GREN Air Quality Briefing: John Oversby August 2016

Overview

Air Quality has been a matter of interest to urban dwellers for decades. Many will know of the smogs in the first half of the century, especially documented for London. Smogs, though, were common in many industrial towns. This impacted first on transport, but the effect on health, especially mortality and reduction in ability to work, was evident in excess deaths and work sickness in comparison to obvious levels of smog. Improvements in measurements of various components of air, and data collection from the medical profession, helped to pinpoint those factors that had the greatest effect on health. Additionally, local variations in air components, specifically related to components close to ground level, and in busy and quiet streets, focused attention to the impact of Air Quality on children, and vulnerable adults. The availability of this data has proved valuable to policy makers and environmentalists.

Features of air quality

This brief is largely concerned with Air Quality in urban environments. The two factors that are of greatest influence on health, and therefore public policy, are oxides of nitrogen, and very small (sub-microscopic) particles. Oxides of nitrogen are formed in internal combustion engines from the nitrogen and oxygen injected (as air), and then heated to high temperatures. All internal combustion engines emit nitrogen oxides, and particles. Catalytic converters can first reduce the production of oxides of nitrogen by splitting them into nitrogen and oxygen. Carbon and carbon monoxide can be converted into carbon dioxide later in the catalytic converter. The internal combustion engine (petrol and diesel) has been designed to be more efficient, leading to lower emissions, and this has been supported by legislated regulations. As we have seen recently, self-monitoring by car engine manufacturers has led to some devious and misleading reporting of data. It is now common for testing stations to check and report on emission levels for statutory purposes.

Health effects

Generally, if you are young and in a good state of health, moderate air pollution levels are unlikely to have any serious short term effects. However, elevated levels and/or long term exposure to air pollution can lead to more serious symptoms and conditions affecting human health. This mainly affects the respiratory and inflammatory systems, but can also lead to more serious conditions such as heart disease and cancer. People with lung or heart conditions may be more susceptible to the effects of air pollution.

The table below shows the types of health effects experienced by the most common pollutants at elevated levels:

Pollutant	Health effects at very high levels
Nitrogen Dioxide, Sulphur Dioxide, Ozone	These gases irritate the airways of the lungs, increasing the symptoms of those suffering from lung diseases
Particles	Fine particles can be carried deep into the lungs where they can cause inflammation and a worsening of heart and lung diseases
Carbon Monoxide	This gas prevents the uptake of oxygen by the blood. This can lead to a significant reduction in the supply of oxygen to the heart, particularly in people suffering from heart disease

Measurement of Air Quality

Measurement of Air Quality is shared between local authorities, and the government through DEFRA. Static monitoring stations are dotted around the country, focusing on oxides of nitrogen and sub-microscopic particles. There are three sites in Reading (see later). The LA sites measure nitrogen dioxide and PM10 (particles 10 µm and below).

Oxides of nitrogen Nitrogen dioxide is measured continuously using an instrument called a chemiluminescence analyser. There are networks of over 200 monitoring sites, using chemiluminescence analysers, throughout the UK. The main network relevant to Reading is The Automatic Urban and Rural Network (AURN) – funded mainly by the UK Governments, but with some local authority sites. Other monitoring sites are run by groups such as local authorities, the Highways Agency and the electricity generating companies.

Sub-microscopic particles The most straightforward of the ambient monitoring techniques available is to draw air through filter papers using pumps followed by gravimetry (weighing before and after sampling). In order to measure different size fractions a size specific sampling head or cascade impactor device is used. Other methods can be used for continuous monitoring. Generally, for PM2.5 the results are not very reliable, even with skilled operators (to only 25%), while PM10 is more straightforward. It is now thought that PM2.5 is more dangerous, since it can more easily get into the lungs.

Reading monitoring sites

Reading Caversham Road (REA2)

Latitude: 51.464355
Longitude: -0.977094
Date Started: 22/11/2006
Environment: Roadside

Latest Data

This monitoring site data was last updated: 27/08/2016 06:00

Parameter	Pollution Band	Concentration	Period
PM_{10} particulate matter (Hourly measured)	Moderate (Index 6)	73 µg/m^3 (Ref.eq)	24 Hour mean
Nitrogen dioxide (NO_2)	Low (Index 2)	69 µg/m^3	Hourly mean
Nitric oxide (NO)	not applicable	89 µg/m^3	Hourly mean
Nitrogen oxides as nitrogen dioxide (NO_x as NO_2)	not applicable	205 µg/m^3	Hourly mean

Note: Values are based on provisional data. Data are GMT hour ending.
PM_{10} is measured as a running 24 hour mean, up to the current hour, and the band/index is calculated accordingly.

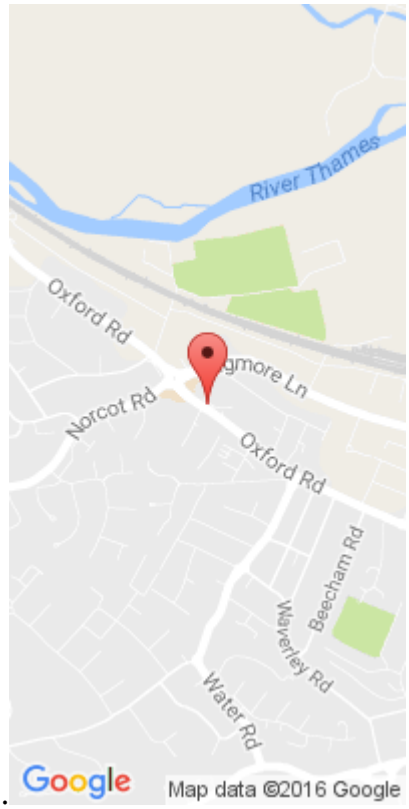
Reading Oxford Road (REA4)

Latitude: 51.461957
Longitude: -1.012459
Date Started: 05/12/2007
Environment: Roadside

Latest Data

This monitoring site data was last updated: 27/08/2016 06:00

Parameter	Pollution Band	Concentration	Period
PM_{10} particulate matter (Hourly measured)	Low (Index 2)	29 µg/m^3 (Ref.eq)	24 Hour mean
Nitrogen dioxide (NO_2)	Low (Index 1)	29 µg/m^3	Hourly mean
Nitric oxide (NO)	not applicable	21 µg/m^3	Hourly mean
Nitrogen oxides as nitrogen dioxide (NO_x as NO_2)	not applicable	61 µg/m^3	Hourly mean



Reading Kings Road site was closed in February 2016

DEFRA data from the London Road site is:

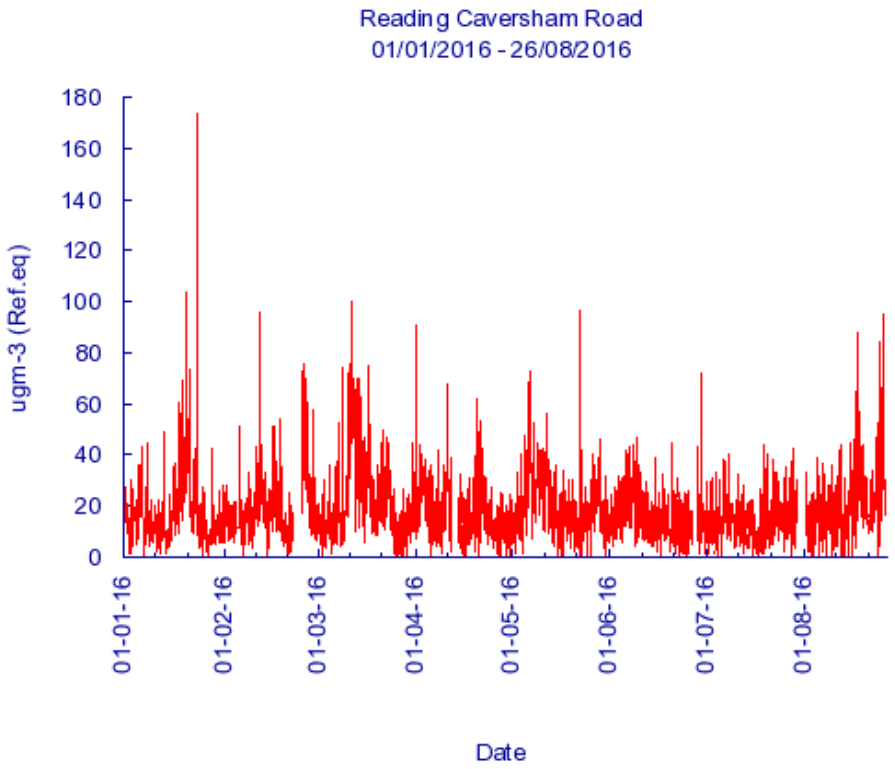
Latest data for Reading London Rd.

The table below shows the latest data for this monitoring site.

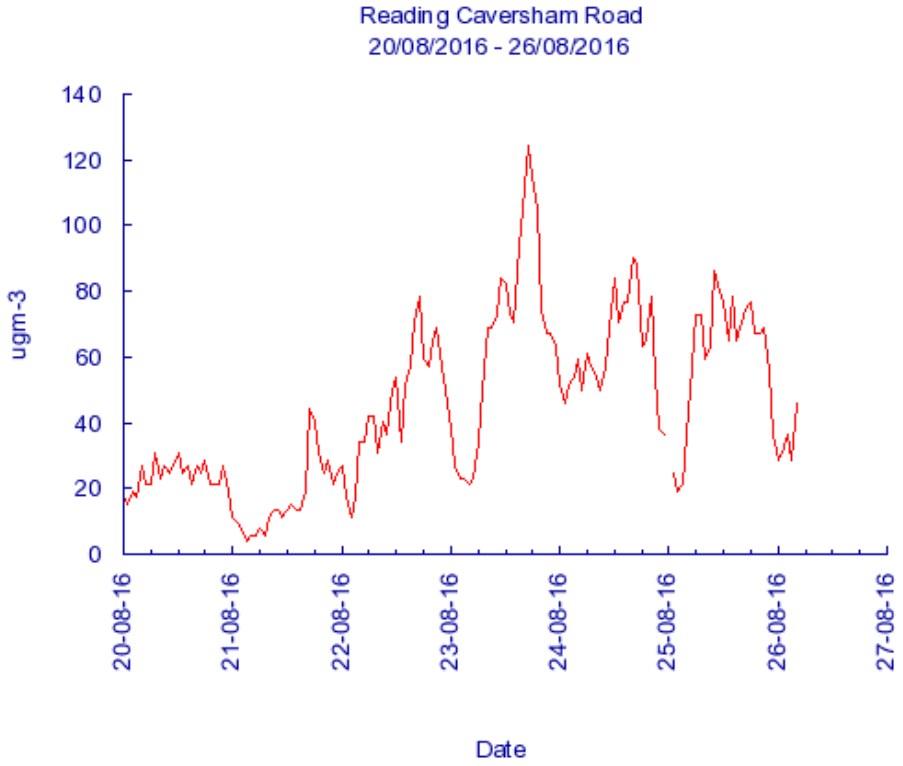
Pollutant	Date	Time	Measurement	Unit	Period	Comment
Nitric oxide (NO)	27/08/2016	13:00	41.90928	µg/m^3	Hourly	-
Nitrogen dioxide (NO_2)	27/08/2016	13:00	69.80625	µg/m^3	Hourly	-
Nitrogen oxides as nitrogen dioxide (NO_XasNO_2)	27/08/2016	13:00	134.06625	µg/m^3	Hourly	-
PM_{10} particulate matter (Hourly measured) (PM_{10})	27/08/2016	05:00	0.000	µg/m^3 (Ref.eq)	Hourly	-
Modelled Wind Direction (Dir)	26/08/2016	24:00	24.9	°	Hourly	- No current data.
Modelled Wind Speed (Speed)	26/08/2016	24:00	2.8	m/s	Hourly	- No current data.
Modelled Temperature (Temp)	26/08/2016	24:00	12.5	°C	Hourly	- No current data.

Long-term and short-term graphs of NO2 for Caversham Road monitor.

1/. NO2 over 8 months – showing wide variation.



2/. NO2 over a week – showing hour-by-hour variation over seven days.



Reflections on Reading data

In an urban environment, readings are affected by the canyon effect, i.e. houses at the roadside that funnels and can trap the air. Some particles are from vehicles and some carried by wind from further afield (such as ammonium compounds and nitrates from farms). Varying road conditions affect hourly values, with a low between 1 am and 5 am, a peak in the morning rush hour (around 8 am) and a higher value in the afternoon and evening, but not so many peaks as the traffic mixes the air and evens out variation.

The Caversham site has some moderate PM10 values but other measurements are in the low category. However, the number of sites is limited (three in total with two only measuring two potential pollutants). Measurement of PM2.5 is not carried out, perhaps through technical difficulties. This is a serious omission.

Suggestion

National FoE can loan out portable SidePak monitors (to measure PM2.5) for up to two weeks and can supply Diffusion Tubes to measure NO2. Since I am convinced that the main culprit causing serious harm is PM2.5 particles, I suggest we focus on that, and not on the oxides of nitrogen. Around the Town Meal, on the fast road towards the train station, could be best. A major aim is to use this as Citizen Science, at least to sensitise members.