Exeter City Council

Proposed Study of Personal Exposure to $PM_{2.5}$

Aim:
To use measurements of the actual exposure of Exeter residents to $PM_{2.5}$ to develop exposure reduction advice, and raise public awareness.

Objectives:
1. To identify five individuals who because of their home address, work or daily activities are likely to have a range of exposure to air pollution, and to equip them with personal $PM_{2.5}$ monitors and GPS loggers for at least 24 hours.
2. To map the exposure of the five individuals by location, and to plot exposure against time and activity.
3. To compare exposure between locations and activities (for example between main roads and back roads, or between travel by car and by train).
4. To discuss their exposure with the five individuals, and make suggestions of how exposure could be reduced (for example by changing mode of travel, or route).
5. To repeat exposure measurements and review the effectiveness of the advice given and any changes made.
6. To produce outputs for public information based on the findings.

Introduction
Air pollution has been linked to a variety of health effects. The greatest body of evidence is for effects on the respiratory system. These range from immediate effects such as coughing and wheezing, to triggering and worsening respiratory diseases such as asthma or chronic obstructive pulmonary disease (COPD). Recent research has also found a clear relationship between air pollution and cardiovascular problems, including hospital admissions and deaths.

Air pollution affects all those who are exposed to it, but it has a more serious effect on vulnerable people. Particularly vulnerable groups include children, pregnant women, the elderly and patients with existing respiratory diseases.

Air pollution does not cause a specific and identifiable 'air pollution disease'. This makes it difficult to measure the impact of poor air quality in health and mortality statistics. Some recent estimates are that fine particles (PM_{10}) cause an annual effect equivalent oto25,000 deaths in England alone. This is more than the number of deaths caused by passive smoking in a year. Estimates of the costs of air pollution to society are equally large. One suggestion is that ultrafine particles ($PM_{2.5}$) cost the UK £15bn per year in health costs (BMA 2012).

Recent modelling suggests that the equivalent of 42 deaths per year in Exeter are attributable to ultra-fine particles ($PM_{2.5}$). The vulnerable groups listed above are likely to be particularly affected, as well as those who by the nature of where they live or work, are exposed to the highest concentrations. In Exeter, the main source of local air pollution is from traffic. The areas most affected are busy roads, with queuing traffic and where buildings are close to the kerbside. Areas with high levels of air pollution also tend to be relatively deprived.

However, health impacts on an individual cannot be assessed by a simple measurement of roadside pollution concentrations alone. Figure 1 below from Kings College, London summarises the complex series of personal and spatial factors which control the effect on any individual.

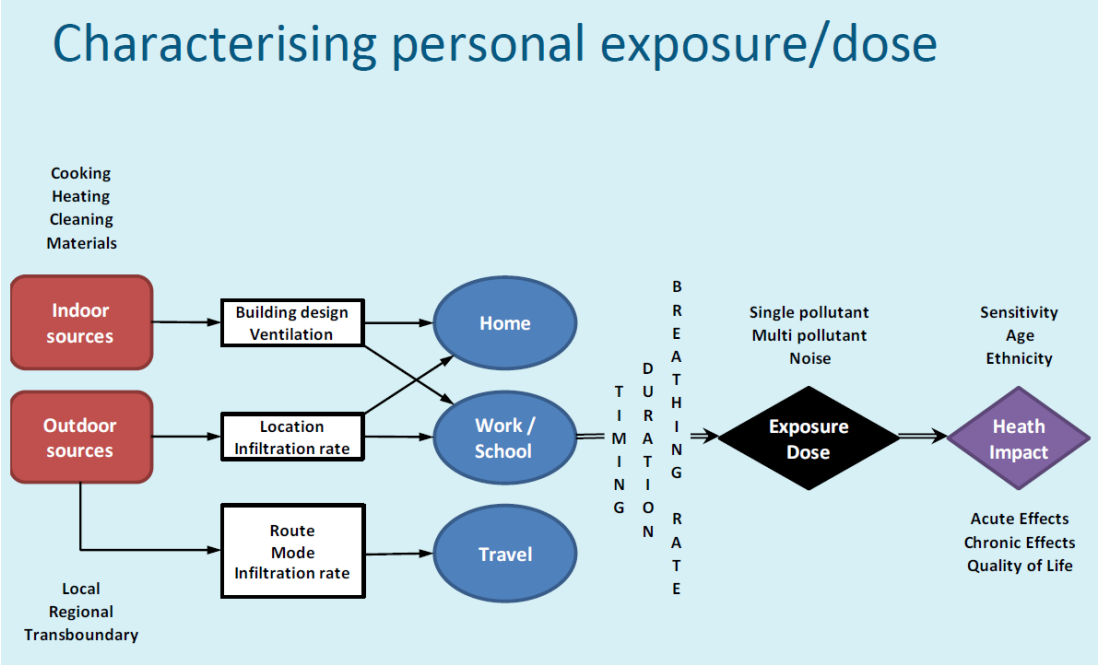

Figure 1 Characterising Personal Exposure/Dose (Barratt 2013)

In the Kings College study, black carbon and GPS monitors were provided to seven volunteers for the same 24 hour period. The results were immediately recognisable and personal to the volunteers (toddler, school pupil, officer worker, home worker, cycle courier, ambulance driver and pensioner). For example, figure 2 shows the day's exposure for the office worker, and figure 3 is a map showing exposure by location for a school pupil.

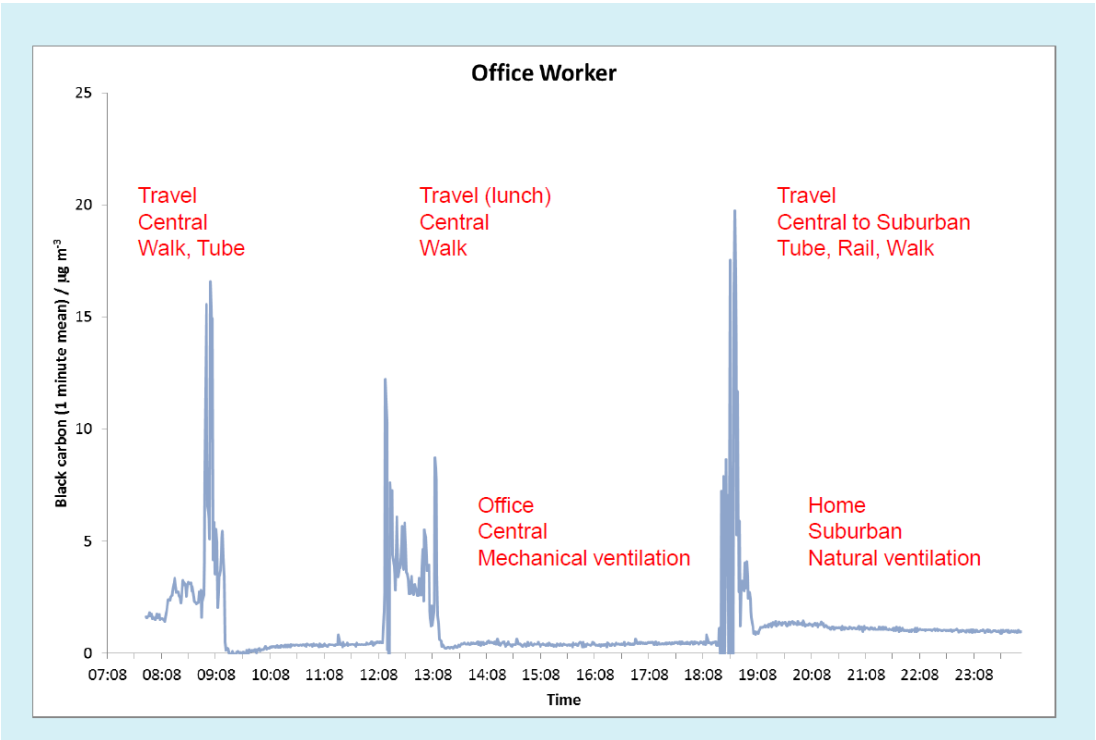

Figure 2 Exposure throughout the day for an office worker (Barratt 2013)

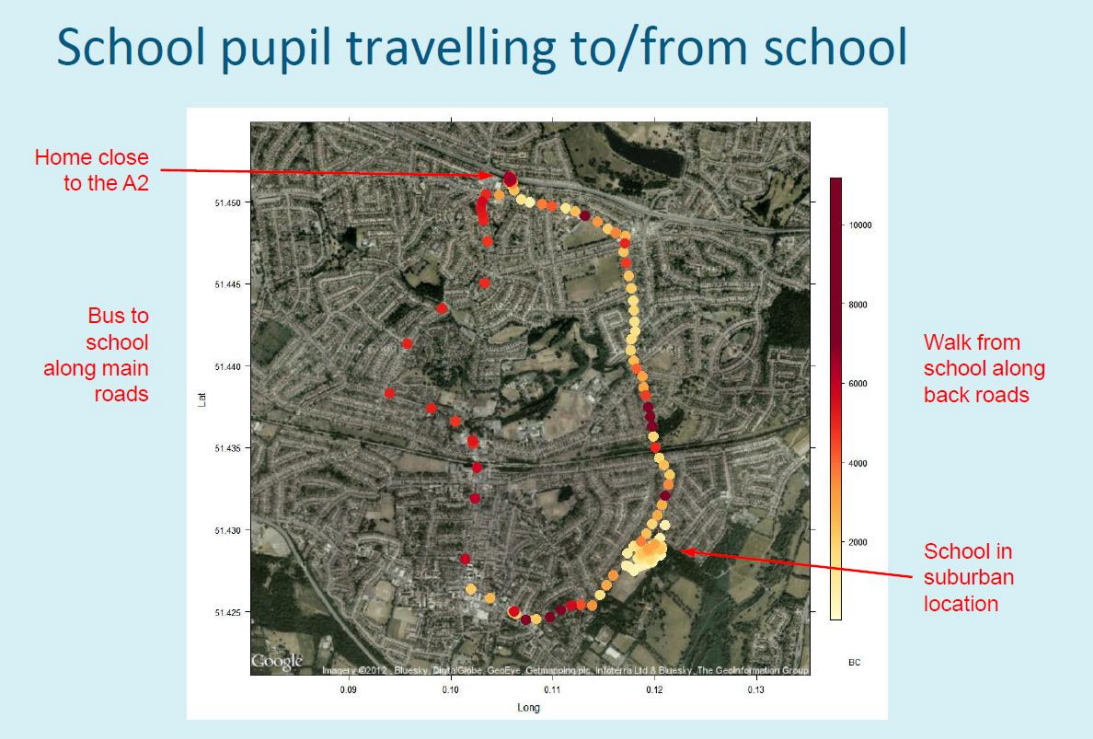

Figure 3 Exposure by location for a school pupil (Barratt 2013)

The project concluded that personal exposure provides an effective way of communicating air pollution issues in an engaging way. The study increased the understanding of personal exposure, but it also provided highly visual outputs for public information, which could be used in tools and information on how air pollution can be avoided (public meetings, website and route planner etc). The study team were able to demonstrate that walking along a back road is better than walking beside a main road, or that exposure is lower on a train than in a car.

Exeter City Council Environmental Health Services would like conduct a similar one-off study in Exeter, using hired equipment.

Methodology

1. Hire portable equipment to measure either black carbon, or PM2.5. It must be able to run at least 24 hours before needing to be re-charged, downloaded or having a filter change. It must be capable of a sample rate which approximates to the respiration rate of a human. It should have suitable accuracy and precision, and meet relevant standards.
2. Hire or buy GPS watches.
3. Identify participants.
4. Undertake study for one single 24 hour periods. We could repeat this with another group of five individuals, if timings allow.
5. Collate results and draw conclusions/make recommendations.
6. Work with health professionals to produce material for public and publicity. This would be based on a message of “the healthiest walk/run possible”, and reinforcing existing sustainable transport messages.

Budget breakdown:
It has proved more difficult than expected to source monitors for hire. Work is ongoing in this regard. Purchase of monitors would cost between £2,500 and £5,500 depending on the type (and accuracy) of the instrument.

Purchase of GPS watches will also be required. It is expected that this will be more cost effective than hire.

References

http://bma.org.uk/transport

Public Health England, PHE-CRCE-010: Estimating Local Mortality Burdens associated with Particulate Air Pollution 2014.
http://www.hpa.org.uk/Publications/Environment/PHECRCEReportSeries/PHECRCE010/

www.londonair.org.uk/london/asp/LAQNSeminar/pdf/June2013/Ben_Barratt_Insights_into_personal_exposure_to_air_pollution.pdf