Hertfordshire Local Authorities Report
on
Particulate Matter ($PM_{2.5}$) in Ambient Air in 2016
for
Hertfordshire County Council Public Health

October 2017

DOCUMENT INFORMATION

Contributing Local Authorities (Hertfordshire):

North Hertfordshire District Council (NHDC)

Broxbourne Borough Council (BBC)

Hertsmere Borough Council (HBC)

East Hertfordshire District Council (EHDC)

Watford Borough Council (WBC)

Stevenage Borough Council (SBC)

Three Rivers District Council (TRDC)

Welwyn and Hatfield District Council (WHDC)

Dacorum Borough Council (DBC)

Additional data obtained from

Central Bedfordshire Council

Luton Borough Council

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Document Status and Approval Schedule

Issue	Status	Description	Prepared by	Reviewed by
0	Draft report	Draft for comment	David Carr	Herts Local Authority Air Quality Officers & HCC PH representatives
1	Final Report	Issued to HCC Public Health	David Carr 16/10/2017	

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Executive Summary

Hertfordshire has over one million residents (Census 2011) and as well as large rural areas has over a dozen medium sized towns all in close proximity to London. It also has a heavy reliance on personal motor vehicles and at many locations across the County is faced with risk of road congestion.

Hertfordshire County Council (HCC) has responsibility for many aspects of public health, including dealing with public health issues associated with poor air quality. As such it has an air pollution related Public Health Outcome Indicator (PHOI). PHOI 3.01 *'the fraction of annual all-cause mortality attributable to long-term exposure to current levels of anthropogenic particulate pollution.'*

However, HCC does not have responsibility for monitoring or managing local air quality; that duty rests with the ten local authorities making up Hertfordshire. It does have responsibility through the Local Transport Plan to work with local authorities in producing Air Quality Management Area Action Plans. Therefore, joint working on air quality issues between HCC and the local authorities became a higher priority and one of the partnership projects identified was the $PM_{2.5}$ monitoring project. This project has the aim of enabling the collection of real-time direct measurements of $PM_{2.5}$ concentrations from multiple locations within Hertfordshire in order to address the paucity of $PM_{2.5}$ data available within the County.

A total of ten real-time automatic $PM_{2.5}$ analysers were funded across eight of the ten local authorities to supplement the two that were already present in Hertsmere Borough Council. All but one of those ten analysers collected data during 2016.

The data collected during 2016 is of limited use for interpretative purposes at this stage but they should represent a useful baseline against which future years' data can be compared. This should enable trends over time and across the County to be assessed and be of worth to Public Health in terms of the interpretation and application of PHOI 3.01.

Nonetheless the data from 2016 has some value in its own right as a measure of the levels of $PM_{2.5}$ air pollution at various locations across the County for that year. Furthermore it showed that breaches of moderate and high air pollution indices

typically occurred in the winter months and that the Defra modelled $PM_{2.5}$ concentrations were largely consistent with those being measured.

It is anticipated that in the short term the existing $PM_{2.5}$ monitoring will be maintained to provide a larger dataset, which will be of progressively more value to Hertfordshire County Council in relation to their public health duties and the local authorities in relation to their local air quality management duties.

1. Introduction

1.1 Hertfordshire County Council (HCC)

Hertfordshire has over one million residents (Census 2011) and as well as large rural areas has over a dozen medium sized towns. The location of Hertfordshire in close proximity to London creates large commuting flows and the County has a north-south orientated transport system. Combined with the settlement pattern of widespread towns this means that there is heavy reliance on personal motor vehicles and an associated risk of congestion at many locations across the County.

Figure 1.1: Hertfordshire County Council

HCC is an upper tier local authority with responsibilities for many aspects of Public Health including working with Public Health England to protect local residents from disease. HCC is also the Highway Authority with responsibility for A, B, C and most unclassified roads.

The only specific indicator for air pollution within the Public Health Outcomes Framework relates to particulate matter (PM) with a diameter of 2.5micro-metres (μm) or less and is Public Health Outcome Indicator (PHOI) 3.01.

PHOI 3.01 is *'the fraction of annual all-cause mortality attributable to long-term exposure to current levels of anthropogenic particulate pollution.'*

The indicator is based on an estimated amount of $PM_{2.5}$ derived from local measurement, one site in Borehamwood, Hertfordshire and another in Sandy, Bedfordshire.

The $PM_{2.5}$ focussed PHOI reflects the adverse impact that this type of air pollution can have on public health as a result of the fine particles being carried deep into the lungs where they can cause inflammation and a worsening of heart and lung diseases.

There are ten second tier local authorities within Hertfordshire and it is these local authorities that have responsibility for monitoring local air pollution. The ten local authorities are:

North Hertfordshire District Council	East Hertfordshire District Council	Three Rivers District Council	Dacorum Borough Council	Broxbourne Borough Council
Hertsmere Borough Council	Watford Borough Council	Stevenage Borough Council	Welwyn & Hatfield District Council	St Albans City & District Council

1.2 Second Tier Local Authorities in Hertfordshire

Each of the ten local authorities has an obligation 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. Those obligations arise as a result of the Local Air Quality Management (LAQM) regime as defined in Part IV of the Environment Act (1995) and the relevant Policy and Technical Guidance documents.

The statutory air quality objectives applicable to LAQM in England are set into law via the Air Quality Standards Regulations (England) 2015 and they are shown in Table 1. This table shows the objectives in units of micro-grammes per cubic metre $\mu g/m^3$.

Table 1.1 also includes the number of permitted exceedences in any year (where applicable).

Table 1.1 – Air Quality Objectives included in Regulations for the purpose of Local Air Quality Management in England.

Pollutant	Air Quality Objective[1]	
	Concentration	Measured as
Nitrogen Dioxide (NO_2)	200µg/m^3 not to be exceeded more than 18 times a year	1-hour mean
	40µg/m^3	Annual mean
Particulate Matter (PM_{10})	50µg/m^3 not to be exceeded more than 35 times a year	24-hour mean
	40µg/m^3	Annual mean
Sulphur Dioxide (SO_2)	350µg/m^3 not to be exceeded more than 24 times a year	1-hour mean
	125µg/m^3 not to be exceeded more than 3 times a year	24-hour mean
	266µg/m^3 not to be exceeded more than 35 times a year	15-minute mean

There are no statutory obligations on local authorities in respect of monitoring concentrations of $PM_{2.5}$ in the ambient air. However, as detailed in Chapter 7 of the LAQM Policy Guidance 2016 (1), local authorities are expected to work towards reducing emissions and/or concentrations of $PM_{2.5}$. Also the EU Ambient Air Quality Directive has identified 25µg/m^3 as a limit value to be met by 2020. The World Health Organisation has set an air quality guideline of 10µg/m^3 as an annual mean for $PM_{2.5}$.

The environmental officers with LAQM responsibility within the ten Hertfordshire local authorities work collaboratively where possible and appropriate via the Hertfordshire and Bedfordshire Air Quality Forum. This forum also comprises environmental officers from the three unitary local authorities in Bedfordshire and professionals from HCC who bring different areas of expertise to the issue of local air quality, for example public health, transport and planning.

1.3 Impact on Public Health of Particulate Matter ($PM_{2.5}$)

$PM_{2.5}$ are one of the best evidenced air pollutants in terms of the health impact from long term exposure and it is reflected in Public Health England's inclusion of premature death due to particulate air pollution in the Public Health Outcomes Framework (PHOI 3.01).

Modelled estimates suggest 4.9% of all Hertfordshire deaths in 2015 in people aged 30 and above were attributable to particulate air pollution ($PM_{2.5}$), and estimated 459 deaths.

[1] The units are in micro-grammes of pollutant per cubic metre of air (µg/m^3).

Chronic exposure to particulate matter contributes to the risk of developing cardiovascular and respiratory diseases and there is an increasing evidence base that long-term exposure to even low levels of particulate matter may have a significant effect on health. This reflects the understanding that there is no threshold below which the inhalation of particulate pollution would have no adverse effects.

Relative risks increase of mortality for each 10μg/m^3 of particulate matter are:

- All cause mortality 6%
- Cardiovascular (heart disease & stroke) 9%
- Pulmonary (asthma & Chronic Obstructive Pulmonary Disease) 9%
- Lung cancer 8%

(Hertfordshire Air Quality Strategic Plan – June 2015)

1.4 Sources of Airborne Particulate Matter ($PM_{2.5}$)

Particulate matter, whether PM_{10} (aerodynamic diameter <10μm), $PM_{2.5}$ (aerodynamic diameter <2.5μm), or $PM_{1.0}$ (aerodynamic diameter <1μm) is emitted from exhausts as a result of the combustion process within engines and also from tyre and brake wear and other vehicle component wear such as the chassis and clutch (Air Quality Expert Group 2005(2).

The Air Quality Expert Group (2015) estimated that UK emissions contribute to approximately 50-55% of the total annual average $PM_{2.5}$ in the UK (3). The European Environment Agency estimates that road transport sources contributed to 13% of European emissions of $PM_{2.5}$ in 2013. Data presented by the Air Quality Expert Group (2015) estimated the contribution from traffic to be 7% (3).This emphasises that a large proportion of airborne $PM_{2.5}$ originate from other sources, including sea-salt, inorganic aerosols, organic aerosols and non-traffic generated rural and urban particulates including biomass burning both domestic and commercial.

2. The Hertfordshire Particulate Matter ($PM_{2.5}$) Monitoring Project

A public health conference on local air quality, held to bring together professionals from environmental health and public health as well as local councillors, identified that among a number of other gaps in knowledge there was minimal locally available monitoring data for $PM_{2.5}$ concentrations in Hertfordshire.

The $PM_{2.5}$ Monitoring Project was a direct outcome of that conference and was funded and overseen by Hertfordshire County Council Public Health, with the Hertfordshire membership of the Hertfordshire and Bedfordshire Air Quality Forum being eligible for funding and responsible for providing the technical expertise in sourcing, locating and establishing the appropriate $PM_{2.5}$ monitoring equipment.

A total of £20,000 per district/borough was made available as a "one off" addition to the existing District Partnership Fund monies that had already agreed and it was made available to spend until autumn 2015. The ring fenced money had to be spent on monitoring equipment for $PM_{2.5}$ and was only available for capital costs, with no equivalent ring-fenced funding available in future years for ongoing servicing and maintenance.

The funding was available for purchasing mobile or fixed site $PM_{2.5}$ analysers, or for the costs of upgrading existing PM_{10} monitoring equipment to also monitor $PM_{2.5}$, or a combination of them.

All local authorities took up the offer of funding other than Hertsmere Borough Council and St Albans Council. St Albans chose not to participate and Hertsmere had no need to take up the offer because they already had PM2.5 analysers within their monitoring network.

Additional expectations of the funding were that the local authorities that took up the funding guaranteed to maintain the equipment for one year and that on an annual basis the collected data would be factually reported and an interpretative report based on the data would be made available to Public Health for consideration and discussion.

2.1 Aims and Objectives

The aim of the $PM_{2.5}$ Monitoring Project was to:

- enable the collection of real-time direct measurements of $PM_{2.5}$ concentrations from multiple locations within Hertfordshire in order to address the paucity of $PM_{2.5}$ data available within the County

The objectives were to provide data for:

- consideration and use by HCC Public Health in relation to PHOI 3.01
- consideration and use by Hertfordshire's local authorities Environmental Health Teams in relation to their Local Air Quality Management duties

- comparison of data from different locations throughout Hertfordshire
- consideration of trends over time
- consideration of relationships between the measured $PM_{2.5}$ concentrations and the concentrations, both background and roadside, predicted by Defra modelling

3. Hertfordshire's Air Quality $PM_{2.5}$ Monitoring Network

3.1 Prior to Public Health Funding

Prior to 2016 there were only two $PM_{2.5}$ analysers located within Hertfordshire and both analysers were operated by Hertsmere Borough Council.

Both of the analysers are Tapered Element Oscillating Microbalances with a Filter Dynamics Measurement System in place (TEOM-FDMS). This is one of three types of real-time automatic analysers, along with BAM and FIDAS analysers, that meet the MCERTS performance standards for continuous ambient air quality monitoring systems with MCERTS for UK particulate matter, including $PM_{2.5}$. As such it is approved for that use by Defra.

One of Hertsmere's TEOM-FDMS analysers (AM1) has been operational since the 9th September 2014 and is positioned at a roadside location at Elstree Way, Borehamwood.

The other of Hertsmere's TEOM-FDMS analysers (AM2) was operational between 5th November 2005 and 23rd May 2017 and was positioned at an urban-background location near Thrift Farm Lane, Borehamwood. This analyser is due to be relocated during 2017 and it is anticipated that it will be collecting data again later in 2017.

The two analysers are located about 300m from each other, so the availability of directly measured $PM_{2.5}$ was limited to a very specific geographical area of the County.

A site plan showing the location of both $PM_{2.5}$ analysers is included as Figure 3.1.

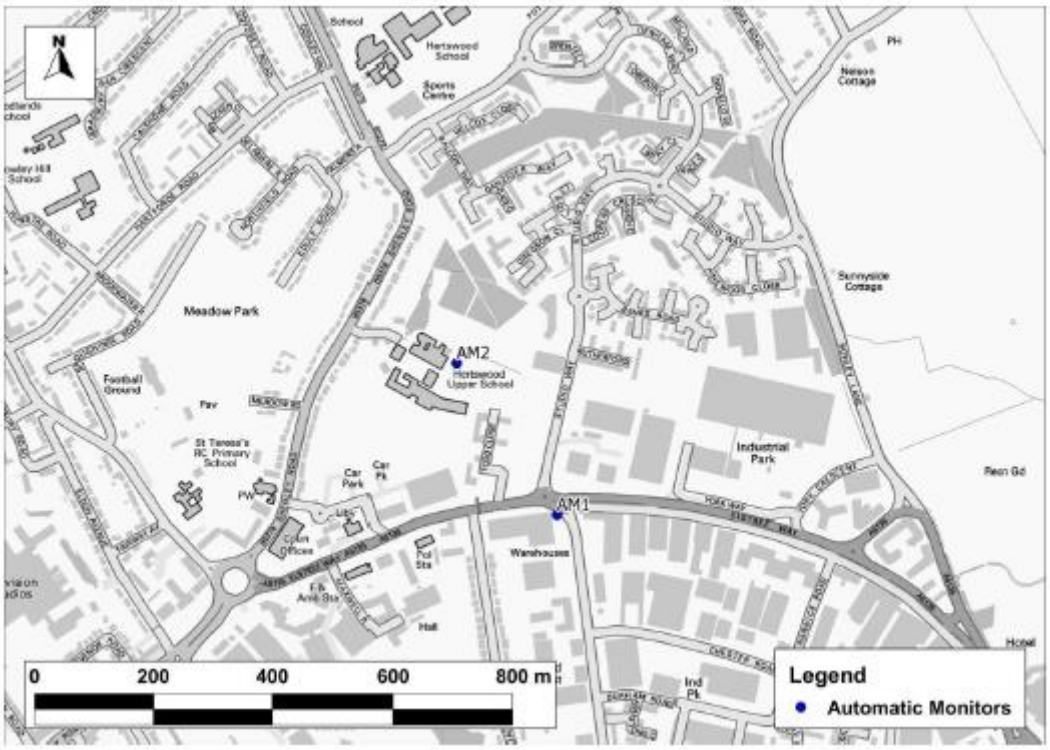


Figure 3.1 Location of $PM_{2.5}$ analysers in Borehamwood, Hertsmere

3.2 Post Public Health Funding

By 2016 the $PM_{2.5}$ monitoring network within Hertfordshire had expanded to eleven monitoring locations with nine of the ten local authority areas having at least one real-time analyser measuring $PM_{2.5}$ concentrations in the ambient air. A summary of the locations and types of $PM_{2.5}$ analysers operating within Hertfordshire in 2016 is included as Table 3.2.

An indication of the geographical coverage of $PM_{2.5}$ monitoring is included as Figure 3.2. However, it must be recognised that the mapping shown in Figure 3.2 should only be considered as indicative.

Table 3.2 Extent & nature of the $PM_{2.5}$ monitoring network in Hertfordshire 2016

Local Authority	Address	Grid Reference	Location Type	Analyser Type
Hertsmere*	Elstree Way, Borehamwood	520319, 197099	Roadside	TEOM-FDMS **
Hertsmere*	Thrift Farm Lane, Borehamwood	520147, 197361	Urban-background	TEOM-FDMS **
Dacorum	High Street, Northchurch	497295, 208901	Roadside	FIDAS **
North Hertfordshire	Stevenage Road, Hitchin	518713, 228349	Roadside	BAM **
Welwyn, Hatfield	St Albans Road East, Hatfield	523283, 209161	Roadside	BAM **
East Hertfordshire	Gascoyne Way, Hertford	532764, 212519	Roadside	BAM **
Watford	Rickmansworth Road, Watford	510572, 196809	Roadside	FIDAS **
Stevenage	Lytton Way, Stevenage	523589, 223965	Roadside	BAM **
Broxbourne	College Road, Cheshunt	535314, 202244	Roadside	AQ Mesh ***
Broxbourne	Eleanor Cross Rd Waltham Cross	536266, 200376	Roadside	AQ Mesh ***
Three Rivers	Rickmansworth Rd, Chorleywood	504162, 196286	Roadside	AQ Mesh ***
Three Rivers	Not yet deployed	Not applicable	Not applicable	AQ Mesh ***

***** not funded by Public Health

****** analysers that are MCERTS accredited for continuous ambient air quality monitoring systems with MCERTS for UK particulate matter, including $PM_{2.5}$ monitoring and are approved by Defra

******* an analyser that is not MCERTS accredited for continuous ambient air quality monitoring systems with MCERTS for UK particulate matter, including $PM_{2.5}$ monitoring and not approved by Defra.

The absence of the necessary MCERTS accreditation means that data from the analyser in question should only be utilised as a screening assessment tool to inform the need for more detailed monitoring.

A roadside monitoring location is one that is typically within 1 - 5 metres of the kerb of a busy road (although can be up to 15m from the kerb) (4).

An urban-background location is one that is in an urban setting, but is not located close to a source (i.e. busy road) (4).

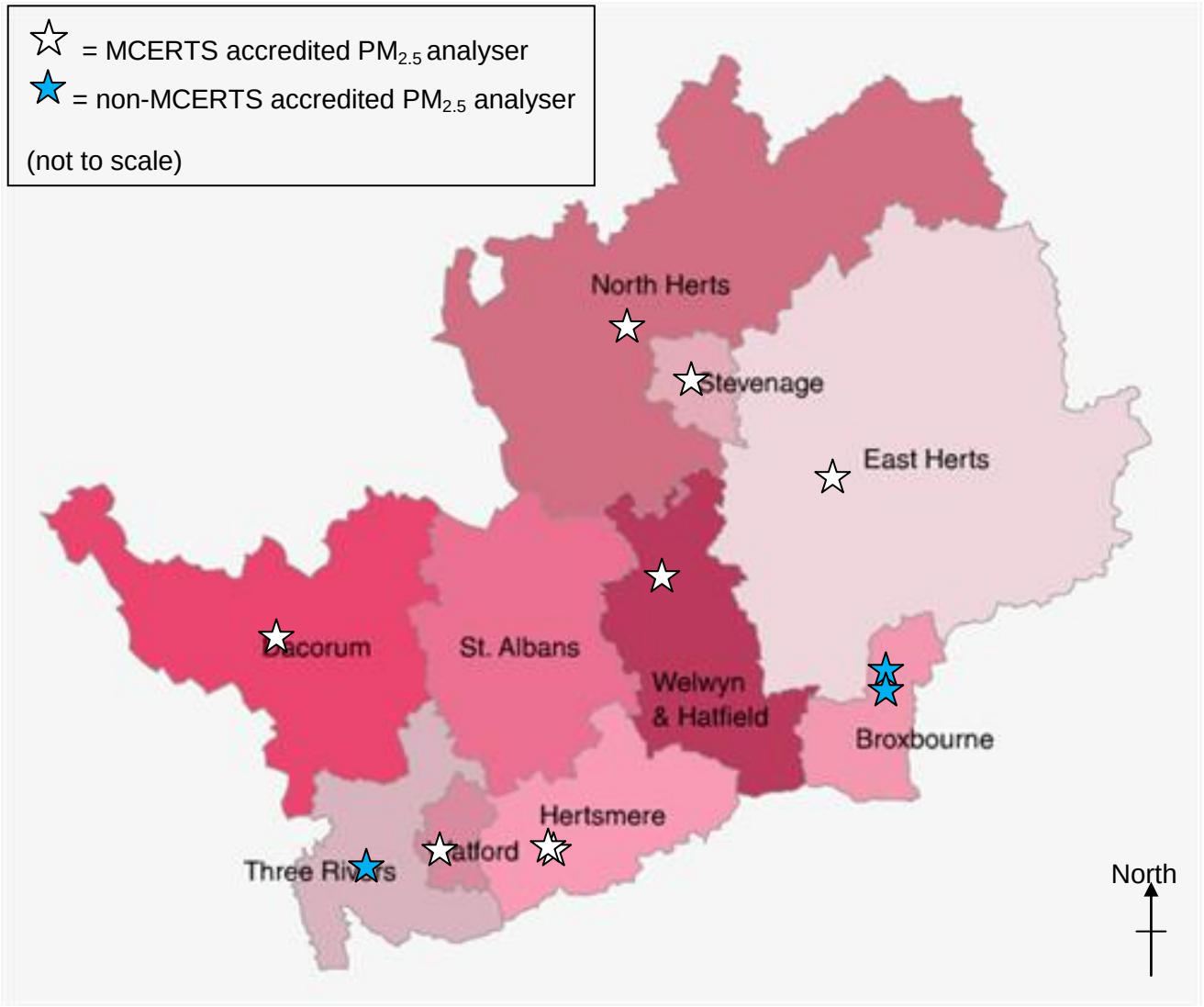


Figure 3.2 Plan of Hertfordshire showing indicative location of $PM_{2.5}$ analysers in 2016

4. Results of $PM_{2.5}$ Monitoring

In addition to understanding the accreditation status of the monitoring equipment it is necessary to understand the data capture rate for the monitoring period in order to assess the significance that can be attributed to data obtained via air quality monitoring. Table 4.1 summarises the periods of monitoring during 2016 and data capture rates for each $PM_{2.5}$ analyser.

Table 4.1 Performance of the $PM_{2.5}$ monitoring network in 2016

Local Authority	Location	2016 commencement date	Data Capture as % of 2016	Analyser Type
Hertsmere*	**Borehamwood**	**01/01/2016**	**90.3**	**TEOM-FDMS**
Hertsmere*	**Borehamwood ****	**01/01/2016**	**96.76**	**TEOM-FDM**
Dacorum	**Northchurch**	**01/01/2016**	**99.99**	**FIDAS**
North Hertfordshire	**Hitchin**	**01/01/2016**	**91.31**	**BAM**
Welwyn, Hatfield	Hatfield	28/04/2016	60.29	BAM
East Hertfordshire	Hertford	22/08/2016	31.25	BAM
Watford	Watford	24/10/2016	18.85	FIDAS
Stevenage	Stevenage	24/10/2016	18.25	BAM
Broxbourne	***Cheshunt***	***01/01/2016***	***85.8***	***AQ Mesh ******
Broxbourne	*Waltham Cross*	*01/01/2016*	*78.2*	*AQ Mesh ****
Three Rivers	*Chorleywood*	*10/03/2016*	*58.8*	*AQ Mesh ****

* = analysers not funded by PH grant
** = urban background site (all other sites are roadside sites)
*** = not MCERTS accredited (all other analysers are MCERTS accredited)

Those sites reporting a data capture of above 85% are considered to have sufficient data capture to provide a meaningful annual mean value (4). Of the five analysers with a sufficient level of data capture four are MCERTS accredited analysers (Borehamwood (x2), Northchurch and Hitchin) suitable for direct comparison with air quality objectives or equivalents. And one is an analyser that is suitable for providing a screening assessment level of data (Cheshunt).

Where data capture rates are below the 85% level it is as a consequence of the analysers not being operational until part way into 2016, with the exception being the AQ Mesh at Waltham Cross, which failed to meet the data capture rate because of a combination of faults and technical difficulties. The 58.8% data capture by the AQ Mesh at Chorleywood was due to a combination of its operation commencing in March 2016 and faults between June and September 2016.

The other consideration about the reliability of the data relates to the quality control and quality assurance in terms of the ongoing calibration, maintenance and servicing of the monitoring equipment. To manage this process the Hertfordshire and Bedfordshire Air Quality Forum employees a consultant recognised to have the relevant expertise and experience to check and ratify the data generated by the monitoring network. All of the data presented in this report has been ratified in line with best practice and meet the requirements of Defra.

Table 4.2 provides an overview of the results of the $PM_{2.5}$ monitoring as an annual average and the number of days on which the levels of $PM_{2.5}$ were measured above a concentration defined by the Defra Index Band for air pollution to be representative of 'moderate' and 'high' air pollution. No occasions were measured where the 'very high' air pollution threshold was breached.

- 'Moderate' is defined as being greater than 36$\mu g/m^3$ but less than 54$\mu g/m^3$ as a 24hour running mean.
- 'High' is defined as being between 54 $\mu g/m^3$ and 70 $\mu g/m^3$ and
- 'Very High' is defined as being 71$\mu g/m^3$ or higher

(5)

- 25$\mu g/m^3$ is the EU Limit Value that has been set for $PM_{2.5}$.

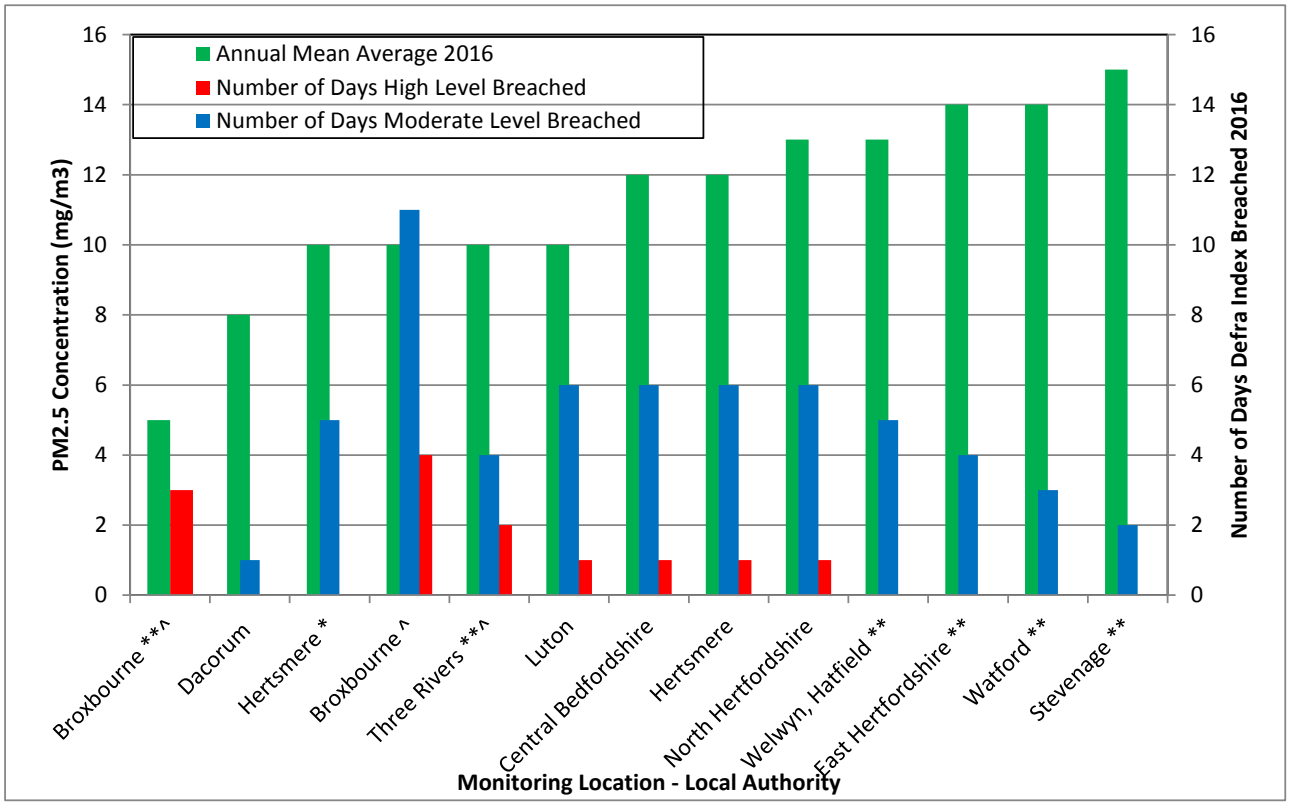
To provide some additional local context the 2016 data from the $PM_{2.5}$ analysers operating in Bedfordshire have been included in Table 4.2.

Table 4.2 Results from the Hertfordshire $PM_{2.5}$ monitoring network in 2016

Local Authority	Location	Annual Mean Average (µg/m^3)	No. of days with Moderate Pollution	No. of days with High Pollution
Hertsmere *	**Borehamwood**	**10**	**5**	**0**
Hertsmere	**Borehamwood**	**12**	**6**	**1**
Dacorum	**Northchurch**	**8**	**1**	**0**
North Hertfordshire	**Hitchin**	**13**	**6**	**1**
Welwyn, Hatfield	Hatfield	13	5	0
East Hertfordshire	Hertford	14	4	0
Watford	Watford	14	3	0
Stevenage	Stevenage	15	2	0
Broxbourne	***Cheshunt***	***10***	***11***	***4***
Broxbourne	*Waltham Cross*	*5*	*0*	*3*
Three Rivers	*Chorleywood*	*10*	*4*	*2*
Bedfordshire Local Authorities				
Luton	**Dunstable Rd, Luton (FIDAS)**	**10**	**6**	**1**
Central Bedfordshire	**A1(M) at Sandy (TEOM-FDMS)**	**12**	**6**	**1**

* = urban background monitoring site. All other sites are roadside sites
Bold **= MCERTS accredited with >85% data capture**
Normal font = MCERTS accredited with <85% data capture
Bold Italics ***= not MCERTS accredited but with >85% data capture***
Italics *= not MCERTS accredited and with <85% data capture*

Figure 4.1 displays the above information arranged from lowest annual mean average $PM_{2.5}$ concentration to the highest.



* = urban-background monitoring site. All other locations are roadside monitoring sites
** = data capture below 85%
^ = equipment not MCERTS accredited

Figure 4.1. $PM_{2.5}$ concentrations and days Defra Index was breached in 2016

Table 4.3 shows the annual mean average $PM_{2.5}$ concentrations at each of the Hertfordshire monitoring sites in 2016 with the concentrations that have been modelled by Defra. The Defra data was taken from https://uk-air.defra.gov.uk/data/gis-mapping on the 16th August 2017 with the year specified to be 2015, which is the most up to date data available. Where modelled data is available specific to the road on which the monitoring equipment is located this is also reported, but where roadside modelled data is not available the background data is used.

Table 4.3 Results from the Hertfordshire $PM_{2.5}$ monitoring network in 2016 compared with modelled data from Defra

Local Authority	Location	Annual Mean Average (µg/m^3)	Defra Modelled Data (µg/m^3) (Roadside)	Defra Modelled Data (µg/m^3) (background)
Hertsmere *	**Borehamwood**	**10**	**no data**	**10 – 12.5**
Hertsmere	**Borehamwood**	**12**	**10 – 12.5**	**10 – 12.5**
Dacorum	**Northchurch**	**8**	**5 – 10**	**5 - 10**
North Hertfordshire	**Hitchin**	**13**	**10 - 12.5**	**5 - 10**
Welwyn, Hatfield	Hatfield	13	no data	10 – 12.5
East Hertfordshire	Hertford	14	10 – 12.5	10 – 12.5
Watford	Watford	14	10 – 12.5	5 - 10
Stevenage	Stevenage	15	10 - 12.5	10 - 12.5
Broxbourne	***Cheshunt***	***10***	***10 – 12.5***	***10 – 12.5***
Broxbourne	*Waltham Cross*	*5*	*10 – 12.5*	*10 – 12.5*
Three Rivers	*Chorleywood*	*10*	*10 – 12.5*	*10 – 12.5*

* = Urban-background monitoring site. All other analysers are roadside sites
Bold **= MCERTS accredited with >85% data capture**
Normal font = MCERTS accredited with <85% data capture
Bold Italics ***= not MCERTS accredited but with >85% data capture***
Italics *= not MCERTS accredited and with <85% data capture*

Figure 4.2 displays the days in 2016 on which breaches of the Defra Index Bands for air pollution by $PM_{2.5}$ were measured.

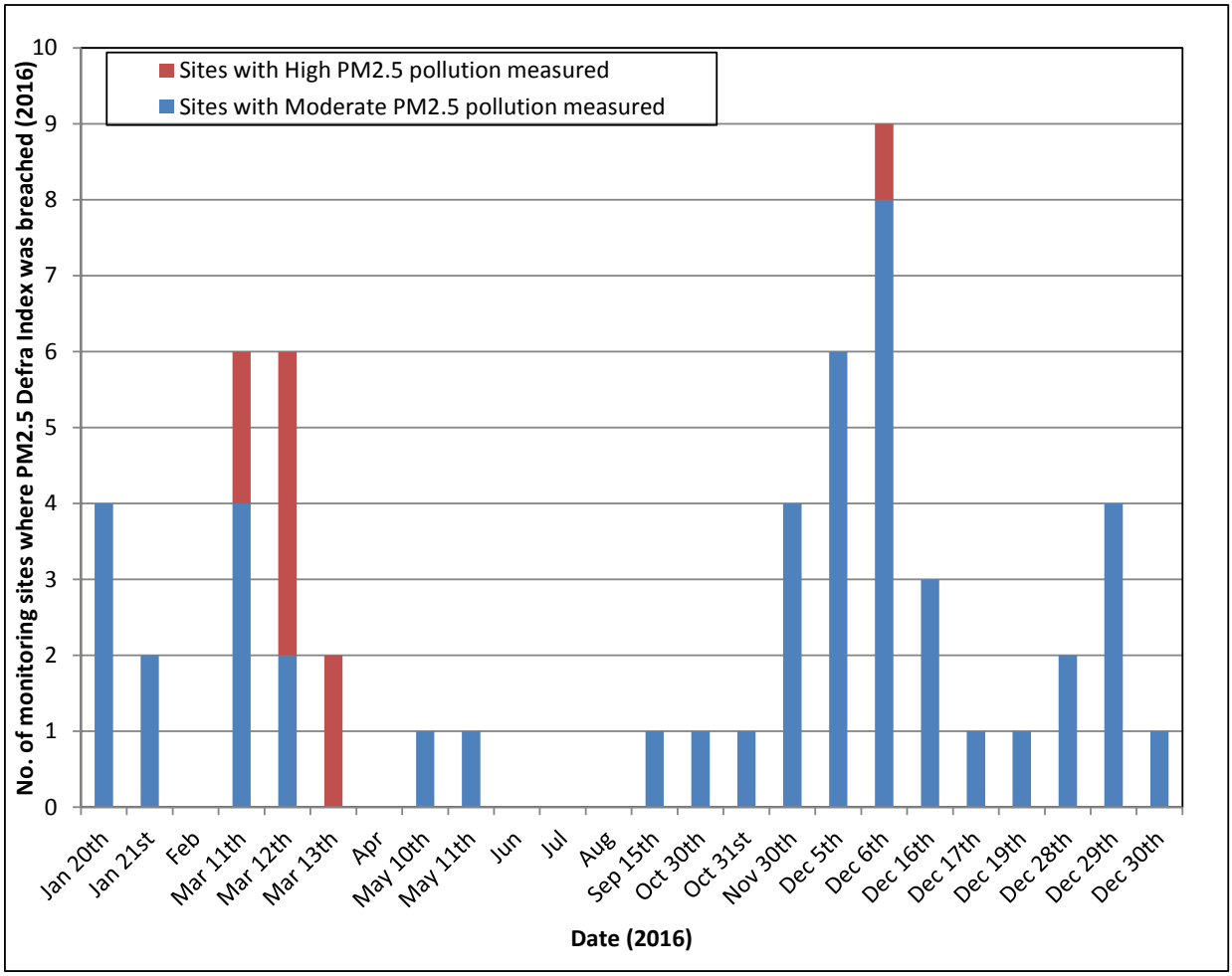


Figure 4.2 Dates of occurrence of breaches by $PM_{2.5}$ of the Defra Index in 2016

Table 4.4 shows the mean average annual $PM_{2.5}$ measured at each of the Local Authorities during 2016 alongside the PHOI value for the fraction of annual all-cause mortality attributable to current levels of anthropogenic particulate pollution. For context data are included for Central Bedfordshire, Bedford, Luton, Hertfordshire, the East of England Region and the London Region.

Figure 4.3 displays the PHOI value for each of the Hertfordshire and Bedfordshire local authorities alongside their respective $PM_{2.5}$ concentrations as measured during 2016.

Table 4.4 PHOI 3.01 data and mean annual average $PM_{2.5}$ concentrations measured in 2016

Regional	PHOI 3.01	Mean Annual Average $PM_{2.5}$ ($\mu g/m^3$)
England	4.7	no data
London	5.6	no data
East of England	5.1	no data
County/Unitary		
Luton	5.0	10
Central Bedfordshire	4.9	12
Hertfordshire	4.9	11.3 *
Bedford	4.8	no data
District/Borough		
Hertsmere	5.1	10 (urban-background site)
		12 (roadside site)
St Albans	5.1	no data
East Hertfordshire	5.0	14
Welwyn Hatfield	5.0	13
Three Rivers	4.9	10
Watford	4.9	14
Broxbourne	4.8	7.5 *
North Hertfordshire	4.7	13
Dacorum	4.6	8
Stevenage	4.6	15

* = mean average of two or more annual values

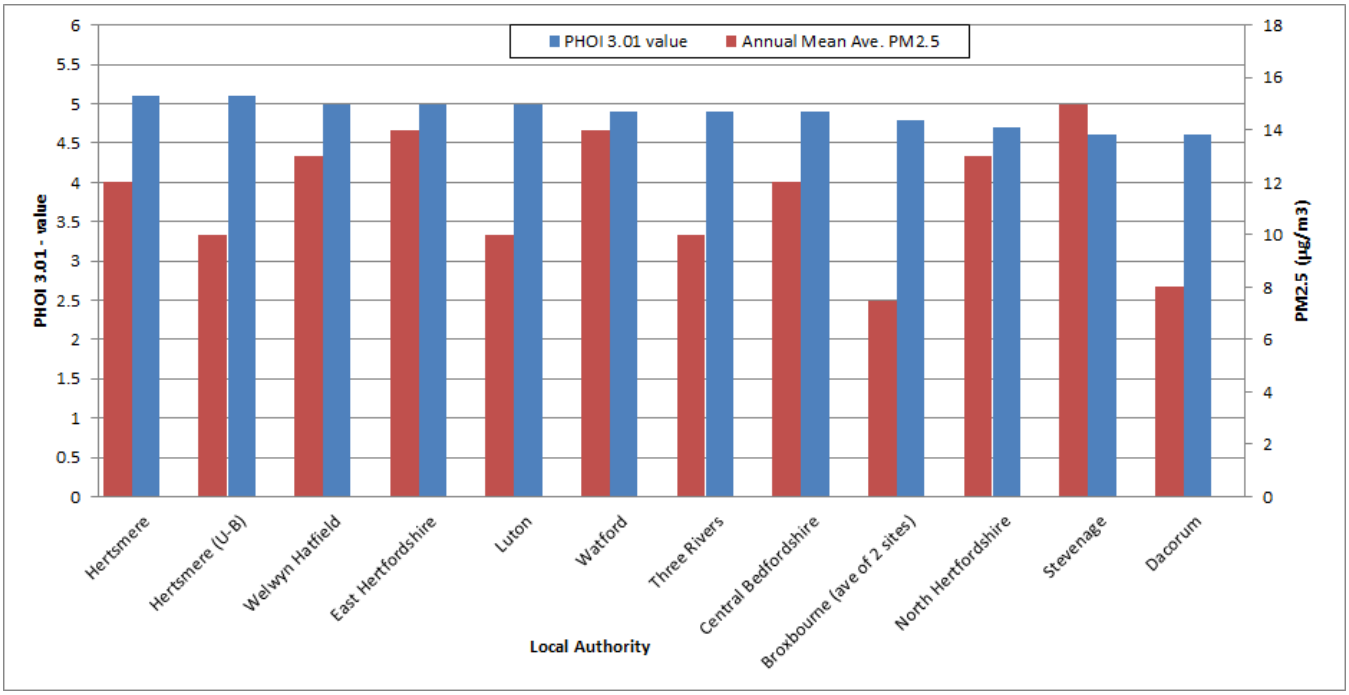


Figure 4.3 PHOI 3.01 values and mean average annual (2016) $PM_{2.5}$ concentrations

5. Discussion and Interpretation of $PM_{2.5}$ Results

The data that have been collected and that are presented in Section 4 of this report represent the first complete year of $PM_{2.5}$ air quality monitoring within Hertfordshire and in six of the eleven monitoring locations (**Table 4.1**) the data capture was below the required level of 85%. Therefore, the discussion of the data and interpretation of trends or patterns will be of limited value. Nevertheless it is anticipated that some broad observations can be made and that the data presented in this report will provide a useful point of comparison for the results obtained from subsequent years of $PM_{2.5}$ monitoring from this network.

5.1 Urban-background and roadside concentrations

Comparing the annual mean average at Hertsmere's urban-background monitoring site (10$\mu g/m^3$) with that from Hertsmere's road-side monitoring site (12$\mu g/m^3$), located 300m apart, indicates a specific localised contribution to $PM_{2.5}$ air pollution from road traffic (**Table 4.2**).

However, in comparison to nitrogen dioxide the localised air pollution impact of $PM_{2.5}$ from a busy road is much less significant. For example, concentrations of nitrogen dioxide would be expected to decline by between 30%-40% over a distance as small as 20 metres.

A further indication of the apparent relatively small degree of difference between $PM_{2.5}$ measured at roadside sites and that measured at a closely neighbouring urban-background site is a comparison of Defra Index breaches. The Hertsmere urban-background site recorded 5 days of moderate $PM_{2.5}$ pollution and no days with high $PM_{2.5}$ pollution, whilst the Hertsmere roadside site recorded 6 days of moderate and one day of high $PM_{2.5}$ pollution.

Looking at just the monitoring results from the MCERTS accredited analysers with a >85% data capture the mean annual average concentration of $PM_{2.5}$ measured at the urban-background site was less than the mean annual average of $PM_{2.5}$ measured at the roadside sites at Hertsmere, North Hertfordshire and Central Bedfordshire (**Table 4.2**). However, the concentration was the same as measured at the roadside site in Luton and was higher than at the roadside site in Dacorum (**Table 4.2**).

5.2 Defra modelled and local authority measured $PM_{2.5}$ concentrations

The data presented in **Table 4.3** show that the Defra modelled $PM_{2.5}$ data is broadly in line with that measured by the automatic analysers within Hertfordshire. Of the four MCERTS accredited analysers with >85% data capture only the concentration of 13μg/m^3 recorded by North Hertfordshire at its roadside site on Stevenage Road, Hitchin was above the modelled range of 10-12.5μg/m^3 for the same road.

Higher concentrations were measured at Welwyn Hatfield, East Hertfordshire, Watford and Stevenage than were predicted by Defra, but it should be recognised that the four locations in question had data capture for 2016 ranging between 18% and 60%.

5.3 Seasonal trends in $PM_{2.5}$ air pollution episodes

With data available for just one year the seasonal trends identified cannot be considered to be representative of anything other than 2016. So from a broad interpretation of **Figure 4.2** it would appear that the winter months are the periods where elevated $PM_{2.5}$ air pollution is most likely to be an issue.

More specifically **Figure 4.2** identifies two periods within 2016 where particularly elevated concentrations of $PM_{2.5}$ where detected across the county, namely the 11th – 12th of March and the 5th - 6th of December.

Over the 11th and 12th of March 2016 breaches of either the moderate air pollution index, or the high air pollution index were measured at all of the operational monitoring sites. It is understood that this period of $PM_{2.5}$ pollution was likely to be associated with a national air pollution episode, which was reported on in at least one national newspaper (http://www.express.co.uk/news/weather/652430/Deadly-toxic-smog-alert-Britain-worst-pollution-this-week).

Over the 5th and 6th of December 2016 breaches of the moderate air pollution index where measured on at least one day by nine of the eleven operational monitoring sites. And at one of those monitoring sites one breach of the high air pollution index was measured. This period of $PM_{2.5}$ pollution was associated with a regional air pollution episode that was widely reported, by news outlets including, www.airqualitynews.com , Sky News and the Independent newspaper, as being a result of cold and stagnant weather leading to poor dispersal of traffic pollutants, particularly $PM_{2.5}$ and nitrogen dioxide.

Other periods where at least four analysers in the network recorded breaches of the moderate air pollution index were on the 20th January 2016 and late in December 2016. The January air pollution episode was also widely reported in the press (Air Quality Bulletin February 2016 and the Evening Standard www.standard.co.uk) and also attributed to cold, still weather conditions preventing the dispersion of local emissions.

5.4 The relationship between PHOI 3.01 indices and measured $PM_{2.5}$ levels

The general expectation in comparing the PHOI 3.01 index for each local authority against the measured $PM_{2.5}$ concentration would be that the highest index would be associated with the highest measured concentration. A significant reason why this may not be borne out by comparing this data is that the PHOI is derived on a local authority scale whereas the $PM_{2.5}$ monitoring is occurring at a fixed location. The fixed location typically selected to be in an area where residential properties are close to localised sources of air pollution, as opposed to multiple locations, or one location chosen to be generally representative of the local authority.

Table 4.4 and **Figure 4.3** show that for four of the Hertfordshire local authorities there is a potential discrepancy between the PHOI value and the measured $PM_{2.5}$ concentration. At Hertsmere and at Three Rivers it could be argued that the PHOI value could be lower if derived solely from the $PM_{2.5}$ concentrations measured during 2016. In contrast it could be argued that the PHOI value could be higher for North Hertfordshire and Stevenage if derived solely from the $PM_{2.5}$ concentrations measured during 2016.

It is important to recognise that the Three Rivers data were obtained from a non-MCERTS accredited analyser and data capture was less than 85% for the year and that although the Stevenage data were collected by an MCERTS accredited analyser the data capture was only 18%.

6. Summary and Further Work

The investment in $PM_{2.5}$ air pollution analysers in Hertfordshire has for the first time provided local authority environmental health officers and their colleagues in public health in HCC with access to county-wide real-time data on concentrations of this non-threshold air pollutant.

As a result of there only being one year of data available and because of a number of the $PM_{2.5}$ analysers not being fully commissioned until part way through 2016 the value of the data collected to date is limited. However, it should form a useful baseline against which subsequently collected data can be considered, particularly in those locations where a full year of data was obtained.

Broad observations that may be made from this one year of data are as follows:

- Breaches of the moderate and high air pollution index typically occurred in the winter months

- Breaches are likely to be associated with regionally and locally derived road vehicle pollution in still and cold weather conditions

- Breaches may also arise if weather conditions are such that air pollution from the continent (and potentially further afield) is transported across to Britain without adequate dispersal

- Defra modelled $PM_{2.5}$ concentrations for each local authority area are broadly consistent with the concentrations being measured by the analysers within each local authority

- $PM_{2.5}$ concentrations measured at the one urban-background site within Hertfordshire were typically slightly lower than the concentrations measured at the roadside sites.

In the short-term the further work should focus on maintaining the existing $PM_{2.5}$ monitoring network so as to build up a more detailed and reliable picture of the levels of $PM_{2.5}$ air pollution at the selected sites across the County and compiling and sharing an annual report on the $PM_{2.5}$ data collected.

Additionally, the report should be made available on an appropriate HCC webpage and on www.airqualityhertsbeds.co.uk.

In the medium-term this work should enable the aim and the objectives of this $PM_{2.5}$ monitoring project (Section 2.1) to be better met.

Where justifiable, appropriate opportunities should also be taken to enhance the existing $PM_{2.5}$ monitoring network as and when they arise.

7. References

1. Defra. 2016. Local Air Quality Management Policy Guidance LAQM.PG(16)
2. Air Quality Expert Group (2005) *Particulate Matter in the United Kingdom.* London: Defra Publications.
3. Air Quality Expert Group (2015) *Mitigation of United Kingdom $PM_{2.5}$ concentrations* [Online]. Available at: http://uk-air.defra.gov.uk/assets/documents/reports/cat11/1508060903_DEF-PB14161_Mitigation_of_UK_PM25.pdf (Accessed: 02 October 2015)
4. Defra. 2016. Local Air Quality Management Technical Guidance LAQM.TG(16)
5. Defra 2013 – what is the daily air quality index - https://uk-air.defra.gov.uk/air-pollution/daqi?view=more-info&pollutant=pm25 (Accessed: 02 August 2017)