General Lessons from the UK's Air Quality Review and Assessment Process

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In 1995 the UK's Environment Act established the UK Environment Agency and also set out the requirements for an air quality strategy. This was published as *The Air Quality Strategy for England, Scotland, Wales and Northern Ireland – Working Together for Clean Air* in January 2000 following a number of consultation drafts. Shortly afterwards, on 6th April 2000 *The Air Quality (England) Regulations 2000* came into force specifying air quality objectives for the common and most significant air pollutants. These are summarised in the following table. Similar regulations were also put in place for Scotland and Wales.

Objectives included in the Regulations 2000 for the purpose of Local Air Quality Management.

Pollutant	Air Quality Objective		Date to be Achieved by
	Concentration[1]	Measured as	
Benzene	16.25 µg/m^3 (5 ppb)	running annual mean	31.12.2003
1,3 Butadiene	2.25 µg/m^3 (1 ppb)	running annual mean	31.12.2003
Carbon monoxide	11.6 mg/m^3 (10 ppm)	running 8-hour mean	31.12.2003
Lead	0.5 µg/m^3	annual mean	31.12.2004
	0.25 µg/m^3	annual mean	31.12.2008
Nitrogen dioxide	200 µg/m^3 (105 ppb) not to be exceeded more than 18 times per year	1 hour mean	31.12.2005
	40 µg/m^3 (21 ppb)	annual mean	31.12.2005
Particles ($_{PM10}$)[2]	50 µg/m^3 (gravimetric) not to be exceeded more then 35 times per year	24 hour mean	31.12.2004
	40 µg/m^3 (gravimetric)	annual mean	31.12.2004
Sulphur dioxide	350 µg/m^3 (132 ppb) not to be exceeded more than 24 times per year	1 hour mean	31.12.2004
	125 µg/m^3 (47 ppb) not to be exceeded more than 3 times per year	24 hour mean	31.12.2004
	266 µg/m^3 (100 ppb) not to be exceeded more than 35 times per year	15 minute mean	31.12.2005

1. Conversion of ppb to µg/m^3, and ppm to mg/m^3 at 20 deg C and 1013 mb
2. Measured using the European gravimetric transfer standard or equivalent

The Air Quality Strategy (AQS) required all local authorities to carry out a phased *Review and Assessment* of the air quality within each of their jurisdictions. The approach was designed so that areas with no, or only very minor, air pollution problems could drop out of the process at an early stage, therefore limiting costs. The three stages of the phased approach were:

- Stage 1 – An initial screening, using simple screening methodologies, of industrial, transport and other sources of pollutants intended to identify those which may have a significant impact within an authority's area. This considered mainly magnitudes of emissions.

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- Stage 2 – If Stage 1 indicated a possible exceedence of an objective for one or more pollutants then a more detailed screening study of the sources giving cause for concern together with analysis of any available monitoring data were carried out. This was to identify the areas of poorest air quality, the potential for public exposure to poor air quality and to ascertain if there was any risk of the objectives not being met.
- Stage 3 – Where there was a risk of the objectives not being met a detailed and accurate appraisal of potential impacts had to be carried out. Authorities would need to make decisions based on the outcome of their Stage 3 study so it needed to be demonstrably adequate for this purpose. To this end a number of guidance documents were produced dealing mainly with Stage 3 studies and covering issues such as the use of dispersion models and "validation".

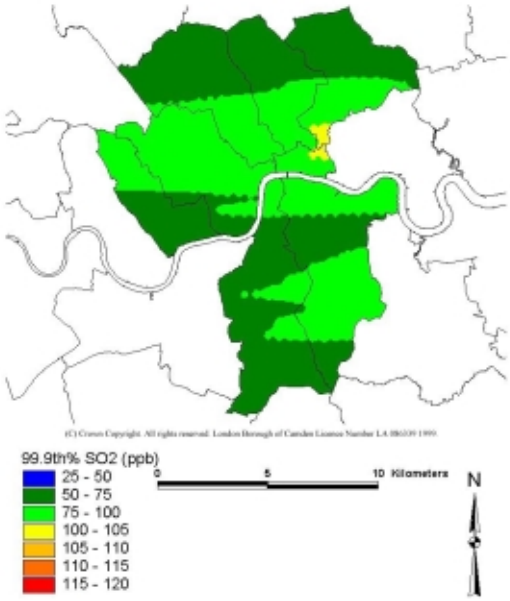
In practice a number of local authorities, including all 33 within London, went directly to Stage 3 without formally carrying out the earlier stages. In these cases, and many of the others, the Stage 3 study took the form of a borough-wide modelling study. Initially one or more recent years were modelled and the results compared with available monitoring data. Based on these results there would be some correction and refinement of the input data to the modelling until acceptable agreement was achieved with the monitoring data. Emissions were then adjusted to take account of known or expected changes occurring by the years to which the objectives applied. Modelling was then carried out with these revised emissions and the results compared with the appropriate objectives.

If an authority, following a Stage 3 study, still has areas predicted to exceed any of the objectives then it is obliged to designate an Air Quality Management Area (AQMA). Currently*, 59% of local authorities (excluding Northern Ireland) have proceeded to Stage 3 and 47% of these (28% of all local authorities) would seem likely to be declaring AQMA's (14% of all local authorities have yet to submit reports). The following table gives the numbers of authorities terminating the process after the various stages and those declaring AQMAs.

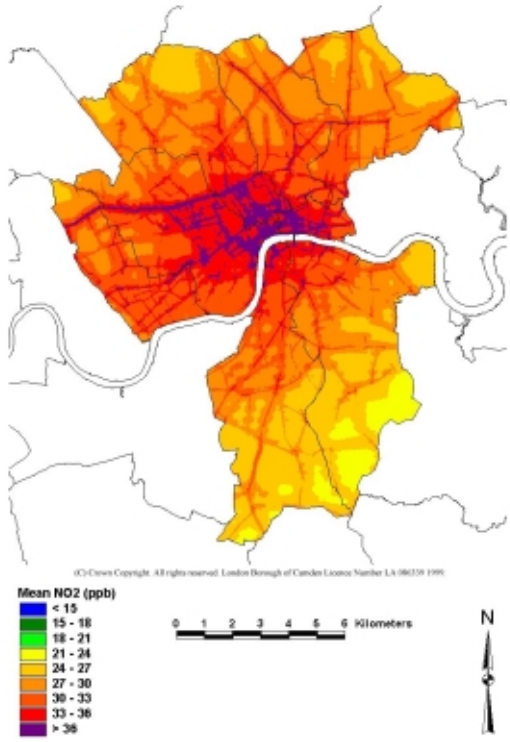
Region	**No. LA's**	**Completed at:**			**AQMA's Expected**
		Stage 1	**Stage 2**	**Stage 3**	
England (Ex. London)	320	10	64	199	74
London	33	0	0	33	32
Scotland	32	12	12	4	3
Wales	22	2	9	4	3
Totals	**407**	**24**	**85**	**240**	**112**
% of total	-	6	21	59	28

*Data to 28th March 2001 – provided by the Air Quality Management Resource Centre, University of the West of England.

CERC was extensively involved in many of the research studies ahead of the implementation of the Air Quality Startegy and subsequently carried out or assisted with a large number of the Stage 3 studies. The ADMS-Urban air quality model, described at previous Harmonisation Workshops, has been used by CERC or local authorities in studies of approximately 70 local authority areas within the UK. These authorities vary from those in Central London, to rural authorities with major motorways, to authorities that have a number of small towns, possibly with some industrial sources. Maps 1 to 3 show modelling results for current air quality for eight central London boroughs (the Central London Cluster Group).



Map 1 Current concentrations of sulphur dioxide in central London based on 1997 weather data.
Note: Areas of the map coloured yellow are those which exceed the air quality target.



Map 2 Current concentrations of nitrogen dioxide in central London based on 1997 weather data.
Note: Areas of the map coloured yellow through to purple are those which exceed the air quality target.

Map 1 gives the 99.9th percentile of 15 minute averages for sulphur dioxide and clearly shows the impact of major point sources located to the east of London. Map 2 shows the annual average nitrogen dioxide concentration with the impacts of individual major roads clearly visible. Finally, Map 3 presents the 99th percentile PM_{10} concentrations. Again the impacts of major roads are apparent. For all of these results, comparison with monitoring data indicated an accuracy of typically ±10%.

Map 3 Current concentrations of particulates (PM10) in central London based on 1996 weather data.
Note: Areas of the map coloured yellow through to red are those which exceed the air quality target.

During the execution of these studies a number of significant issues were identified which are of general relevance to this type of detailed, spatially extensive air quality modelling study both within the UK and elsewhere. These included:

- Input data – Careful consideration needs to be given to both the quality and quantity of both emissions and monitoring data used in a study;
- Effectively dealing with extensive areas – Spatially extensive studies need to be divided into manageable sub-areas to ensure that adequate resolution is achieved at key locations such as major road junctions;
- Assessment of uncertainty in model predictions – Care has to be taken in using the often very limited monitoring data that are available;
- Accounting for secondary and coarse fraction particulates – These normally dominate the primary contribution so their level of accuracy can be very significant;
- The background monitoring data used for NO_2 predictions – Care has to be taken in distinguishing between the emissions included within the modelling and those represented by background concentration values.

For those local authorities that declare an Air Quality Management Area (AQMA) there are immediately requirements for additional studies and, after consultation with the relevant stakeholders, a requirement for the development of an Air Quality Action Plan (AQAP). The AQAP must identify mitigating measures necessary for reducing the exceedences of air quality objectives identified. For most local authorities with air quality concerns, this is the stage that they have now reached and they are now embarking on prediction of the effectiveness of some likely typical elements of AQAP's, such as Low Emission Zones (LEZs), road closures, speed restrictions and changes to the vehicle fleet. A discussion of the work currently being carried out will be given together with preliminary predictions of the likely outcomes.