

Hertfordshire Local Authorities Report
on
Particulate Matter (PM_{2.5}) in Ambient Air in 2018
for
Hertfordshire County Council Public Health

November 2019

DOCUMENT INFORMATION

Contributing Local Authorities (Hertfordshire):

North Hertfordshire District Council (NHDC)

Hertsmere Borough Council (HBC)

East Hertfordshire District Council (EHDC)

Watford Borough Council (WBC)

Stevenage Borough Council (SBC)

Welwyn and Hatfield District Council (WHDC)

Dacorum Borough Council (DBC)

Hertfordshire County Council – Public Health (HCC-PH)

Additional data obtained from

Central Bedfordshire Council

Luton Borough Council

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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) does not have responsibility for monitoring or managing local air quality; that duty rests with the ten District and Borough Authorities within Hertfordshire. However, it does have responsibility through the Local Transport Plan to work with local authorities in producing Air Quality Management Area Action Plans. Furthermore, HCC through its Public Health remit is responsible for working with local authorities to reduce public exposure to elevated concentrations of air pollutants, particularly PM_{2.5}. HCC published its Air Quality Strategy and Implementation Plan in April 2019⁹.

Therefore, joint working on air quality issues between HCC and the local authorities has become 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.

In 2015 Public Health funding was provided for the purchase of ten real-time automatic PM_{2.5} analysers across eight of the ten local authorities. Nine of the ten analysers collected data during 2016, in 2017 eight were operational and in 2018 six analysers were still operational. In addition to the Public Health funded analysers, two analysers owned and operated by Hertsmere Borough Council were operational throughout 2016-2018.

Prior to the funding the only real-time automatic PM_{2.5} analysers operating in Hertfordshire, were those owned by Hertsmere Borough Council.

As a result of there being three years 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 the three years of data are as follows:

- Breaches of the moderate and high daily air pollution index typically occur in the winter months in weather conditions that are still and cold
- Breaches are likely to be associated with regional or national scale air pollution episodes and only partially associated with locally derived road vehicle pollution
- Breaches may also arise if weather conditions are such that air pollution from the continent (and potentially further afield) is transported across to Britain
- 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
- Where data capture rates have been reliable the mean annual average concentrations of PM_{2.5} recorded have not varied significantly from 2016 to 2018.

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 – Local Government and Air Quality Responsibilities

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, with the exception of the M25, 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

1.1. Roles and Responsibilities

Section 82 of the Environment Act 1995¹⁰ provides that every local authority shall review the air quality within its area, both at the present time and the likely future air quality. In two-tier local government areas such as Hertfordshire, this duty sits with the District and Borough Councils.

Section 83 requires these local authorities to designate an Air Quality Management Area (AQMA) where air quality objectives are not being achieved (or are not likely to be achieved) as set out in the Air Quality (England)

Regulations 2000. Once designated, Section 84 requires the local authority to develop an Action Plan detailing remedial measures to tackle the problem within the AQMA.

There are obligations placed on the County Council however – detailed in the 2016 Defra Local Air Quality Management guidance⁵. In summary, the district/borough councils are accountable for monitoring air quality, designating AQMAs, preparing the annual reports and Action Plans. However, the Secretary of State expects county councils to actively engage at all stages of review, assessment and action planning, and ensure that all necessary measures to address air pollution in their local area are included.

HCC is an upper tier local authority with statutory responsibilities for both Public Health, Highways and Transport Planning. As the Highway Authority, the County Council has responsibility for A, B, C and most unclassified roads. Highways England is responsible for the Motorway network.

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 National Policy and Guidance

The recent publication of the Government's Clean Air Strategy¹¹ sets out how the government will work to implement its 25-year environment plan, alongside its clean growth proposals. The cross government plan is published by the Departments for Business, Energy and Industrial Strategy, Environment, Food and Rural Affairs, Transport, the Health and Social Care, the Treasury, and the Ministry of Housing, Communities and Local Government.

The Government Clean Air Strategy details a raft of new powers for local authorities and sets out a number of options which could be included in the Draft Environment (Principles and Governance) Bill 2018, although it is (at the time of writing) unclear who these duties would fall on within councils, nor how they would be funded.

The Clean Air Strategy focusses on the importance of facilitating the sharing of best practice and knowledge between local authorities.

February 2019 saw the publication of the National Institute for Clinical Excellence (NICE) Quality Standard for outdoor air pollution and health¹², describing high-quality actions in priority areas for improvement. The standard is endorsed by The Department of Health and Social Care as required by the Health and Social Care Act (2012) builds on the 2017 publication of NICE air pollution guidance NG70.

Public Health England published a review of interventions¹³ to improve outdoor air quality and public health in March 2019⁸, and was unequivocal in stating that the evidence for effective air quality interventions is developing all the time and can face challenges and limitations. The PHE review sets out a number of clear principles, including:

- Local authorities need to work together
- Everyone has a role to play
- Effective strategies require a coherent approach
- It is better to reduce air pollution at source than to mitigate the consequences
- Improving air quality can go hand in hand with economic growth

1.3 Air Quality Data

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 $\mu\text{g}/\text{m}^3$. 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)	200 $\mu\text{g}/\text{m}^3$ not to be exceeded more than 18 times a year	1-hour mean
	40 $\mu\text{g}/\text{m}^3$	Annual mean
Particulate Matter (PM ₁₀)	50 $\mu\text{g}/\text{m}^3$ not to be exceeded more than 35 times a year	24-hour mean
	40 $\mu\text{g}/\text{m}^3$	Annual mean
Sulphur Dioxide (SO ₂)	350 $\mu\text{g}/\text{m}^3$ not to be exceeded more than 24 times a year	1-hour mean
	125 $\mu\text{g}/\text{m}^3$ not to be exceeded more than 3 times a year	24-hour mean
	266 $\mu\text{g}/\text{m}^3$ 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 25 $\mu\text{g}/\text{m}^3$ as a limit value to be met by 2020 and the World Health Organisation (WHO) has set an air quality guideline of 10 $\mu\text{g}/\text{m}^3$ as an annual mean for PM_{2.5}.

It should be noted that within the government's Air Quality (Clean Air) Strategy 2019 there is an aim to progressively cut public exposure to particulate matter pollution, as recommended by WHO. The Strategy states that by 2050 it is proposed to have halved the number of people living in locations where concentrations of PM_{2.5} are above 10 $\mu\text{g}/\text{m}^3$ ⁽⁶⁾.

The Environmental Health 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

¹ The units are in micro-grammes of pollutant per cubic metre of air ($\mu\text{g}/\text{m}^3$).

Environmental Health 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.

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

Poor air quality is considered to be the largest environmental risk to the public's health and contributes to

- Cardiovascular disease
- Lung cancer
- Respiratory diseases
- Increased chance of hospital admissions and visits to Emergency Departments.

There is growing evidence that air pollution is a significant contributor to preventable ill health and early death.

Whilst legal limits are in place, evidence suggests that health effects can still occur below these limits. This is recognised by the World Health Organisation, which sets lower pollutant exceedance thresholds than some EU limits adopted into UK legislation.

The only specific indicator for air pollution is included within the Public Health Outcomes Framework and relates to particulate matter (PM) with a diameter of 2.5micro-metres (µm) or smaller (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 by Defra modelling from local measurement, one site in Borehamwood, Hertfordshire and another in Sandy, Bedfordshire. That data is then adjusted by way of population to give a population weighted figure before its use in deriving the PHOI.

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.

However, it is important to recognise that the figures published for PHOI 3.01 are

estimates and therefore cannot be used for performance monitoring; they can only provide an indication of the scale of the issue. Further information on the use of health related air quality data is available at <https://hertshealthevidence.org/documents/thematic/airqualitydatafaq-briefing-2019-07.pdf>. It is for this reason that this report no longer makes direct reference to the PHOI figures, but uses the population weighted Defra modelled PM_{2.5} concentrations in their place.

1.5 Sources of Airborne Particulate Matter (PM_{2.5})

Particulate matter, whether PM₁₀ (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% in the UK ⁽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. Hertfordshire Particulate Matter (PM_{2.5}) Monitoring Project

A 2014 public health conference on local air quality, that was 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 local authorities 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 in 2015 as ring fenced money which had to be spent on monitoring equipment for PM_{2.5} as a capital cost only. 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 PM₁₀ monitoring equipment to also monitor PM_{2.5}, or a combination of those.

All local authorities took up the offer of funding apart from 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 PM_{2.5} analysers within their monitoring network.

Additional expectations of the funding were that the local authorities will maintain the equipment for one year and that on an annual basis the collected data will be factually reported with an interpretative report based on the data being 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, although this has now been recognised as a limited approach - see section 1.3.
- consideration and use by Hertfordshire's local authority 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 Hertsmeire 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 for UK particulate matter, including PM_{2.5}. As such it is approved for that use by Defra.

One of Hertsmeire'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 Hertsmeire'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 was disconnected on the 23rd May 2017 in order to be relocated to the Borehamwood Bowls Club, Meadow Park, because of the development of the land where the analyser was located. Following relocation, to its new urban-background location, the analyser was collecting data again from the 24th May 2017.

The two analysers were located about 300m from each other until the relocation of AM2, so the availability of directly measured PM_{2.5} was limited to a very specific geographical area of the County. Even with the relocation of the AM2 analyser it is still relatively close to the AM1 analyser, being approximately 600m apart.

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

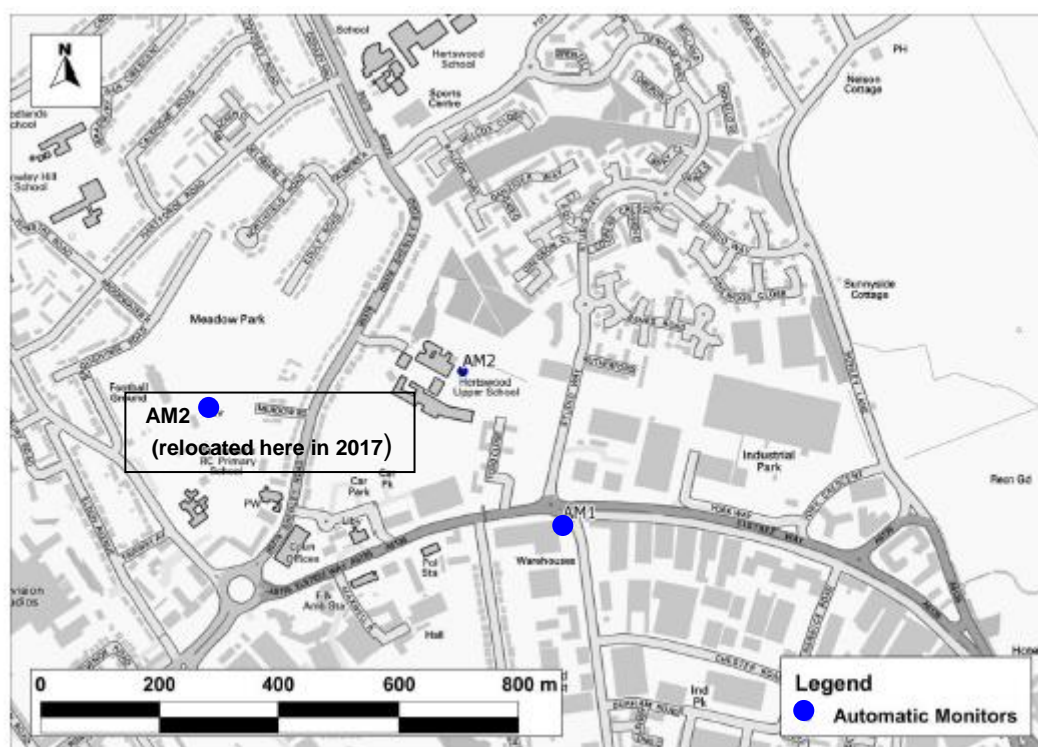


Figure 3.1 Location of PM_{2.5} analysers in Borehamwood, Hertsmere

3.2 Post Public Health Funding

By 2016 the PM_{2.5} monitoring network within Hertfordshire had expanded to eleven analysers 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 2018 is included as Table 3.2 and shows that the network now comprises of ten analysers. The analysers lost from the network in 2017 are in *red* and the additions are in *blue*. No changes occurred between 2017 and 2018, except for the fact that the Three Rivers analysers were not operational during 2018.

Table 3.2 Extent & nature of the PM_{2.5} monitoring network in Hertfordshire 2018

Local Authority	Address	Grid Reference	Location Type	Analyser Type
Hertsmere*	Elstree Way, Borehamwood	520319, 197099	Roadside	TEOM-FDMS **
<i>Hertsmere*</i> <i>Closed in May 2017</i>	<i>Thrift Farm Lane, Borehamwood</i>	<i>520147, 197361</i>	<i>Urban- background</i>	<i>TEOM-FDMS **</i>
<i>Hertsmere*</i> <i>Opened in 2017</i>	<i>Bowls Club, Borehamwood</i>	<i>519759, 197107</i>	<i>Urban- background</i>	<i>TEOM-FDMS **</i>
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 **
<i>Broxbourne Closed in 2017</i>	<i>College Road, Cheshunt</i>	<i>535314, 202244</i>	<i>Roadside</i>	<i>AQ Mesh ***</i>
<i>Broxbourne Closed in 2017</i>	<i>Eleanor Cross Rd Waltham Cross</i>	<i>536266, 200376</i>	<i>Roadside</i>	<i>AQ Mesh ***</i>
Three Rivers - NOT OPERATIONAL 2018	Rickmansworth Rd, Chorleywood	504162, 196286	Roadside	AQ Mesh ***
Three Rivers Opened in 2017 - NOT OPERATIONAL 2018	Uxbridge Road, Rickmansworth	505263, 194250	Kerbside	AQ Mesh ***

* not funded by Public Health

** Defra approved analysers that are UK MCERTS accredited for continuous ambient air quality monitoring systems and that have MCERTS for PM_{2.5}.

*** analyser that is not Defra approved & is not UK MCERTS accredited for continuous ambient air quality monitoring systems for PM_{2.5}.

Where an analyser does not have MCERTS accreditation it 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⁾.

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

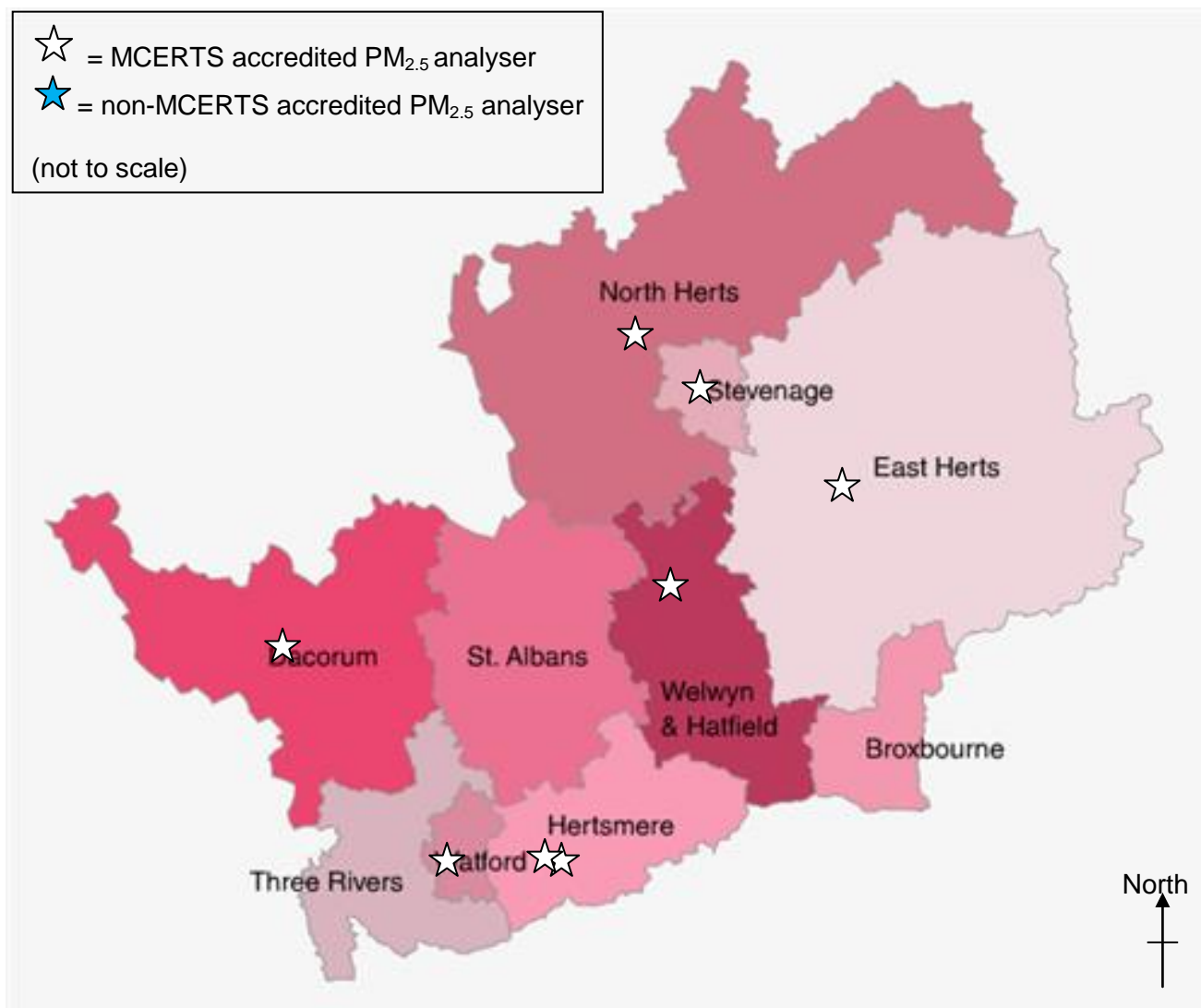


Figure 3.2 Plan of Hertfordshire showing indicative location of PM_{2.5} analysers in 2018

4. Results of PM_{2.5} Monitoring

4.1 Data Capture

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 2018 and data capture rates for each PM_{2.5} analyser.

Table 4.1 Performance of the PM_{2.5} monitoring network in 2018

Local Authority	Location (roadside unless stated)	Monitoring Commencement Date	Data Capture as % of 2018	Analyser
Hertsmere*	Borehamwood	01/01/2016	93.11	TEOM-FDMS
Hertsmere*	Borehamwood (urban background)	24/05/2017	94.71	TEOM-FDMS
Dacorum	Northchurch	01/01/2016	99.89	FIDAS
North Hertfordshire	Hitchin	01/01/2016	95.59	BAM
Welwyn, Hatfield	Hatfield	28/04/2016	97.44	BAM
East Hertfordshire	Hertford	22/08/2016	91	BAM
Watford	Watford	24/10/2016	99.94	FIDAS
Stevenage	Stevenage	24/10/2016	86.35	BAM
Three Rivers	Chorleywood	10/03/2016	0	AQ Mesh **
Three Rivers	Rickmansworth (Kerbside)	2017	0	AQ Mesh **

* = analysers not funded by PH grant

** = not MCERTS accredited (all other analysers are MCERTS accredited)

Sites reporting a data capture of above 85% are considered to have sufficient data capture to provide a meaningful annual mean value ⁽⁴⁾.

In 2018 all eight of the MCERTS accredited analysers achieved a rate of data capture above 85%.

The two AQ Mesh analysers in Three Rivers were not maintained as operational during 2018. These County-wide data capture rates, with the exception of Three Rivers represent the best performance of the network since it was established.

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 employs 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 have been ratified in line with best practice and meet the requirements of Defra.

4.2 Results

Table 4.2 provides an overview of the results of the PM_{2.5} monitoring as an annual average. It also shows 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', 'high' and 'very high' air pollution.

- 'Moderate' is defined as being greater than 36µg/m³ but less than 54µg/m³
 - 'High' is defined as being between 54 µg/m³ and 70 µg/m³ and
 - 'Very High' is defined as being 71µg/m³ or higher
- all calculated as a 24hour running mean. ⁽⁵⁾

25µg/m³ is the EU Limit Value that has been set for PM_{2.5} and 10µg/m³ is the World Health Organisation guideline for PM_{2.5}

To provide some additional local context the 2018 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 2018

Local Authority	Location	Annual Mean Ave. (µg/m ³)	Number of Days with		
			Moderate Pollution	High Pollution	Very High Pollution
Hertsmere *	Borehamwood	10	2	1	0
Hertsmere	Borehamwood	10	1	1	0
Dacorum	Northchurch	11	3	1	0
North Hertfordshire	Hitchin	10	1	1	0
Welwyn, Hatfield	Hatfield	11	3	0	1
East Hertfordshire	Hertford	10	1	1	0
Watford	Watford	9	2	1	0
Stevenage	Stevenage	10	2	1	0
Three Rivers	Chorleywood	No data	No data	No data	No data
Three Rivers	Rickmansworth	No data	No data	No data	No data
Bedfordshire Local Authorities					
Luton	Dunstable Rd, Luton (FIDAS)	10	1	1	0
Central Bedfordshire	A1(M) at Sandy (TEOM-FDMS)	13	2	0	1

* = urban background monitoring site. All other sites are roadside sites

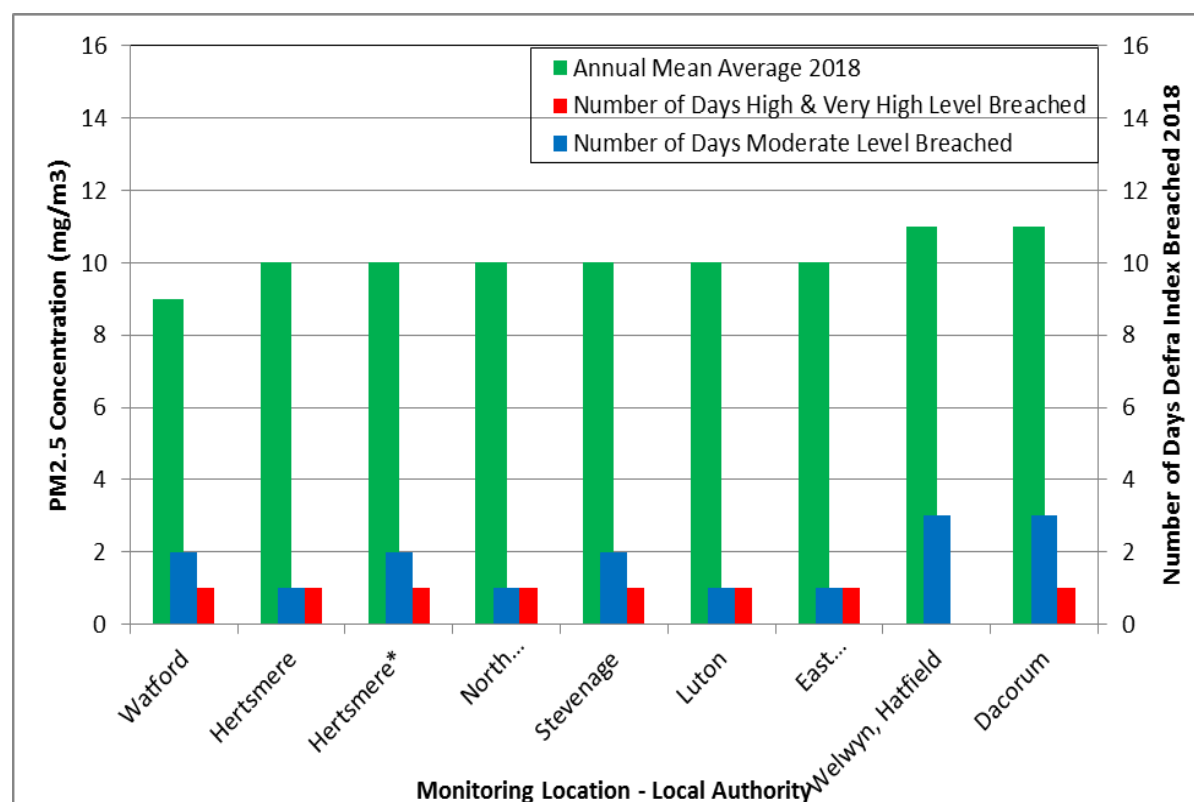
** = combined data from two different urban background sites in Borehamwood

Bold = MCERTS accredited with >85% data capture

Normal font = MCERTS accredited 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

^ = equipment not MCERTS accredited

Figure 4.1 PM_{2.5} concentrations and days Defra Index was breached in 2018

Table 4.3 shows the annual mean average PM_{2.5} concentrations at each of the Hertfordshire monitoring sites in 2018 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 23rd May 2018 with the year specified to be 2017, 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 2018 compared with modelled data from Defra

Local Authority	Location (roadside unless stated)	Annual Mean Average (µg/m ³)	Defra Modelled Data (µg/m ³) (Roadside)	Defra Modelled Data (µg/m ³) (background)
Hertsmere	Borehamwood (urban-background)	10	no data	10 – 12.5
Hertsmere	Borehamwood	10	12.5 - 15	10 – 12.5
Dacorum	Northchurch	11	10 - 12.5	10 – 12.5
North Hertfordshire	Hitchin	10	12.5 - 15	10 – 12.5
Welwyn, Hatfield	Hatfield	11	no data	10 – 12.5
East Hertfordshire	Hertford	10	10 – 12.5	10 – 12.5
Watford	Watford	9	12.5 - 15	10 – 12.5
Stevenage	Stevenage	10	10 - 12.5	10 - 12.5
<i>Three Rivers</i>	<i>Chorleywood</i>	<i>no data</i>	<i>10 – 12.5</i>	<i>10 – 12.5</i>
<i>Three Rivers</i>	<i>Rickmansworth (kerbside)</i>	<i>no data</i>	<i>10 – 12.5</i>	<i>10 – 12.5</i>

Bold = MCERTS accredited with >85% data capture
 Normal font = MCERTS accredited with <85% data capture
Italics = not MCERTS accredited and with <85% data capture

Figure 4.2 displays the days in 2018 on which breaches of the Defra Index Bands for air pollution by PM_{2.5} were measured.

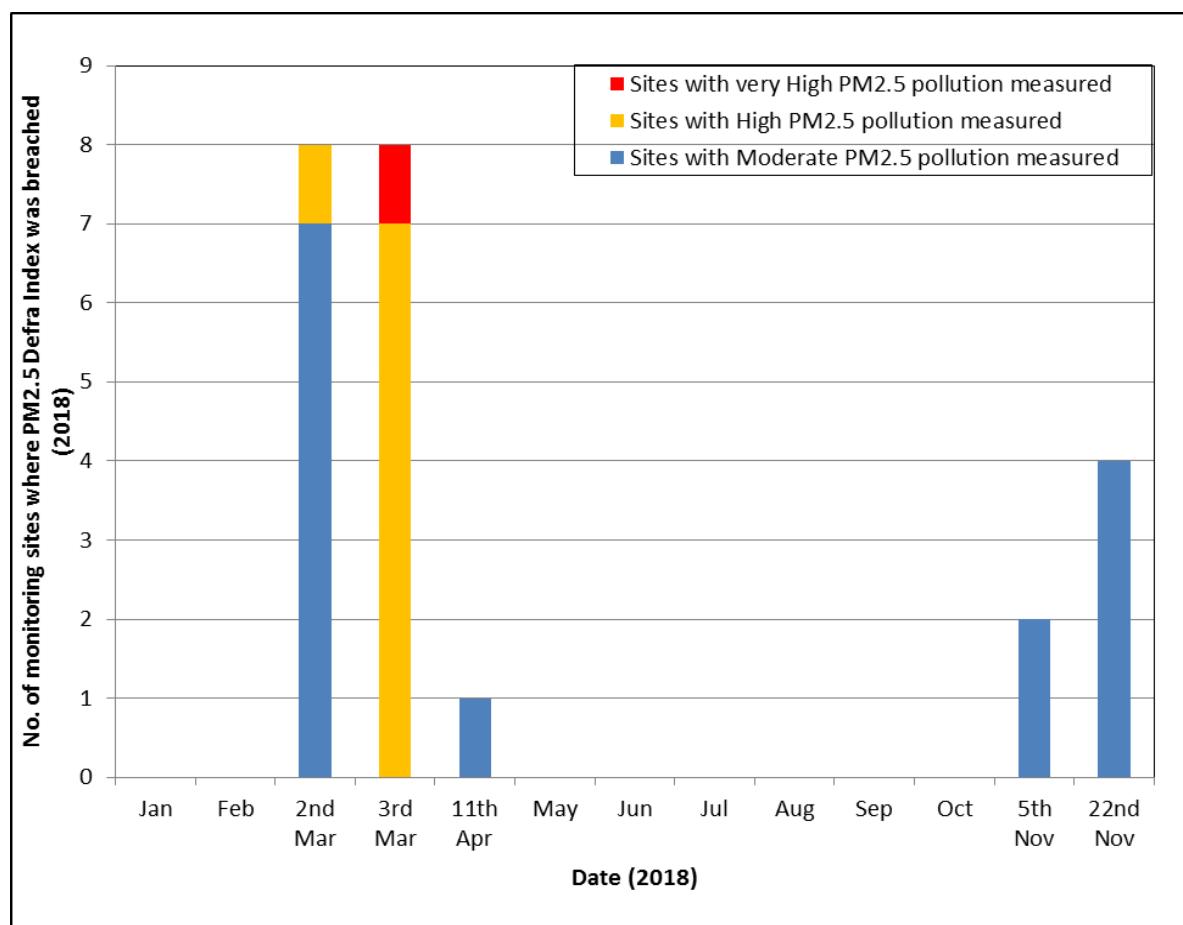


Figure 4.2 Dates of occurrence of breaches by PM_{2.5} of the Defra Index in 2018

Table 4.4 shows the mean average annual PM_{2.5} measured at each of the Local Authorities during 2018 alongside the Defra modelled population weighted mean average annual concentration for PM_{2.5}. This is the figure from which the PHOI for the fraction of annual all-cause mortality attributable to current levels of anthropogenic particulate pollution is derived. For context, data are included for Central Bedfordshire, Bedford, Luton, Hertfordshire, the East of England Region and the London Region.

Table 4.4 Defra modelled, population weighted mean average annual PM_{2.5} data and mean annual average PM_{2.5} concentrations measured in 2018

Regional	Defra modelled, population weighted, mean average annual PM _{2.5} (µg/m ³) 2018	Mean Annual Average PM _{2.5} (µg/m ³) 2018
England	9.0	no data
County/Unitary		
Luton	11	10
Central Bedfordshire	9.9	13
Hertfordshire	10.7	10.1*
Bedford	9.8	No data
District/Borough		
Hertsmere	10.5	10 (urban-background site)
		10 (roadside site)
St Albans	10.3	no data
East Hertfordshire	9.8	10
Welwyn Hatfield	10.4	11
Three Rivers	10.2	no data
Watford	10.7	9
Broxbourne	10.4	no data
North Hertfordshire	9.9	10
Dacorum	9.9	11
Stevenage	10	10

* = mean average of annual values from all Hertfordshire based PM_{2.5} analysers

Figure 4.3 displays the same data as displayed in Table 4.4 graphically.

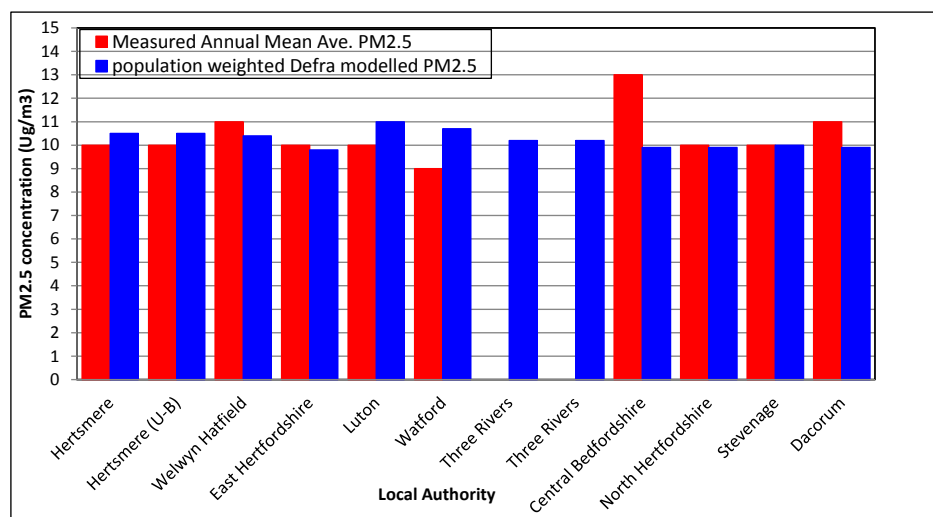


Figure 4.3 Defra modelled, population weighted mean average annual PM_{2.5} data and mean average annual (2018) PM_{2.5} concentrations

Figure 4.4 shows the PM_{2.5} concentrations measured at each monitoring location in 2018 alongside the concentrations in 2016 and 2017.

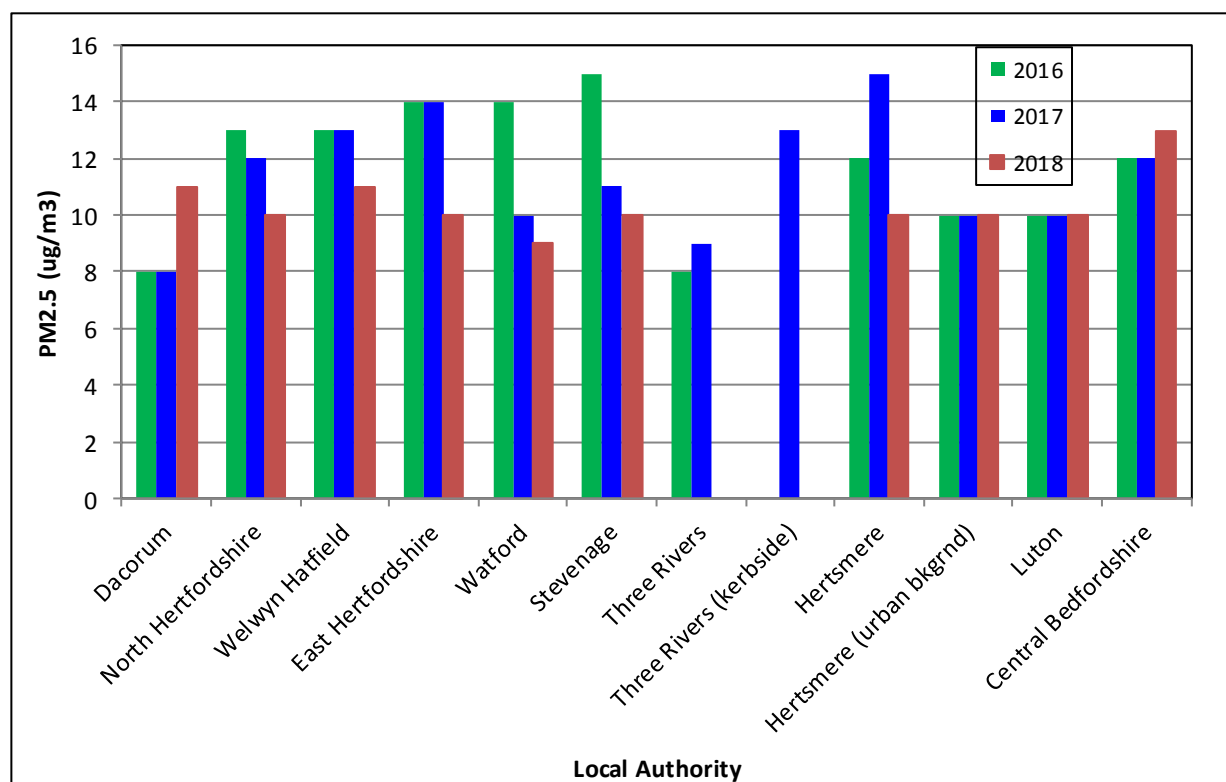


Figure 4.4 PM_{2.5} concentrations measured from 2016-2018

With the exception of the monitoring location at Dacorum and Central Bedfordshire all monitoring locations measured a lower or identical concentration of PM_{2.5} in comparison to the previous years.

It is understood that the road alongside which the Dacorum Borough Council analyser is located was subject to surface redressing over several weeks in 2018 and that this resulted in a period of atypically elevated PM concentrations. This is considered likely to have contributed to the increased annual average PM_{2.5} concentrations recorded in 2018.

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 third full year of PM_{2.5} air quality monitoring within Hertfordshire. Data capture rates (**Table 4.1**) were above the recommended level of 85% in all of the 8 Hertfordshire monitoring locations that were operational during 2018. This is an improvement on both 2016 and 2017.

The discussion of the data and interpretation of trends or patterns will need to bear in mind the data capture rates. However, it is considered that broad observations can be made and that the data presented in this report will provides a useful point of comparison for the results obtained from the PM_{2.5} monitoring network in subsequent years.

5.1 Urban-background and roadside concentrations

A comparison of the annual mean average at Hertsmere's urban-background monitoring site (10µg/m³) with that from Hertsmere's roadside monitoring site (12µg/m³) in 2016 is suggestive of a specific localised contribution to PM_{2.5} air pollution from road traffic. This observation was repeated in 2017 when the urban-background site(s) recorded 10µg/m³ compared to the 15µg/m³ measured at the roadside site (**Figure 4.4**). However, in 2018 this pattern was not observed with both sites recording the same level of 10µg/m³.

This change in relationship between the concentrations might reflect the fact that the urban-background monitoring was relocated part way through 2017 and so 2018 represented the first full year in its new location.

The 2018 mean annual average concentration of PM_{2.5} measured at the urban-background site was only lower than the mean annual average of PM_{2.5} measured at the roadside sites at Welwyn Hatfield, Dacorum and Central Bedfordshire (**Table 4.2**). The concentration was the same as measured at the roadside site in Luton, Stevenage, East Hertfordshire and North Hertfordshire (**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 roadside modelled PM_{2.5} data is broadly in line with that measured by the automatic analysers within Hertfordshire. In 2017 in East Hertfordshire the measured concentration (14µg/m³) was greater than the Defra modelled range, but in 2018 the measured concentration was within the 10-12.5µg/m³ range. In 2018 the only difference was in Watford where 9µg/m³ was measured compared to the modelled range of 12.5–15µg/m³.

5.3 Seasonal trends in PM_{2.5} air pollution episodes

Figure 4.2 shows only 5 days in 2018 where PM_{2.5} concentrations exceeded the air quality objective. Compared to the results from 2016 and 2017 the number of breaches was much lower, with breaches on 19 days in 2016 and on 24 days in

2017. However, the seasonality of the breaches across the three years was consistent with no breaches occurring during the summer months in any of the three years (**Appendix 1**).

This apparent seasonal trend is as would be expected because it is recognised that cold, still weather conditions typically prevent the dispersal of local air pollution including particulate matter.

In 2018, as with the previous two years when elevated concentrations of PM_{2.5} were detected they were typically detected at multiple Hertfordshire based analysers (**Figure 4.2**). This would suggest that on the majority of the days where breaches were measured these would have been associated with a non-localised air pollution episode.

5.4 The relationship between the population weighted Defra modelled data and the measured PM_{2.5} levels

The general expectation in comparing the population weighted data for each local authority against the measured PM_{2.5} concentration would be that the highest values would be associated with the highest measured concentration. This, however, *is not the case*, with for example Luton and Watford having measured concentrations lower than their population weighted modelled values and lower, or the same concentrations, as those measured in other Hertfordshire and Bedfordshire local authorities.

A significant reason why that expectation is not being borne out is reflected by the choice of siting of the PM_{2.5} analysers particularly in those local authorities where the measurements are higher than the modelled values. For example, in Central Bedfordshire, which is a large semi-rural area the PM_{2.5} analyser is located in a residential area immediately next to the A1(M) motorway and so, quite correctly, is measuring in a significant hotspot for air pollution. In contrast Watford and Luton, whilst also monitoring by busy roads those locations are more representative of the wider nature of their respective boroughs, which are more densely populated, largely urban boroughs.

As a reminder as to why the PHOI figures that are derived from the population weighted data it is acknowledged by Public Health England that the PHOI figures are

only estimates, are population weighted, and should not be used for performance monitoring, only to give an indication of the scale of the issue.

5.5 Yearly trends in PM_{2.5} air pollution

Only three years of data are available for the majority of the local authorities in Hertfordshire, so a year to year comparison of PM_{2.5} concentrations measured from each location is of limited value at this time.

Nevertheless it can be seen from Figure 4.4 that at ten of the twelve Hertfordshire and Bedfordshire monitoring locations where 3 years of data are available the annual average concentrations measured in 2018 are lower or the same as those measured in 2016 and 2017. The two exceptions are the roadside sites in Dacorum and Central Bedfordshire. It will be important to continue monitoring to assess whether this is a longer-term trend.

6. Summary and Further Work

The investment in PM_{2.5} air pollution analysers in Hertfordshire has 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 being three years 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 the three years of data are as follows:

- Breaches of the moderate and high daily air pollution index typically occur in the winter months in weather conditions that are still and cold
- Breaches are likely to be associated with regional or national scale air pollution episodes and only partially associated with locally derived road vehicle pollution

- Breaches may also arise if weather conditions are such that air pollution from the continent (and potentially further afield) is transported across to Britain
- 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
- Where data capture rates have been reliable the mean annual average concentrations of PM_{2.5} recorded have not varied significantly from 2016 to 2018.

In the short-term the further work should focus on:

- Retention of 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.
- Compilation of 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.

This work should, in the medium-term, 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 be taken to enhance the existing PM_{2.5} monitoring network as and when they arise.

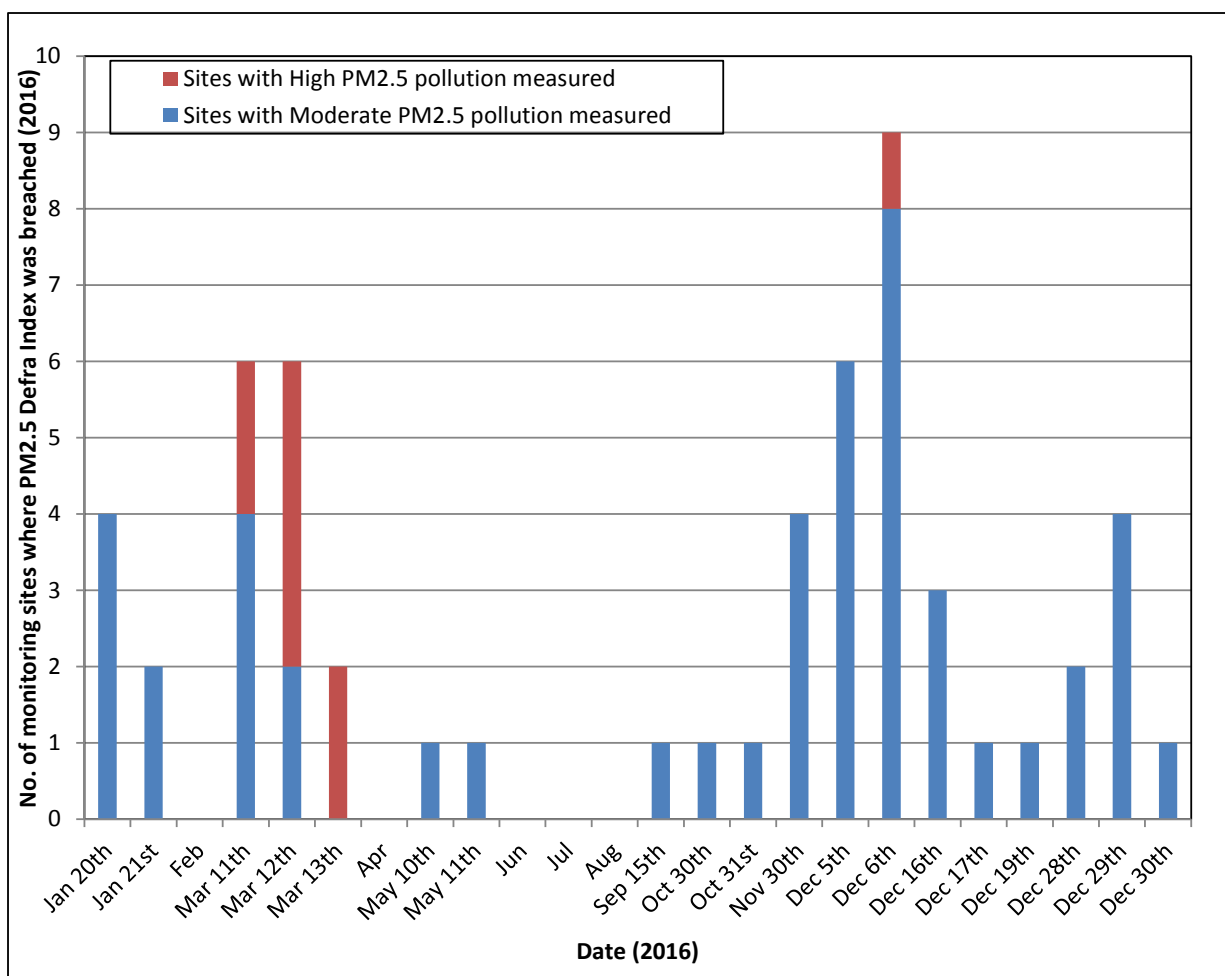
7. References

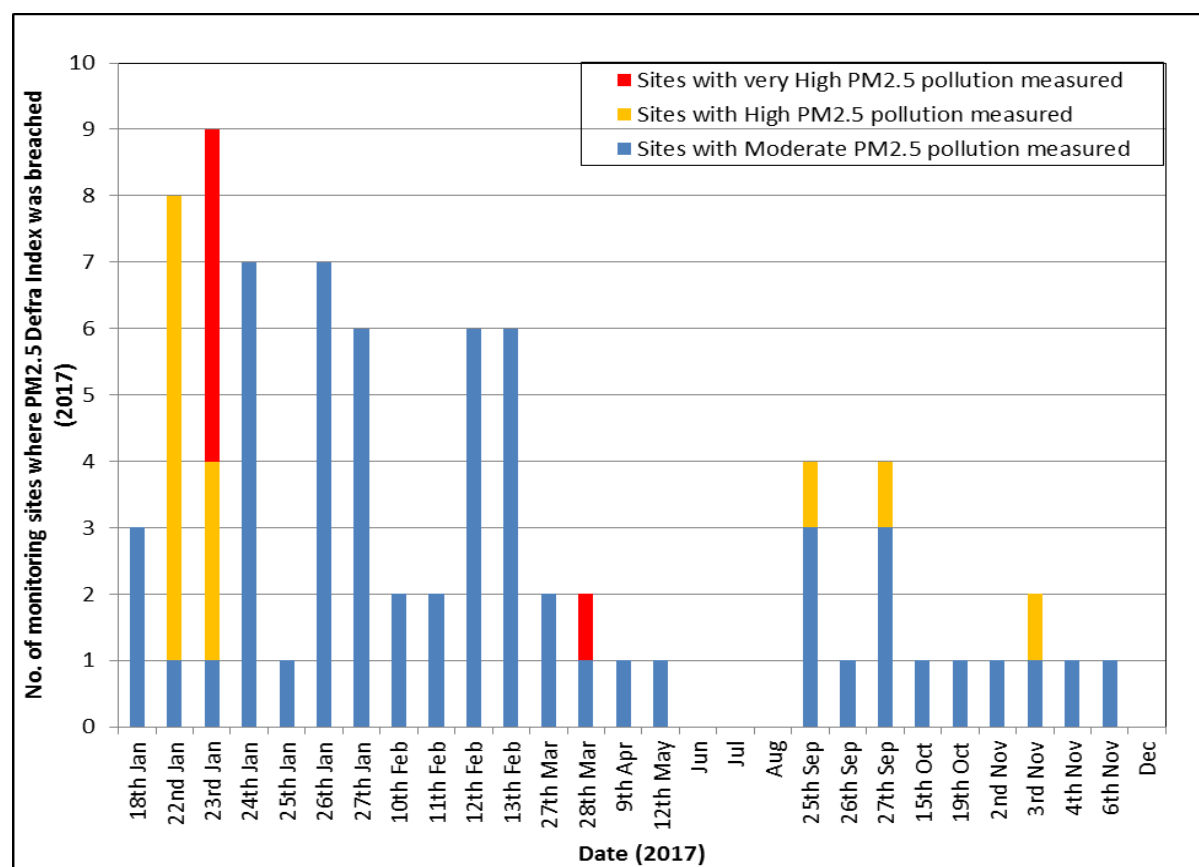
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APPENDIX 1

Dates of Occurrence of Breaches by PM_{2.5} of the Defra Index in 2016 and 2017





APPENDIX 2

Derivation of the Population-weighted annual mean average PM_{2.5} data

These data are population-weighted annual mean concentrations ($\mu\text{g m}^{-3}$) for each Local Authority. These data are suitable for use in estimating the burden of mortality attributable to long-term exposure to particulate air pollution using methods such as those recommended by COMEAP in its statement "[Estimating the mortality burden of particulate air pollution at the local level](#)" and used in calculating the Public Health Outcomes Framework indicator "Fraction of Mortality Attributable to Particulate Air Pollution".

Concentrations of anthropogenic, rather than total, PM_{2.5} are used as the basis for this indicator, as burden estimates based on total PM_{2.5} might give a misleading impression of the scale of the potential influence of policy interventions (COMEAP, 2012). However, modelled concentrations of anthropogenic PM_{2.5} are more uncertain than those of total PM_{2.5} because of the uncertainty associated with the assignment to anthropogenic and non-anthropogenic sources.

Background annual average PM_{2.5} concentrations for the year of interest are modelled on a 1km x 1km grid using an air dispersion model (Pollution Climate Mapping), and calibrated using measured concentrations taken from background sites in Defra's [Automatic Urban and Rural Network](#). Data on primary emissions from different sources from the National Atmospheric Emissions Inventory and a combination of measurement data for secondary inorganic aerosol and models for sources not included in the emission inventory (including re-suspension of dusts) are used to estimate the anthropogenic (human-made) component of these concentrations. By approximating LA boundaries to the 1km by 1km grid, and using census population data, population weighted background PM_{2.5} concentrations for each lower tier LA are calculated. This work is completed under contract to Defra, as a small extension of its obligations under the Ambient Air Quality Directive (2008/50/EC).

The data are available from the download links in the table below on an annual basis. Estimated concentrations are population-weighted annual mean PM_{2.5} in $\mu\text{g m}^{-3}$. For 2010 the data are provided for UK by Local Authority only. For 2011 onwards, the data are provided for UK by Local Authority and by country. Data are also provided for England by region and upper tier Local Authority.