | 45.3 | 34.91 | 24.57 |

☑ National bias adjustment factor used

☑ Annualisation has been conducted where data capture is <75%

☑ Where applicable, data has been distance corrected for relevant exposure

Notes:

Exceedances of the NO₂ annual mean objective of $40\mu g/m^3$ are shown in **bold**.

NO₂ annual means exceeding 60µg/m³, indicating a potential exceedance of the NO₂ 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. See Appendix C for details about this process

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

Automatic Monitoring QA/QC

Chelmsford City Council operates four automatic monitoring sites measuring NO₂, PM_{10} and O_3 . Data from these sites is collected by a contractor.

Daily data validation checks are made to ensure the analysers are working correctly and to identify any abnormal readings that may occur. Monitoring data is forwarded to the Council.

The automatic monitoring station equipment is serviced every six months by a contractor who also carries out maintenance callouts when faults are identified.

The analysers are calibrated fortnightly with a certified reference gas by Council officers. All sites also have triplicate NO₂ diffusion tubes.

Data ratification for the analyser contains following processes;

- Applying the scaling factors derived from calibrations, maintenance visits and servicing
- Checking for equipment drift with adjustments made where detected
- Comparison of data with other pollutants and other appropriate Essex Air monitoring sites
- Checking for and deletion of erroneous data that can be linked to analyser failure or unrepresentative periods of operation

Diffusion Tubes QA/QC

Chelmsford City Council undertook monitoring using 75 nitrogen dioxide diffusion tubes at 57 sites in 2017.

The diffusion tubes were supplied by Environmental Scientifics Group (ESG Didcot) (UKAS Testing Laboratory number 1015) with a preparation method of 50% triethanolamine (TEA) in Acetone.

The AIR NO₂ proficiency testing scheme found that the laboratory achieved the following percentage of results determined as satisfactory for 2017:

| AIR PT | AIR PT | AIR PT AR019 | AIR PT AR021 | AIR PT AR022 |
|---------------|-----------|--------------|---------------|--------------|
| Round | AR018 | | | |
| Round | January – | April – May | July – August | September – |
| conducted | February | 2017 | 2017 | October 2017 |
| in the period | 2017 | | | |
| ESG Didcot | 100% | 100% | 100% | 100% |

Table C.1 – AIR PT Results 2017

Diffusion Tube Bias Adjustment Factors

Chelmsford City Council has historically used the bias adjustment figure calculated from a local co-location study for adjusting raw diffusion tube data.

Although the local co-location study recently used was in Springfield Road close to a pollution hotspot, it was felt that because the local bias adjustment figure was so large (0.71-0.72) this may not be representative at other sites in Chelmsford and that the national bias adjustment factor should be used.

The Diffusion Tube Bias Adjustment Factors Spreadsheet 03/18 identified that for ESG (Didcot) 50% TEA in acetone diffusion tubes in 2017, a bias adjustment factor of 0.77 should be used. This was derived from orthogonal regression analysis of 27 studies.

Although both methods of adjustment are acceptable, in this instance use of the national factor is a risk averse approach ensuring that monitored concentrations are not underreported. This is especially important when exceedances have been measured and when new AQMA is proposed.

Point Sources

No significant new point sources of emissions have been identified.

Diffusion Tube Data Annualisation

Two diffusion tube monitoring sites were discontinued after four months of monitoring. As these sites had less than 8 months' worth of data it was necessary to annualise the data. The rural background AURN sites at St. Osyth and Rochester Stoke were used for the process.

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Table C.2 – CB19 92 Maldon Road Annualisation

| CB19 92 Maldon Road Exposure Dates | | Background Site Mean (B1) | CB19 92 Maldon Road(D1) | B1 when D1 is available | | | |
|------------------------------------|---------------------|---------------------------|-------------------------|-------------------------|--|--|--|
| 4th January 2017 | 1st February 2017 | 28.91 | 45.50 | 28.91 | | | |
| 1st February 2017 | 1st March 2017 | 16.80 | 29.40 | 16.80 | | | |
| 1st March 2017 | 29th March 2017 | 15.04 | 30.30 | 15.04 | | | |
| 29th March 2017 | 26th April 2017 | 11.82 | 24.80 | 11.82 | | | |
| 26th April 2017 | 31st May 2017 | 12.49 | | | | | |
| 31st May 2017 | 28th June 2017 | 12.38 | | | | | |
| 28th June 2017 | 2nd August 2017 | 7.81 | | | | | |
| 2nd August 2017 | 30th August 2017 | 11.32 | | | | | |
| 30th August 2017 | 27th September 2017 | 12.03 | | | | | |
| 27th September 2017 | 1st November 2017 | 13.38 | | | | | |
| 1st November 2017 | 6th December 2017 | 20.19 | | | | | |
| 6th December 2017 | 3rd January 2018 | 17.56 | | | | | |
| Average | | 14.74 | 32.50 | 18.14 | | | |
| Annualis | ation Factor | 0.81 | | | | | |
| Average (| Concentration | 26.41 | | | | | |

Table C.3 – CB88 147 Baddow Road Annualisation

| CB88 147 Baddow | Road Exposure Dates | Background Site Mean (B1) | CB88 147 Baddow Road Maldon Road(D1) | B1 when D1 is available | | | |
|-----------------------|---------------------|---------------------------|---|-------------------------|--|--|--|
| 4th January 2017 | 1st February 2017 | 29.24 | 48.40 | 29.24 | | | |
| 1st February 2017 | 1st March 2017 | 16.39 | 16.39 | | | | |
| 1st March 2017 | 29th March 2017 | 14.89 | 32.40 | 14.89 | | | |
| 29th March 2017 | 26th April 2017 | 11.72 | 25.10 | 11.72 | | | |
| 26th April 2017 | 31st May 2017 | 12.71 | | | | | |
| 31st May 2017 | 28th June 2017 | 12.03 | | | | | |
| 28th June 2017 | 2nd August 2017 | 7.83 | | | | | |
| 2nd August 2017 | 30th August 2017 | 11.52 | | | | | |
| 30th August 2017 | 27th September 2017 | 12.31 | | | | | |
| 27th September 2017 | 1st November 2017 | 13.39 | | | | | |
| 1st November 2017 | 6th December 2017 | 20.04 | | | | | |
| 6th December 2017 | 3rd January 2018 | 17.68 | | | | | |
| A | verage | 14.74 | 35.25 | 18.06 | | | |
| Annualisation Factor | | 0.82 | | | | | |
| Average Concentration | | 28.75 | | | | | |

NO₂ Fall Off Estimation

Diffusion tube monitoring shown in Table B.1 in Appendix B has been adjusted for NO₂ falloff between the monitoring location and the point of relevant exposure.

Using the equation from the Air Quality Consultants 'NO₂ Concentrations and Distance from Roads (2008)' report a custom Excel spreadsheet has been developed to derive the NO₂ concentrations at relevant exposure from the measured annual mean concentrations and using 2017 NO₂ background maps.

Estimated Annual Mean at Relevant Exposure:

Cz = ((Cy-Cb) / (-0.5476 x Ln(Dy) + 2.7171)) x (-0.5476*Ln(Dz)+2.7171) + Cb Where:

Cz is the total predicted concentration (μ g/m³) at distance Dz;

Cy is the total measured concentration (μ g/m³) at distance Dy;

Cb is the background concentration (μ g/m³);

Dy is the distance from the kerb at which concentrations were measured;

Dz is the distance from the kerb (m) at which concentrations are to be predicted; and Ln(D) is the natural log of the number D

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



Figure D.1 - Army & Navy AQMA Diffusion Tube Monitoring



Figure D.2 - Boreham & Springfield Diffusion Tube Monitoring

Figure D.3 - Chignal St James Diffusion Tube Monitoring



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Figure D.4 - Danbury Diffusion Tube Monitoring



Figure D.5 – Howe Green & Great Baddow Diffusion Tube Monitoring

Figure D.6 - Springfield Road Diffusion Tube Monitoring





Figure D.7 – West Chelmsford Diffusion Tube Monitoring

Appendix E: Summary of Air Quality Objectives in England

Table E.2 – Air Quality Objectives in England

| Dollutont | Air Quality Objective ⁴ | | | | | | |
|---------------------------------------|--|----------------|--|--|--|--|--|
| Ponutant | Concentration | Measured as | | | | | |
| Nitrogen Dioxide | 200 µg/m ³ not to be exceeded more than 18 times a year | 1-hour mean | | | | | |
| (NO_2) | 40 μg/m ³ | Annual mean | | | | | |
| Particulate Matter | 50 μg/m ³ , not to be exceeded more than 35 times a year | 24-hour mean | | | | | |
| (PIVI10) | 40 μg/m ³ | Annual mean | | | | | |
| | 350 μg/m ³ , not to be exceeded more than 24 times a year | 1-hour mean | | | | | |
| Sulphur Dioxide (SO ₂) | 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 | | | | | |

 $^{^4}$ The units are in microgrammes of pollutant per cubic metre of air (µg/m³).

Appendix F: A414 Maldon Road, Danbury AQMA Declaration Report

Local authorities have a legal requirement to work towards Air Quality Strategy (AQS) objectives under Part IV of the Environment Act 1995 and relevant regulations made under that part and to meet the requirements of the Local Air Quality Management (LAQM) statutory process.

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.

Whilst conducting the LAQM process, Chelmsford City Council have identified high concentrations of Nitrogen Dioxide (NO2) on the A414 Maldon Road, Danbury. Analysis of roadside air quality monitoring has identified that for 2017 the maximum measured mean concentration of NO2 at relevant exposure1 was $47.26\mu g/m^3$ and that an exceedance of the annual mean Air Quality Objectives ($40\mu g/m^3$) has taken place.

This report identifies a suitable boundary for an Air Quality Management Area and sets out a timeline for the process of AQMA declaration and AQAP development.

Alternative Options

There is no alternative option – failure to declare affected areas AQMAs could result in the Council being prosecuted by the Department for the Environment, Food and Rural Affairs (Defra), who in turn, could be prosecuted by the EU if the UK fails to comply with EU directives.

Local Air Quality Management

After an audit of air quality monitoring locations in 2014, Chelmsford City Council commenced air quality monitoring at two locations along the A414 in Danbury. Measured concentrations for 2015 were considered 'normal' for a busy roadside monitoring location.

However, monitored concentrations jumped significantly in 2016 at CB76 5/7 Maldon Road to borderline with the air quality objectives. The decision was made to increase monitoring between Eves Corner and Copt Hill to further understand the air quality at this location and should a breach of the air quality objectives occur, identify a boundary for an AQMA.

In 2017, the air quality objectives were breached at CB76 and also at the new monitoring site of CB91/CB92/CB93 26 Maldon Road.

¹ Relevant exposure is defined in this instance, is at the façade of a residential property.

| Site ID | Site Name | 2015 | 2016 | 2017 |
|--------------|---|-------|-------|-------|
| CB75 | A414 Main Road, Danbury | 30.55 | 34.27 | 36.00 |
| CB76/76B/76C | 5/7 Maldon Road, Danbury | 33.43 | 39.36 | 41.82 |
| CB91/92/93 | 26 Maldon Road, Danbury | N/A | N/A | 47.26 |
| CB94 | Copt Hill, Danbury | N/A | N/A | 28.03 |
| CB95 | Eves Corner, Danbury | N/A | N/A | 31.74 |
| CB96 | Heathcote School, Main Road, Danbury | N/A | N/A | 34.91 |

Diffusion Tube Monitoring Results

Danbury Air Quality Trends



A414 Maldon Road, Danbury

The A414 Maldon Road is a busy road that connects Maldon and the Dengie area with the A12 and Chelmsford.

The road has a slight gradient. When vehicles travel up inclines, engines are required to work harder to overcome gravity and emissions are significantly higher. The opposite occurs for vehicles travelling downhill however combined, a general increase in emissions occurs when compared with flat roads.

Areas of the road are flanked by buildings on one or both sides. Street canyons and facades built close to the kerbside significantly reduce the dispersal of pollution.

The footway is less than 1 metre wide meaning that relevant exposure is within 1 metre of the kerb.

Google Streetview image of A414 Maldon Road to indicate street canyon characteristics with monitoring locations marked up



Despite the monitoring locations of CB76 and CB91/92/93 being very close to each other, concentrations of NO₂ are significantly higher at CB91/92/93. This is expected to be due to the west bound side of the road having more significant queuing because of its proximity with the Eves Corner junction.

Also, CB91/92/93 is on the lee-side of the street canyon where vortex flow causes increased deposition of pollution and walls provide shelter from prevailing winds which reduces the dispersal of pollution.

Chelmsford City Council

A414, Maldon Road Monitoring Locations



Air Quality Management Area Declaration

Appendix A contains a draft order which would designate the stretch of A414 Maldon Road, Danbury and adjacent properties between the junction with Butts Lane and Danbury village green as an Air Quality Management Area. This is for likely breaches of the annual mean Air Quality Objective for Nitrogen Dioxide.

Breaches of the 1-hour objective are not considered likely because the monitored annual mean does not exceed $60\mu g/m^3$ which can be considered a proxy value for identifying exceedances of the short-term objective.

The boundary of the Air Quality Management Area has been chosen using the following information:

- Between Butts Lane and Danbury Village green, brick walls and buildings flank the relatively narrow road to form a street canyon. Dispersion of emissions will take place at a significantly lower rate than in open areas.
- Monitoring at location CB94 near to Gay Bowers Lane/Copt Hill has not exceeded the Air Quality Objectives and there is no street canyon effect.
- Monitoring at location CB95 & CB96 at the Eves Corner roundabouts has not exceeded the Air Quality Objectives and there is no street canyon effect.
- Properties located within the proposed AQMA are immediately adjacent to the road and are at worst case exposure.

Properties to be designated within the AQMA;

- 1 Maldon Road
- 3 Maldon Road
- 5 Maldon Road
- Flat at the Bakers Arms, 7 Maldon Road
- Land at 18 Maldon Road
- Hill Cottage, Maldon Road
- 24a Maldon Road
- 26 Maldon Road
- 28 Maldon Road

Project Timeline

Development and delivery of the project would take place across the following anticipated timeline:



Development of the Air Quality Action Plan would likely include the following tasks:

- Creation of steering group
- Source apportionment & dispersion modelling of area in and surrounding AQMA
- Development and quantification of measures
- Identify how measures would be delivered and funding streams
- Writing of Air Quality Action Plan
- Internal and external consultation
- Formal adoption of Air Quality Action Plan

Draft Air Quality Management Area Order

Environment Act 1995 Part IV Section 83(1) Chelmsford City Council Air Quality Management Order

Chelmsford City Council in exercise of the powers conferred upon it by Section 83(1) of the Environment Act 1995, hereby makes the following Order.

This Order may be cited/referred to as the Chelmsford City Council Air Quality Management Area **A414 Maldon Road**, **Danbury** and shall come into effect on **[date]**.

The area shown on the attached map in red is to be designated as an Air Quality Management Area. The designated area incorporates the stretch of road between Gay Bowers Lane and Danbury Village Green and adjacent properties.

The map may be viewed at the Council Offices.

This area is designated in relation to the likely breach of the nitrogen dioxide annual mean as specified in the Air Quality Regulations 2000.

This Order shall remain in force until it is varied or revoked by a subsequent order.

The Common Seal of Chelmsford City Council was hereunto affixed in the presence of:

Authorised signatory

.....



2017 Diffusion Tube Monitoring Results

| | | | Nitrogen Dioxide (NO ₂) concentrations measured in µg/m ³ | | | | | | | | | | | | | | |
|---------|--|------------|--|------------|------------|---------|------------|------------|--|--------|---------|--------|--------|-----------------------|----------------------------------|--|--|
| Site ID | Monitoring Address | Jan- 17 | Feb- 17 | Mar- 17 | Apr- 17 | May-17 | Jun- 17 | Jul- 17 | Aug-17 | Sep-17 | Oct-17 | Nov-17 | Dec-17 | Raw Annual Mean | Valid Data Capture rate | Bias Adjusted Annual Mean (0.77) | Estimated Concentration at Nearest Receptor |
| CB75 | Main Road, Danbury | 66.3 | 53.4 | 50.1 | 41.8 | 42.8 | 46.3 | 35.1 | 49.2 | 45.3 | 36.5 | 49.6 | 44.7 | 46.76 | 100.00 | 36.00 | 36.00 |
| CB76 | 5/7 Maldon Road, Danbury | 72 | 55.5 | 58.6 | 52.4 | 46.1 | 43.5 | 42.3 | 49 | 48 | 56.3 | 68.4 | 47.2 | 53.28 | 100.00 | 41.02 | 41.02 |
| CB76B | 5/7 Maldon Road, Danbury | 70.5 | 58.7 | 52.7 | 52.4 | 46.8 | 46.7 | 45.8 | 55.3 | 41.4 | 57.4 | 64.8 | 62.4 | 54.58 | 100.00 | 42.02 | 42.02 |
| CB76C | 5/7 Maldon Road, Danbury | 77 | 58.9 | 58.1 | 55.5 | 45.9 | 47.4 | 43.2 | 49.1 | 44.4 | 55 | 68.9 | 57.6 | 55.08 | 100.00 | 42.41 | 42.41 |
| CB91 | 26 Maldon Road, Danbury | | | 70.8 | 63.5 | 50.2 | 55.9 | 64.1 | 27.2* Data Point Removed from Calculations | 66.9 | 73.5 | 69.7 | 55.3 | 59.71 | 75.00 | 48.76 | 48.76 |
| CB92 | 26 Maldon Road, Danbury | | | 52.3 | 57.6 | 58.5 | 48.9 | 48.2 | 63.5 | 69 | 66.5 | 72.5 | 65.7 | 60.27 | 83.33 | 46.41 | 46.41 |
| CB93 | 26 Maldon Road, Danbury | | | 53.7 | 54.6 | 49.5 | 60.3 | 49.8 | 76.1 | 65.1 | 67.6 | 66.7 | 63.9 | 60.73 | 83.33 | 46.76 | 46.76 |
| CB94 | Copt Hill, Danbury | | | 24.8 | 37.6 | 36.1 | 30.6 | 29 | 40.3 | 32.2 | 39.7 | 47.3 | 46.4 | 36.40 | 83.33 | 28.03 | 31.37~ |
| CB95 | Eves Corner, Danbury | | | 35.4 | 39.9 | 49.8 | 30.4 | 31.9 | 45 | 42.6 | Missing | 49.5 | 46.5 | 41.22 | 75.00 | 31.74 | 26.93 |
| CB96 | Heathcote School, Main Road, Danbury | | | 33.1 | 47.1 | Missing | 39.9 | 38.4 | 42.4 | 41 | 58.5 | 61.3 | 46.3 | 45.33 | 75.00 | 34.91 | 24.57 |

* CB91 August 2017: The concentration from the laboratory report was 27.2µg/m³ which when compared with the other tubes at the same site, highlighted poor precision. and for the process of calculating annual mean was removed to ensure overall reliability for the data set.

~ CB94. The diffusion tube is further from the road than the property façade hence the estimated concentration at a nearest receptor being higher than the monitored concentration.

When interpreting these results, it should be noted that sites of CB91-93, CB94, CB95 & CB96 commenced in March 2017 and had the sites been operating during the months of January and February, it is likely that the annual average mean concentration would have been higher.

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 |
| AURN | The Automatic Urban and Rural Network is the UK's largest automatic monitoring network and is the main network used for compliance reporting against the Ambient Air Quality Directives |
| BAM | Beta Attenuation Monitor. a widely used air monitoring technique employing the absorption of beta radiation by solid particles extracted from air flow. This technique allows for the detection of PM ₁₀ and PM _{2.5} |
| Defra | Department for Environment, Food and Rural Affairs |
| DVSA | Driver and Vehicle Standards Agency |
| EU | European Union |
| EV | Electric Vehicle |
| HGV | Heavy Goods Vehicle |
| LAQM | Local Air Quality Management |
| NO ₂ | Nitrogen Dioxide |
| NOx | Nitrogen Oxides |
| O ₃ | Ozone |
| PM10 | 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 |
| PSV | Public Service Vehicle |

| QA/QC | Quality Assurance and Quality Control |
|-------|---|
| SELEP | South East Local Enterprise Partnership |
| TEA | Triethanolamine. The absorbing substance used in diffusion tubes measuring Nitrogen Dioxide |
| UKAS | United Kingdom Accreditation Service |

References

airTEXT Twitter for Chelmsford available at; https://twitter.com/airtext_chelm airTEXT signup web page available at; http://www.airtext.info/signup Air Quality Consultants (AQC) NO₂ Concentrations and Distance from Roads (2008) available at; https://laqm.defra.gov.uk/documents/FallOffWithDistanceReptJuly08.pdf Chelmsford City Council New Local Plan available at; https://www.chelmsford.gov.uk/planning-andbuilding-control/planning-policy-and-new-local-plan/new-local-plan/ Chelmsford City Council Air Quality Check January 2018 available at; www.chelmsford.gov.uk/ resources/assets/attachment/full/0/1150501.pdf Chelmsford Growth Package Volume 1 https://www.essexhighways.org/uploads/CCGP/CCGP Vol1 Web.pdf Chelmsford City Growth Package Volume 5 https://www.essexhighways.org/uploads/CCGP/CCGP Vol5 Web.pdf Chelmsford Future Transport Network available at; https://www.essexhighways.org/highway-schemesand-developments/major-schemes/chelmsford-future-transport-network.aspx Defra Diffusion Tube Bias Adjustment Factors Spreadsheet available at; https://lagm.defra.gov.uk/assets/Database Diffusion Tube Bias Factors v03 18%20FINAL.xls DVSA Smoky Vehicle Reporting Service available at; https://www.gov.uk/report-smoky-vehicle Defra LAQM Summary of Laboratory Performance in AIR NO₂ PT Scheme available at; https://laqm.defra.gov.uk/assets/AIR-PT-Rounds-13-to-24-Apr-2016-Feb-2018.pdf Defra PG.16 Air Quality Policy Guidance available at; https://lagm.defra.gov.uk/documents/LAQM-PG16-April-16-v1.pdf Defra TG.16 Air Quality Technical Guidance available at; https://lagm.defra.gov.uk/documents/LAQM-TG16-February-18-v1.pdf Essex Air Twitter Feed available at; https://twitter.com/essexair EssexCarShare.com available at; https://essex.liftshare.com/ Essex County Council Local Transport Plan available at; http://www.essexhighways.org/Transportand-Roads/Highway-Schemes-and-Developments/Local-Transport-Plan.aspx Essex County Council Major Schemes available at; http://www.essexhighways.org/highway-schemesand-developments/major-schemes.aspx Fine (PM_{2.5}) and Course (PM_{2.5-10}) Particulate Matter on a Heavily Trafficked London Highway: Sources and Processes available at; https://ukair.defra.gov.uk/assets/documents/reports/cat05/0506061415 Fine PM25 and Coarse4.pdf Public Health Outcomes Framework Indicator 3.01 available at; http://www.phoutcomes.info/ UK-AIR Background Mapping Data for Local Authorities available at; https://ukair.defra.gov.uk/data/lagm-background-maps?year=2015