

## Air Quality: Ashton Hayes and the surrounding Countryside

### Findings

- CWaC and DEFRA monitor air quality using a range of monitoring equipment<sup>1, 2, 3, 4</sup>. Pollutant levels are reported on a regular basis and much monitoring site data can be accessed over the internet. None of the sites are particularly close to Ashton. The most relevant are in Helsby, Ince, Elton, Mold and Speke.
- Currently in CWaC there are just two “Air Quality Management Areas” (AQMA’s) designated due to an exceedance of, or the risk of exceedance of, pollutant (NO<sub>2</sub>) levels. These AQMA’s are a considerable distance from Ashton Hayes in Ellesmere Port and Chester (Boughton). They are associated with vehicle emissions. It is known that the concentration of vehicular pollutants falls off very quickly<sup>7</sup> as one moves away from the road (the source of the pollution), reaching background levels at about 50 metres from the road.
- Although benzene can also be associated with vehicle emissions, the main monitoring sites (diffusion tube) are in Elton/ Ince/ Helsby close to large industrial sites in CWaC. CWaC state<sup>1</sup> that ***“there were no exceedances of the annual mean objective for benzene at the four benzene monitoring sites”***.
- Ground-level ozone is one of the most harmful air pollutants in Europe (including the UK) today<sup>13</sup>. Studies have clearly associated it with negative health effects and with premature human deaths especially in hot, sunny, summers and especially in southern Europe; the UK does not escape the negative effects on health however.
- Ozone is rarely emitted directly into the atmosphere (it is rarely a primary pollutant). It is produced in a complex series of photochemical reactions involving primary pollutants such as oxides of nitrogen, hydrocarbons etc... and strong sunlight.
- The level of primary pollutants in the UK has generally fallen in the last 15-20 years though there is evidence that these have plateaued recently. Notwithstanding this, measured levels of ozone have not paralleled this fall. This unexpected trend is also seen in European and North American reports. There is some admission in some reports that perhaps the origin of the ground level ozone is not fully understood.
- Levels of pollutants that are now considered to be acceptable may well be revised downwards as new research<sup>15</sup> reveals the negative impact these levels can have.

## Conclusions specifically relevant to Ashton Hayes

- As regards industrial activity, any pollutants from Ellesmere Port, Runcorn or Warrington are not generally carried to Ashton since the prevailing winds are from the South, South West or West <sup>5</sup>. This coupled with the turbulence within the air itself means that significantly problematic levels of these primary industrial pollutants from these areas are unlikely to be often experienced in Ashton.
- The main sources of primary pollutants (not ozone) in Ashton appear to be from (a) traffic passing through the village on the B5393 (b) sources in Ashton itself (bonfires/ house fires and boiler emissions). Some pollutants will travel from sources further afield (e.g. industry near Ellesmere Port) but this will depend crucially on wind direction and on weather conditions. Since the level of pollution from vehicles falls off quite quickly as one moves away from the road then this will be most problematic for people/ plants etc... close to the B5393.
- Ozone levels in Mold <sup>12</sup> can be seen to be close to or higher than the European Union Long Term Objective (LTO) value on a very hot, sunny day (August Bank Holiday 2013). It is therefore possible that on some summer days ground-level ozone pollution in Ashton may possibly pose a problem to some people (and to wildlife/ plant life) that are susceptible.

## Introduction

Air pollution has the potential to impact on human health and hence quality of life <sup>8, 13, 14, 15</sup>. This short report aims to briefly summarise data that is available from CWaC, DEFRA, the UK MET Office and the European Environment Agency about air quality, pollutant levels and prevailing winds near (or as near as possible to) Ashton Hayes. It also attempts to briefly summarise some of the data available on UK trends over the last 15 years or so.

The Government's "Expert Panel on Air Quality Standards" has prescribed health-based standards and objectives for several key pollutants <sup>1, 2</sup>. These are (Table 1 below taken directly from the DEFRA website <sup>16</sup>):

**Table 1: Air Quality Objectives included in Regulations for the Purpose of Local Air Quality Management in England.**

Pollutant	Air Quality Objective Concentration	Measured as	To be achieved by
<b>Benzene</b>			
All authorities	16.25 $\mu\text{g m}^{-3}$	Running annual mean	31 December 2003
England and Wales Only	5.00 $\mu\text{g m}^{-3}$	Annual mean	31 December 2010
<b>1,3-Butadiene</b>	2.25 $\mu\text{g m}^{-3}$	Running annual mean	31 December 2003
<b>Carbon Monoxide</b>			
England, Wales and N. Ireland	10.0 $\text{mg m}^{-3}$	Maximum daily running 8-hour mean	31 December 2003
<b>Lead</b>			
	0.5 $\mu\text{g m}^{-3}$	Annual mean	31 December 2004
	0.25 $\mu\text{g m}^{-3}$	Annual mean	31 December 2008
<b>Nitrogen Dioxide</b>			
	200 $\mu\text{g m}^{-3}$ not to be exceeded more than 18 times a year	1-hour mean	31 December 2005
	40 $\mu\text{g m}^{-3}$	Annual mean	31 December 2005
<b>Sulphur dioxide</b>			
	350 $\mu\text{g m}^{-3}$ , not to be exceeded more than 24 times a year	1-hour mean	31 December 2004
	125 $\mu\text{g m}^{-3}$ , not to be exceeded more than 3 times a year	24-hour mean	31 December 2004
	266 $\mu\text{g m}^{-3}$ , not to be exceeded more than 35 times a year	15-minute mean	31 December 2005

<b>Particles (PM<sub>10</sub>) (gravimetric)</b>			
All authorities	50 µg m <sup>-3</sup> , not to be exceeded more than 35 times a year	Daily mean	31 December 2004
	40 µg m <sup>-3</sup>	Annual mean	31 December 2004
	18 µg m <sup>-3</sup>	Annual mean	31 December 2010
<b>Particles (PM<sub>2.5</sub>) (gravimetric) *</b>	25 µg m <sup>-3</sup> (target)	Annual mean	2020
All authorities	20% cut in urban background exposure	Annual mean	2010 - 2020
<b>PAH *</b>	0.25 ng m <sup>-3</sup>	Annual mean	31 December 2010
<b>Ozone *</b>	100 µg m <sup>-3</sup> not to be exceeded more than 10 times a year	8 hourly running or hourly mean*	31 December 2005

**\* Not included in regulations at present**

**England:** The Air Quality (England) Regulations 2000 (SI 928), The Air Quality (England) (Amendment) Regulations 2002 (SI 3043),

**Wales:** Air Quality (Wales) Regulations 2000, No 1940 (Wales 138), Air Quality (Amendment) (Wales) Regulations 2002, No 3182 (Wales 298),

Some of these pollutants are emitted mainly from industrial processes (e.g. benzene, butadiene); some are emitted mainly if not exclusively by motor vehicles (e.g. nitrogen dioxide, PM<sub>10</sub> particles). The above Table mentions the gas ozone (O<sub>3</sub>) but this is not included in the Regulations at the moment. It is produced in the air through a series of complex chemical reactions involving primary pollutants under the influence of sunlight. DEFRA<sup>8</sup> and European studies<sup>13, 14, 15</sup> have stated quite clearly that current ozone concentrations in Europe do have negative health effects, especially in summer. Other studies<sup>10, 11</sup> have highlighted the possible the contribution of ozone to death rates so it is a very significant pollutant gas.

In CWaC these levels are monitored, are reported on regularly and are generally met. Where there is an exceedance or a risk of an exceedance an "Air Quality Management Areas" (AQMA's) is designated. There are currently two in the Borough and are associated with motor vehicle emissions.

It is important to note here that currently acceptable levels of some pollutants are likely to be revised down<sup>15</sup> as the long term effects on human, animal and plant life is better understood.

## The Monitoring of Air Quality Locally

### CWaC and DEFRA Monitoring Sites

The Borough of Cheshire West and Chester (CWaC) has an obligation under the Environment Act (1995) Part 4 to review and assess local air quality<sup>1, 2</sup>. To this end it operates a number of monitoring sites. Automatic monitoring sites are located in Helsby, Ellesmere Port and in Chester (Boughton) and monitor sulphur dioxide/ nitrogen dioxide (NO<sub>2</sub>) and PM<sub>10</sub> particles. CWaC also operates 80 diffusion tube sites, the closest being Helsby, Thornton le Moor and Elton/Ince. The Elton/Ince sites monitor benzene and NO<sub>2</sub>; the Helsby sites monitor just NO<sub>2</sub>; the Thornton le Moor site monitors benzene; the Chester sites monitor just NO<sub>2</sub>. There are no CWaC monitoring sites nearer to Ashton Hayes than these.

DEFRA runs the UK's largest automatic monitoring network (AURN)<sup>3</sup>. These monitoring sites measure a range of parameters and pollutants at high resolution and can provide hourly information. Of interest in this report they measure sulphur dioxide, nitrogen dioxide, PM<sub>10</sub> and PM<sub>2.5</sub> particles (the so-called particulates), carbon monoxide and ozone together with wind speed and direction. These sites do not measure benzene. The "local" sites are located at Speke, Mold, Warrington and Manchester<sup>4</sup>.

### Prevailing Winds

The Met Office states<sup>5</sup> that ***"The annual wind roses for Ringway and for Ronaldsway are typical of open, level locations across the region. There is a prevailing south-westerly wind direction through the year, but a high frequency of north to north-east winds in spring. Topography again plays a part in modifying the climate with channelling of winds between areas of high ground. For example, the Pennines and N Wales give a southerly bias to winds over Cheshire and Greater Manchester"***

The winds that Ashton experiences will therefore be from South/ South West/ West bringing air from South Cheshire, Chester, Ellesmere Port and, more rarely, from Runcorn or Warrington.

### Dispersion of Pollutants (Industrial and Vehicular) with Distance

Dispersion of pollutants from point sources (e.g. industrial sources) is difficult to model accurately<sup>6</sup> since it depends on a large number of variables including the weather, wind speed and wind turbulence. What is clear is that pollution levels do generally fall off with increasing distance from the source especially in turbulent wind conditions.

Pollution from vehicles has also been studied<sup>7</sup> recently and here reduction in, say, NO<sub>2</sub> levels from vehicles as one moves away from a busy road (e.g. M25 or M62) is linear with the natural logarithm of distance from the kerb. This report supports the generally-made assumption that beyond 50 metres from the road, concentrations approach background levels.

## **Pollution in the CWaC area (real time monitoring and diffusion tube monitoring)**

A number of Smoke Control Areas were designated under the Clean Air Acts between the 1950's and 1980's in Ellesmere Port, Helsby, Frodsham and Northwich which led to an immediate improvement in air quality. Nitrogen dioxide levels have generally halved since 1990<sup>2</sup> due to the introduction of catalytic converters and tighter controls on industrial emissions.

Currently in CWaC there are just two "Air Quality Management Areas" (AQMA's) designated due to an exceedance of, or the risk of exceedance of, NO<sub>2</sub> levels. These are in Ellesmere Port and Chester (Boughton) and are associated with vehicle emissions. Overall for the real time monitoring sites CWaC state<sup>1</sup> that:

***"In 2010 there were no exceedances of Air Quality Objectives for nitrogen dioxide, particulates (PM<sub>10</sub>'s etc... ) or sulphur dioxide measured at real time monitoring stations"***

And, as regards diffusion tube monitoring:

***"There were no exceedances of the annual mean objective for benzene at the four benzene monitoring sites. For nitrogen dioxide exceedances of the annual mean were recorded within the Boughton and the Ellesmere Port AQMA's"***

It is clear therefore that any primary pollutant issues that exist in the CWaC borough are not associated with industrial activity (apart from possible one-off events that obviously could occur in the future), only with vehicle emissions. The problematic areas are found in the busiest parts of Chester and Ellesmere Port and since pollution from vehicles is known to fall off quickly as one moves away from the kerbside<sup>7</sup> (at 50 metres from the kerb pollutant levels are generally approaching background levels) there is little danger of these pollutants affecting Ashton Hayes.

As regards industrial activity, primary pollutants from Ellesmere Port, Runcorn or Warrington are not generally carried to Ashton since the prevailing winds are South/ South West/ West<sup>5</sup>. This coupled with the turbulence within the air itself means that problematic levels of these industrial pollutants from these towns are unlikely to be experienced in Ashton.

From the above the main sources of primary pollutants (not ozone) in the Ashton Hayes area appear to be:

- 1) Traffic passing through the village on the B5393
- 2) "Fires" in Ashton itself (bonfires, fires heating houses and boiler emissions)

## UK-wide Trends in Pollution Levels – pollutants except ozone

As has been stated earlier in this report, DEFRA runs the UK's largest automatic monitoring network (AURN)<sup>3</sup>. These monitoring sites measure a range of parameters and pollutants at high resolution. Of interest in this report they measure sulphur dioxide, nitrogen dioxide, PM<sub>10</sub> and PM<sub>2.5</sub> particles (the so-called particulates), carbon monoxide and ozone together with wind speed and direction. These sites do not measure benzene. The sites local to Ashton Hayes are located at Speke, Mold, Warrington and Manchester<sup>4</sup>.

In April 2013 DEFRA issued a statistical release<sup>8</sup> for the two pollutants thought to have the greatest health impacts – ozone and particulates (PM's). This release gave annual average concentrations for the UK and states that since 1987 (and up to 2012) there have been marked improvements. Some of the conclusions from this release are relevant here and are given below:

- ***“Urban background and roadside particulate pollution has shown long-term improvement but has remained stable since 2008”***
- ***“There were on average fewer days of moderate or higher pollution at both urban and rural monitoring sites in 2012 compared with 2011. However, there is a great deal of year-on-year variability and there is no clear long-term trend. The main drivers for producing these days of moderate or higher pollution are particulate matter (PM's) and ozone”***

It is clear from the above that in some respects pollution levels (of particulate matter) have fallen in the last 15 years. It also seems that levels may have plateaued in the last 5 years but the current trend is unclear. These comments do not apply however to the second pollutant covered in this statistical release – ozone.

## UK-wide Trends in Pollution Levels – ozone

Ozone is rarely emitted directly into the atmosphere in significant quantities so that the gas is not usually regarded as a primary industrial or a vehicular pollutant. It is however produced in the air by the reaction under the influence of sunlight of other pollutants (e.g. hydrocarbons and nitrogen oxides) to form ozone either at the source of the primary pollution or even many kilometers down wind<sup>9</sup> from the emission site. Hydrocarbons and nitrogen oxides can be produced by both industrial activities (at Ellesmere Port and Runcorn for instance) and by motor vehicles.

It is known that ozone does damage to the mucus and respiratory tissues in animals, and also to the tissues in plants<sup>9</sup>. This makes ozone a potent pollutant and respiratory hazard when it occurs at ground level. This ground level ozone is not to be confused with the so-called ozone layer which is a portion of the stratosphere containing a higher concentration

of ozone that is beneficial to plants and animals by preventing damaging UV light from reaching the Earth's surface.

The DEFRA statistical release <sup>8</sup> concludes the following about annual mean ozone levels for the whole of the UK:

- ***“Urban background ozone pollution has shown a long-term increase while rural background ozone pollution has shown no clear long-term trend and has changed little recently”***

Since the levels of pollution that lead to ozone production has on average fallen in the UK then one would expect ozone levels to have fallen; this is not the case however. DEFRA speculate <sup>8</sup> that the above trends in ozone levels can be partly explained by assuming some of the ozone pollution that we experience in the UK originates in Europe. Given the prevailing winds in the UK this may be seen as a surprising speculation.

In the EU the Long Term Objective (LTO) <sup>14</sup> ozone level is 120  $\mu\text{g}/\text{m}^3$ . This is not a strict target. However all EU member states are required <sup>14</sup> to report on ozone levels measured annually. There are no monitoring sites for ozone in the immediate Ashton area so Mold has been chosen as an approximate comparison site. The DEFRA website gives information on the ozone levels measured at this site <sup>12</sup>. Interestingly in the month of August in 2013 ozone levels peaked at just below 120  $\mu\text{g}/\text{m}^3$  on the 26<sup>th</sup> August at approximately mid-day. On other days in August the level reached anywhere from 50 to 80  $\mu\text{g}/\text{m}^3$ . Ozone levels in a town in rural Wales are therefore measured to be at times quite significant; usually in the middle of the day in summer (26<sup>th</sup> August was Bank Holiday Monday and was a very sunny day).

## **Discussion – Ozone levels in Ashton Hayes and their significance**

It seems that ozone does have the potential to cause harm to human beings and plants. It also seems that even though the precursor pollutants that are involved in the production of ozone have fallen in the UK, measured levels of ozone have not paralleled this fall. This appears to be true too in most of Europe and in the USA <sup>13, 14, 15</sup>. It also appears that on some days, especially hot, still days in summer that ozone levels can exceed levels that the EU consider should not be breached <sup>13, 14, 15</sup>.

Ozone levels in Mold <sup>12</sup> can be seen to be close to or higher than the Long Term Objective (LTO) value on a very hot, sunny day. It is therefore possible that on some summer days ozone levels near the ground in Ashton may pose possibly a problem to those who are susceptible. Any fuller statement on this subject is completely outside the scope of this short report.



## References

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