

www.defra.gov.uk

Air Pollution in the UK 2009

Edition A: Summary of the UK's Annual Report to the EU Commission under Directives 2008/50/EC and 2004/107/EC



A report prepared by AEA for Defra and the Devolved Administrations.

Title	Air Pollution in the UK 2009 – Edition A, A Summary of the UK’s Annual Report to the EU Commission under Directives 2008/50/EC and 2004/107/EC
--------------	--

Authors	AEA Technology: Agnieszka Griffin, Andrew Kent, Alison Loader, Carlos Martinez, John Stedman, Ken Stevenson, Keith Vincent, Paul Willis, Rachel Yardley Defra: Emily Connolly and Clare Bayley
----------------	---

Published by the Department for Environment, Food and Rural Affairs, September 2010

Department for Environment, Food and Rural Affairs
Nobel House
17 Smith Square
London SW1P 3JR
Telephone 020 7238 6000
Website: www.defra.gov.uk

© Crown copyright 2010
Copyright in the typographical arrangement and design rests with the Crown.

This publication (excluding the Royal Arms and departmental logos) may be re-used free of charge in any format or medium for research for non-commercial purposes, private study or for internal circulation within an organisation. This is subject to it being re-used accurately and not used in a misleading context. The material must be acknowledged as Crown copyright and the title of the publication specified.

For any other use of this material please apply for a Click-Use Licence for Public Sector Information (PSI) or core material at:

<http://www.opsi.gov.uk/click-use/psi-licence-information/index.htm>

or by writing to:

Office of Public Sector Information
Information Policy Team
St Clements House
2-16 Colegate
Norwich NR3 1BQ

Fax: 1603 723000
Email: licensing@cabinet-office.x.gsi.gov.uk

Executive Summary

The UK is required to report air quality data on an annual basis under the following European Directives:

- The Council Directive on ambient air quality and cleaner air for Europe (2008/50/EC)
- The Fourth Daughter Directive 2004/107/EC under the Air Quality Framework Directive (1996/62/EC)

This report summarises the UK's 2009 submission on air quality to the EU Commission, presenting air quality modelling data and measurements from national air pollution monitoring networks. These data are produced on behalf of Defra (the Department for Environment, Food and Rural Affairs) and the Devolved Administrations of Scotland, Wales and Northern Ireland.

The pollutants covered in this report are:

- Sulphur dioxide (SO₂)
- Nitrogen oxides: (NO_x) comprising NO and NO₂
- PM₁₀ and PM_{2.5} particles
- Benzene
- Carbon Monoxide (CO)
- Heavy Metals
- Polycyclic aromatic hydrocarbons (PAH)
- Ozone (O₃)

The report provides background information on the pollutants, their sources and effects, the UK's statutory monitoring networks, the UK's modelling methodology and detail on the exceedences reported in 2009, with an overview of trends.

The 2009 results can be summarised as follows.

- No exceedences of the SO₂ limit value were reported in 2009 or in recent years.
- The UK exceeded the limit value plus margin of tolerance for hourly mean nitrogen dioxide in two zones, and annual mean nitrogen dioxide in 40 zones (out of a total of 43 zones). This is similar to the numbers of exceedences both measured and modelled in previous years.
- Only one zone was reported as exceeding the 24-hour limit value for PM₁₀ during the year, after subtraction of the contribution from natural sources. This is the same as last year.
- Exceedences were reported for the long term ozone objective for human health in 39 zones, and exceedences were reported for the long term ozone objective for vegetation in 10 of the 15 non-agglomeration zones where it applies.
- Two exceedences of the target values for nickel were reported in 2009, as was the case in 2008.
- Six exceedences of the target values were reported for benzo[a]pyrene as in 2008.

Copies of previous annual submissions can be found on the Commission website:

<http://cdr.eionet.europa.eu/gb/eu/annualair>. For more information on air quality in the UK visit the Defra website at www.defra.gov.uk/environment/quality/air/index.htm and the UK Air Quality websites at www.airquality.co.uk, www.scottishairquality.co.uk, www.welshairquality.co.uk and www.airqualityni.co.uk.

Table of contents

1	Introduction	3
2	The Evidence Base	4
2.1	Pollutants of Concern	4
2.2	Current UK Air Quality Monitoring	7
2.3	Modelling	9
3	Assessment of Compliance	11
3.1	Definition of Zones	11
3.2	Air Quality Assessment for 2009	13
3.3	Comparison with Previous Years	20
4	Where to find more information	25

1 Introduction

European Directives on ambient air quality require the UK to undertake air quality assessment, and to report the findings to the Commission on an annual basis. Historically this has been under:

- The Air Quality Framework Directive (1996/62/EC)
- The Daughter Directives (DD) (1st DD -1999/30/EC, 2nd DD -2000/69/EC, 3rd DD - 2002/3/EC and 4th DD- 2004/107/EC).

In June 2008, a new Directive came into force: the Council Directive on ambient air quality and cleaner air for Europe (2008/50/EC) – known as the “Air Quality Directive”¹. This Directive consolidates the first three Daughter Directives, and was transposed into the Regulations in England, Scotland, Wales and Northern Ireland in June 2010. The 4th Daughter Directive² remains in force.

The UK has statutory monitoring networks in place to meet the requirements of these Directives, with air quality modelling used to supplement the monitored data.

In 2009 the UK undertook the annual air quality assessment in accordance with the Air Quality Directive and the 4th Daughter Directive (4th DD). The results were submitted to the European Commission in the form of a standard questionnaire which each Member State must complete. Previous annual submissions can be found on the Commission website:

<http://cdr.eionet.europa.eu/gb/eu/annualair>.

This report provides a summary of the UK’s 2009 annual report to the Commission, based upon measurements and modelling results. The 2009 Air Pollution in the UK report follows a different structure to recent years’ publications. This year two editions of the report will be published:

- Edition A, published in September 2010, has the primary objective of accompanying the UK’s submission of 2009 air quality data via a Questionnaire to the European Commission and making it more public facing. This report focuses on the *statutory* monitoring, and supplementary modelling, undertaken in the UK.
- Edition B will be published in December 2010, to provide information to a wider group of stakeholders and members of the public. This report will look in more detail at other monitoring undertaken for research purposes and will include more detailed analysis of air pollution in the UK.

This report (Edition A of Air Pollution in the UK 2009) will:

- Review the evidence base – the pollutants of concern and where and how air pollution is measured and modelled in the UK (*Section 2*).
- Provide a summary of the UK air quality in relation to two European Directives (*Section 3*):
 - Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe
 - Directive 2004/107/EC of the European Parliament and of the Council of 15 December 2004 relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air – the 4th Daughter Directive.

This summary also compares the 2009 data with recent years and provides an assessment of the data trends.

- Provide information on where and how to find out more about air pollution emissions, levels and effects in the UK (*Section 4*).

Links to the suite of EC Directives on ambient air quality are provided on Defra’s web pages at <http://www.defra.gov.uk/environment/quality/air/airquality/eu-int/eu-directives/airquality-directives/index.htm> .

2 The Evidence Base

2.1 Pollutants of Concern

This section describes the sources and effects of the pollutants being assessed in relation to the Air Quality Directive and 4th Daughter Directive.

Sulphur Dioxide

Sulphur dioxide (SO₂) is an acidic gas, formed by the oxidation of sulphur impurities in fuels during combustion processes. A very high proportion (approximately 85%) of UK SO₂ emissions originate from power stations and industrial sources.

SO₂ can cause constriction of the airways of the lung. This effect is particularly likely to occur in people suffering from asthma and chronic lung disease. It is a precursor to secondary PM and therefore contributes to the ill-health effects caused by PM₁₀ and PM_{2.5}. There is potential for damage to ecosystems at high levels, including degradation of chlorophyll, reduced photosynthesis, raised respiration rates and changes in protein metabolism. Deposition of pollution derived from SO₂ emissions can contribute to acidification of soils and waters and subsequent loss of biodiversity, often at locations far removed from the original emissions.

As the use of coal for domestic heating has decreased over the last 30-40 years, SO₂ emissions and atmospheric concentrations have decreased. In recent decades, SO₂ concentrations have remained high in some mining regions in England, also in parts of Northern Ireland. However recent years have seen a decrease in SO₂ concentrations here as well.

Nitrogen Oxides

A mixture of nitrogen oxides NO and NO₂, collectively referred to as NO_x, are emitted from many combustion processes. In the UK, the main sources of NO_x are power generation and road transport. Motor vehicles make the largest contribution to long-term ground level concentrations in urban areas, and highest NO_x levels in UK cities generally occur at kerbside locations in urban areas. In the presence of sunlight, nitrogen oxides can react with Volatile Organic Compounds (VOCs) to produce photochemical pollutants including ozone. Nitrogen dioxide can be further oxidised in air to acid gases such as nitric acid, which contribute to the production of acid rain.

NO₂ is associated with adverse effects on human health. At high levels NO₂ causes inflammation of the airways. Long term exposure may affect lung function and respiratory symptoms. NO₂ also enhances the response to allergens in sensitive individuals. High levels of NO_x can have an adverse effect on vegetation, including leaf or needle damage and reduced growth. Deposition of pollutants derived from NO_x emissions contribute to acidification and/or eutrophication of sensitive habitats leading to loss of biodiversity, often at locations far removed from the original emissions. NO_x also contributes to the formation of secondary particles and ground level ozone, both of which are associated with ill-health effects. Ozone also damages vegetation.

Particulate Matter

Particulate Matter (PM) is a generic term referring to suspended particles consisting of a wide range of sizes and chemical compositions. Particles are produced from a variety of natural and man-made sources. Natural sources include sea salt, wind-blown soil, Saharan dust, forest fires and volcanic activity. Man-made sources include incomplete combustion processes (e.g. coal and diesel smoke), industry and construction activity.

Particles may be either directly emitted into the atmosphere (primary particles) or formed there by chemical reactions (secondary particles). Sulphate and nitrate aerosols are secondary particles; these can often transported over national or continental distances.

Particle size is usually expressed in terms of its aerodynamic diameter. Two fine size fractions of particulate matter are measured in UK national monitoring networks: PM₁₀ and PM_{2.5}. These are the mass fractions of particles collected by a sampler with a 50% inlet cut-off at aerodynamic diameter 10 µm and 2.5 µm respectively. Fine particles are the main focus in air quality monitoring, as fine

particulate matter can penetrate deep into the airways, carrying surface-absorbed harmful compounds into the lungs, increasing the risk of health effects.

Both short-term and long-term exposure to ambient levels of PM are consistently associated with respiratory and cardiovascular illness and mortality as well as other ill-health effects. The associations are believed to be causal. It is not currently possible to discern a threshold concentration below which there are no effects on the whole population's health.

Carbon Monoxide

Carbon monoxide (CO) is a colourless, odourless and tasteless gas. Carbon monoxide in urban areas results almost entirely from vehicle emissions. Ambient concentrations are therefore closely linked to road transport emissions. In urban areas, concentrations are highest at the kerbside and decrease rapidly with increasing distance from the road. Highest levels are observed in the city centres, near the kerb of congested roads.

At worst-case ambient levels (in congested streets, car-parks or tunnels), exposure may reduce the oxygen-carrying capacity of the blood and impair oxygen delivery to the brain and other organs, particularly affecting adults with angina and diseases of the coronary arteries.

Benzene

Benzene is an organic chemical compound with the molecular formula C_6H_6 . Ambient benzene concentrations result primarily from road transport and the domestic combustion of wood fuel. Benzene is naturally broken down by chemical reactions in the atmosphere over a period up to several days; thus outdoor benzene concentrations tend to reflect road networks and traffic density patterns.

Benzene is a recognised human carcinogen which attacks genetic material and, as such, no absolutely safe level can be specified in ambient air. Studies in workers exposed to high levels have shown an excessive risk of leukaemia.

Ozone

Ozone (O_3) is a form of oxygen, with three atoms per molecule instead of the usual two. Ozone in the stratosphere (the "ozone layer") helps protect life on earth against harmful levels of UV radiation: however, at ground level it is a harmful pollutant.

Ozone is not emitted directly into the atmosphere in any significant quantity, but is formed from a complex series of chemical reactions involving other "precursor" pollutants - volatile organic compounds (VOCs) and presence of nitrogen oxides (NO_x) - in the presence of sunlight.

The reactions producing ozone occur in air containing these NO_x and VOC precursors as it moves downwind; ozone formation can occur over a timescale of a few hours to several days. As a result, highest concentrations of ozone usually occur in rural areas, and often a long distance from the source of the precursor emissions.

Exposure to high concentrations may cause irritation to eyes and nose. Very high levels can damage airways leading to inflammatory reactions. Ozone reduces lung function and increases incidence of respiratory symptoms, respiratory hospital admissions and mortality. Ground level ozone can also cause damage to many plant species leading to loss of yield and quality of crops, damage to forests and impacts on biodiversity.

Lead

The majority of lead emissions arise from industry, in particular non-ferrous metal smelters. Exposure to high levels in air may result in toxic biochemical effects which have adverse effects on the kidneys, gastrointestinal tract, the joints and reproductive systems, and acute or chronic damage to the nervous system. Lead can affect intellectual development in young children.

Heavy Metals

Nickel is found in ambient air as a result of releases from oil and coal combustion, nickel metal refining, sewage sludge incineration, manufacturing facilities, and other sources. It may cause damage to the kidneys, inhibit reproductive ability, and result in respiratory problems.

Arsenic is emitted into the atmosphere as arsenic trioxide in the form of particulate matter. The primary source of arsenic emissions to the air in the UK is the combustion of coal and other fossil fuels, also industrial processes which use arsenic. Exposure to arsenic dust causes respiratory irritation and it is believed to be a carcinogen.

Inhalation of cadmium present in airborne particulate matter results in a build-up of cadmium in the kidneys that can cause kidney disease. Exposure to cadmium is also likely to increase the risk of lung cancer in humans.

Mercury is released to the air by human activities, such as coal burning, use of mercury in industrial processes, and the release of mercury in dental fillings from crematoria. High levels of mercury in the bloodstream of unborn babies and infants may impede the development of the nervous system.

Benzo[a]pyrene

Benzo[a]pyrene is used as a "marker" for a group of chemical compounds known as polycyclic aromatic hydrocarbons (PAHs). Polycyclic aromatic hydrocarbons are a large group of persistent bio-accumulative organic compounds with toxic or human carcinogenic effects; they are produced from a wide range of industrial, chemical and combustion processes.

The main sources of ambient B[a]P are fossil fuel combustion, vehicle exhaust and the production of asphalt. (A major source of human exposure is also cigarette smoke). Studies of occupational exposure to PAHs have shown an increased incidence of tumours of the lung, skin and possibly bladder and other sites. Lung cancer is most obviously linked to exposure to PAHs through inhaled air. Individual PAHs vary in their ability to induce tumours in animals or humans.

2.2 Assessment of Air Quality in the UK

The evidence base for the annual questionnaire and assessment of compliance is based on a combination of information from the UK national monitoring networks and the results of modelling assessments. Considerably more monitoring sites would be required across the whole of the UK if monitoring data were to be used as the sole source of information. The use of models has the added benefits of enabling air quality to be assessed at locations without monitoring sites and providing additional information on source apportionment and projections required for the development and implementation of air quality plans.

Annex III of the Air Quality Directive provides information on where ambient air quality should be assessed and this applies to both measurements and modelling. The Annex is very prescriptive and identifies how many monitors are needed and where they should be located.

Modelling is undertaken using a national model known as the Pollution Climate Mapping (PCM) model. The PCM models have been designed to assess compliance with the limit values at locations defined within the directives. It should be noted that at a local level, Local Authorities undertake air quality assessment for a different purpose and following different methodologies. Local Air Quality Monitoring (LAQM) modelling will usually output contour plots showing dispersion away from the source, on a fine resolution grid. National modelling focuses on concentrations at four metres away from selected road links. The level of detail and resolution of LAQM modelling is therefore much greater in order to focus on local exposure and hotspots. See Section 2.4 for more details on modelling.

Local Air Quality Management aims to identify and assess hot-spots within the Authority's boundary with focus on locations where members of the public are likely to be regularly present and are likely to be exposed for a period of time appropriate to the averaging period of the objective. The criteria for locations requiring assessment are different to those modelled at national level. For example, junctions are explicitly required to be assessed under LAQM if in the Updating and Screening Assessment, new exceedences of objectives are identified, whereas Directive 2008/50/EC excludes junctions from assessment at national level. Both of these are in contrast to the approach of national modelling which is to assess only at the locations defined within the Directives.

Local authorities undertake air quality monitoring for the purpose of local air quality management, in particular of nitrogen dioxide and PM₁₀. Examples of differences between the monitoring undertaken by local authorities and by Defra and the Devolved Administrations for compliance purposes are as follows:

- The monitoring undertaken for reporting to the Commission is undertaken in accordance with the assessment procedures set out in the Air Quality Directive, 2008/50/EC. In contrast, there are no restrictions on where local authority monitors can be located, and these monitors are often placed in hot spot locations which are not required to be assessed under the Air Quality Directive.
- The QA/QC procedures applied to the data are not to the same standard as those on the national compliance monitoring networks.
- The Air Quality Directive requires either reference method equipment or equivalent to be used for compliance purposes. The equipment used by local authorities may not meet these standards and therefore data quality might be affected.

2.3 Current UK Air Quality Monitoring

There are nearly 400 national air quality monitoring sites across the UK, each with different objectives, scope and coverage. This section provides a brief description of those used to monitor compliance with the Air Quality Directive and the 4th Daughter Directive. A summary of the UK national networks is provided in Table 2.1, and the measurement techniques are summarised in Table 2.2.

Table 2.1 The UK Air Quality Monitoring Networks

Network	Statutory or Research	Pollutants	Number of Sites
The Automatic Urban and Rural Network (AURN)	Statutory	CO, NO _x , SO ₂ , PM ₁₀ , PM _{2.5} .	132 (97 urban, 27 rural, 8 London)
Ammonia Network	Research	Gaseous ammonia (NH ₃), particulate aerosol ammonium (NH ₄ ⁺).	83
Eutrophying and Acidifying Pollutants	Research	NO ₂ , gaseous nitric acid, SO ₂ , hydrochloric acid, aerosol nitrate, sulphate and chloride.	38
Toxic Organic Micropollutants (TOMPS)	Research	Toxic organic compounds	7
Polycyclic Aromatic Hydrocarbons (PAH)	Statutory	PAH	31
Particle concentrations and numbers	Research	Total particle number, concentration, size distribution	4
Black Carbon	Research	Black Carbon	20
UK Heavy Metals Monitoring Network	Statutory	Metals As, Cd, Cr, Cu, Fe, Hg, Mn, Ni, Pb, Pt, V, Zn	24
Non automatic Hydrocarbon Network	Statutory	Benzene	36
Automatic Hydrocarbon Network	Statutory	Range of VOCs	4

2.3.1 The Automatic Urban and Rural Network (AURN)

The AURN is currently the largest automatic monitoring network in the UK and forms the bulk of the UK's statutory compliance monitoring evidence base. Data from the AURN are available on the Air Quality Archive at www.airquality.co.uk.

The techniques used for monitoring within the AURN are the reference methods of measurement defined in the relevant EU Directives for the gaseous pollutants. For particulate matter the AURN uses methods which have demonstrated equivalence to the reference method, but which (unlike the reference method) allow continuous on-line monitoring. Details are in Table 2.2.

Table 2.2 AURN Measurement Techniques

Pollutant	CEN standard/ref method	Details
O₃	EN 14625:2005 "Ambient air quality – standard method for the measurement of the concentration of ozone by ultraviolet photometry" ³	UV absorption: ozone absorbs UV light. The absorption of UV by sampled air is used to calculate the ozone concentration.
NO₂/NO_x	EN 14211:2005 "Ambient air quality – Standard method for the measurement of the concentration of nitrogen dioxide and nitrogen monoxide by Chemiluminescence" ⁴	Chemiluminescent: this method measures the energy emitted when nitric oxide (NO) is reacted with ozone (O ₃) in an evacuated chamber to form chemiluminescent nitrogen dioxide (NO ₂).
SO₂	EN 14212:2005 "Ambient air quality – Standard method for the measurement of the concentration of sulphur dioxide by UV fluorescence" ⁵	UV fluorescence: SO ₂ molecules are excited to higher energy states by UV radiation. These excited molecules then release this energy as light (fluorescent radiation). The intensity of this can be used to calculate the concentration of SO ₂ in sampled air.
CO	EN 14625:2005 "Ambient air quality – Standard method for the measurement of the concentration of carbon monoxide by infra red absorption" ⁶	IR absorption: Carbon monoxide strongly absorbs infrared radiation of wavelength 4.5 to 4.9 µm. A reference detection system is used to alternately measure absorption due to CO in the sampled air stream and absorption by interfering species. An infrared detector gives a signal proportional to the CO concentration.
PM₁₀ and PM_{2.5}	EN 12341:1999 "Air quality. Determination of the PM ₁₀ fraction of suspended particulate matter. Reference method and field test procedure to demonstrate reference equivalence of measurement methods." ⁷ EN 14907:2005 "Ambient air quality – Standard gravimetric measurement method for the determination of the PM _{2.5} mass fraction of suspended particulate matter" ⁸	The AURN uses three equivalent methods: the Filter Dynamic Measurement System (FDMS), which determines particulate concentration by continuously weighing particles deposited on a filter: the beta-attenuation monitor (BAM) which measures the attenuation of beta rays passing through a paper filter on which particulate matter from sampled air has been collected, and Partisol – an equivalent gravimetric sampler that collects daily samples onto a filter for subsequent weighing.

2.3.2 Heavy Metals Network

The UK Heavy Metals Network forms the basis of the UK's compliance monitoring for:

- The Air Quality Directive (for lead)
- The 4th Daughter Directive (for arsenic, cadmium and nickel).

This network monitors a range of metallic elements at urban, industrial and rural sites, using a method equivalent to the CEN standard method⁹. In 2009, it comprised 24 sites, all of which monitored As, Cd, Cr, Cu, Fe, Hg, Mn, Ni, Pb, Pt, V and Zn. Additionally, measurements of ambient vapour phase mercury concentrations are made at 13 sites.

2.3.3 Non-automatic Hydrocarbon Network

In this network of 36 sites, ambient concentrations of benzene are measured by the CEN standard method¹⁰, which involves pumping air across an adsorption tube to trap the compound, which is later analysed in a laboratory. This network monitors compliance with the CAFÉ Directive.

2.3.4 Automatic Hydrocarbon Network

Automatic hourly measurements of a range of hydrocarbon species are made using automated pumped sampling with in situ gas chromatography, which is an EU reference method¹¹, at five sites in the UK. These sites monitor benzene, which is covered by the CAFÉ Directive. This network also provides data on ozone precursors (compounds that lead to the formation of ozone), which must also be reported to the European Commission.

Two monitoring sites, at Harwell in Oxfordshire and Auchencorth Moss in Lothian, are also part of the European EMEP programme, an international co-operative programme for monitoring and evaluation of the long-range transmissions of air pollutants in Europe.

2.3.5 PAH Monitoring Network

The PAH Network monitors compliance with the 4th Daughter Directive, which includes a target value of 1 ngm⁻³ for the annual mean concentration of benzo[a]pyrene as a representative PAH, to be achieved by 2012. This network uses the CEN reference method¹². Ambient air is sampled through glass fibre filters and polyurethane foam pads, which capture the PAH compounds for later analysis in a laboratory. During 2009, there were 31 sites in this network.

2.4 Modelling

2.4.1 Why Do Modelling?

The UK's monitoring programmes are supplemented by air quality modelling. There are several benefits of using modelling to complement the monitoring data gathered across the UK national monitoring networks:

- The reduced need for fixed continuous monitoring – freeing up resources to be spent elsewhere such as on developing policy to improve air quality.
- Coverage of the whole UK rather than specific locations where there is a monitoring site. A monitoring site might not fully represent the wider region in which it is located.
- Provides a framework within which to assess different air quality scenarios – for example projecting concentrations forward to assess levels in future years, representing potential changes to emissions in order to assess the impact of policy initiatives on air quality.

2.4.2 How the Models Work

The modelling method varies between pollutants. Methodology is explained in separate reports^{13,14,15} (the latest versions of these can be found on the Air Quality Archive¹⁶).

Air quality modelling in the UK consists of two aspects:

- Background concentrations – on a 1x1km resolution, representing ambient air quality concentrations at background locations.
- Roadside concentrations – concentrations at the roadside of urban major road links throughout the UK (i.e. motorways and major A-roads). There are approximately 9,000 of these road links.

Roadside concentrations are not modelled for SO₂, ozone, benzo[a]pyrene (BaP) and heavy metals which do not have significant roadside sources.

The models have been designed to assess compliance at locations defined by the Directives as relevant for air quality assessment.

2.4.3 Background Air Quality

The 1x1 km background maps are made up of several components which are modelled separately and then added together to make the final grid. These individual components (supplemented by some additional components for various pollutants) are:

- **Large point sources** (e.g. power stations, steel works, oil refineries)
- **Small point sources** (e.g. boilers in town halls, schools or hospitals, crematoria)
- **Distant sources** (characterised by the rural background concentration)
- **Local area sources** (e.g. road traffic, domestic and commercial combustion, agriculture).

In order to ensure that these ambient concentrations from area sources are representative of the real world situation, they are calibrated against measurements taken from the national networks (including the AURN). After the calibration has been completed the large points, small points, distant sources and calibrated area source components are added together to provide the final background map.

2.4.4 Roadside Air Quality

Roadside concentrations are estimated by using a roadside increment model which attempts to estimate the contribution from road traffic sources and adds this on top of the modelled background concentrations discussed above.

For each of the road links that are modelled, there are emissions estimates from the NAEI for each pollutant and road traffic count. A roadside increment is calculated for road links with a roadside monitoring station on them by taking the modelled background concentration (from the 1x1 km modelled maps) link away from the relevant measured roadside concentration. The emission for the road link is scaled according to annual average daily traffic flow for that link and then this is compared against the roadside increment to establish a relationship. This relationship is then used to scale the link emission for different ranges of traffic flow and added to the modelled background concentration to calculate an estimated roadside concentration.

3 Assessment of Compliance

3.1 Definition of Zones

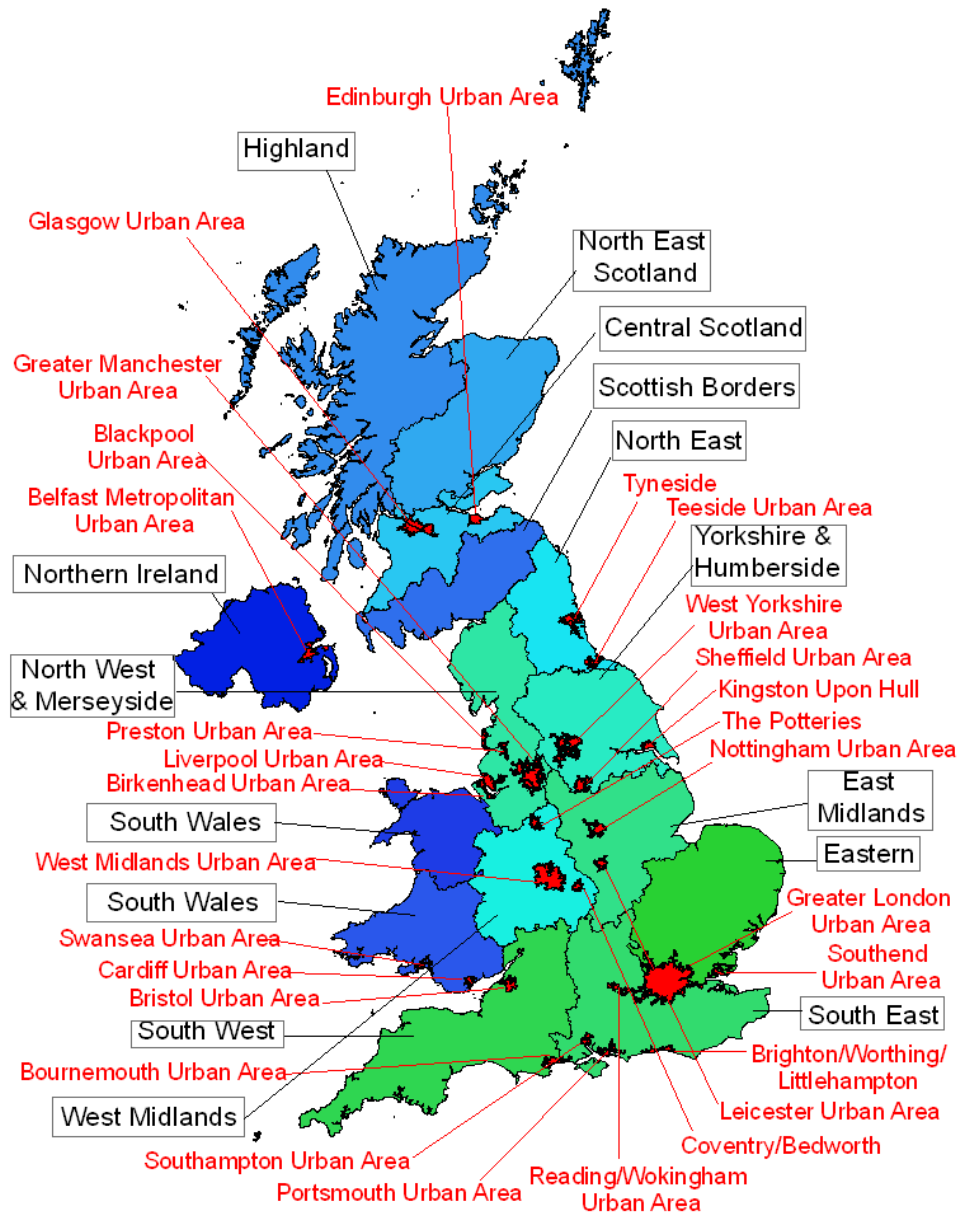
The UK has been divided into 43 zones for air quality assessment. There are 28 agglomeration zones (large urban areas) and 15 non-agglomeration zones. Form 2 of the Questionnaire contains details of these including type, area, and population (from the 2001 census). Each zone is assigned an identification code: these are listed in Table 3.1 and illustrated in Figure 3.1.

Table 3.1 UK zones and agglomerations for ambient air quality reporting 2009

Zone	Zone code	Ag or non-ag*
Greater London Urban Area	UK0001	ag
West Midlands Urban Area	UK0002	ag
Greater Manchester Urban Area	UK0003	ag
West Yorkshire Urban Area	UK0004	ag
Tyneside	UK0005	ag
Liverpool Urban Area	UK0006	ag
Sheffield Urban Area	UK0007	ag
Nottingham Urban Area	UK0008	ag
Bristol Urban Area	UK0009	ag
Brighton/Worthing/Littlehampton	UK0010	ag
Leicester Urban Area	UK0011	ag
Portsmouth Urban Area	UK0012	ag
Teesside Urban Area	UK0013	ag
The Potteries	UK0014	ag
Bournemouth Urban Area	UK0015	ag
Reading/Wokingham Urban Area	UK0016	ag
Coventry/Bedworth	UK0017	ag
Kingston upon Hull	UK0018	ag
Southampton Urban Area	UK0019	ag
Birkenhead Urban Area	UK0020	ag
Southend Urban Area	UK0021	ag
Blackpool Urban Area	UK0022	ag
Preston Urban Area	UK0023	ag
Glasgow Urban Area	UK0024	ag
Edinburgh Urban Area	UK0025	ag
Cardiff Urban Area	UK0026	ag
Swansea Urban Area	UK0027	ag
Belfast Metropolitan Urban Area	UK0028	ag
Eastern	UK0029	non-ag
South West	UK0030	non-ag
South East	UK0031	non-ag
East Midlands	UK0032	non-ag
North West & Merseyside	UK0033	non-ag
Yorkshire & Humberside	UK0034	non-ag
West Midlands	UK0035	non-ag
North East	UK0036	non-ag
Central Scotland	UK0037	non-ag
North East Scotland	UK0038	non-ag
Highland	UK0039	non-ag
Scottish Borders	UK0040	non-ag
South Wales	UK0041	non-ag
North Wales	UK0042	non-ag
Northern Ireland	UK0043	non-ag
Total		

ag = agglomeration zone, non-ag = non-agglomeration zone

Figure 3.1 UK zones and agglomerations for ambient air quality reporting 2009



Agglomeration zones (red)

Non-agglomeration zones (blue/green)

© Crown copyright. All rights reserved Defra, Licence number 100022861 [2010]

3.2 Air Quality Assessment for 2009

As explained in section 2, the air quality assessment for each pollutant is derived from a combination of measured and modelled concentrations. Where both measurements and model results are available the assessment of compliance for each zone is based on the higher concentration of the two.

The results of the air quality assessment submitted to the European Commission are summarised in the tables below. The tables have been completed as follows:

- Where all measurements were within the relevant limit values, (or limit values with margins of tolerance where applicable) in 2009, the table shows this as "OK".
- Where compliance was determined by modelling, this is shown as "OK (m)".
- Where locations were identified as exceeding a limit value, or a limit value plus margin of tolerance where applicable, this is identified as ">MOT" or ">LV" as applicable.
- Where an exceedence was determined by modelling, this is indicated by (m), as above.

Zones that complied with the relevant limit values, targets or long-term objectives are shaded blue, while those that did not are shaded red.

A similar approach has also been used to compare concentrations with target values (TV) and long term objectives (LTO). "n/a" means that an assessment is not relevant for this zone, such as for the vegetation limit value in agglomeration zones.

3.2.1 Assessment under Directive 2008/50/EC on Ambient Air Quality and Cleaner Air for Europe

Sulphur dioxide: the results of the air quality assessment for sulphur dioxide are presented in Form 8a of the Questionnaire.

In 2009, all zones and agglomerations within the UK complied with the limit values for 1-hour mean and 24-hour mean SO₂ concentration, set for protection of human health.

All non-agglomeration zones within the UK also complied with the limit values for annual mean and winter mean SO₂ concentration, set for protection of ecosystems. (These are not applicable to built-up areas).

Nitrogen dioxide: the results of the air quality assessment for nitrogen dioxide for each zone are presented in Form 8b of the Questionnaire, and summarised in Table 3.2.

Two agglomeration zones - **Greater London Urban Area (UK0001)** and **Glasgow Urban Area (UK0024)** had locations which exceeded the 1-hour limit value plus margin of tolerance (220 µg m⁻³) on more than the permitted number of occasions during 2009.

The majority of zones and agglomerations in the UK had locations with measured or modelled annual mean NO₂ concentrations higher than the annual mean limit value plus margin of tolerance (42 µg m⁻³). This was the case in 40 zones of the 43 zones. Only the following three zones **met** the annual mean limit value in 2009:

- Blackpool Urban Area (UK0022)
- Highland (UK0039)
- Scottish Borders (UK0040)

All others exceeded the annual mean limit value.

All non-agglomeration zones within the UK also complied with the limit value for annual mean NO₂ concentration, set for protection of vegetation.

Particulate matter: the results of the air quality assessment for PM₁₀ and PM_{2.5} for each zone are presented in Form 8c and 9c of the Questionnaire respectively, and summarised in Table 3.3.

Three zones had locations where measured or modelled PM₁₀ concentrations exceeded the 24-hour mean limit value of 50 µg m⁻³ on more than the permitted number of days:

- Greater London Urban Area (UK0001)
- Southampton Urban Area (UK0019)
- Eastern (zone) (UK0029)

The Directive requires Member States to quantify the contribution to PM₁₀ from natural sources, and subtract this. After subtraction of the contribution from natural sources, one modelled exceedence of the 24-hour limit value remained in one zone (**Greater London Urban Area, UK0001**)

All zones and agglomerations complied with the annual mean limit value of 40 µg m⁻³ for PM₁₀.

Annual mean concentrations of PM_{2.5} were below the target value in all zones and agglomerations.

Carbon monoxide, benzene and lead: the results of the air quality assessment for lead, benzene and CO are presented in Form 8d, 8e and 8f of the Questionnaire respectively. All zones or agglomerations were compliant with the limit values for these three pollutants in 2009.

Ozone: the results of the air quality assessment for ozone for each zone are presented in Form 9a of the Questionnaire.

All zones and agglomerations were compliant with the two target values, which are based on the maximum daily 8-hour mean and on the AOT40 statistic¹.

There are also two long-term objectives, one for human health, and one (only applicable in the non-agglomeration zones) for vegetation. 39 zones and agglomerations were above the long-term objective (LTO) for health, and 10 of the 15 non-agglomeration zones were above the long-term objective for vegetation. This is illustrated in Table 3.4 below with compliant zones shaded blue and non-compliant ones shaded red.

Table 3.2 Results of air quality assessment for nitrogen dioxide in 2009

Zone	Zone code	NO ₂ LV for health (annual mean)	NO _x LV for vegetation (annual mean)
Greater London Urban Area	UK0001	> MOT	n/a
West Midlands Urban Area	UK0002	> MOT	n/a
Greater Manchester Urban Area	UK0003	> MOT	n/a
West Yorkshire Urban Area	UK0004	> MOT	n/a
Tyneside	UK0005	> MOT (m)	n/a
Liverpool Urban Area	UK0006	> MOT (m)	n/a
Sheffield Urban Area	UK0007	> MOT (m)	n/a
Nottingham Urban Area	UK0008	> MOT (m)	n/a
Bristol Urban Area	UK0009	> MOT	n/a
Brighton/Worthing/Littlehampton	UK0010	> MOT (m)	n/a
Leicester Urban Area	UK0011	> MOT (m)	n/a
Portsmouth Urban Area	UK0012	> MOT (m)	n/a
Teesside Urban Area	UK0013	> MOT (m)	n/a
The Potteries	UK0014	> MOT (m)	n/a
Bournemouth Urban Area	UK0015	> MOT (m)	n/a
Reading/Wokingham Urban Area	UK0016	> MOT (m)	n/a
Coventry/Bedworth	UK0017	> MOT (m)	n/a
Kingston upon Hull	UK0018	> MOT (m)	n/a
Southampton Urban Area	UK0019	> MOT (m)	n/a
Birkenhead Urban Area	UK0020	> MOT (m)	n/a
Southend Urban Area	UK0021	> MOT (m)	n/a
Blackpool Urban Area	UK0022	OK (m)	n/a
Preston Urban Area	UK0023	> MOT (m)	n/a
Glasgow Urban Area	UK0024	> MOT	n/a
Edinburgh Urban Area	UK0025	> MOT (m)	n/a
Cardiff Urban Area	UK0026	> MOT (m)	n/a
Swansea Urban Area	UK0027	> MOT (m)	n/a
Belfast Urban Area	UK0028	> MOT (m)	n/a
Eastern	UK0029	> MOT	OK
South West	UK0030	> MOT	OK (m)
South East	UK0031	> MOT	OK
East Midlands	UK0032	> MOT (m)	OK
North West & Merseyside	UK0033	> MOT (m)	OK (m)
Yorkshire & Humberside	UK0034	> MOT (m)	OK (m)
West Midlands	UK0035	> MOT (m)	OK (m)
North East	UK0036	> MOT (m)	OK (m)
Central Scotland	UK0037	> MOT (m)	OK (m)
North East Scotland	UK0038	> MOT (m)	OK (m)
Highland	UK0039	OK	OK (m)
Scottish Borders	UK0040	OK	OK (m)
South Wales	UK0041	> MOT (m)	OK
North Wales	UK0042	> MOT (m)	OK (m)
Northern Ireland	UK0043	> MOT (m)	OK (m)

Table 3.3 Results of air quality assessment for PM₁₀ and PM_{2.5} in 2009 prior to subtraction of natural sources.

Zone	Zone code	PM ₁₀ LV (24hr mean)	PM ₁₀ LV (annual mean)	PM _{2.5} Target value (annual mean)
Greater London Urban Area	UK0001	> LV	OK	OK
West Midlands Urban Area	UK0002	OK	OK	OK
Greater Manchester Urban Area	UK0003	OK	OK	OK
West Yorkshire Urban Area	UK0004	OK	OK	OK
Tyneside	UK0005	OK	OK	OK
Liverpool Urban Area	UK0006	OK	OK	OK
Sheffield Urban Area	UK0007	OK (m)	OK (m)	OK
Nottingham Urban Area	UK0008	OK (m)	OK (m)	OK
Bristol Urban Area	UK0009	OK	OK	OK
Brighton/Worthing/Littlehampton	UK0010	OK (m)	OK (m)	OK
Leicester Urban Area	UK0011	OK	OK	OK (m)
Portsmouth Urban Area	UK0012	OK (m)	OK (m)	OK
Teesside Urban Area	UK0013	OK (m)	OK (m)	OK (m)
The Potteries	UK0014	OK	OK	OK
Bournemouth Urban Area	UK0015	OK (m)	OK (m)	OK
Reading/Wokingham Urban Area	UK0016	OK	OK	OK
Coventry/Bedworth	UK0017	OK (m)	OK (m)	OK
Kingston upon Hull	UK0018	OK	OK	OK
Southampton Urban Area	UK0019	> LV (m)	OK	OK
Birkenhead Urban Area	UK0020	OK (m)	OK (m)	OK
Southend Urban Area	UK0021	OK (m)	OK (m)	OK
Blackpool Urban Area	UK0022	OK (m)	OK (m)	OK
Preston Urban Area	UK0023	OK (m)	OK (m)	OK
Glasgow Urban Area	UK0024	OK	OK	OK
Edinburgh Urban Area	UK0025	OK (m)	OK (m)	OK
Cardiff Urban Area	UK0026	OK	OK	OK
Swansea Urban Area	UK0027	OK	OK	OK
Belfast Urban Area	UK0028	OK	OK	OK
Eastern	UK0029	> LV (m)	OK	OK
South West	UK0030	OK	OK	OK (m)
South East	UK0031	OK	OK	OK
East Midlands	UK0032	OK	OK	OK
North West & Merseyside	UK0033	OK	OK	OK
Yorkshire & Humberside	UK0034	OK	OK	OK
West Midlands	UK0035	OK	OK	OK
North East	UK0036	OK	OK	OK
Central Scotland	UK0037	OK	OK	OK
North East Scotland	UK0038	OK	OK	OK (m)
Highland	UK0039	OK	OK	OK
Scottish Borders	UK0040	OK (m)	OK (m)	OK (m)
South Wales	UK0041	OK	OK	OK
North Wales	UK0042	OK	OK	OK (m)
Northern Ireland	UK0043	OK	OK	OK (m)

Note: Following subtraction of natural sources, only UK001, Greater London Urban Area remained non-compliant with the 24 hour mean limit value for PM₁₀.

Table 3.4 Results of air quality assessment for ozone in 2009

Zone	Zone code	O ₃ LTO for health (8hr mean)	O ₃ LTO for health (annual mean)
Greater London Urban Area	UK0001	Meets TV, >LTO	OK
West Midlands Urban Area	UK0002	Meets TV, >LTO	OK
Greater Manchester Urban Area	UK0003	Meets TV, >LTO (m)	OK
West Yorkshire Urban Area	UK0004	Meets TV, >LTO (m)	OK
Tyneside	UK0005	Meets TV, >LTO (m)	OK
Liverpool Urban Area	UK0006	Meets TV, >LTO	OK
Sheffield Urban Area	UK0007	Meets TV, >LTO (m)	OK
Nottingham Urban Area	UK0008	Meets TV, >LTO (m)	OK
Bristol Urban Area	UK0009	Meets TV, >LTO	OK
Brighton/Worthing/Littlehampton	UK0010	Meets TV, >LTO	Meets TV, >LTO
Leicester Urban Area	UK0011	Meets TV, >LTO	OK
Portsmouth Urban Area	UK0012	Meets TV, >LTO	OK
Teesside Urban Area	UK0013	Meets TV, >LTO (m)	OK
The Potteries	UK0014	Meets TV, >LTO	OK
Bournemouth Urban Area	UK0015	Meets TV, >LTO	OK
Reading/Wokingham Urban Area	UK0016	Meets TV, >LTO	Meets TV, >LTO
Coventry/Bedworth	UK0017	Meets TV, >LTO	OK
Kingston upon Hull	UK0018	Meets TV, >LTO (m)	OK
Southampton Urban Area	UK0019	Meets TV, >LTO (m)	OK
Birkenhead Urban Area	UK0020	Meets TV, >LTO	OK
Southend Urban Area	UK0021	Meets TV, >LTO	Meets TV, >LTO
Blackpool Urban Area	UK0022	Meets TV, >LTO	OK
Preston Urban Area	UK0023	Meets TV, >LTO	OK
Glasgow Urban Area	UK0024	OK	OK
Edinburgh Urban Area	UK0025	OK	OK
Cardiff Urban Area	UK0026	Meets TV, >LTO	OK
Swansea Urban Area	UK0027	Meets TV, >LTO	OK
Belfast Urban Area	UK0028	OK	OK
Eastern	UK0029	Meets TV, >LTO	Meets TV, >LTO
South West	UK0030	Meets TV, >LTO	Meets TV, >LTO
South East	UK0031	Meets TV, >LTO	Meets TV, >LTO (m)
East Midlands	UK0032	Meets TV, >LTO	Meets TV, >LTO
North West & Merseyside	UK0033	Meets TV, >LTO	OK
Yorkshire & Humberside	UK0034	Meets TV, >LTO (m)	OK
West Midlands	UK0035	Meets TV, >LTO	Meets TV, >LTO (m)
North East	UK0036	Meets TV, >LTO (m)	OK (m)
Central Scotland	UK0037	Meets TV, >LTO (m)	OK
North East Scotland	UK0038	Meets TV, >LTO (m)	OK
Highland	UK0039	OK	OK
Scottish Borders	UK0040	Meets TV, >LTO (m)	OK
South Wales	UK0041	Meets TV, >LTO	Meets TV, >LTO
North Wales	UK0042	Meets TV, >LTO	Meets TV, >LTO
Northern Ireland	UK0043	Meets TV, >LTO (m)	OK

Measured exceedences of limit values, margins of tolerance, target values, long term objectives, information and alert thresholds are also listed within the annual air quality assessment questionnaire. Summary statistics for the exceedences identified are provided in Table 3.5 – Table 3.10.

Table 3.5 Exceedences of the NO₂ limit value plus MOT for health (1 hour mean)

Site name	Zone code	Number of 1-hour exceedences of MOT	Number of 1-hour exceedences of LV	Maximum 1-hour concentration ($\mu\text{g m}^{-3}$)
Glasgow Centre	UK0024	43	48	701
Glasgow Kerbside	UK0024	32	57	384
London Marylebone Road	UK0001	312	486	332

Table 3.6 Exceedences of the NO₂ limit value plus MOT for health (annual mean)

Site name	Zone code	Annual mean concentration ($\mu\text{g m}^{-3}$)
Bath Roadside	UK0030	65
Birmingham Tyburn Roadside	UK0002	47
Bristol Old Market	UK0009	63
Bury Roadside	UK0003	72
Glasgow City Chambers	UK0024	46
Glasgow Kerbside	UK0024	78
Haringey Roadside	UK0001	43
Leeds Headingley Kerbside	UK0004	48
London Bloomsbury	UK0001	54
London Cromwell Road 2	UK0001	72
London Hillingdon	UK0001	54
London Marylebone Road	UK0001	107
London Westminster	UK0001	44
Oxford Centre Roadside	UK0031	50
Sandy Roadside	UK0029	46
Tower Hamlets Roadside	UK0001	61

Table 3.7 Exceedences of the PM₁₀ limit value (24 hour mean)

Site name	Zone code	Number of 24-hour exceedences of LV	Maximum 24-hour concentration ($\mu\text{g m}^{-3}$)
London Marylebone Road PARTISOL	UK0001	36	88

Note: Number of exceedences reduced to 25 after subtraction of the contribution from natural sources but a modelled exceedence of the 24 hour mean limit value remains in this zone after subtraction of the contribution from natural sources.

Table 3.8 Exceedences of the ozone information threshold value

Site name	Zone code	Number of 1-hour exceedences of alert threshold	Maximum 1-hour concentration ($\mu\text{g m}^{-3}$)
Brighton Preston Park	UK0010	1	184
Sibton	UK0029	3	200
Southend-on-Sea	UK0021	2	210
St Osyth	UK0029	5	258

Table 3.9 Exceedences of the ozone alert threshold value

Site name	Zone code	Number of 1-hour exceedences of information threshold	Maximum 1-hour concentration ($\mu\text{g m}^{-3}$)
St Osyth	UK0029	2	258

Table 3.10 Exceedences of the ozone long term objective for health protection

Site name	Zone code	Number of days with exceedences	Maximum 8-hour concentration ($\mu\text{g m}^{-3}$)
Aston Hill	UK0042	5	136
Birmingham Tyburn	UK0002	2	150
Birmingham Tyburn Roadside	UK0002	1	132
Blackpool Marton	UK0022	1	137
Bottesford	UK0032	1	121
Bournemouth	UK0015	3	131
Brighton Preston Park	UK0010	2	171
Bristol St Paul's	UK0009	5	128
Cardiff Centre	UK0026	2	125
Charlton Mackrell	UK0030	3	122
Coventry Memorial Park	UK0017	3	150
Cwmbran	UK0041	6	131
Glazebury	UK0033	1	124
Harwell	UK0031	3	157
Ladybower	UK0032	2	128
Leamington Spa	UK0035	2	148
Leicester Centre	UK0011	1	138
Leominster	UK0035	2	131
Liverpool Speke	UK0006	1	125
London Haringey	UK0001	1	151
London Harlington	UK0001	1	136
London N. Kensington	UK0001	1	128
London Teddington	UK0001	3	154
Lullington Heath	UK0031	2	145
Market Harborough	UK0032	1	128
Narberth	UK0041	4	134
Northampton	UK0032	5	163
Port Talbot Margam	UK0027	1	125
Portsmouth	UK0012	2	161
Preston	UK0023	1	124
Reading New Town	UK0016	5	164
Rochester Stoke	UK0031	1	124
Sandwell West Bromwich	UK0002	4	157
Sibton	UK0029	2	170
Southend-on-Sea	UK0021	2	152
St Osyth	UK0029	2	188
Stoke-on-Trent Centre	UK0014	1	122
Thurrock	UK0029	1	134
Weybourne	UK0029	12	144
Wicken Fen	UK0029	3	147
Wigan Centre	UK0033	1	124
Wirral Tranmere	UK0020	1	133
Yarner Wood	UK0030	6	133

3.2.2 Assessment under the Fourth Daughter Directive 2004/107/EC

The results of the air quality assessment for arsenic, cadmium, nickel and benzo(a)pyrene for each zone are presented in Form 9b of the Questionnaire, and illustrated in Table 3.11.

All zones and agglomerations met the target values for arsenic and cadmium. Two zones exceeded the target value for nickel and below in all other zones. Concentrations of B[a]P were above the target value in six zones and below in all other zones.

Table 3.11 Results of air quality assessment for As, Cd, Ni and benzo(a)pyrene in 2009

Zone	Zone code	As TV	Cd TV	Ni TV	B(a)P TV
Greater London Urban Area	UK0001	OK	OK	OK	OK (m)
West Midlands Urban Area	UK0002	OK	OK	OK	OK
Greater Manchester Urban Area	UK0003	OK	OK	OK	OK
West Yorkshire Urban Area	UK0004	OK (m)	OK (m)	OK (m)	OK
Tyneside	UK0005	OK (m)	OK (m)	OK (m)	OK
Liverpool Urban Area	UK0006	OK (m)	OK (m)	OK (m)	OK
Sheffield Urban Area	UK0007	OK	OK	OK	OK (m)
Nottingham Urban Area	UK0008	OK (m)	OK (m)	OK (m)	OK (m)
Bristol Urban Area	UK0009	OK	OK	OK	OK (m)
Brighton/Worthing/Littlehampton	UK0010	OK (m)	OK (m)	OK (m)	OK
Leicester Urban Area	UK0011	OK (m)	OK (m)	OK (m)	OK (m)
Portsmouth Urban Area	UK0012	OK (m)	OK (m)	OK (m)	OK (m)
Teesside Urban Area	UK0013	OK	OK	OK	> TV (m)
The Potteries	UK0014	OK (m)	OK (m)	OK (m)	OK (m)
Bournemouth Urban Area	UK0015	OK (m)	OK (m)	OK (m)	OK (m)
Reading/Wokingham Urban Area	UK0016	OK (m)	OK (m)	OK (m)	OK (m)
Coventry/Bedworth	UK0017	OK (m)	OK (m)	OK (m)	OK (m)
Kingston upon Hull	UK0018	OK (m)	OK (m)	OK (m)	OK (m)
Southampton Urban Area	UK0019	OK (m)	OK (m)	OK (m)	OK (m)
Birkenhead Urban Area	UK0020	OK (m)	OK (m)	OK (m)	OK (m)
Southend Urban Area	UK0021	OK (m)	OK (m)	OK (m)	OK (m)
Blackpool Urban Area	UK0022	OK (m)	OK (m)	OK (m)	OK (m)
Preston Urban Area	UK0023	OK (m)	OK (m)	OK (m)	OK (m)
Glasgow Urban Area	UK0024	OK	OK	OK	OK
Edinburgh Urban Area	UK0025	OK (m)	OK (m)	OK (m)	OK
Cardiff Urban Area	UK0026	OK	OK	OK	OK
Swansea Urban Area	UK0027	OK	OK	> TV (m)	> TV (m)
Belfast Urban Area	UK0028	OK	OK	OK	OK
Eastern	UK0029	OK	OK	OK	OK
South West	UK0030	OK	OK	OK	OK (m)
South East	UK0031	OK	OK	OK	OK
East Midlands	UK0032	OK	OK	OK	OK
North West & Merseyside	UK0033	OK	OK	OK	OK
Yorkshire & Humberside	UK0034	OK	OK	OK	> TV
West Midlands	UK0035	OK (m)	OK (m)	OK (m)	OK (m)
North East	UK0036	OK	OK	OK	> TV (m)
Central Scotland	UK0037	OK	OK	OK	OK
North East Scotland	UK0038	OK	OK	OK	OK (m)
Highland	UK0039	OK (m)	OK (m)	OK (m)	OK
Scottish Borders	UK0040	OK	OK	OK	OK (m)
South Wales	UK0041	OK	OK	> TV (m)	> TV (m)
North Wales	UK0042	OK (m)	OK (m)	OK (m)	OK (m)
Northern Ireland	UK0043	OK (m)	OK (m)	OK (m)	> TV

3.3 Comparison with Previous Years

Tables 3.12 to 3.17 summarise the results of the air quality assessment for 2009 and provide a comparison with the results of the assessments carried out in previous years.

Table 3.12 Exceedences of limit values plus margins of tolerance for the Air Quality Directive

Pollutant	Averaging time	2009	2008	2007	2006	2005	2004	2003	2002	2001
SO ₂	1-hour	n/a	n/a	n/a	n/a	n/a	1 zone modelled (Eastern)	1 zone modelled (Eastern)	none	none
SO ₂	24-hour ¹	n/a	n/a	n/a	n/a	n/a	none	1 zone modelled (Eastern)	none	1 zone measured (Belfast Urban Area)
SO ₂	annual ²	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
SO ₂	winter ²	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
NO ₂	1-hour ³	2 zones measured (London, Glasgow)	2 zones measured (London, Glasgow)	1 zone measured (Greater London Urban Area)	1 zone measured (Greater London Urban Area)	1 zone measured (Greater London Urban Area)	1 zone measured (Greater London Urban Area)	1 zone measured (Greater London Urban Area)	none	none
NO ₂	annual	40 zones (9 measured + 31 modelled)	40 zones (7 measured + 33 modelled)	39 zones (6 measured + 33 modelled)	38 zones (6 measured + 32 modelled)	35 zones (6 measured + 29 modelled)	34 zones (6 measured + 28 modelled)	35 zones (5 measured + 30 modelled)	19 Zones (5 measured + 14 modelled)	21 Zones (4 measured + 17 modelled)
NO _x	annual ²	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
PM ₁₀	24-hour ⁴ (Stage 1)	n/a	n/a	n/a	n/a	n/a	19 zones (1 measured + 18 modelled)	18 zones (2 measured + 16 modelled)	1 zone modelled (Greater London Urban Area)	1 zone modelled (Greater London Urban Area)
PM ₁₀	annual (Stage 1)	n/a	n/a	n/a	n/a	n/a	1 zone modelled (Greater London Urban Area)	10 zones (1 measured + 9 modelled)	1 zone modelled (Greater London Urban Area)	1 zone modelled (Greater London Urban Area)
Lead	annual	n/a	n/a	n/a	n/a	n/a	none	none	none	none

Pollutant	Averaging time	2009	2008	2007	2006	2005	2004	2003	2002	2001
Benzene	annual	none	none	none	none	none	none	none	not assessed	not assessed
CO	8-hour	n/a	n/a	n/a	n/a	n/a	none	none	not assessed	not assessed

¹ No MOT defined, LV + MOT = LV

² Applies to vegetation and ecosystem areas only. No MOT defined, LVs are already in force

³ No modelling for 1-hour LV

Table 3.13 Exceedences of limit values for the Air Quality Directive

Pollutant	Averaging time	2009	2008	2007	2006	2005	2004	2003	2002	2001
SO ₂	1-hour	none	none	none	1 zone modelled (Eastern)	1 zone modelled (Eastern)	1 zone modelled (Eastern)	1 zone modelled (Eastern)	none	none
SO ₂	24-hour ¹	none	none	none	1 zone modelled (Eastern)	1 zone modelled (Eastern)	none	1 zone modelled (Eastern)	none	1 Zone measured (Belfast Urban Area)
SO ₂	Annual ²	none	none	none	none	none	none	none	none	none
SO ₂	Winter ²	none	none	none	none	none	none	none	none	not assessed
NO ₂	1-hour ³	2 zones measured (London, Glasgow)	3 zones measured (London, Glasgow, NE Scotland)	2 zones measured (London, Glasgow)	1 zone measured (Greater London Urban Area)	2 zones measured (London, Bristol)	1 zone measured (Greater London Urban Area)	3 zones measured (London, Glasgow, South East)	1 zone measured (Glasgow Urban Area)	4 zones measured
NO ₂	Annual	40 zones (9 measured + 31 modelled)	40 zones (10 measured + 30 modelled)	41 zones (8 measured + 33 modelled)	39 zones (7 measured + 32 modelled)	38 zones (8 measured + 30 modelled)	39 zones (9 measured + 30 modelled)	42 zones (10 measured + 32 modelled)	36 zones (6 measured + 30 modelled)	38 zones (6 measured + 32 modelled)
NO _x	Annual ²	none	none	none	none	none	none	none	none	None

Pollutant	Averaging time	2009	2008	2007	2006	2005	2004	2003	2002	2001
PM ₁₀	24-hour (Stage 1)	3 zones (1 measured + 2 modelled) 1 zone modelled after subtraction of natural contribution	2 zones (1 measured + 1 modelled) 1 zone measured after subtraction of natural contribution	6 zones (3 measured + 3 modelled)	30 zones (5 measured + 25 modelled)	29 zones (3 measured + 26 modelled)	27 zones (2 measured + 25 modelled)	33 zones (10 measured + 23 modelled)	18 zones (1 measured + 17 modelled)	26 zones (5 measured + 21 modelled)
PM ₁₀	annual (Stage 1)	none	none	1 zone measured (Greater London Urban Area)	2 zones (1 measured + 1 modelled)	4 zones (1 measured + 3 modelled)	2 zones (1 measured, London + 1 modelled, West Midlands Urban Area)	15 zones (1 measured + 14 modelled)	2 zones (Greater London Urban Area measured, Eastern modelled)	2 zones (London measured, Manchester modelled)
Lead	Annual	none	none	none	none	none	none	none	none	None
Benzene	Annual	none	none	none	1 zone modelled (Yorkshire & Humberside)	2 zones modelled (Yorkshire & Humberside, Central Scotland)	none	1 zone modelled (Greater London Urban Area)	not assessed	not assessed
CO	8-hour	none	none	none	none	none	none	none	not assessed	not assessed

¹ No MOT defined, LV + MOT = LV

² Applies to vegetation and ecosystem areas only. No MOT defined, LVs are already in force

³ No modelling for 1-hour LV

Table 3.14 Exceedences of Air Quality Directive Target Values

Pollutant	Averaging time	2009	2008	2007	2006	2005	2004
O ₃	8-hour	none	1 zone measured (Eastern)	none	none	none	none
O ₃	AOT40	none	none	none	none	none	none

Table 3.15 Exceedences of Air Quality Directive Long Term Objectives

Pollutant	Averaging time	2009	2008	2007	2006	2005	2004
O ₃	8-hour	39 zones (25 measured + 14 modelled)	43 zones (35 measured + 8 modelled)	41 zones (24 measured + 17 modelled)	43 zones (41 measured + 2 modelled)	37 zones (22 measured + 15 modelled)	43 zones (36 measured + 7 modelled)
O ₃	AOT40	10 zones (8 measured + 2 modelled)	41 zones (25 measured + 16 modelled)	3 zones (1 measured + 2 modelled)	41 zones (32 measured + 9 modelled)	16 zones (9 measured + 7 modelled)	7 zones (5 measured + 2 modelled)

Table 3.16 Exceedences of 4th Daughter Directive Target Values

Pollutant	Averaging time	2009	2008	2007
As	Annual	none	none	none
Cd	Annual	none	none	none
Ni	Annual	2 zones modelled (Swansea, S Wales)	2 zones modelled (Swansea, S Wales, measured at non-network site, so reported as m)	1 zone (Swansea Urban area, measured but low data capture, so reported as m)
BaP	Annual	6 zones, (2 zones measured Yorkshire & Humberside, N Ireland + 4 zones modelled Teesside, Swansea, North East, S Wales)	6 zones, (3 zones measured Yorkshire & Humberside, Teesside, N Ireland + 3 zones modelled Swansea, S Wales, Belfast)	1 zone measured (Yorkshire & Humberside)

Table 3.17 Exceedences of Air Quality Directive Target Value for PM_{2.5}

Pollutant	Averaging time	2009
PM _{2.5}	Annual	none

4 Where to find more information

This section provides details of sources of further information on the UK's air quality, including media and web-based resources.

The Defra air quality information web resource at <http://www.defra.gov.uk/environment/airquality/index.htm> contains details of what the UK is doing to tackle air pollution, and the science and research programmes in place.

As shown in previous sections, the UK's air monitoring programmes produce very large amounts of data. The UK's **Air Quality Archive** at www.airquality.co.uk and **Air Quality Information Service** are the key tools enabling the widest access and use of air quality information in the UK.

The main functions of these systems are:

- To inform citizens about the quality of the outdoor air we all breathe
- To provide information to Local Government, for the purpose of planning and Local Air Quality Management
- To provide public warnings in the event of extreme conditions, as required by a number of EC Directives and Decisions
- To raise awareness, inform and educate
- To provide a comprehensive data and information resource to scientists, doctors and epidemiologists, both in UK and worldwide.

The Air Quality Archive is also the national repository for historical ambient air quality measurements and emissions data. It contains measurements from automatic measurement programmes dating back to 1972, together with non-automatic sampler measurements dating back to the 1960s. The Archive brings together into one coherent database both data and information from all the UK's measurement networks.

Similar national archives have also been developed for Scotland, Wales and Northern Ireland:

- The Welsh Air Quality Archive at www.welshairquality.org.uk
- The Scottish Air quality Archive at www.scottishairquality.co.uk
- The Northern Ireland Archive at www.airqualityni.co.uk

Together, these four national websites provide a comprehensive resource for data and analyses covering all aspects of air quality throughout the UK and all its regions.

The UK Air Quality Archive also provides a twice-daily air quality forecast, which is further disseminated via email and the **Air Pollution Information Service**, a free telephone service on 0800 556677. Latest forecasts are issued twice daily, at http://www.airquality.co.uk/archive/uk_forecasting/apfuk_home.php

- The National Atmospheric Emissions Inventory on www.naei.org.uk
- The Scottish Government Air Quality pages on <http://www.scotland.gov.uk/Topics/Environment/Pollution/16215/4561>
- The Welsh Assembly Government Environment link at <http://www.wales.gov.uk/subienvironment/index.htm>
- The Northern Ireland DoE Environmental Policy Division website at <http://www.doeni.gov.uk/epd>

Detailed pollutant emission data for the UK are available from the National Atmospheric Emissions Inventory (NAEI) at www.naei.org.uk.

References

1. European Commission "**Directive 2008/50/EC Of The European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe**" [online]. Available at <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:152:0001:0044:EN:PDF> [Accessed 9th Sep 2010].
2. European Commission "**Directive 2004/107/EC of the European Parliament and of the Council of 15 December 2004 Relating to Arsenic, Cadmium, Mercury, Nickel And Polycyclic Aromatic Hydrocarbons In Ambient Air**" [online]. Available at <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:152:0001:0044:EN:PDF> [Accessed 9th Sep 2010].
3. CEN "**EN 14625:2005 Ambient air quality – standard method for the measurement of the concentration of ozone by ultraviolet photometry**"
4. CEN "**EN 14211:2005 Ambient air quality - Standard method for the measurement of the concentration of nitrogen dioxide and nitrogen monoxide by Chemiluminescence**"
5. CEN "**EN 14212:2005 Ambient air quality – Standard method for the measurement of the concentration of sulphur dioxide by UV fluorescence**" [
6. CEN "**EN 14626:2005 Ambient air quality - Standard method for the measurement of the concentration of carbon monoxide by non dispersive infra red spectroscopy**"
7. CEN "**EN 12341:1999 Air quality. Determination of the PM₁₀ fraction of suspended particulate matter. Reference method and field test procedure to demonstrate reference equivalence of measurement methods.**"
8. CEN "**EN 14907:2005 Ambient air quality - Standard gravimetric measurement method for the determination of the PM_{2.5} mass fraction of suspended particulate matter**"
9. CEN "**EN 14902:2005 Reference method for determination of Pb/Cd/As/Ni in ambient air**".
10. CEN "**EN 14662-1:2005 Ambient air quality - Standard method for measurement of benzene concentrations - Part 1 : Pumped sampling followed by thermal desorption and gas chromatography**"
11. CEN "**EN 14662-3:2005 "Ambient Air Quality - Standard method for the measurement of benzene concentrations - Part 3: Automated pumped sampling with in situ gas chromatography**"
12. CEN "**EN 15549:2008 Air quality - Standard method for the measurement of the concentration of benzo[a]pyrene in ambient air**"
13. Grice, S. E. et al. (2010) "**UK air quality modelling for annual reporting 2008 on ambient air quality assessment under Council Directives 96/62/EC, 1999/30/EC and 2000/69/EC**" (AEA report: AEAT/ENV/R/2859 Issue 1) [online]. Available at http://www.airquality.co.uk/reports/cat09/1007201636_dd122008mapsrep_v4.pdf [accessed 7th Sep 2010]. Yap, F. et al. (2009) "**UK air quality modelling for annual reporting 2008 on ambient air quality assessment under Council Directives 96/62/EC, 1999/30/EC and 2004/107/EC**" (AEA report: AEAT/ENV/R/2860 Issue 1).

14. Kent, A. J. et al. (2010) "**UK and Gibraltar air quality modelling for annual reporting 2008 on ambient air quality assessment under Council Directives 96/62/EC and 2002/3/EC relating to ozone in ambient air**" (AEA report: AEAT/ENV/R/2860 Issue 1).
15. Defra (2010) **Air Quality Archive (homepage)** [online] Available at <http://www.airquality.co.uk/index.php> [Accessed 7th Sep 2010].

