Hertfordshire Local Authorities Report
on
Particulate Matter ($PM_{2.5}$) in Ambient Air in 2020
for
Hertfordshire County Council Public Health

February 2022

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

London Luton Airport

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Document Status and Approval Schedule

Issue	Status	Description	Prepared by	Reviewed by	Date
1	Final report	Final Version	David Carr	Matthew Clark	08/02/2022
0	Draft report	Draft for comment	David Carr	Matthew Clark	07/02/2022

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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 2019 [9].

Joint working on air quality issues between HCC and the local authorities has been a priority long before the above publication and one of the partnership projects identified in 2014/2015 was a $PM_{2.5}$ monitoring project. This project had 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 from 2018 to 2020 six analysers were still operational. In addition to the Public Health funded analysers, two analysers owned and operated by Hertsmere Borough Council were operational from 2016 to 2020.

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 five 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 has its limitations. 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 collected in 2016 and data capture has been good.

Broad observations that may be made from the five 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. However, in 2020 these breaches were limited to dates on which a local contribution from celebrations associated with the use of fireworks would be anticipated.

- Breaches are likely to be associated with regional or national scale air pollution episodes and only partially associated with locally derived road vehicle pollution. As per the above bullet point, 2020 may to a degree have represented an exception and one that can potentially be linked to the Covid-19 lockdowns.

- 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 2020, but the trend has been a gradual reduction in concentrations over that period.

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. With new $PM_{2.5}$ legislative thresholds expected to be in force in October 2022 following enactment of The Environment Act 2021 the requirement to hold and continue to generate local monitoring data is considered to be increasingly important.

1. Introduction – Local Government 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. National Highways 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. This reflects its focus 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

The Environment Act 2021[14], published after the data collection period on which this report is based, established a new 'watchdog' the Office for Environmental Protection (OEP) that is intended to hold public authorities to account if they fail to comply with environmental law. In terms of changes specific to local air quality the Act has:

- failed to implement any changes to pre-existing air quality objectives, but has placed a duty on the government to bring forward at least two new air quality targets by October 2022 for consultation that will be set in secondary legislation
- amended the Environment Act 1995 to "strengthen" the LAQM Framework to enable increased cooperation at the local level and broaden the responsibility for tackling local air pollution from just local authorities
- amended the Clean Air Act 1993 with the intention of giving local authorities more power to reduce pollution from domestic burning which contributed 38% of $PM_{2.5}$ emissions in 2019. It does so primarily by replacing the criminal offence with a civil penalty regime and strengthens the offences in relation to the sale of certain fuels for use in smoke control areas
- introduced a new power to "compel vehicle manufacturers to recall vehicles and non-road machinery if they are found not to comply with the environmental standards that they are legally required to meet".

Also, published after the data collection period for this report was the Coroner's Inquiry[15] (April 2021) into the death of 9 year old Ella Kissi-Debrah, which found that air pollution, including nitrogen dioxide and particulate matter, principally from traffic emission, was a significant contributory factor to both the induction and exacerbations of her asthma which caused respiratory and cardiac arrest and ultimately her death. It is considered important to reference the Prevention of Future Deaths report that followed which stated a lack of awareness within the general population of the health impacts of exposure to air pollution and a lack of consideration to those presenting to health practitioners of potential air pollution impacts.

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 exceedances 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

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

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$\mu g/m^3$ as a limit value to be met by 2020 and the World Health Organisation (WHO) has set an air quality guideline of 10$\mu g/m^3$ as an annual mean for $PM_{2.5}$. Government will look to set a legally binding objective level by October 2022.

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$\mu g/m^3$ [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. In addition a Hertfordshire focussed forum has recently been set up to enable closer collaboration of the 11 local authority bodies that act within the geographical area.

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 all non-communicable disease although the most commonly referenced are:

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

Evidence also states 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 occur significantly 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 included within the Public Health Outcomes Framework 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. They may also carry other pollutants into the lungs allowing them to be passed into the bloodstream where they access all tissues of the body. It is thought that health impact is caused through oxidative stress [(16)].

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.

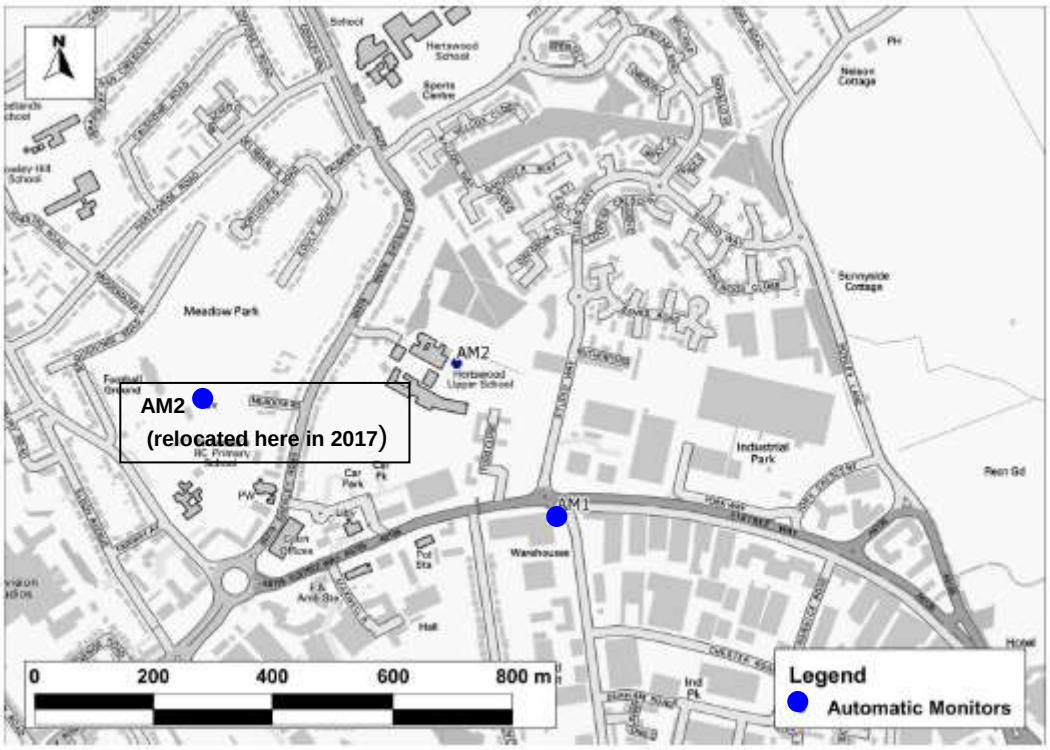


Figure 3.1 Location of $PM_{2.5}$ analysers in Borehamwood, Hertsmere

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 2020 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 2020.

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.

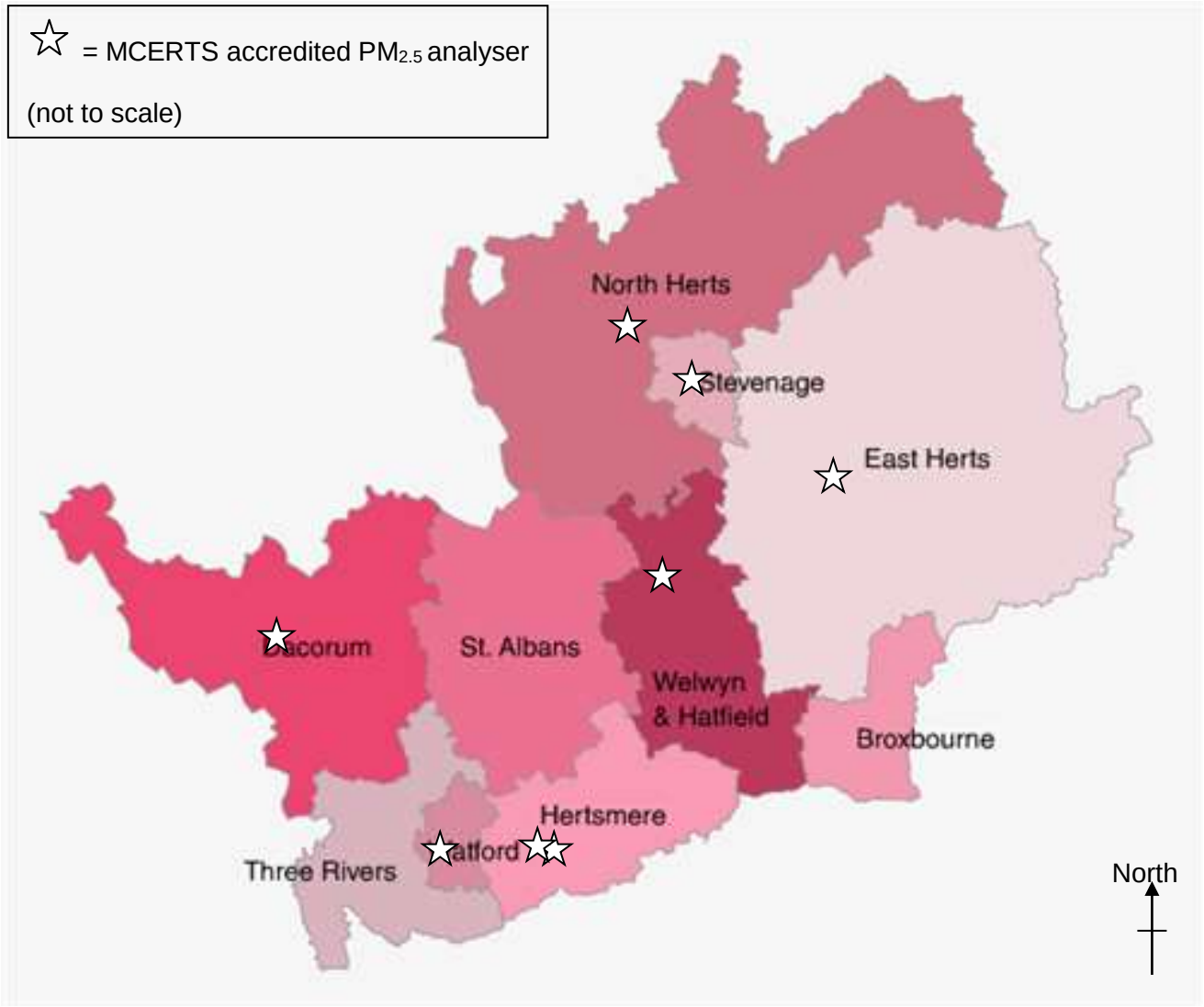


Figure 3.2 Plan of Hertfordshire showing indicative location of $PM_{2.5}$ analysers in 2020

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 2020 and data capture rates for each $PM_{2.5}$ analyser.

Table 4.1 Performance of the $PM_{2.5}$ monitoring network in 2020

Local Authority	Location (roadside unless stated)	Monitoring Commencement Date	Data Capture as % of 2020	Analyser
Hertsmere*	**Borehamwood**	**01/01/2016**	*82.49*	**TEOM-FDMS**
Hertsmere*	**Borehamwood (urban background)**	**24/05/2017**	**92.82**	**TEOM-FDMS**
Dacorum	**Northchurch**	**01/01/2016**	*65.56*	**FIDAS**
North Hertfordshire	**Hitchin**	**01/01/2016**	*83.03*	**BAM**
Welwyn, Hatfield	**Hatfield**	**28/04/2016**	**94.25**	**BAM**
East Hertfordshire	**Hertford**	**22/08/2016**	*83.60*	**BAM**
Watford	**Watford**	**24/10/2016**	**95.43**	**FIDAS**
Stevenage	**Stevenage**	**24/10/2016**	**97.19**	**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 2020, only four of the analysers returned data capture rates of >85% unlike in the previous two years, when all eight of the MCERTS accredited analysers achieved a rate of data capture above 85%. Therefore, County-wide data capture rates represent a decline in the high standard of performance of the network from previous years.

The other data reliability consideration relates to 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 Defra requirements.

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)].

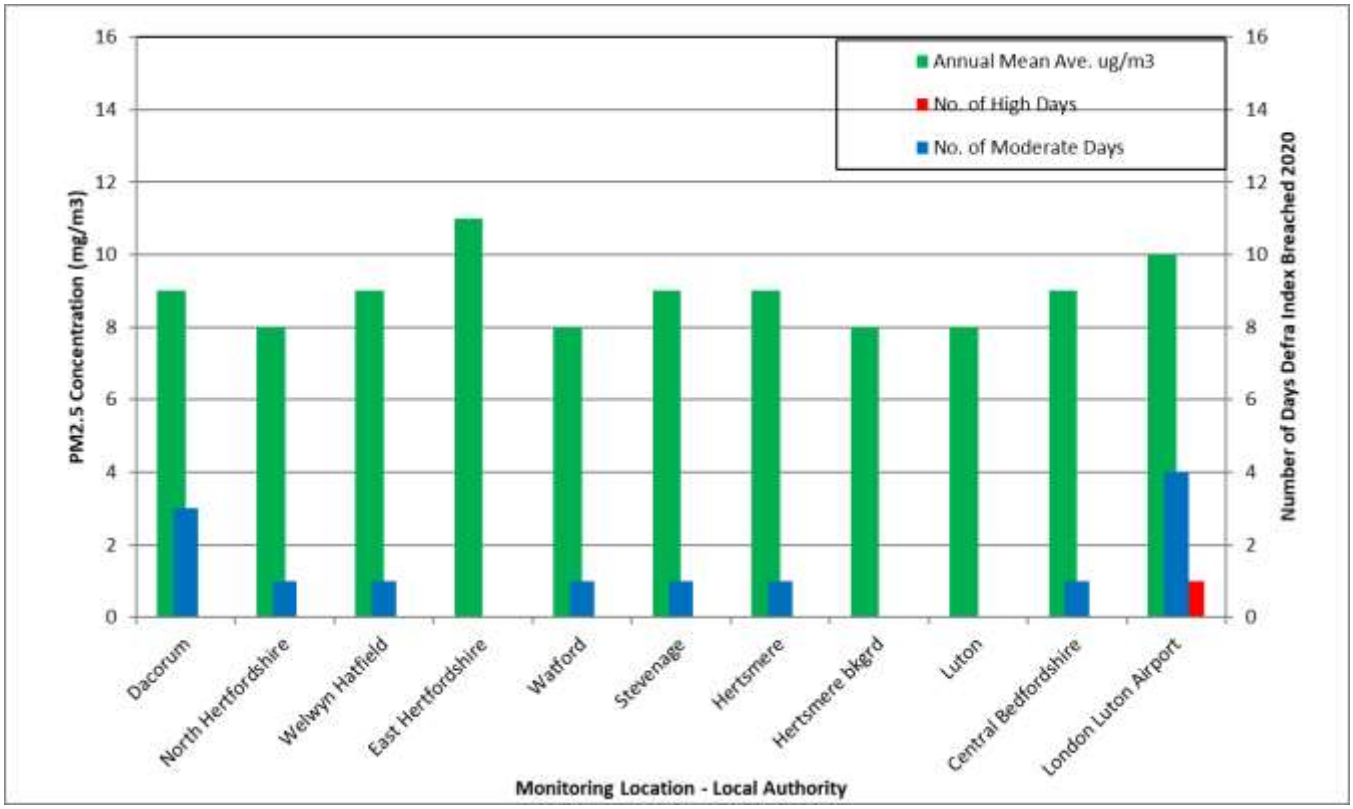
25μg/m^3 is the EU Annual Limit Value set for $PM_{2.5}$ and 10μg/m^3 is the equivalent WHO guideline.

To provide additional local context the 2020 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 2020

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



* = Locations are roadside monitoring sites, except Hertsmere bkgrd (Urban background) and London Luton Airport (industrial background). All equipment is MCERTS accredited.

Figure 4.1 $PM_{2.5}$ concentrations and days Defra Index was breached in 2020

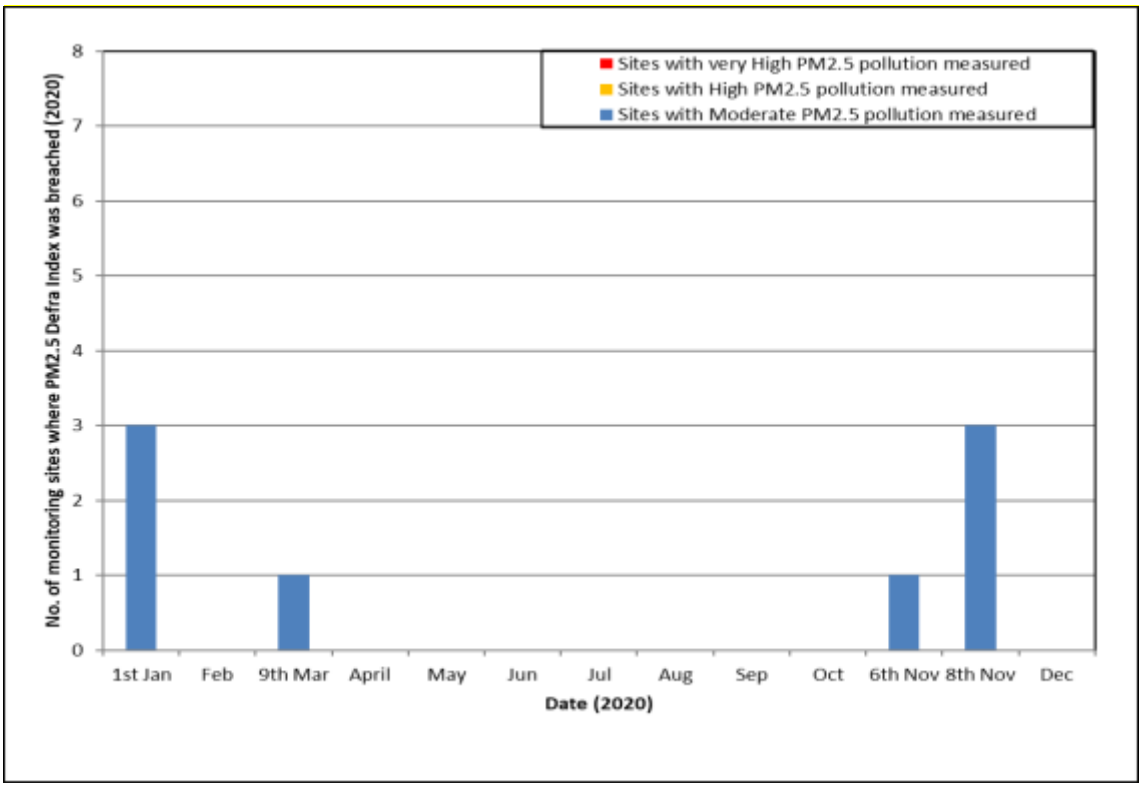


Figure 4.2 Dates of occurrence of breaches by $PM_{2.5}$ of the Defra Index in 2020

Figure 4.2 displays the days in 2020 on which breaches of the Defra Index Bands for air pollution by $PM_{2.5}$ were measured by the Hertfordshire monitoring network.

Table 4.3 shows the annual mean average $PM_{2.5}$ concentrations at each of the Hertfordshire monitoring sites in 2020 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 17th January 2022 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 Hertfordshire $PM_{2.5}$ monitoring network results in 2020 compared with modelled data from Defra (https://uk-air.defra.gov.uk/data/gis-mapping/)

Local Authority	Location (roadside unless stated)	Annual Mean Average ($\mu g/m^3$)	Defra Modelled Data ($\mu g/m^3$) (Roadside)	Defra Modelled Data ($\mu g/m^3$) (background)
Hertsmere	Borehamwood *(urban-background)*	8	no data	5 - 10
Hertsmere	**Borehamwood**	**9**	5 - 10	5 - 10
Dacorum	Northchurch	9	5 - 10	5 - 10
North Hertfordshire	Hitchin	8	5 - 10	5 - 10
Welwyn, Hatfield	**Hatfield**	**9**	no data	5 - 10
East Hertfordshire	Hertford	11	5 - 10	5 - 10
Watford	**Watford**	**8**	5 - 10	5 - 10
Stevenage	**Stevenage**	**9**	5 - 10	5 - 10

Bold = MCERTS accredited with >85% data capture
Normal font = MCERTS accredited with <85% data capture

Table 4.4 shows the mean average annual $PM_{2.5}$ measured at each of the Local Authorities during 2020 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 2020

Regional	Defra modelled, population weighted, mean average annual $PM_{2.5}$ ($\mu g/m^3$) 2020 *	Mean Annual Average $PM_{2.5}$ ($\mu g/m^3$) 2020
England	9.0 **	no data
County/Unitary		
Luton Airport	11.5	10
Luton (Dunstable Rd)	10.1	8
Central Bedfordshire	9.8	9
Hertfordshire	10.1**	8.8***
Bedford	9.9 **	No data
District/Borough		
Hertsmere	10.3	8 (urban-background site)
		9 (roadside site)
St Albans	10.2 **	no data
East Hertfordshire	10.1	11
Welwyn Hatfield	10.2	9
Three Rivers	10.2 **	no data
Watford	11.2	8
Broxbourne	10.4 **	no data
North Hertfordshire	9.8	8
Dacorum	9.6	9
Stevenage	9.9	9

* = values obtained from grid references closest to $PM_{2.5}$ analyser locations within each District or Borough via https://uk-air.defra.gov.uk/data/laqm-background-home
** = values obtained for 2019 (most current available) from Wider Determinants of Health - Data - OHID (phe.org.uk)
*** = mean average of annual values from all Hertfordshire based $PM_{2.5}$ analysers

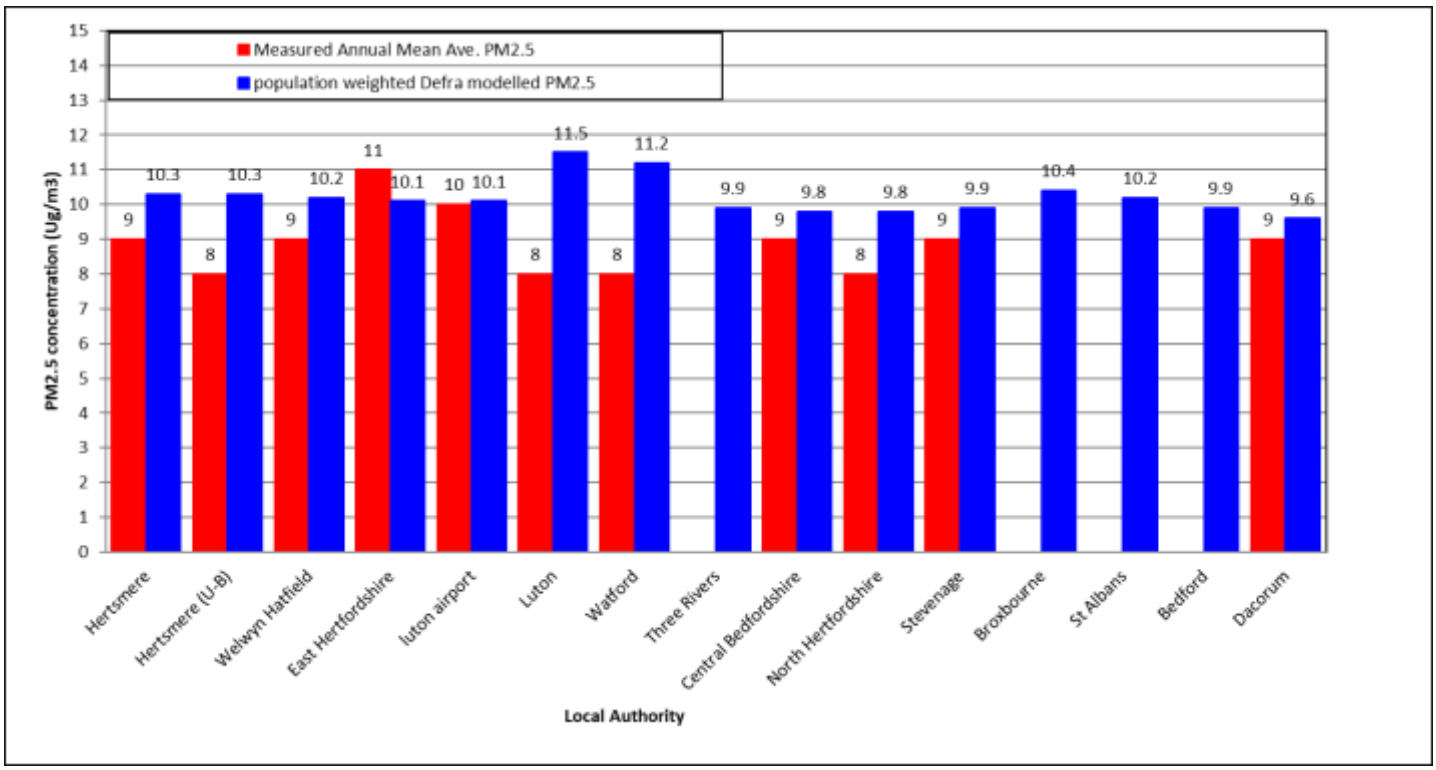


Figure 4.3 Defra modelled, population weighted mean average annual $PM_{2.5}$ data and mean average annual (2020) $PM_{2.5}$ concentration

Figure 4.4 shows the $PM_{2.5}$ concentrations measured at each monitoring location in 2020 alongside the concentrations in 2016 - 2019.

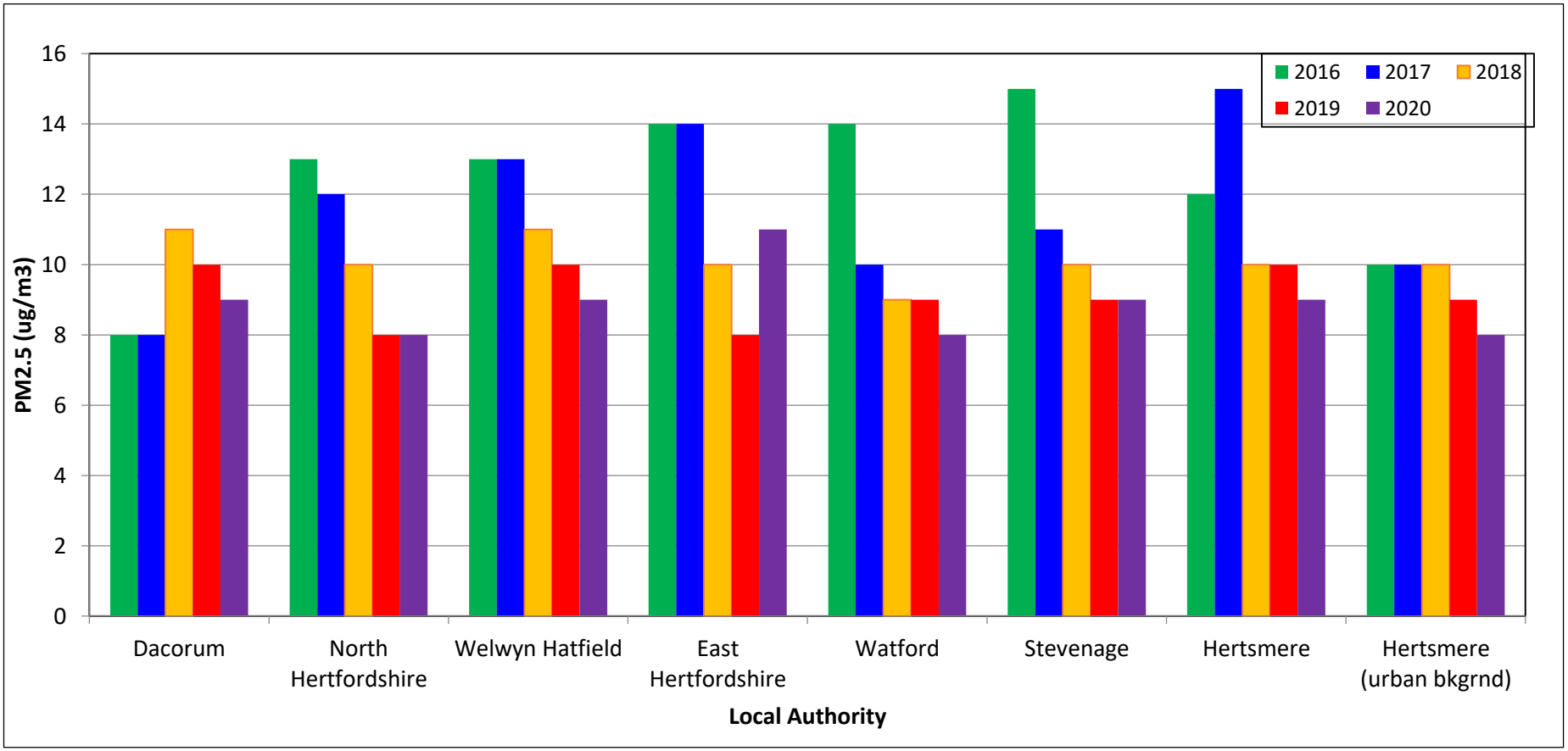


Figure 4.4 $PM_{2.5}$ concentrations measured from 2016-2020

At all monitoring locations a lower or identical concentration of $PM_{2.5}$ in comparison to the previous years was recorded, with the exception of East Hertfordshire. In all monitoring locations, again with the exception of East Hertfordshire 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 fifth full year of $PM_{2.5}$ air quality monitoring within Hertfordshire. Data capture rates (**Table 4.1**) were below the recommended level of 85% in half of the Hertfordshire monitoring locations that were operational during 2020, which is well below the situation in 2018 and 2019 when all locations were at or above 85% data capture.

Reasons for the decline were due to a complicated technical fault that required significant analyser downtime at the Dacorum site and more routine, repetitive maintenance issues that were responsible for data capture rates that were slightly below the required 85% level at the Hertsmere, North Hertfordshire and East Hertfordshire analysers.

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 five years is suggestive of a specific localised contribution to $PM_{2.5}$ air pollution from road traffic. In 2016 and 2017 the urban-background site recorded concentrations below those measured at the roadside site (**Figure 4.4**). The difference was not observed in 2018, when the urban background analyser was relocated during 2018, with both sites recording the same level of $10\mu g/m^3$. However, the difference was observed again in 2019 and 2020 with the roadside site recording $10\mu g/m^3$ and $9\mu g/m^3$ and the urban background site $9\mu g/m^3$ and $8\mu g/m^3$ respectively. It is noted that in 2020 reduced transport was likely to have been found on the road network.

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. All but the East Hertfordshire analyser measured concentrations within the range of concentrations modelled by Defra in 2020. In 2019 and 2018 all analysers measured concentrations within the modelled range. 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 4 days in 2020 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 lower than in all previous years when 14 days were recorded in 2019, 9 days in 2018, 19 days in 2016 and 24 days in 2017.

The lower number of days where breaches were recorded was also reflected by a lower number of locations where breaches were detected. So in all a total of 8 breaches were recorded in 2020, compared to 46 in 2019 and 23 in 2018. It was also the case that all 8 of the breaches were limited to a breach of the moderate daily air quality index, whereas in all previous years exceedances of the high or less commonly the very high index were breached.

The significant decline in number of recorded breaches of the Defra moderate daily air quality index might be attributable to the impact of the Covid 19 pandemic. In the UK this resulted in nationwide lock-downs from the 23rd March 2020 to June 2020 and from the 5th November 2020 to the 2nd December 2020. And similar restrictions were in place across the world which may also have resulted in a reduction in anthropogenic contributions from further afield.

The seasonality of the breaches during 2016 to 2020 was consistent with no breaches occurring during the summer months in any of the five years **(Appendix 1)**. In 2020 all but one of the exceedances coincided with the 1st January and the Bonfire Night Weekend, 5th November to 8th November, suggestive of a very particular cause of the elevated concentrations of $PM_{2.5s}$. 2020 was the first year that such an isolated occurrence of exceedances has been observed.

Between 2017 and 2019 the first four months of each year was when the majority of exceedances were recorded, although in 2016 a more even split of breaches were recorded across the first four months of the year and last three months.

This general seasonal trend is to be expected because it is recognised that cold, still weather conditions typically prevent the dispersal of local air pollution including particulate matter. It may also be indicative of higher levels of domestic burning of solid fuels in fireplaces during the colder months.

In 2020, unlike in the previous years, the dates on which breaches were recorded where limited to no more than 3 different sites on any given day. In previous 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 they would have been associated with a non-localised air pollution episode. Either one that was responsible for the breach in itself, or responsible for increasing the underlying concentrations so that more localised sources of $PM_{2.5}$ pollution, such as local traffic, were sufficient to result in a breach.

5.4 Relationship between population weighted Defra modelled data & measured $PM_{2.5}$

In all but East Hertfordshire (data capture at the East Hertfordshire analyser was below the 85% collection threshold) the analysers recorded annual mean average of $PM_{2.5}$ concentrations that were below the Defra modelled data for the 1km grid square within which the analysers were located.

This is a reassuring observation given that the analysers are placed, with the exception of the Hertsmere Urban Background site, at roadside locations were exposure to higher than average concentrations of particulate matter might be expected.

5.5 Yearly trends in $PM_{2.5}$ air pollution

Five years of data are now 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 increasing value. 2020, however, was a year dominated by the Covid 19 pandemic and the lockdowns that occurred not just in the UK but across Europe and other continents. Therefore, the 2020 data will have to be viewed with

that in mind even though the lockdown is more likely to have impacted concentrations of other pollutants, such as nitrogen dioxide, because of the relatively lower contribution of $PM_{2.5s}$ from road traffic emissions.

Figure 4.4 shows that at the eight Hertfordshire and Bedfordshire monitoring locations where five years of data are available the annual average concentrations measured have declined since 2015 or 2016. With the exception of East Hertfordshire all of the monitoring locations recorded annual mean concentrations that were lower or the same as 2019. It will be important to continue monitoring to assess the impact of the Covid-19 lockdown on the 2020 data and also to determine if the gradual reduction in $PM_{2.5s}$ identified to date will be a longer-term trend or whether it will eventually plateau.

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 five 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 still 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. It will also provide an interesting insight into the impact of the Covid-19 lockdowns particularly during 2020.

Broad observations that can be made from the five 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. However, in 2020 these breaches were limited to dates on which a local contribution from celebrations associated with the use fireworks would be anticipated.

- Breaches are likely to be associated with regional or national scale air pollution episodes and only partially associated with locally derived road vehicle pollution. As per the above bullet point, 2020 may to a degree have

- represented an exception and one that can potentially be linked to the Covid-19 lockdowns.

- 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 2020, but the trend has been a gradual 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 as it appears that the Country is emerging from the national Covid-19 emergency, which had encompassed a number of national lockdowns. As such it will be important that the data from 2021 is collated and reported and that monitoring continues throughout future years.

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 also be taken to enhance the existing $PM_{2.5}$ monitoring network as and when they arise. This opportunity may arise in the event that updated Air Quality Objectives for $PM_{2.5}$ are included in the Environmental Act 2021 during 2022 or subsequent years.

7. References

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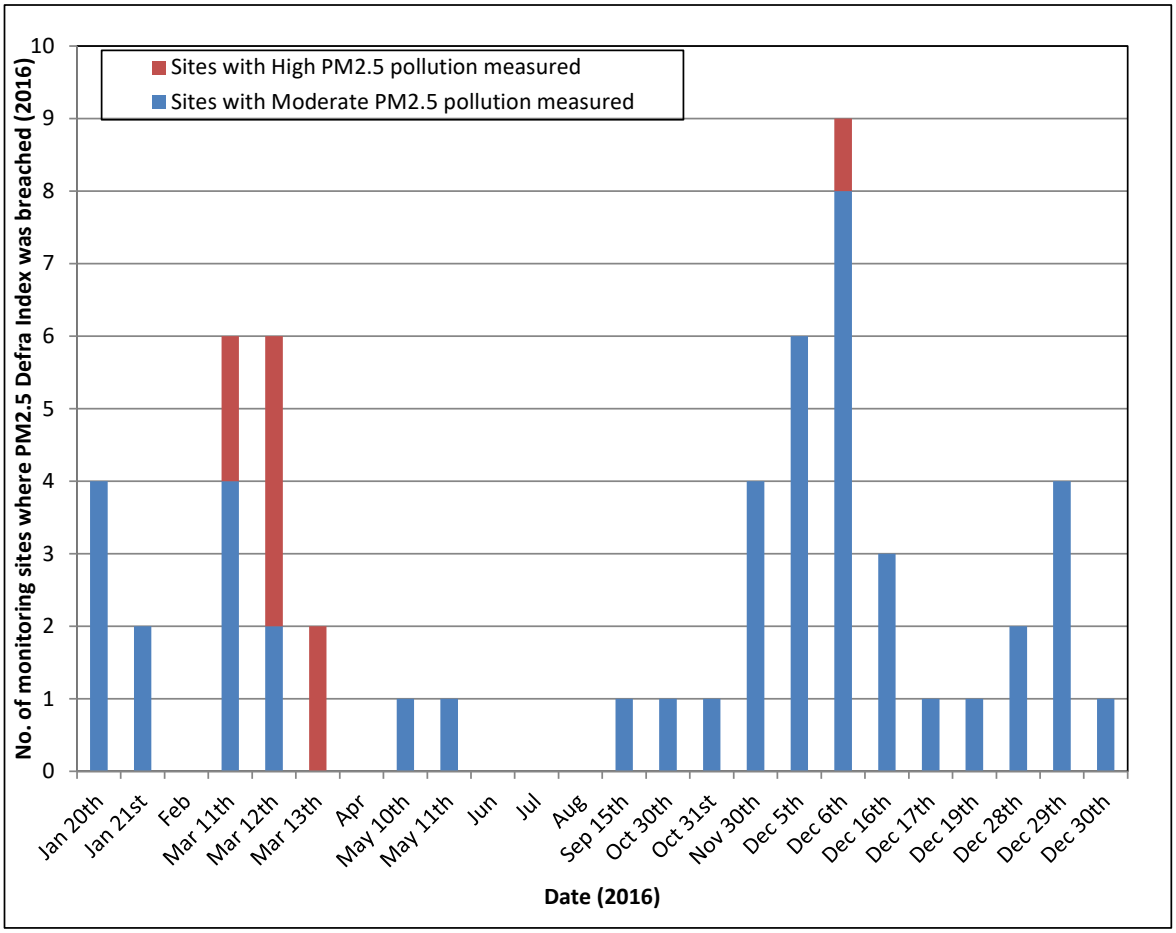
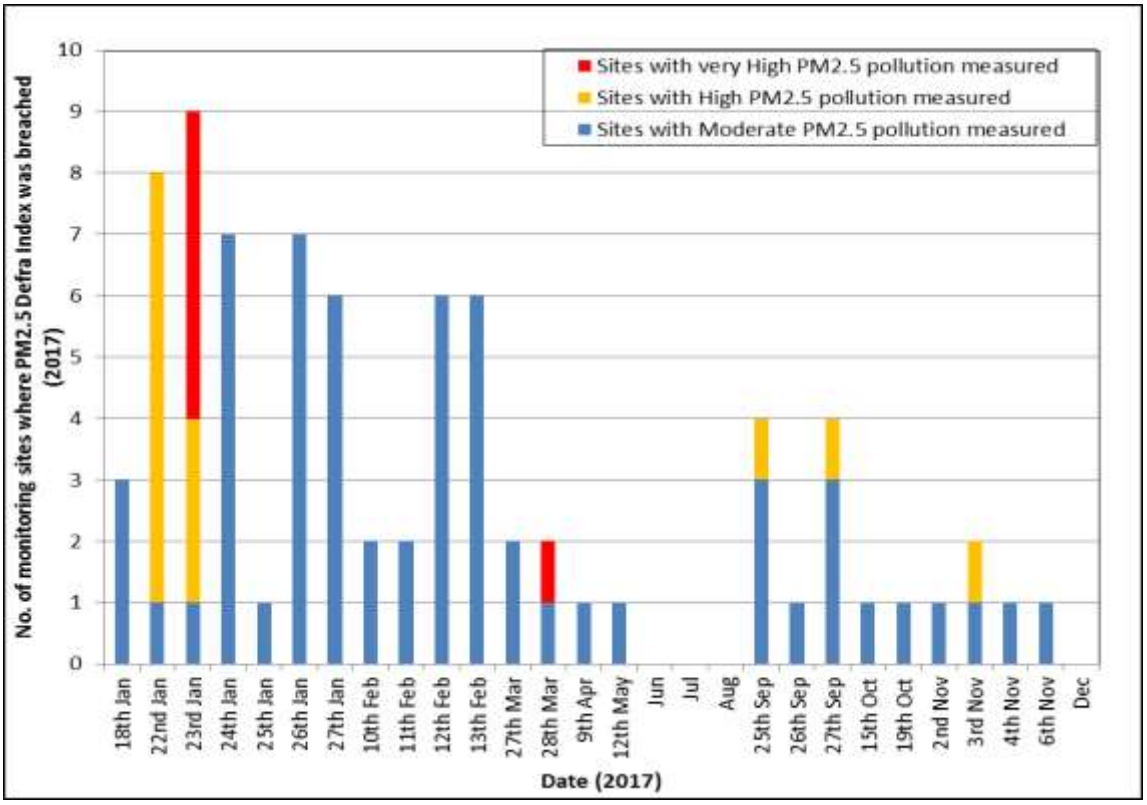
APPENDIX 1
Dates of Occurrence of Breaches by $PM_{2.5}$ of the Defra Index in 2016 - 2019





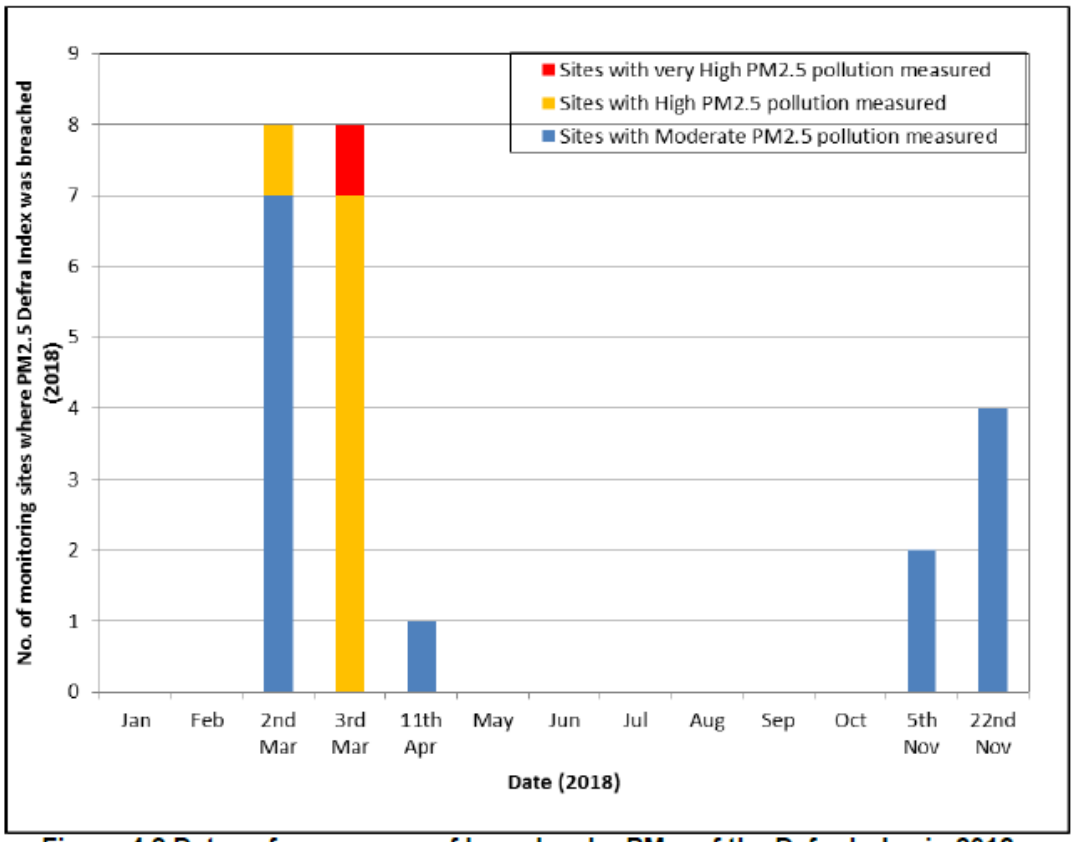
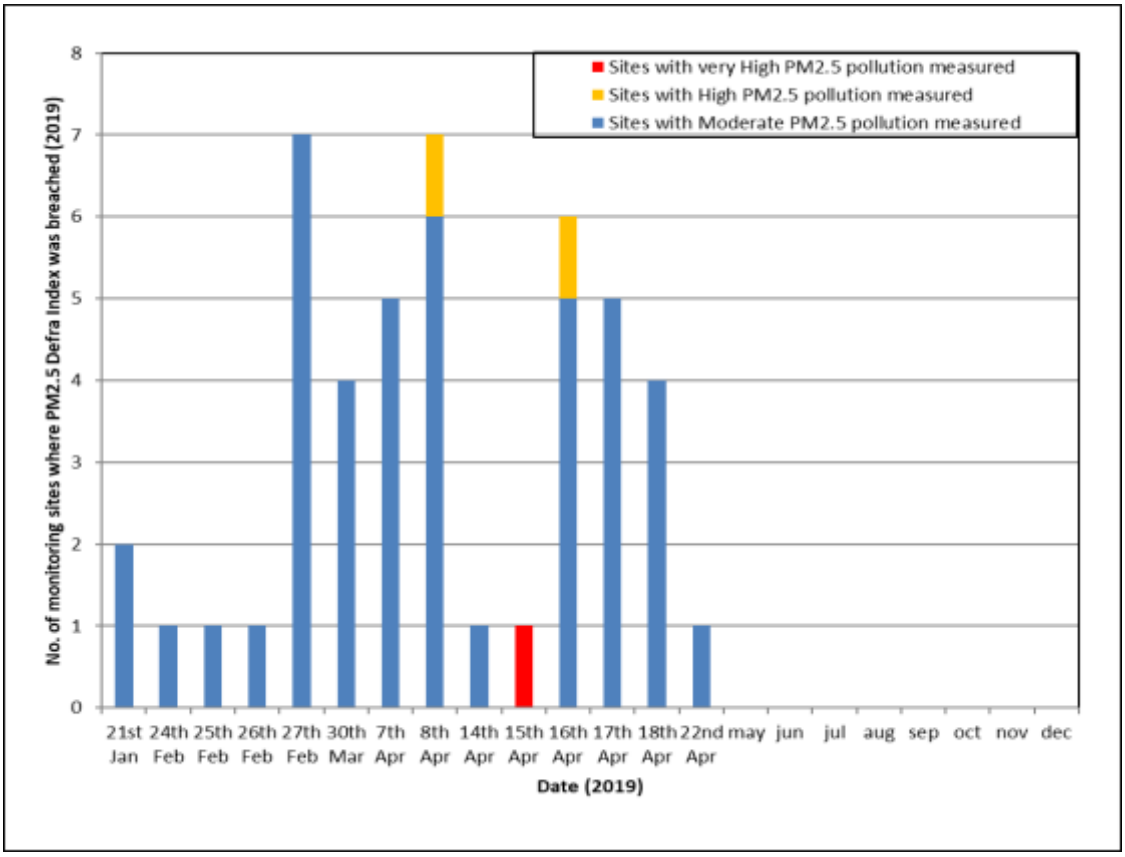


Figure 4.2 Dates of occurrence of breaches by $PM_{2.5}$ of the Defra Index in 2018



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.