Hertfordshire Local Authorities Report
on
Particulate Matter ($PM_{2.5}$) in Ambient Air in 2017
for
Hertfordshire County Council Public Health

November 2018

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)

Three Rivers District Council (TRDC)

Welwyn and Hatfield District Council (WHDC)

Dacorum Borough Council (DBC)

Additional data obtained from

Central Bedfordshire Council

Luton Borough Council

Report Author: David Carr NHDC (Chairman, Herts & Beds Air Quality Forum)
Telephone: 01462 474263
Email: david.carr@north-herts.gov.uk

Document Status and Approval Schedule

Issue	Status	Description	Prepared by	Reviewed by
0	Draft report	Draft for comment	David Carr	Herts Local Authority Air Quality Officers & HCC PH representative
1	Final Report	Issued to HCC Public Health	David Carr 01/11/2018	

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

HCC does not have responsibility for monitoring or managing local air quality; that duty rests with the ten local 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. Therefore, joint working on air quality issues between HCC and the local authorities has become a higher priority and one of the partnership projects identified was the $PM_{2.5}$ monitoring project. This project has the aim of enabling the collection of real-time direct measurements of $PM_{2.5}$ concentrations from multiple locations within Hertfordshire in order to address the paucity of $PM_{2.5}$ data available within the County.

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

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

The data collected during 2016 and 2017 is of limited use for interpretative purposes at this stage but they will represent a useful baseline against which future years' data can be compared. This should enable trends over time and across the County to be

assessed and be of value to Public Health in terms of the interpretation and application of PHOI 3.01.

Additionally the data from 2016 and 2017 has value in its own right as a measure of the levels of $PM_{2.5}$ air pollution at various locations across the County for those years. Furthermore it has shown that the breaches of moderate, high and in isolated cases the very high air pollution indices typically occurred in the winter months. It has also demonstrated that the Defra modelled $PM_{2.5}$ concentrations were largely consistent with those being measured.

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

1. Introduction

1.1 Hertfordshire County Council (HCC)

Hertfordshire has over one million residents (Census 2011) and as well as large rural areas has over a dozen medium sized towns. The location of Hertfordshire in close proximity to London creates large commuting flows and, 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

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

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

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

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

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

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

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

1.2 Second Tier Local Authorities in Hertfordshire

Each of the ten local authorities has an obligation to regularly review and assess air quality in their areas, and to determine whether or not the air quality objectives are likely to be achieved. Where an exceedance is considered likely the local authority must declare an Air Quality Management Area (AQMA) and prepare an Air Quality Action Plan (AQAP) setting out the measures it intends to put in place in pursuit of the objectives. Those obligations arise as a result of the Local Air Quality Management (LAQM) regime as defined in Part IV of the Environment Act (1995) and the relevant Policy and Technical Guidance documents.

The statutory air quality objectives applicable to LAQM in England are set into law via the Air Quality Standards Regulations (England) 2015 and they are shown in Table 1. This table shows the objectives in units of micro-grammes per cubic metre $\mu g/m^3$. Table 1.1 also includes the number of permitted exceedences in any year (where applicable).

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

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

There are no statutory obligations on local authorities in respect of monitoring concentrations of $PM_{2.5}$ in the ambient air. However, as detailed in Chapter 7 of the LAQM Policy Guidance 2016 (1), local authorities are expected to work towards reducing emissions and/or concentrations of $PM_{2.5}$. Also, the EU Ambient Air Quality Directive has identified 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 $PM_{2.5}$.

It should be noted that within the government's draft Air Quality Strategy 2018 there is an aim to progressively cut public exposure to particulate matter pollution, as recommended by WHO. The Strategy states that by 2025 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 officers with LAQM responsibility within the ten Hertfordshire local authorities work collaboratively where possible and appropriate via the Hertfordshire and Bedfordshire Air Quality Forum. This forum also comprises environmental officers from the three unitary local authorities in Bedfordshire and professionals from HCC who bring different areas of expertise to the issue of local air quality, for example public health, transport and planning.

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

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

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

The current PHOI 3.01 for Hertfordshire is 5.5, which compares to 4.9 at the time of the 2016 report. This is a modelled estimate that suggests that 5.5% of all Hertfordshire deaths in 2016 in people aged 30+ were attributable to $PM_{2.5}$ air pollution, compared to 4.9% in 2015.

The primary care mortality database for 2016 showed that there were 9,220 deaths registered for people aged 30 and over, which would equate to 507 deaths being attributable to $PM_{2.5}$ air pollution. This compares to 469 deaths attributable to $PM_{2.5}$ air pollution that were estimated based on the previous PHOI.

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

Relative risks increase of mortality for each $10\mu g/m^3$ of particulate matter are:

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

(Hertfordshire Air Quality Strategic Plan – June 2015)

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

Particulate matter, whether PM_{10} (aerodynamic diameter $<10\mu m$), $PM_{2.5}$ (aerodynamic diameter $<2.5\mu m$), or $PM_{1.0}$ (aerodynamic diameter $<1\mu m$) 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 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 as a “one off” addition to the existing District Partnership Fund monies that had already agreed and it was made available to spend until autumn 2015. The ring fenced money had to be spent on monitoring equipment for $PM_{2.5}$ and was only available for capital costs, with no equivalent ring-fenced funding available in future years for ongoing servicing and maintenance.

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

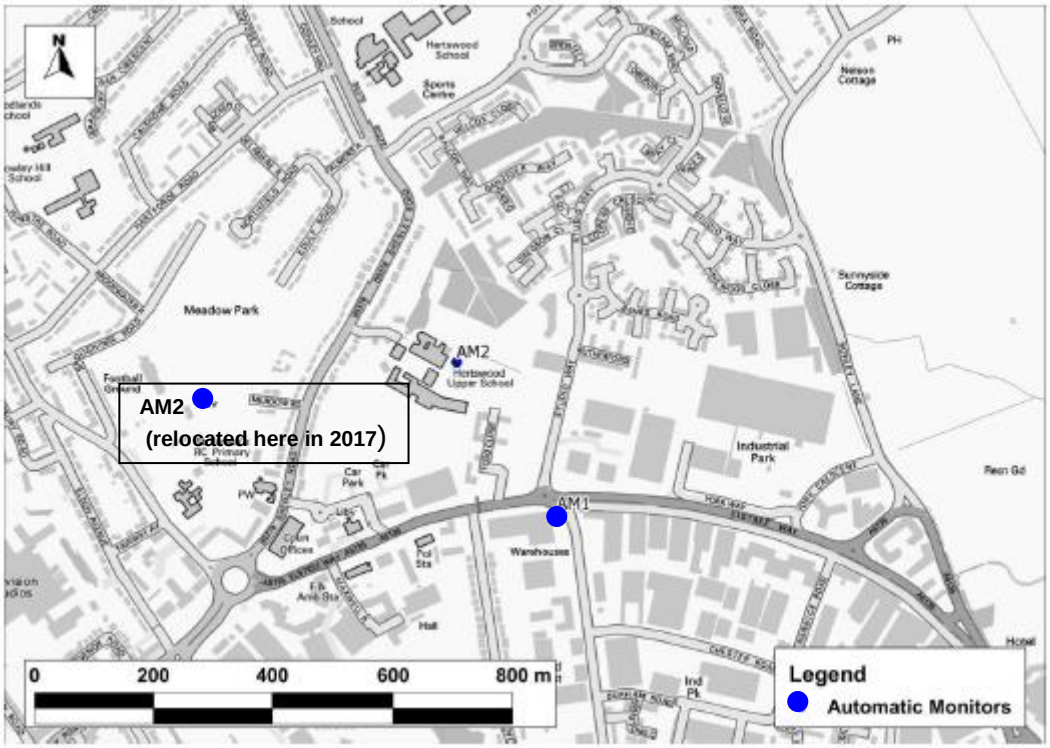


Figure 3.1 Location of PM$_{2.5}$ analysers in Borehamwood, Hertsmere

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 2017 is included as Table 3.2 and shows that the network now comprises of ten analysers. The analysers lost from the network in 2017 are in *red* and the additions are in **blue.**

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

Local Authority	Address	Grid Reference	Location Type	Analyser Type
Hertsmere*	Elstree Way, Borehamwood	520319, 197099	Roadside	TEOM-FDMS **
Hertsmere Closed in May 2017*	*Thrift Farm Lane, Borehamwood*	*520147, 197361*	*Urban-background*	*TEOM-FDMS **
Hertsmere*	**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 **
Broxbourne	*College Road, Cheshunt*	*535314, 202244*	*Roadside*	*AQ Mesh ****
Broxbourne	*Eleanor Cross Rd Waltham Cross*	*536266, 200376*	*Roadside*	*AQ Mesh ****
Three Rivers	Rickmansworth Rd, Chorleywood	504162, 196286	Roadside	AQ Mesh ***
Three Rivers	**Uxbridge Road, Rickmansworth**	**505263, 194250**	**Kerbside**	**AQ Mesh ****

***** not funded by Public Health
****** Defra approved analysers that are UK MCERTS accredited for continuous ambient air quality monitoring systems and that have MCERTS for $PM_{2.5}$.
******* analyser that is not Defra approved & is not UK MCERTS accredited for continuous ambient air quality monitoring systems for $PM_{2.5}$.

Where an analyser does not have MCERTS accreditation it means that data from the analyser in question should only be utilised as a screening assessment tool to inform the need for more detailed monitoring.

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

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

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

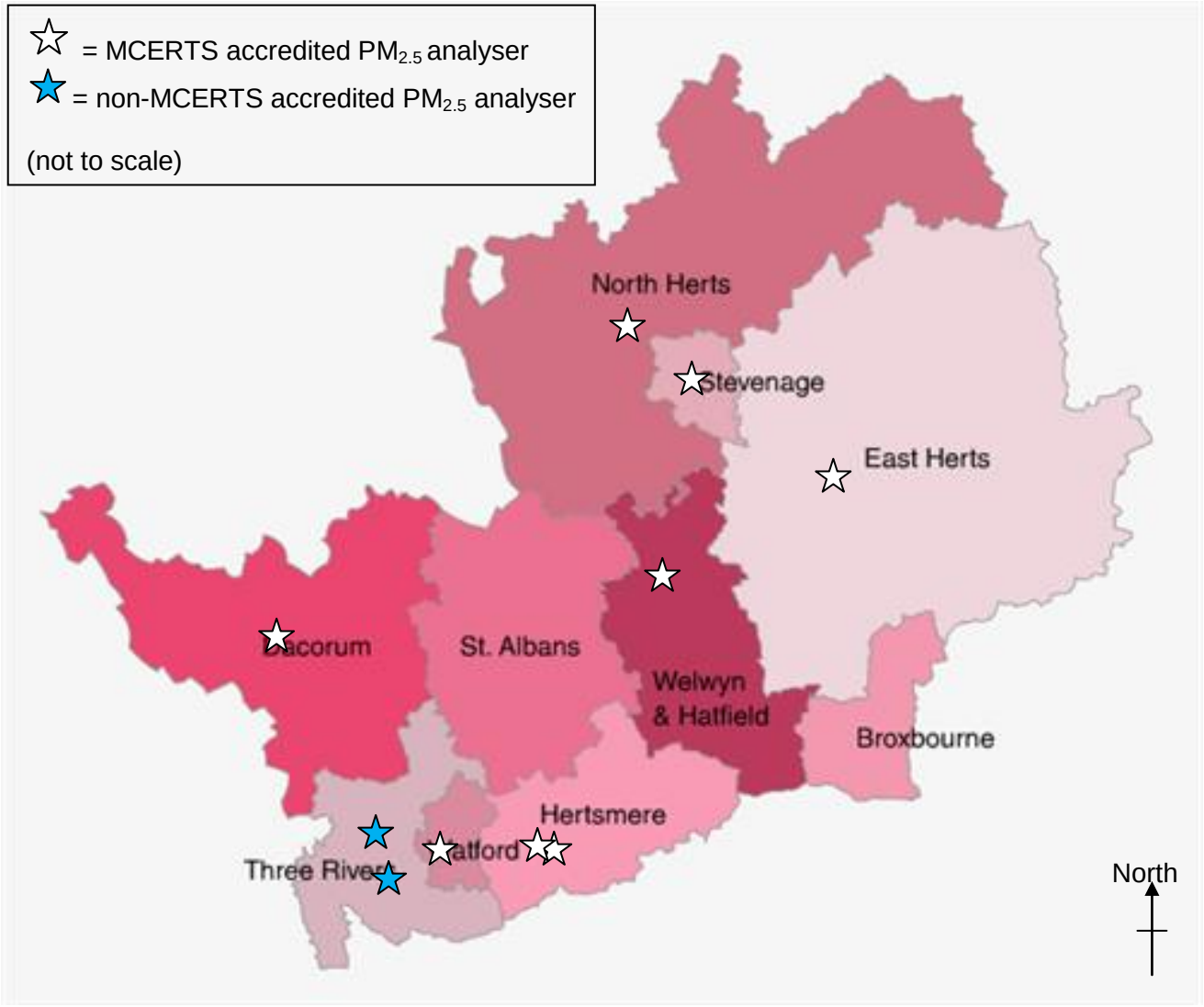


Figure 3.2 Plan of Hertfordshire showing indicative location of $PM_{2.5}$ analysers in 2017

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 2017 and data capture rates for each $PM_{2.5}$ analyser.

Table 4.1 Performance of the $PM_{2.5}$ monitoring network in 2017

Local Authority	Location (roadside unless stated)	Monitoring Commencement Date	Data Capture as % of 2017	Analyser
Hertsmere*	Borehamwood	01/01/2016	45.7	TEOM-FDMS
Hertsmere*	Borehamwood (urban background)	(01/01/2017 - 23/05/2017) 24/05/2017	38.82 59.34	TEOM-FDMS
Dacorum	**Northchurch**	**01/01/2016**	**99.95**	**FIDAS**
North Hertfordshire	**Hitchin**	**01/01/2016**	**86.63**	**BAM**
Welwyn, Hatfield	**Hatfield**	**28/04/2016**	**92.47**	**BAM**
East Hertfordshire	**Hertford**	**22/08/2016**	**86.15**	**BAM**
Watford	Watford	24/10/2016	82.92	FIDAS
Stevenage	**Stevenage**	**24/10/2016**	**96.96**	**BAM**
Three Rivers	Chorleywood	10/03/2016	43.4	AQ Mesh **
Three Rivers	Rickmansworth (Kerbside)	2017	77.6	AQ Mesh **

* = analysers not funded by PH grant
** = not MCERTS accredited (all other analysers are MCERTS accredited)

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

In 2017, five of the MCERTS accredited analysers achieved that rate of data capture, another fell only fractionally short at 83.92% and another met the data capture rate, but split across two different monitoring locations.

Only the roadside analyser at Borehamwood and the two AQ Mesh analysers in Three Rivers had poor rates of data capture for the year. These County-wide data capture rates represent an improvement on 2016 when only four MCERTS analysers had adequate data capture.

There will always be the risk of analyser faults or failures over a given year, such as that experienced at the roadside site in Borehamwood. However, now all of the MCERTS analysers are established it would be expected that consistently high levels of data capture should be achievable.

Despite being non-MCERTS accredited the data from the AQ Mesh analysers utilised by Three Rivers will still be of value in assessing air quality against the annual average air quality standards that exist for $PM_{2.5}$.

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

4.1 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 36$\mu g/m^3$ but less than 54$\mu g/m^3$
- 'High' is defined as being between 54 $\mu g/m^3$ and 70 $\mu g/m^3$ and
- 'Very High' is defined as being 71$\mu g/m^3$ or higher

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

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

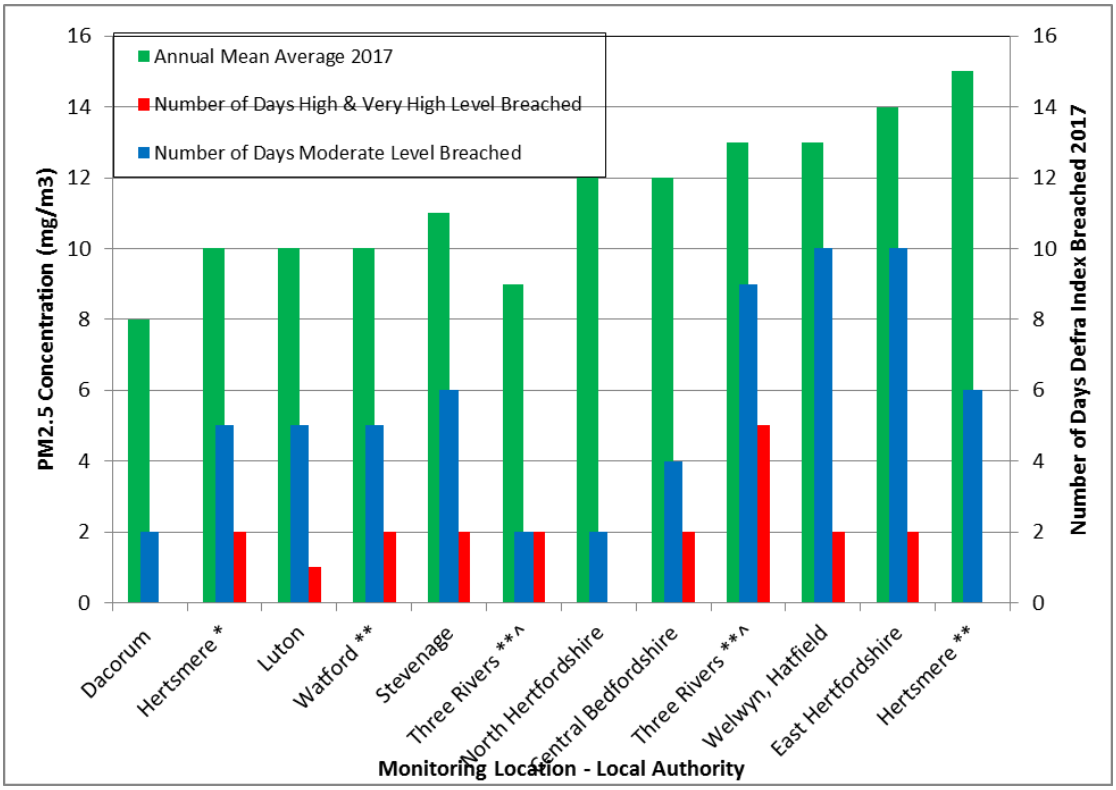
To provide some additional local context the 2017 data from the $PM_{2.5}$ analysers operating in Bedfordshire have been included in Table 4.2.

Table 4.2 Results from the Hertfordshire $PM_{2.5}$ Monitoring Network in 2017

Local Authority	Location	Annual Mean Ave. (μg/m^3)	Number of Days with		
			Moderate Pollution	High Pollution	Very High Pollution
Hertsmere *	**Borehamwood ****	**10**	**5**	**1**	**1**
Hertsmere	Borehamwood	15	6	1	1
Dacorum	**Northchurch**	**8**	**2**	**0**	**0**
North Hertfordshire	**Hitchin**	**12**	**2**	**0**	**0**
Welwyn, Hatfield	**Hatfield**	**13**	**10**	**1**	**1**
East Hertfordshire	**Hertford**	**14**	**10**	**1**	**1**
Watford	Watford	10	5	1	1
Stevenage	**Stevenage**	**11**	**6**	**2**	**0**
Three Rivers	*Chorleywood*	*9*	*2*	*1*	*1*
Three Rivers	*Rickmansworth*	*13*	*9*	*5*	*0*
Bedfordshire Local Authorities					
Luton	**Dunstable Rd, Luton (FIDAS)**	**10**	**5**	**1**	**0**
Central Bedfordshire	**A1(M) at Sandy (TEOM-FDMS)**	**12**	**4**	**2**	**0**

* = urban background monitoring site. All other sites are roadside sites
** = combined data from two different urban background sites in Borehamwood
Bold **= MCERTS accredited with >85% data capture**
Normal font = MCERTS accredited with <85% data capture
Italics = *not MCERTS accredited and with <85% data capture*

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



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

Figure 4.1 $PM_{2.5}$ concentrations and days Defra Index was breached in 2017

Table 4.3 shows the annual mean average $PM_{2.5}$ concentrations at each of the Hertfordshire monitoring sites in 2017 with the concentrations that have been modelled by Defra. The Defra data was taken from https://uk-air.defra.gov.uk/data/gis-mapping on the 1st August 2018 with the year specified to be 2015, which is the most up to date data available. Where modelled data is available specific to the road on which the monitoring equipment is located this is also reported, but where roadside modelled data is not available the background data is used.

Table 4.3 Results from the Hertfordshire $PM_{2.5}$ monitoring network in 2017 compared with modelled data from Defra

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)	**10**	**no data**	**10 – 12.5**
Hertsmere	Borehamwood	15	10 – 12.5	10 – 12.5
Dacorum	**Northchurch**	**8**	**5 – 10**	**5 - 10**
North Hertfordshire	**Hitchin**	**12**	**10 - 12.5**	**5 - 10**
Welwyn, Hatfield	**Hatfield**	**13**	**no data**	**10 – 12.5**
East Hertfordshire	**Hertford**	**14**	**10 – 12.5**	**10 – 12.5**
Watford	Watford	10	10 – 12.5	5 - 10
Stevenage	**Stevenage**	**11**	**10 - 12.5**	**10 - 12.5**
Three Rivers	*Chorleywood*	*9*	*10 – 12.5*	*10 – 12.5*
Three Rivers	*Rickmansworth* (kerbside)	*13*	*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 displays the days in 2017 on which breaches of the Defra Index Bands for air pollution by $PM_{2.5}$ were measured.

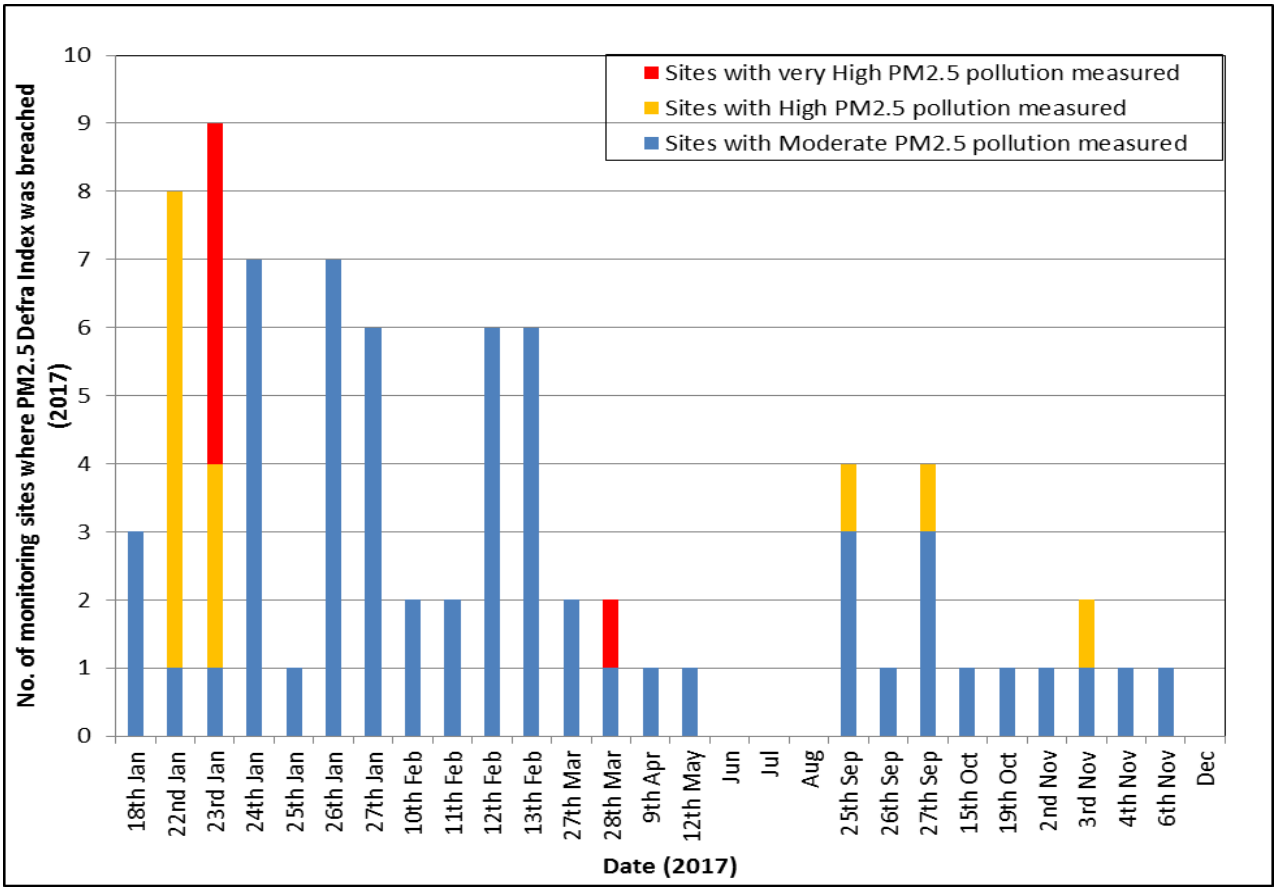


Figure 4.2 Dates of occurrence of breaches by $PM_{2.5}$ of the Defra Index in 2017

Table 4.4 shows the mean average annual $PM_{2.5}$ measured at each of the Local Authorities during 2017 alongside the PHOI value for the fraction of annual all-cause mortality attributable to current levels of anthropogenic particulate pollution. For context, data are included for Central Bedfordshire, Bedford, Luton, Hertfordshire, the East of England Region and the London Region.

Figure 4.3 displays the PHOI value for each of the Hertfordshire and Bedfordshire local authorities alongside their respective $PM_{2.5}$ concentrations as measured during 2017.

Table 4.4 PHOI 3.01 data and mean annual average $PM_{2.5}$ concentrations measured in 2017

Regional	PHOI 3.01	Mean Annual Average $PM_{2.5}$ ($\mu g/m^3$) 2017
England	5.3	no data
London	6.4	no data
East of England	5.4	no data
County/Unitary		
Luton	6.0	10
Central Bedfordshire	5.4	12
Hertfordshire	5.5	11.5*
Bedford	5.5	11**
District/Borough		
Hertsmere	5.7	10 (urban-background site)
		15 (roadside site)
St Albans	5.6	no data
East Hertfordshire	5.4	14
Welwyn Hatfield	5.6	13
Three Rivers	5.6	9 & 13
Watford	5.9	10
Broxbourne	5.7	no data
North Hertfordshire	5.4	12
Dacorum	5.4	8
Stevenage	5.4	11

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

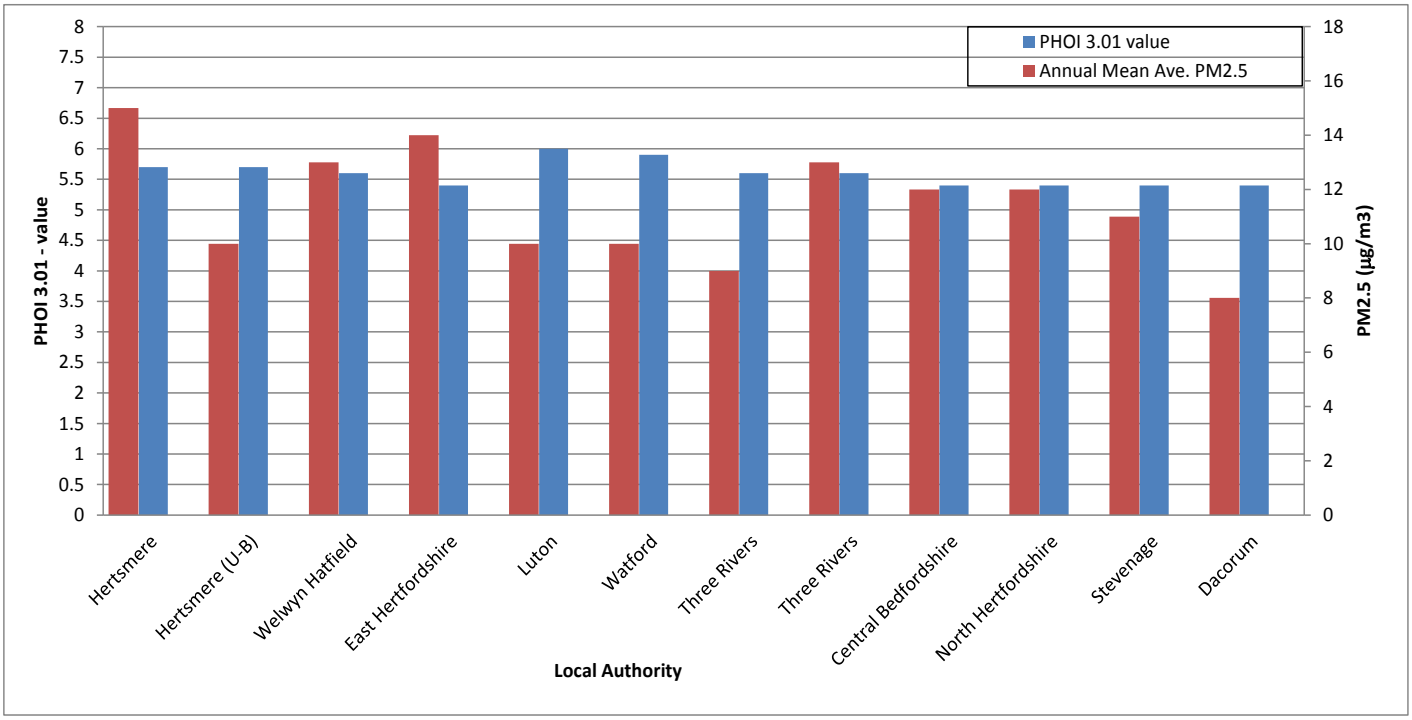


Figure 4.3 PHOI 3.01 values and mean average annual (2017) $PM_{2.5}$ concentrations

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

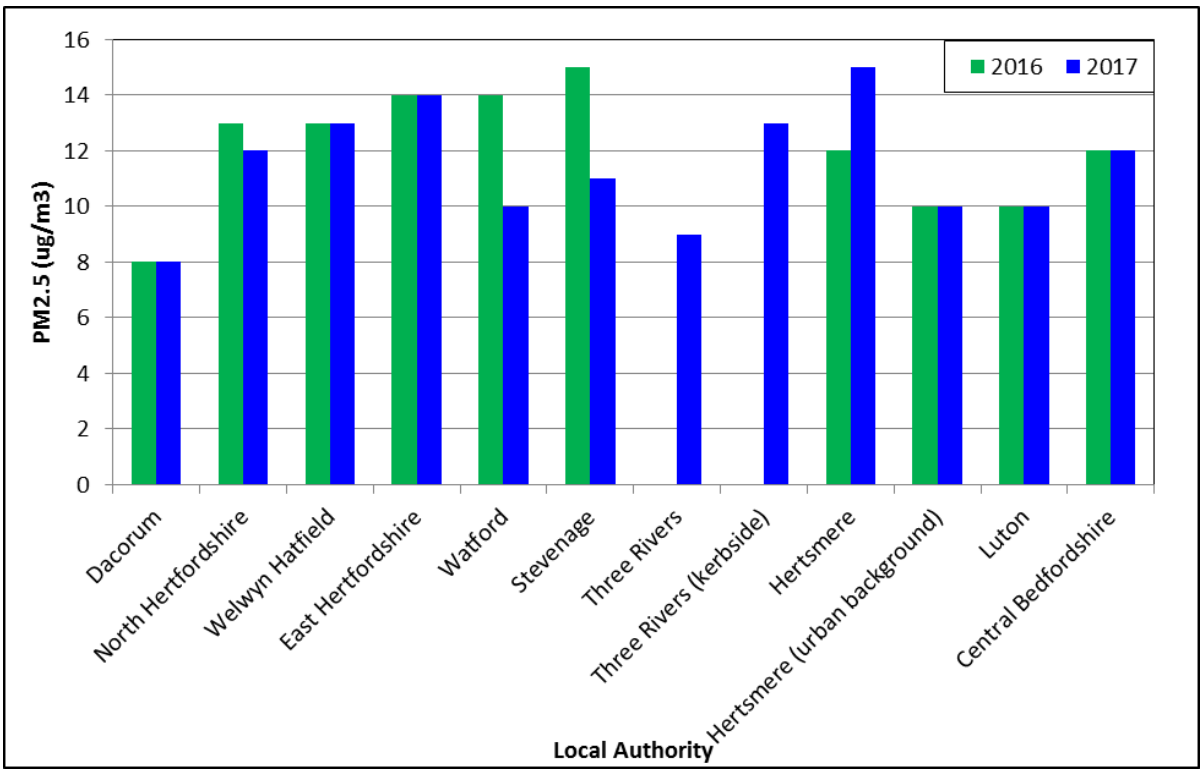


Figure 4.4 $PM_{2.5}$ concentrations measured in 2016 and 2017

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 second full year of $PM_{2.5}$ air quality monitoring within Hertfordshire and in five of the ten monitoring locations (**Table 4.1**) the data capture was below the required level of 85%. This is an improvement on 2016 when six of the eleven monitoring locations recorded data capture below the required level.

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

5.1 Urban-background and roadside concentrations

A comparison of the annual mean average at Hertsmere's urban-background monitoring site (10μg/m^3) with that from Hertsmere's roadside monitoring site (12μg/m^3) in 2016, indicated a specific localised contribution to $PM_{2.5}$ air pollution from road traffic. This observation was repeated in 2017 when the urban-background site(s) recorded 10μg/m^3 compared to the 15μg/m^3 measured at the roadside site (**Figure 4.4**).

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

The 2017 mean annual average concentration of $PM_{2.5}$ measured at the urban-background site was also less than the mean annual average of $PM_{2.5}$ measured at the roadside sites at North Hertfordshire, Welwyn Hatfield, East Hertfordshire, Stevenage and Central Bedfordshire (**Table 4.2**). The concentration was the same as measured at the roadside site in Luton and was higher than at the roadside site in Dacorum (**Table 4.2**). Only sites with greater then 85% capture rates have been considered.

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. Of the five MCERTS accredited analysers with >85% data capture only the concentration of 14μg/m^3 recorded by East Hertfordshire at its roadside site in Hertford was above the modelled range of 10-12.5μg/m^3 for the same road.

Hertsmere's roadside site in Borehamwood recorded a higher concentration (15μg/m^3) than was predicted by Defra, but it should be recognised that the data capture from that analyser was only 43.4%.

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

In both 2016 and 2017 the winter months are the periods where elevated $PM_{2.5}$ air pollution was most frequently measured. December was the period in 2016 (**Appendix 1**) when the $PM_{2.5}$ concentrations were most regularly elevated and January was the period in 2017 when the $PM_{2.5}$ concentrations were regularly elevated (**Figure 4.2**). This apparent seasonal trend, while only based on two years,

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

In 2017, of the twenty-four days that the Defra Index was recorded as having been breached the elevated concentrations were recorded at multiple monitoring locations on fifteen days and on six of those days the elevated concentrations were measured by over half of the monitoring locations (**Figure 4.2**). This would suggest that on the majority of the days where breaches were measured these would have been associated with a national air pollution episode.

An example that supports this assumption can be seen in this BBC news article for the 23rd January 2017, https://www.bbc.co.uk/news/uk-england-london-38716498, which corresponds with the 22nd to 24th January 2017 when the highest concentrations of $PM_{2.5}$ were measured by the majority of the $PM_{2.5}$ analysers based in Hertfordshire.

Similar comparisons were able to be made in the 2016 report.

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

The general expectation in comparing the PHOI 3.01 index for each local authority against the measured $PM_{2.5}$ concentration would be that the highest index would be associated with the highest measured concentration.

A significant reason why this may not be borne out by comparing this data is that the PHOI is derived on a local authority scale whereas the $PM_{2.5}$ monitoring is occurring at a single fixed location. The fixed location typically selected to be in an area where residential properties are close to localised sources of air pollution.

Table 4.4 and **Figure 4.3** show that Luton and Watford have the highest PHOI but are not the locations where the highest $PM_{2.5}$ concentrations were recorded in 2017. A similar situation was noticeable for Luton in 2016 but no useful comparison can be made with Watford because the 2016 data capture was only 18% (**Appendix 2**).

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

Only two 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 five of the eight Hertfordshire monitoring locations the annual average concentrations measured in 2016 and 2017 were the same, or very similar.

The three exceptions were at the roadside sites in Hertsmere, Stevenage and Watford. In Hertsmere the comparison is not reliable because the 2017 data capture rate was only 43.4% and in Watford and Stevenage the comparison is not reliable because the 2016 data capture rates were both 18%.

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 two 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 this one year of data are as follows:

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

- Breaches are likely to be associated with regional or national scale air pollution episodes associated with locally derived road vehicle pollution in still and cold weather conditions

- Breaches may also arise if weather conditions are such that air pollution from the continent (and potentially further afield) is transported across to Britain

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

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

- Where data capture rates have been reliable the mean annual average concentrations of $PM_{2.5}$ recorded have not varied significantly from 2016 to 2017.

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

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

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

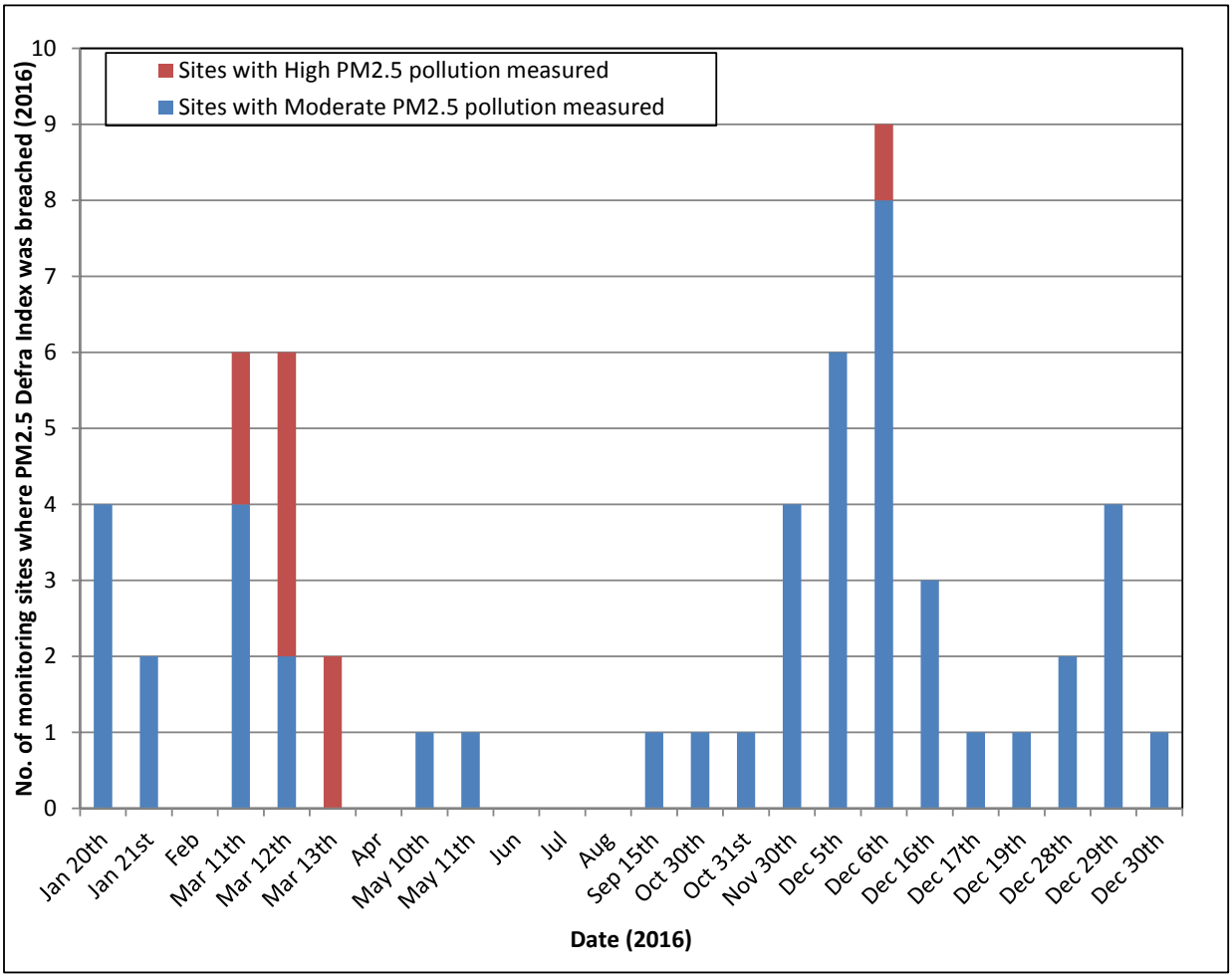
This work should, in the medium-term, enable the aim and the objectives of this $PM_{2.5}$ monitoring project (Section 2.1) to be better met.

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 2018. Draft Clean Air Strategy 2018. https://consult.defra.gov.uk/environmental-quality/clean-air-strategy-consultation/ (Accessed: 22 July 2018).

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



APPENDIX 2
PHOI 3.01 values and mean average annual (2016) $PM_{2.5}$ concentrations