Hertfordshire Local Authorities Report
on
Particulate Matter ($PM_{2.5}$) in Ambient Air in 2019
for
Hertfordshire County Council Public Health

March 2021

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

Report Author: David Carr DBC (Chairman, Herts & Beds Air Quality Forum)
Telephone: 01442 228562
Email: david.carr@dacorum.gov.uk

Document Status and Approval Schedule

Issue	Status	Description	Prepared by	Reviewed by	Date
1	Final report	Final Version	David Carr	Bethan Clemence	Mar. 2021
0	Draft report	Draft for comment	David Carr	Bethan Clemence	Jan. 2021

TABLE OF CONTENTS

Figures

Tables

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 2019 [9].

Therefore, joint working on air quality issues between HCC and the local authorities has become a 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 historical 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 and 2019 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 2016-2019.

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

As a result of there being four 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 four 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 when weather conditions are more commonly 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 2019. However, there has been a downward trend in annual mean average $PM_{2.5}$ concentrations

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 1995[10] 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 guidance [5]. 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 Strategy[11] 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 health[12], 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 interventions[13] to improve outdoor air quality and public health in March 2019[8], 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 $\mu g/m^3$. 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 and the World Health Organisation (WHO) has set an air quality guideline of 10µg/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 10µg/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 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] The units are in micro-grammes of pollutant per cubic metre of air (µg/m^3).

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, Hertsmere, 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. 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.

Further information on the use of health related air quality data is available at https://hertshealthevidence.org/documents/thematic/airqualitydatafaq-briefing-2019-07.pdf.

1.5 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% 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 PM_{10} 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 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 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 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.

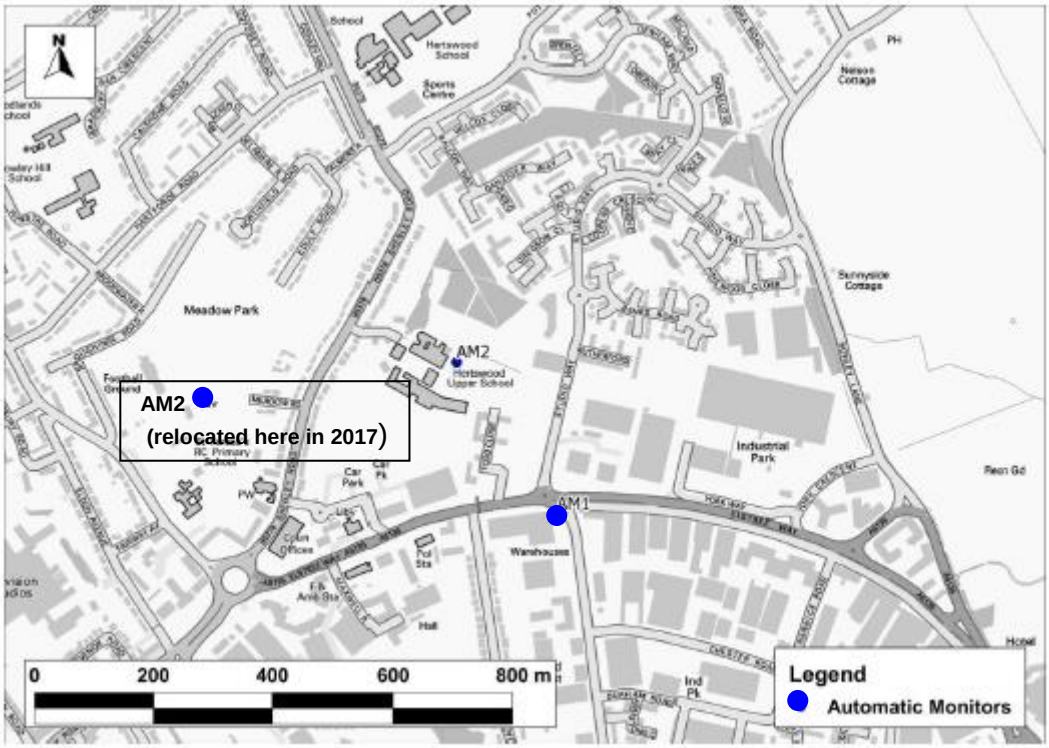


Figure 3.1 Location of $PM_{2.5}$ analysers in Borehamwood, Hertsmere

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 2019 is included as Table 3.2 and shows that the network now comprises of eight analysers. The analysers lost from the network in 2017 and 2018 are in *red*. No changes occurred between 2018 and 2019.

Table 3.2 Extent & nature of the $PM_{2.5}$ monitoring network in Hertfordshire 2019

Local Authority	Address	Grid Reference	Location Type	Analyser Type
Hertsmere*	Elstree Way, Borehamwood	520319, 197099	Roadside	TEOM-FDMS **
Hertsmere* Opened in 2017	Bowls Club, Borehamwood	519759, 197107	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 **
Hertsmere* Closed in May 2017	Thrift Farm Lane, Borehamwood	520147, 197361	Urban-background	TEOM-FDMS **
Broxbourne Closed in 2017	*College Road, Cheshunt*	*535314, 202244*	*Roadside*	*AQ Mesh ****
Broxbourne Closed in 2017	*Eleanor Cross Rd Waltham Cross*	*536266, 200376*	*Roadside*	*AQ Mesh ****
Three Rivers - NOT OPERATIONAL from 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. As of 2019 all of the Analysers were MCERTS accredited.

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.

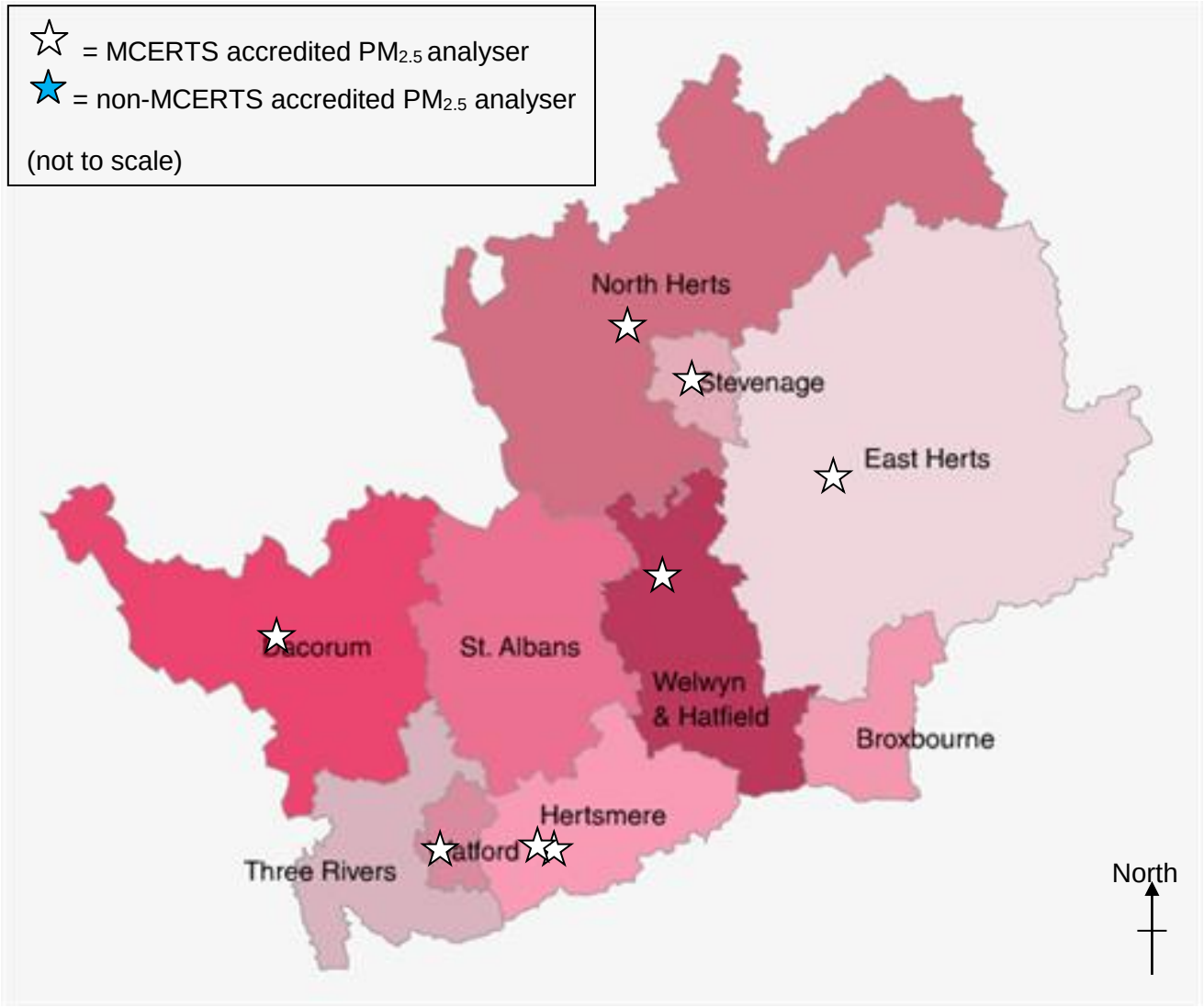


Figure 3.2 Plan of Hertfordshire showing indicative location of $PM_{2.5}$ analysers in 2019

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 2019 and data capture rates for each $PM_{2.5}$ analyser.

Table 4.1 Performance of the $PM_{2.5}$ monitoring network in 2019

Local Authority	Location (roadside unless stated)	Monitoring Commencement Date	Data Capture as % of 2019	Analyser
Hertsmere*	**Borehamwood**	**01/01/2016**	**96.31**	**TEOM-FDMS**
Hertsmere*	**Borehamwood (urban background)**	**24/05/2017**	**91.68**	**TEOM-FDMS**
Dacorum	**Northchurch**	**01/01/2016**	**99.85**	**FIDAS**
North Hertfordshire	**Hitchin**	**01/01/2016**	**99.54**	**BAM**
Welwyn, Hatfield	**Hatfield**	**28/04/2016**	**97.26**	**BAM**
East Hertfordshire	**Hertford**	**22/08/2016**	**83.66**	**BAM**
Watford	**Watford**	**24/10/2016**	**97.69**	**FIDAS**
Stevenage	**Stevenage**	**24/10/2016**	**86.80**	**BAM**

* = analysers not funded by PH grant

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

In 2019, as was the case in 2018, all eight of the MCERTS accredited analysers achieved a rate of data capture above 85%. These County-wide data capture rates represent a continuation of the high standard of performance of the network from 2018.

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/m^3 but less than 54μg/m^3
- 'High' is defined as being between 54 μg/m^3 and 70 μg/m^3 and
- 'Very High' is defined as being 71μg/m^3 or higher

all calculated as a 24hour running mean. (5)

25μg/m^3 is the EU Limit Value that has been set for $PM_{2.5}$ and 10μg/m^3 is the World Health Organisation guideline for $PM_{2.5}$

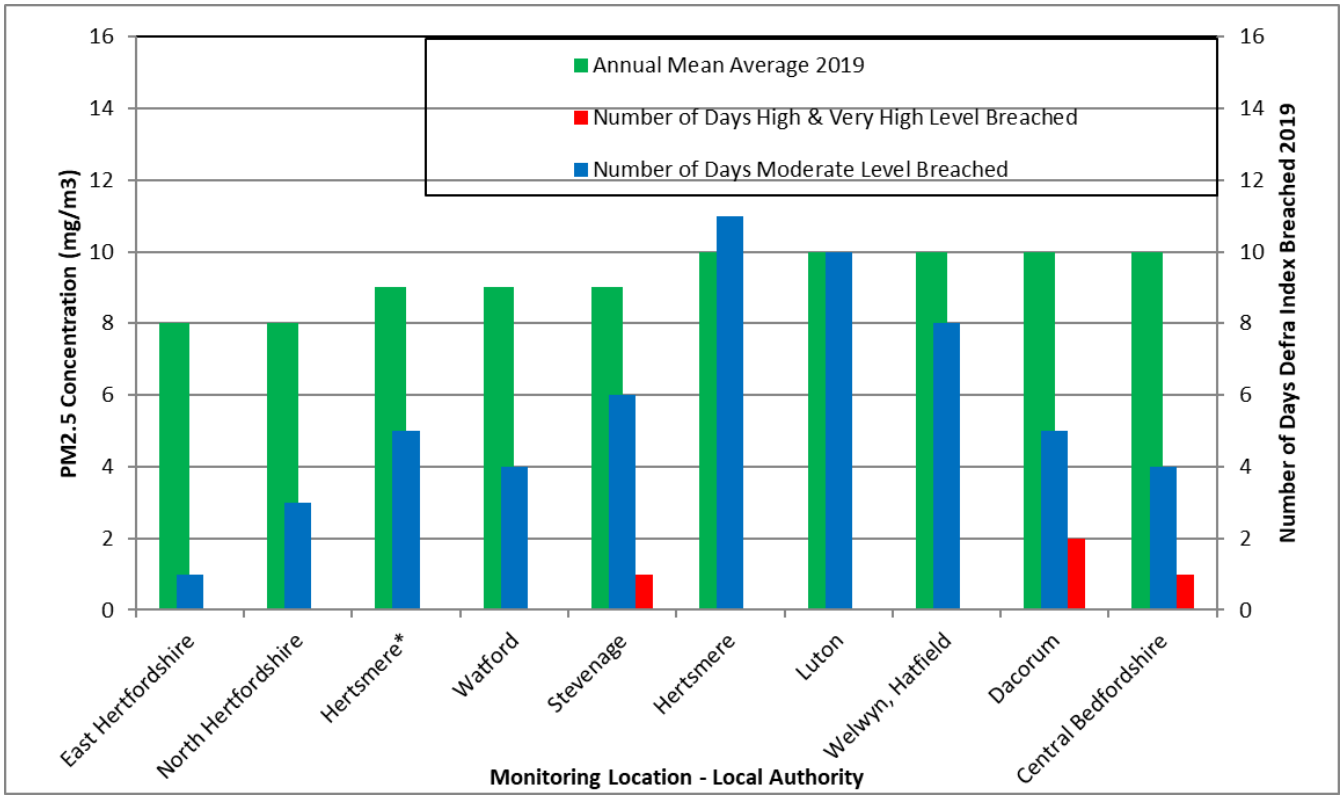
To provide some additional local context the 2019 data from the $PM_{2.5}$ analysers operating in Bedfordshire have been included in Table 4.2.

Table 4.2 Results from the Hertfordshire $PM_{2.5}$ Monitoring Network in 2019

Local Authority	Location	Annual Mean Ave. (μg/m^3)	Number of Days with		
			Moderate Pollution	High Pollution	Very High Pollution
Hertsmere *	**Borehamwood**	**9**	**5**	**0**	**0**
Hertsmere	**Borehamwood**	**10**	**11**	**0**	**0**
Dacorum	**Northchurch**	**10**	**5**	**1**	**1**
North Hertfordshire	**Hitchin**	**8**	**3**	**0**	**0**
Welwyn, Hatfield	**Hatfield**	**10**	**8**	**0**	**0**
East Hertfordshire	**Hertford**	**8**	**1**	**0**	**0**
Watford	**Watford**	**9**	**4**	**0**	**0**
Stevenage	**Stevenage**	**9**	**6**	**1**	**0**
Bedfordshire Local Authorities					
Luton	**Dunstable Rd, Luton (FIDAS)**	**10**	**10**	**0**	**0**
Central Bedfordshire	**A1(M) at Sandy (TEOM-FDMS)**	**10**	**4**	**1**	**0**

* = 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

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 2019

Table 4.3 shows the annual mean average $PM_{2.5}$ concentrations at each of the Hertfordshire monitoring sites in 2019 with the concentrations that have been modelled by Defra. The Defra data was taken from https://uk-air.defra.gov.uk/data/gis-mapping/ and https://uk-air.defra.gov.uk/data/laqm-background-home on the 31st December 2020 with the year specified to be 2018, 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 2019 compared with modelled data from Defra

Local Authority	Location (roadside unless stated)	Annual Mean Average (µg/m³)	Defra Modelled Data (µg/m³) (Roadside)	Defra Modelled Data (µg/m³) (background)
Hertsmere	Borehamwood *(urban-background)*	9	no data	10 – 12.5
Hertsmere	Borehamwood	10	10 – 12.5	10 – 12.5
Dacorum	Northchurch	10	10 - 12.5	10 – 12.5
North Hertfordshire	Hitchin	8	10 - 12.5	10 – 12.5
Welwyn, Hatfield	Hatfield	10	no data	10 – 12.5
East Hertfordshire	Hertford	8	10 – 12.5	10 – 12.5
Watford	Watford	9	12.5 - 15	10 – 12.5
Stevenage	Stevenage	9	10 - 12.5	10 - 12.5

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

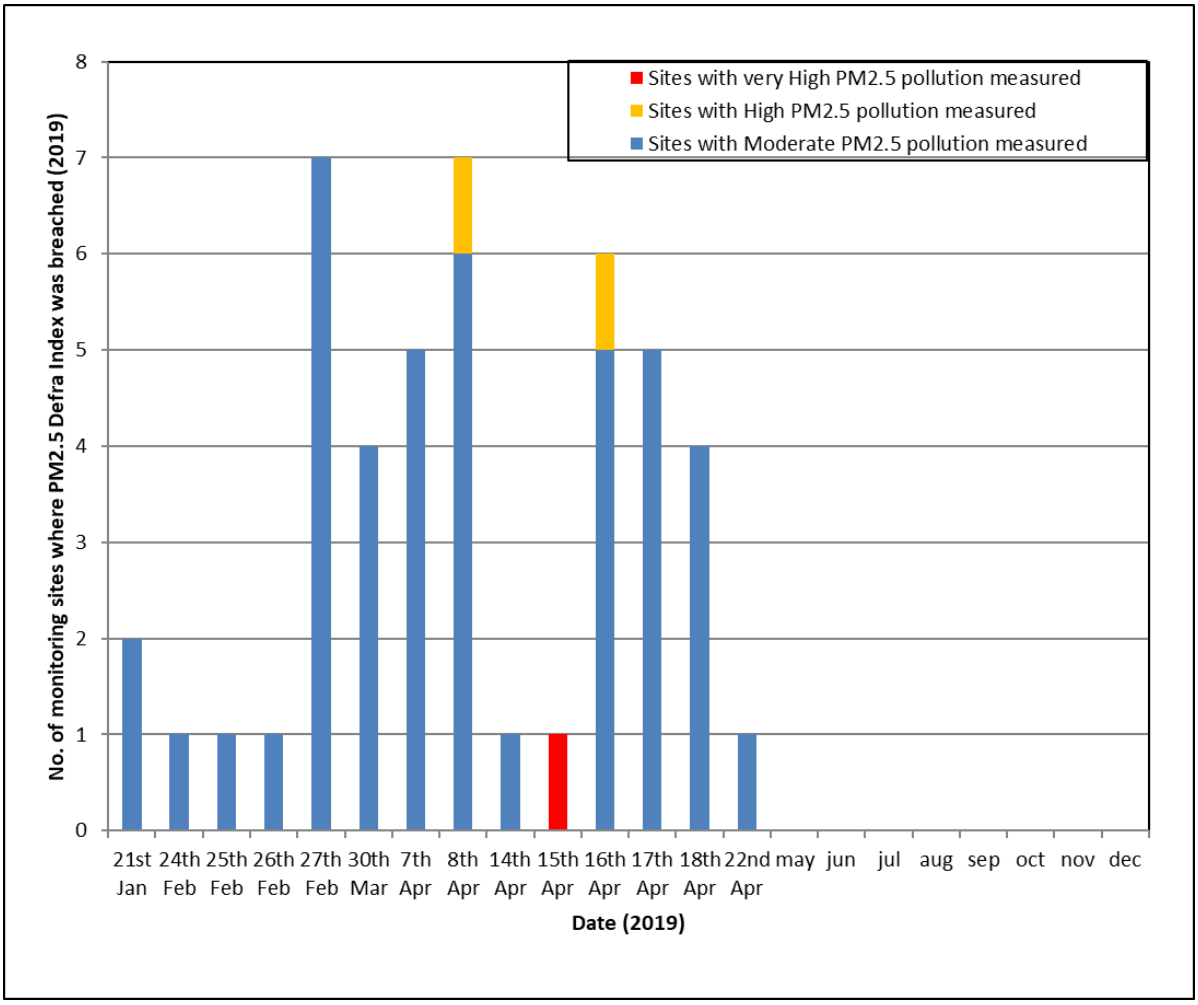


Figure 4.2 Dates of occurrence of breaches by $PM_{2.5}$ of the Defra Index in 2019

Figure 4.2 displays the days in 2019 on which breaches of the Defra Index Bands for air pollution by $PM_{2.5}$ were measured, with all breaches recorded in the first four months of the year.

Table 4.4 shows the mean average annual $PM_{2.5}$ measured at each of the Local Authorities during 2019 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 2019

Regional	**Defra modelled, population weighted, mean average annual $PM_{2.5}$ ($\mu g/m^3$) 2019**	**Mean Annual Average $PM_{2.5}$ ($\mu g/m^3$) 2019**
England	8.9	no data
County/Unitary		
Luton	11	10
Central Bedfordshire	9.9	10
Hertfordshire	10.2	9.1*
Bedford	9.8	No data
District/Borough		
Hertsmere	10.5	9 (urban-background site)
		10 (roadside site)
St Albans	10.3	no data
East Hertfordshire	9.8	8
Welwyn Hatfield	10.4	10
Three Rivers	10.2	no data
Watford	10.7	9
Broxbourne	10.4	no data
North Hertfordshire	9.9	8
Dacorum	9.9	10
Stevenage	10	9

* = mean average of annual values from all Hertfordshire based $PM_{2.5}$ analysers
Source:
https://fingertips.phe.org.uk/search/particulate%20matter#page/0/gid/1/pat/6/par/E12000006/ati/302/are/E06000055/cid/4/page-options/ovw-do-0

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

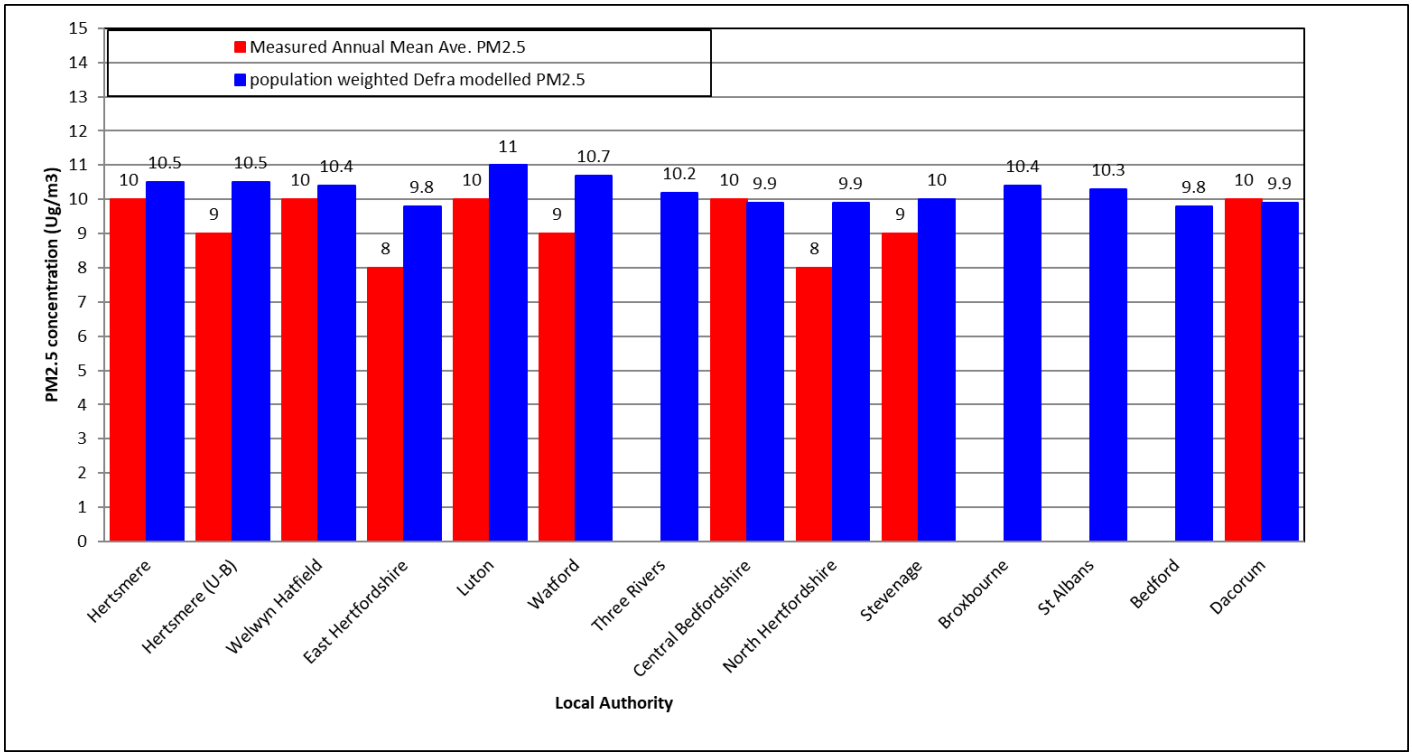


Figure 4.3 Defra modelled, population weighted mean average annual $PM_{2.5}$ data and mean average annual (2019) $PM_{2.5}$ concentrations

Figure 4.4 shows the $PM_{2.5}$ concentrations measured at each monitoring location in 2019 alongside the concentrations in 2016 - 2018.

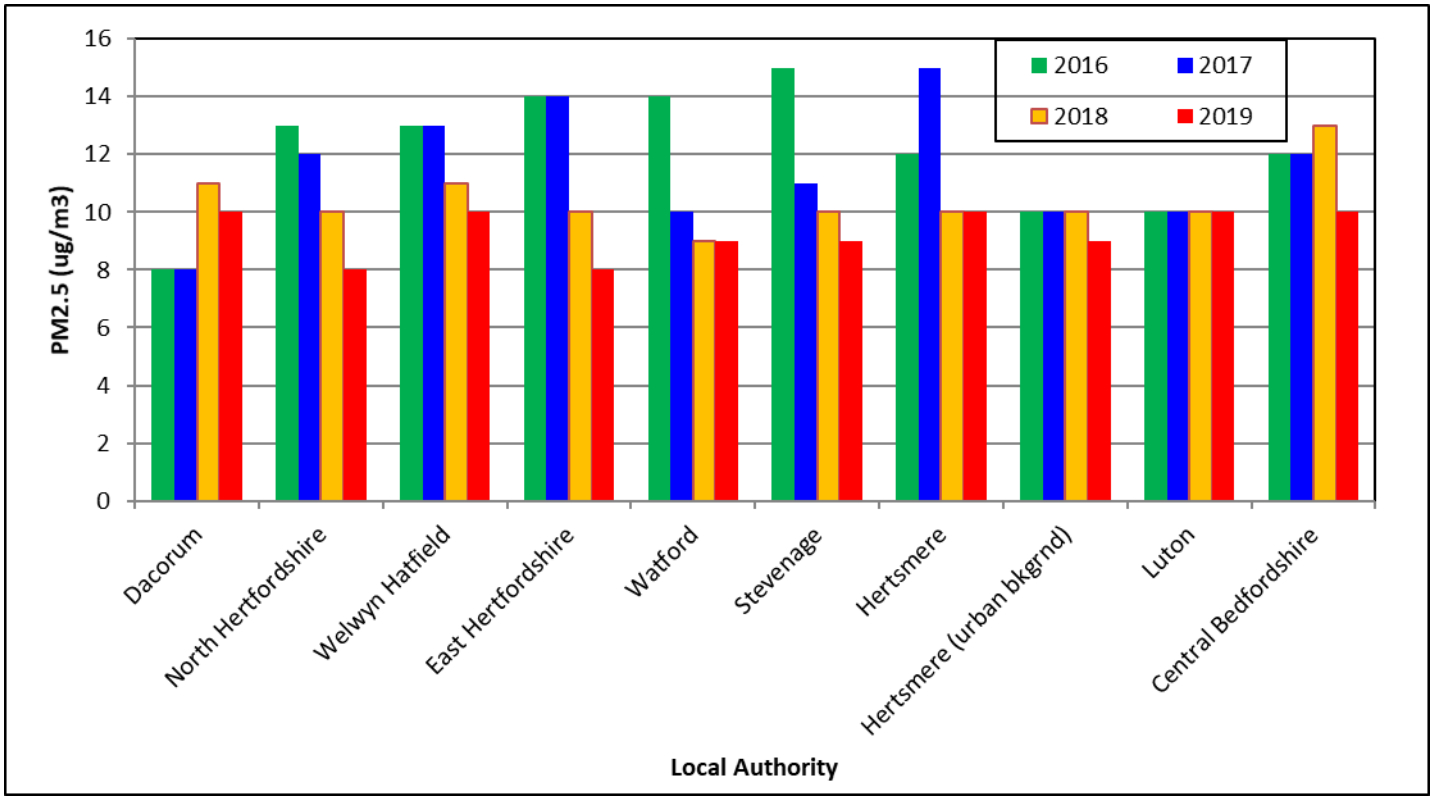


Figure 4.4 $PM_{2.5}$ concentrations measured from 2016-2019

At all monitoring locations measured a lower or identical concentration of $PM_{2.5}$ in comparison to the previous years and in all monitoring locations the measured concentrations were at or below the Defra modelled population weighted mean average.

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 fourth 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 2019, which was consistent with 2018 and an improvement on 2016 and 2017.

The discussion of the data and interpretation of trends or patterns will need to bear in mind the data capture rates and the fact that meteorological trends across the years have not been considered. However, it is considered that broad observations can be made and that the data will provide basic information on trends in $PM_{2.5}$ concentrations as measured by this monitoring network.

5.1 Urban-background and roadside concentrations

A comparison of the annual mean average at Hertsmere's urban-background monitoring site with that from Hertsmere's roadside monitoring site over the four years is suggestive of a specific localised contribution to $PM_{2.5}$ air pollution from road traffic. In 2016 and 2017 when the urban-background site recorded concentrations below those measured at the roadside site (**Figure 4.4**). The difference was not observed in 2018 (the urban background analyser was relocated during 2018) with both sites recording the same level of 10$\mu g/m^3$, but was observed again in 2019 with the roadside site recording 10$\mu g/m^3$ and the urban background site 9$\mu g/m^3$.

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, with all results measured in 2019 being within or below the concentrations modelled by Defra. This was also the situation in 2018, but in 2016 and 2017 the monitoring from one or more local authorities exceeded the modelled concentrations.

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

Figure 4.2 shows only 14 days in 2019 where $PM_{2.5}$ concentrations were measured across the network at levels above Defra's moderate daily air quality index

(https://uk-air.defra.gov.uk/air-pollution/daqi?view=more-info&pollutant=pm25#pollutant). This was higher than the 5 days recorded in 2018 but lower than the number of days in 2016 and 2017 when there were 19 days and 24 days respectively.

The seasonality of the breaches during 2016 to 2019 was consistent with no breaches occurring during the summer months in any of the four years **(Appendix 1)**. In 2019 the exceedences were recorded in the first four months of the year. A similar pattern was recorded in the first four months of 2018 and 2017, although in 2016 a more even split of breaches were recorded across the first four months of the year and last three months.

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 2019, as with the previous three years when elevated concentrations of $PM_{2.5}$ were detected they were usually 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, has not historically been 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.

In fact 2019 (Figure 4.3) has been the first of the four years when all monitoring locations have measured $PM_{2.5}$ at concentrations the same as or below the Defra modelled data.

One explanation as to why the expectation has not been 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 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 it is acknowledged by Public Health England that the PHOI (Public Health Outcome Indicatory) figures for $PM_{2.5}$ 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 four 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 eight of the ten Hertfordshire and Bedfordshire monitoring locations where 4 years of data are available the annual average concentrations measured in 2019 are lower or the same as those measured in 2016, 2017 and 2018. The two exceptions are the roadside sites in Dacorum, where 2018 and 2019 concentrations were higher than the levels recorded in 2016 and 2017 and in Central Bedfordshire, where in 2018 the annual average concentration was higher than that recorded in 2016, 2017 and 2019. 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 can be made from the four years of data are as follows:

- Breaches of the moderate and high daily air pollution index typically occur in the winter months when weather conditions are more likely to be 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 2019, but the trend has been a reduction in concentrations over that period

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.

- This report was prepared and written during the national Covid-19 emergency, which has encompassed a number of national lockdowns so it

will be important that the data from 2020 and 2021 are collated and reported during 2021 and 2022.

The reports are continuing to 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.

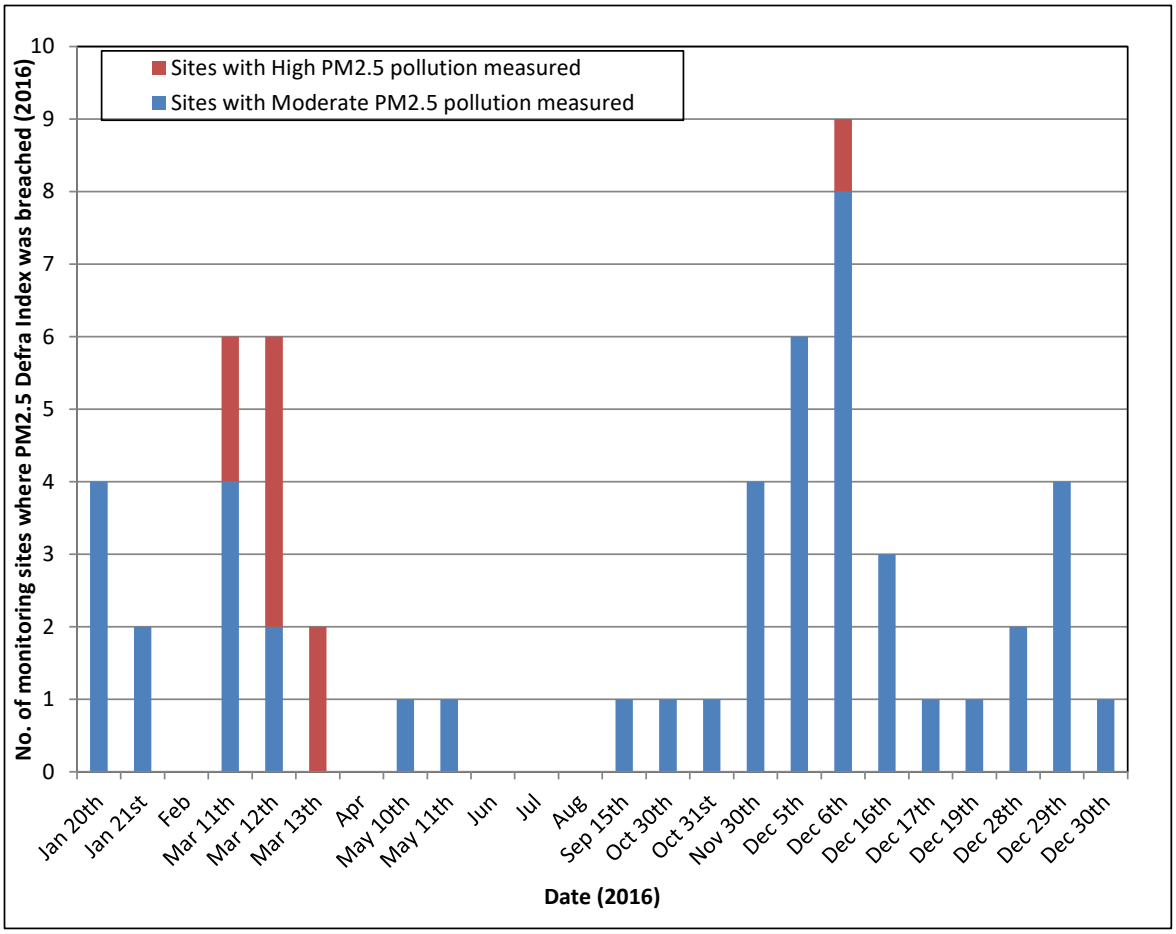
7. References

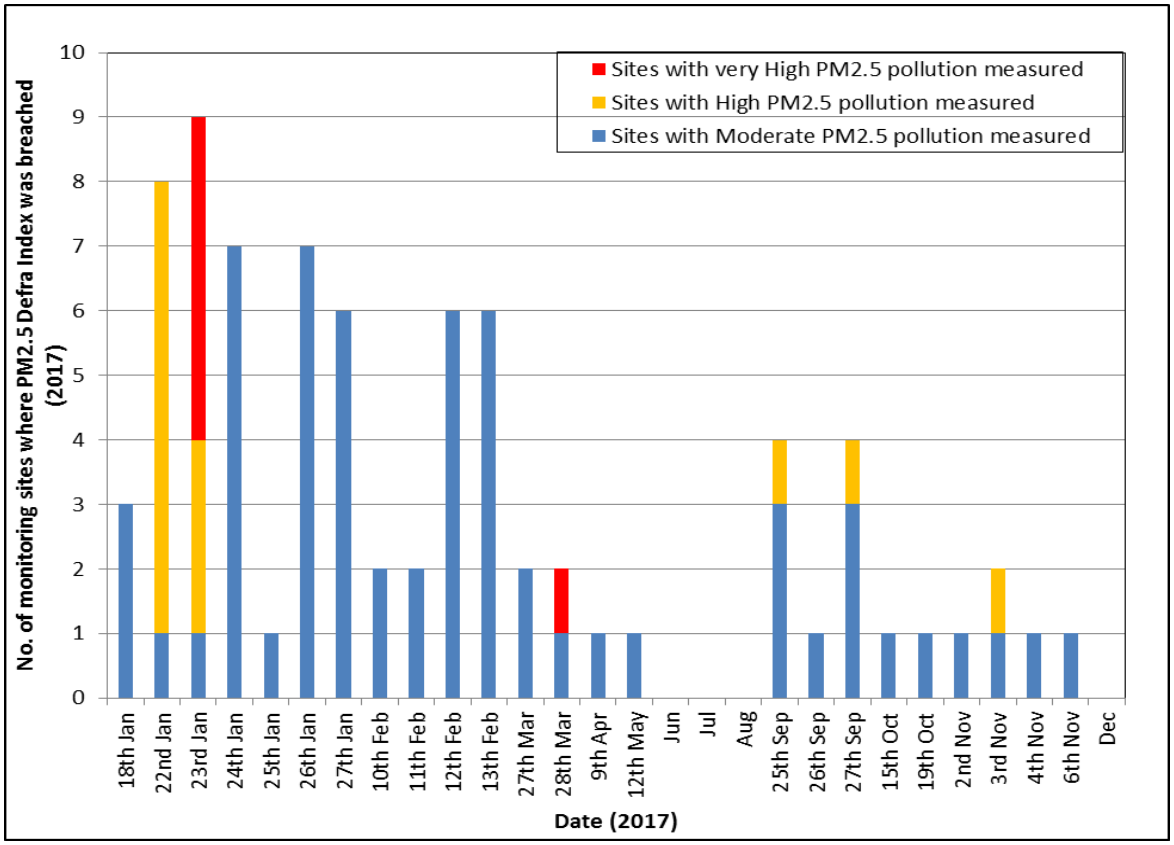
1. Defra. 2016. Local Air Quality Management Policy Guidance LAQM.PG(16)
2. Air Quality Expert Group (2005) *Particulate Matter in the United Kingdom.* London: Defra Publications.
3. Air Quality Expert Group (2015) *Mitigation of United Kingdom $PM_{2.5}$ concentrations* [Online]. Available at: http://uk-air.defra.gov.uk/assets/documents/reports/cat11/1508060903_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)
6. Defra 2019. Clean Air Strategy 2019. https://www.gov.uk/government/publications/clean-air-strategy-2019 (Accessed: 23 May 2019).
7. NHDC. 2018. *Hertfordshire Local Authorities Report on Particulate Matter (PM2.5) in Ambient Air in 2017 for Hertfordshire County Council Public Health*. Available at https://www.airqualityengland.co.uk/local-authority/hnb-reports
8. NHDC. 2017. *Hertfordshire Local Authorities Report on Particulate Matter (PM2.5) in Ambient Air in 2016 for Hertfordshire County Council Public Health*. Available at https://www.airqualityengland.co.uk/local-authority/hnb-reports
9. Hertfordshire Air Quality Strategy and Implementation Plan https://www.hertfordshire.gov.uk/services/Health-in-Herts/Healthy-places/Healthy-places.aspx#air
10. https://laqm.defra.gov.uk/documents/LAQM-PG16-April-16-v1.pdf
11. https://www.gov.uk/government/publications/clean-air-strategy-2019

12. https://www.nice.org.uk/guidance/ng70
13. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/795185/Review_of_interventions_to_improve_air_quality.pdf

APPENDIX 1

Dates of Occurrence of Breaches by $PM_{2.5}$ of the Defra Index in 2016 - 2018





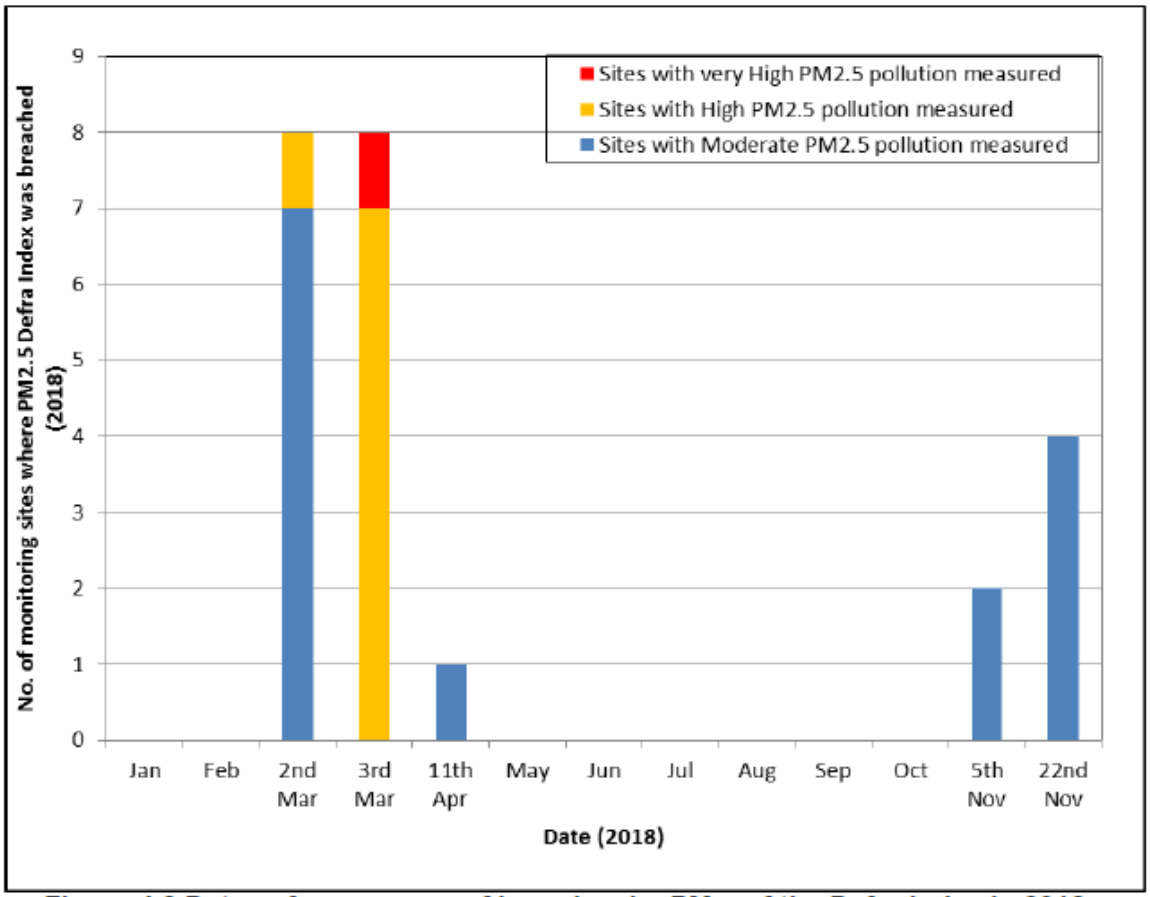


Figure 4.2 Dates of occurrence of breaches by $PM_{2.5}$ of the Defra Index in 2018

APPENDIX 2

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

These data are population-weighted annual mean concentrations (µg 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 µg 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.