

Report

UK Smoke and Sulphur Dioxide Network 2002

Report prepared by **netcen** as part of the Air Quality Research Programme of the Department for Environment, Food and Rural Affairs, Scottish Executive, Welsh Assembly Government and Department of the Environment in Northern Ireland.

Title	UK Smoke and Sulphur Dioxide Network 2002
Customer	Department of the Environment, Food and Rural Affairs, Scottish Executive, Welsh Assembly Government and Department of the Environment in Northern Ireland.
Customer reference	EPG 1/3/174
Confidentiality, copyright and reproduction	Copyright AEA Technology plc 2002. All rights reserved. Enquiries about copyright and reproduction should be addressed to the Commercial Manager, AEA Technology plc.
File reference	ED 45005001
Reference number	AEAT/ENV/R/1559 Issue 1

Address for Correspondence

netcen
Culham Science Park
Abingdon
Oxon
OX14 3ED
Telephone 0870 190 6518
Facsimile 0870 190 6377

e-mail alison.loader@aeat.co.uk

netcen is a operating division of AEA Technology plc

netcen is certificated to ISO9001 & ISO 14001

	Name	Signature	Date
Author	Alison Loader Diane Mooney Marvin Coghlan		
Reviewed by	Ken Stevenson		
Approved by	Geoff Dollard		

Executive Summary

This report presents the results from the UK Smoke and Sulphur Dioxide Network for the calendar year 1st January to 31st December 2002. This network measures two pollutant parameters; particulate matter as black smoke, and net gaseous acidity, expressed as SO₂ equivalent. This report provides a summary of data from the 156 sites comprising the Network this year. These data are compared with the standards and objectives specified in the Air Quality Strategy, and with limit and guide values specified in applicable EC Directives on sulphur dioxide and suspended particles. Concentration trends and spatial distributions throughout the UK are also discussed.

UK average concentrations for calendar year 2002, based on 105 "core" sites, were 6.8 $\mu\text{g m}^{-3}$ and 13.9 $\mu\text{g m}^{-3}$ for smoke and net acidity respectively. These concentrations are slightly lower than the averages reported for calendar year 2001, which were 8.2 $\mu\text{g m}^{-3}$ for smoke and 14.9 $\mu\text{g m}^{-3}$ (SO₂ equivalent) for net acidity.

Data for calendar year 2002 were compared with the 1st Daughter Directive (1999/30/EEC) 24-hour limit value for SO₂ (to be met by 1st January 2005), and the identical Air Quality Strategy 24-hour objective, (to be met by 31st December 2004). No Network sites had daily mean net acidity concentrations exceeding the AQS objective of 125 $\mu\text{g m}^{-3}$ for 24-hour mean SO₂ on more than the three permitted occasions. 2002 is the first year for which this has been the case.

Data for calendar year 2002 were also compared with the Stage 1 limit values and objectives for particulate matter contained in the 1st Daughter Directive and the Air Quality Strategy, (which are to be met by 1st January 2005 and 31st December 2004 respectively). These specifically apply to PM₁₀, not black smoke, and the latest Technical Guidance does not recommend that black smoke data are routinely used to assess compliance with AQS objectives. However, black smoke can be considered a subset of PM₁₀, so if black smoke exceeds an objective it is reasonable to suspect that total PM₁₀ has also exceeded. There were no sites in the Network at which the daily mean black smoke concentration exceeded the 24-hour limit of 50 $\mu\text{g m}^{-3}$ for PM₁₀ on more than the 35 permitted occasions.

Contents

1	Introduction	1
2	Network Objectives	1
3	Data Reporting and Use	3
3.1	STATUTORY REPORTING: EC DIRECTIVE	3
3.2	EC EXCHANGE OF INFORMATION	3
3.3	PUBLIC DISSEMINATION	3
3.4	REVIEW AND ASSESSMENT	3
4	Results and Discussion	4
4.1	METHODS AND UNITS	4
4.2	SUMMARY OF RESULTS	4
4.3	DATA CAPTURE	5
4.4	UK AVERAGE SMOKE AND NET ACIDITY CONCENTRATIONS	5
4.5	NATIONAL AND REGIONAL ANALYSIS	5
4.5.1	England	8
4.5.2	Scotland	8
4.5.3	Wales	8
4.5.4	Northern Ireland	9
4.6	SEASONAL ANALYSIS	9
5	Comparison with Air Quality Limit Values and Objectives	12
5.1	LIMITS AND OBJECTIVES FOR SO ₂	12
5.2	LIMITS AND OBJECTIVES FOR SMOKE	13
6	Trends and Comparison with Emission Estimates	14
7	Comparison of Net Acidity and SO₂	18
8	Acknowledgements	18
9	References	19

Appendices

APPENDIX 1	CALCULATION OF RESULTS AND STATISTICS
APPENDIX 2	DATA FILES FOR 2002
APPENDIX 3	SITES COMPRISING "CORE" SUBSET

1 Introduction

This is the annual summary report for the Smoke and Sulphur Dioxide Network, for calendar year 2002. This report presents a description of the Network, and a summary and review of the data for 2002. Results are compared with applicable air quality limit values and objectives. Trends, spatial distribution of smoke and sulphur dioxide concentrations throughout the UK, data reporting commitments and data usage are discussed. The main report is followed by Appendices which provide details of the derivation and calculation of the statistics presented in the report.

2 Network Objectives

The UK Smoke and Sulphur Dioxide (SO₂) Network (Figure 1) measures two pollutant parameters; particulate matter as black smoke, and net gaseous acidity, expressed as SO₂ equivalent. The Network, together with its predecessor the National Survey, has been in operation for over 40 years, and currently has two purposes.

Firstly, the Network still monitors compliance with the original European Council Directive on Sulphur Dioxide and Suspended Particles (80/779/EEC)¹. This Directive, in force since 1980, is now being superseded. The European Commission issued a Directive on Ambient Air Quality Assessment and Management² - the so-called "Framework Directive" in 1996. Under this framework, a number of "Daughter Directives" covering specific pollutants are being prepared. The first Daughter Directive (1999/30/EEC)³ came into force in July 2001 and includes limit values for SO₂ and particulate matter as PM₁₀, to be met by 1 January 2005. The old Directive 80/779/EEC will be fully repealed on 1 January 2005, but the existing standards for particulate matter and SO₂, which in the UK are measured as smoke and net acidity, will remain in force until then. Comparison of Network data with this Directive is now reported to Defra separately from this report.

Secondly, the Network provides a long-term database of smoke and net acidity measurements, used to assess trends in concentration and spatial distribution. For this purpose, a "core" subset of sites is used to provide a representative sample of monitoring locations in major population centres throughout the UK, with a wide spatial coverage of the whole country. A total of 156 Network sites were in operation during part or all of 2002 (see Figure 1). Of these sites, 105 comprised the "core" subset used to provide national trend statistics (see discussion in Section 4).

It is not envisaged that the repeal of 80/779/EEC on 1 January 2005 will mark the end of black smoke monitoring in the UK. The scientific community remains interested in black smoke as a useful particulate metric. As summarised in last year's report, numerous scientific studies have found that black smoke is linked to health impacts, even at today's relatively low concentrations. While no decision has yet been made, these factors, together with the value of the long-term historic database, indicate that some smoke monitoring is likely to continue for research purposes.



Figure 1. Locations of Smoke and Sulphur Dioxide Network Monitoring Sites

3 Data Reporting and Use

The Smoke and SO₂ Network, and its predecessor the National Survey, together provide one of the longest running databases of air quality measurements in the UK, having been in operation as a coordinated national network for over 40 years. The results have shown clearly the dramatic decrease in the concentrations of these pollutants in the UK over this period. With the exception of the UK Nitrogen Dioxide Diffusion Tube Network, the Smoke and SO₂ Network remains the most widespread air quality monitoring network in the UK. At a local level, many Local Authorities, particularly in areas where levels of these pollutants are relatively high, find the smoke and net acidity methods to be a useful and relatively low-cost supplement to expensive automatic techniques.

3.1 STATUTORY REPORTING: EC DIRECTIVE

The Smoke and SO₂ Network will continue to fulfil the statutory monitoring requirements of EC Directive 80/779/EEC¹, until this is fully repealed in 2005. In July each year, the data from the previous pollution year (April - March) are compared with the requirements of the Directive. The results are supplied to the Department for Environment, Food and Rural Affairs (Defra) for formal submission to the European Commission.

3.2 EC EXCHANGE OF INFORMATION

Under the terms of the EC Exchange of Information Decision⁴, Defra has agreed to supply to the Commission, full daily data for all sites in the Network, from 1997 onwards. The data are supplied to the European Topic Centre on Air Quality, for inclusion in their "AIRBASE" database, at <http://bettie.rivm.nl/etc-acc/appletstart.html>. (Note: in AIRBASE, the term "Strong Acidity" is used for net gaseous acidity).

3.3 PUBLIC DISSEMINATION

This report provides a major route for public dissemination of data from the Network. However, data are also summarised in the Digest of Environmental Statistics, published annually by the Stationery Office⁵. Also, ad hoc requests for data are serviced by retrievals from the database held at **netcen**. These are normally provided free of charge.

A comprehensive archive of air quality measurements, including data from the Smoke and SO₂ Network, is available on the World Wide Web, via Defra's Air Quality Archive at www.airquality.co.uk. Daily data from 1961 onwards are available, and are updated regularly.

3.4 REVIEW AND ASSESSMENT

Black smoke and net acidity measurements are of limited use in the Review and Assessment process⁶. In the case of black smoke, there is no simple or universally applicable relationship between this parameter and PM₁₀, so smoke data cannot be used as a substitute for PM₁₀ measurements. However, existing smoke monitoring sites may be useful in identifying areas of high particulate pollution, which can then be targeted for PM₁₀ monitoring. Also, net acidity data can be used to predict possible exceedence of the 24-hour objective for SO₂.

4 Results and Discussion

4.1 METHODS AND UNITS

Both smoke and sulphur dioxide concentrations are expressed in microgrammes per cubic metre ($\mu\text{g m}^{-3}$) in this report.

(i) Smoke: in the UK, smoke concentrations are usually calculated according to the British Standard Smoke Stain (BS) Calibration. This report primarily uses the BS calibration, and all black smoke concentrations are in this form except where stated. However, elsewhere in Europe, the Organisation for Economic Co-operation and Development (OECD) Smoke Calibration Curve (OECD Publication no. 17913: 1964) is used. Concentrations given according to the BS calibration can be converted to OECD by dividing by 0.85. In any communication with the European Commission, it is normal to use the OECD calibration. Where OECD smoke concentrations appear in this report, they are indicated as OECD and shown in *italics*.

(ii) SO₂: this network uses the peroxide bubbler method to determine the total concentration of strong acidic gases in the air; the results are by convention expressed as SO₂ equivalent. The units used in this report for net acidity as SO₂ equivalent are $\mu\text{g m}^{-3}$. However, concentrations of gaseous pollutants are sometimes expressed as parts per billion by volume (abbreviated to "ppb"). For SO₂, the conversion factor used by the EC is as follows: **1 ppb = 2.66 $\mu\text{g m}^{-3}$, at a temperature of 20°C and 1013 mb pressure.** (This **only** applies to SO₂; conversion factors are different for other gaseous pollutants.)

4.2 SUMMARY OF RESULTS

Summary statistics for the year 2002 for each Network site are provided in Table 1. The sites are listed by Government region (Scotland, the North East, North West and Merseyside, Yorkshire and the Humber, East Midlands, West Midlands, Wales, Eastern, London, South East, South West and Northern Ireland). Table 1 is subdivided into 12 separate Tables, 1.1 to 1.12, for the 12 regions. ***As Table 1 is large, it has been placed at the end of the text.*** Within each region, sites are grouped by the Local or Unitary Authority in whose area they are situated. In most cases, this Authority is responsible for the operation of the site, although a small number are operated by other organisations such as universities.

For sites in England, Wales and Scotland, Table 1 gives the location as an Ordnance Survey grid reference, to the nearest 100m. For sites in Northern Ireland, the Irish Grid is used.

The following abbreviations are used in Table 1:

1. "**Data Capt. %**" is percentage data capture – the number of days in the calendar year for which valid data was obtained, expressed as a percentage.
2. "**Arith. Mean**" is the arithmetic mean of all daily values, calculated by the usual method, as described in Appendix 1.
3. "**Median**" is the median, or 50th percentile, of all daily values. See Appendix 1.
4. "**98th %ile**" is the 98th percentile of all daily values, see Appendix 1.
5. "**Max. Day**" is the maximum daily value measured during the year.

4.3 DATA CAPTURE

The data capture objective specified by Annex IV of the First Daughter Directive (1999/30/EEC) for indicative techniques is 90%; therefore this is the target for minimum data capture in the Network. The number of sites in operation for the whole year was 131 (i.e. excluding those which started up or closed down during this period, and so could not have achieved 90% data capture). 64% of these 131 sites achieved the data capture target of 90% for smoke. The average data capture for smoke was 88%. In the case of net acidity (as SO₂) data capture is usually lower, as the method can be affected by factors such as alkaline interference, which is usually outside the operator's control. 59% of the sites in operation for the full year achieved the data capture target of 90% for net acidity, while the average data capture for this parameter was 86%.

These data capture statistics represent a small improvement on the previous year. However, data capture remains an area where improvement is needed. Advice for site operators on dealing with equipment faults and improving data capture are given in the Network's Instruction Manual. Every site operator should have an up-to-date copy of the Manual to hand: it can be downloaded from <http://www.aeat.co.uk/netcen/airqual/reports/smkman/shead.html> ; alternatively printed copies are available from **netcen**. Site operators are welcome to contact **netcen** for advice on any aspect of smoke or net acidity monitoring.

4.4 UK AVERAGE SMOKE AND NET ACIDITY CONCENTRATIONS

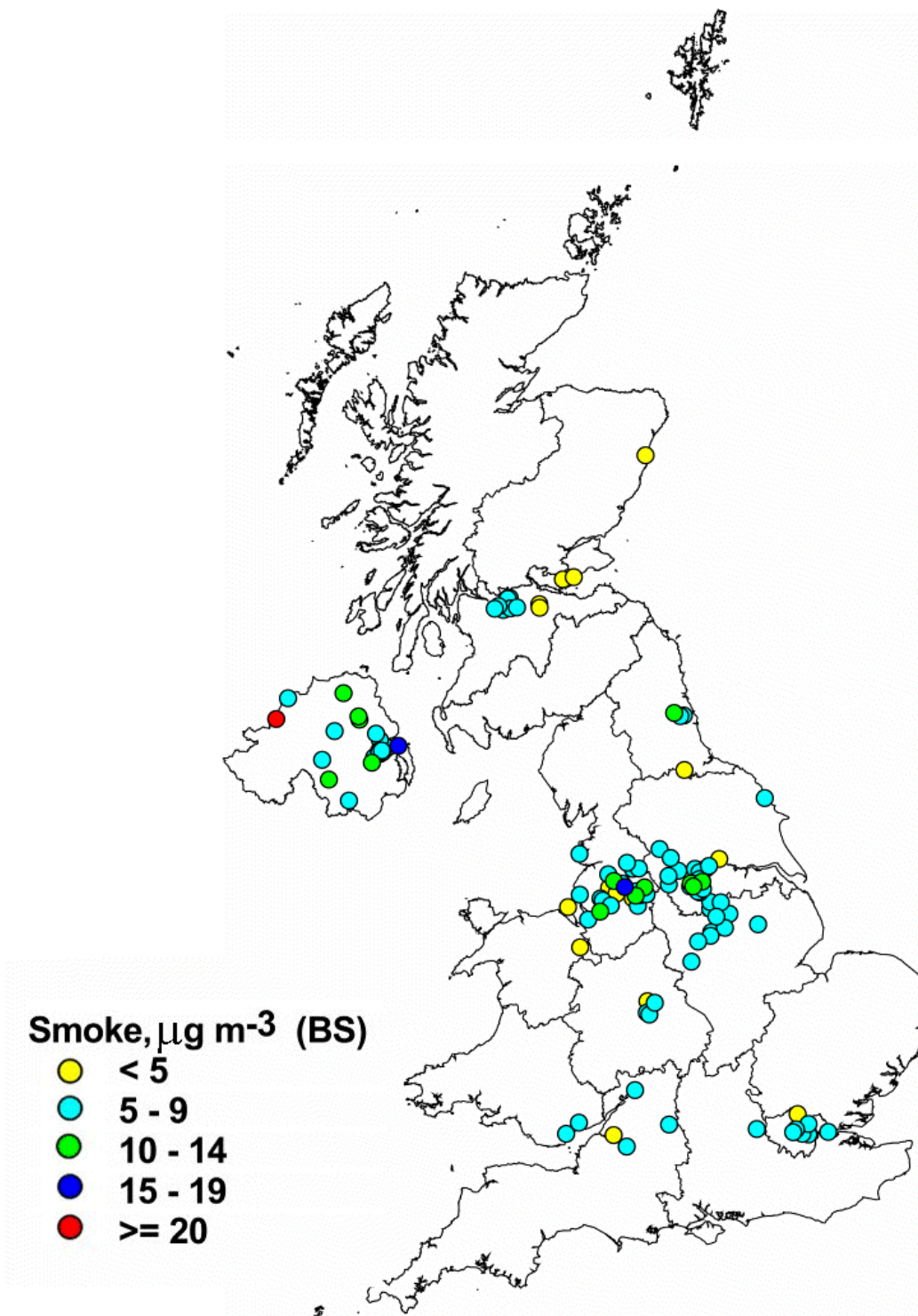
Annual mean UK smoke and net acidity are estimated on the basis of a "core" subset of sites. There were 105 sites in the "core" subset during 2002. Annual mean concentrations were calculated by averaging the annual means from all core sites, excluding any with data capture of less than 70%, and for 2002 were as follows:

- Smoke: 6.8 $\mu\text{g m}^{-3}$ BS (8.0 $\mu\text{g m}^{-3}$ OECD).
- net acidity: 13.9 $\mu\text{g m}^{-3}$.

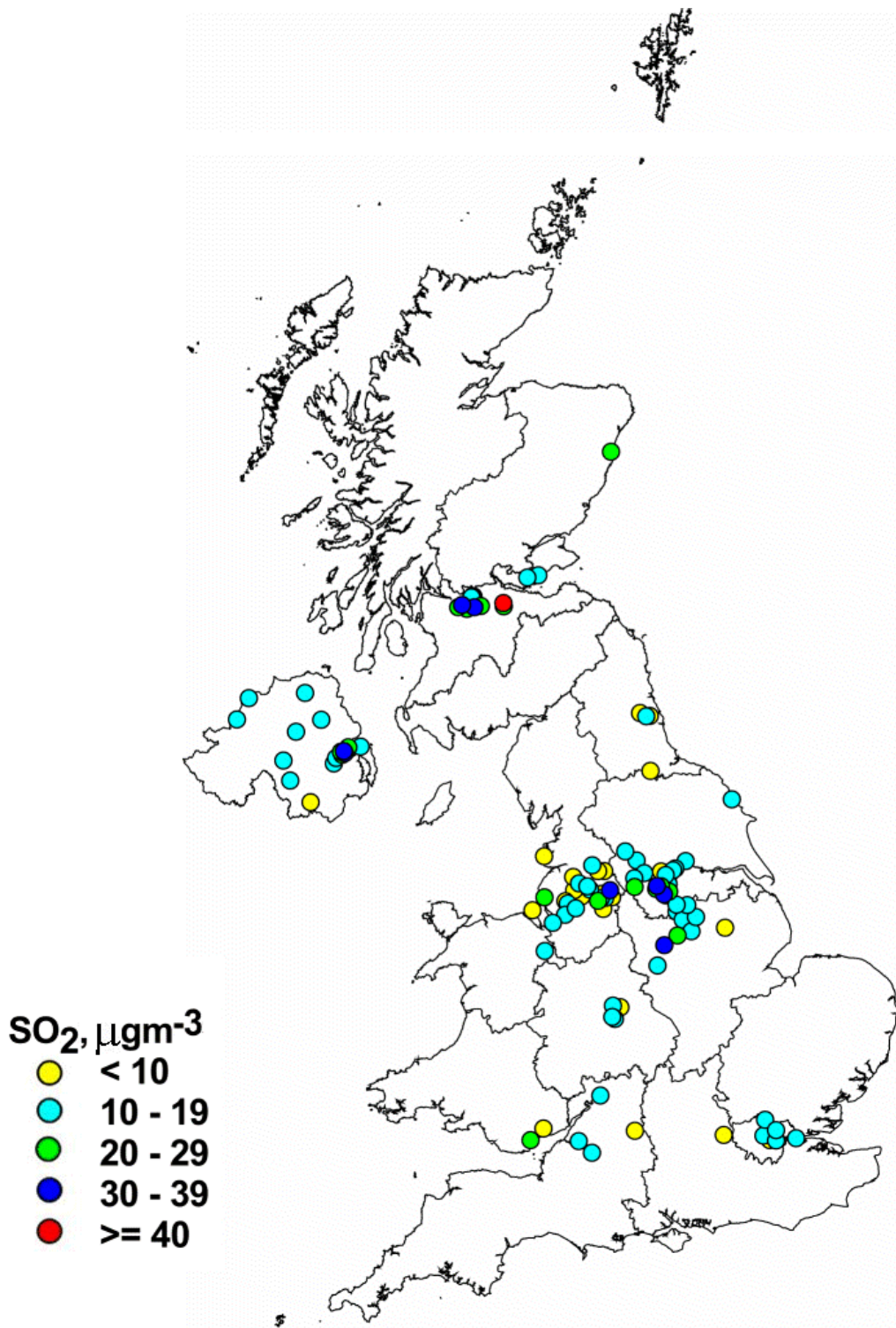
Both the annual mean smoke and net acidity concentrations for 2002 were lower than the annual means for 2001 (which were 8.2 $\mu\text{g m}^{-3}$ and 14.8 $\mu\text{g m}^{-3}$ respectively). It should be noted that the net acidity method is likely to over-estimate network average SO₂ concentrations, due to the contribution from other acidic gases.

4.5 NATIONAL AND REGIONAL ANALYSIS

Figures 2 and 3 show annual means of smoke and net acidity respectively, for the entire Network. Only sites with at least 75% data capture are shown.



**Figure 2. Annual Mean Smoke Concentrations
(Only sites with at least 75% data capture are shown.)**



**Figure 3. Annual Mean Concentrations of net acidity.
(Only sites with at least 75% data capture are shown.)**

Table 2 summarises key statistics for England, Scotland, Wales and Northern Ireland.

Table 2. Statistical Summary for England, Scotland, Wales and Northern Ireland.

	<i>England</i>	<i>Scotland</i>	<i>Wales</i>	<i>N. Ireland</i>
Smoke ($\mu\text{g m}^{-3}$ BS)				
No. of sites with > 75% data	78	13	3	22
Min. Annual Mean	2	2	4	5
Ave. Annual Mean	7	5	5	9
Max. Annual Mean	16	7	6	27
Net Acidity ($\mu\text{g m}^{-3}$)				
No. of sites with > 75% data	76	13	3	19
Min. Annual Mean	1	10	6	7
Ave. Annual Mean	14	22	14	18
Max. Annual Mean	37	46	20	32

Note: all statistics in Table 2 are based only on sites with at least 75% data capture.

4.5.1 England

Smoke in England: Annual mean smoke at English sites ranged from $2 \mu\text{g m}^{-3}$ at WEST KIRBY 2 (in the Wirral) and at the three sites operated by Wigan MBC, to $16 \mu\text{g m}^{-3}$ at FARNWORTH 8 near Bolton. However, few sites this year had annual mean smoke concentrations greater than $10 \mu\text{g m}^{-3}$. There was no clear pattern in the types of locations with highest smoke concentrations this year. The average for all sites in England was $7 \mu\text{g m}^{-3}$. This is consistent with the mean of $6.9 \mu\text{g m}^{-3}$ for the whole UK, based on core sites.

Net acidity in England: Few sites had annual means greater than $30 \mu\text{g m}^{-3}$ in 2002, but those that did (including OLDHAM 13, BRAMPTON 1 (near Rotherham), and ALFRETON 4 in Amber Valley) were all in areas where domestic coal use is relatively widespread. The annual mean net acidity for all English sites was $14 \mu\text{g m}^{-3}$. Again, this is consistent with the mean of $13.9 \mu\text{g m}^{-3}$ for the whole UK (based on core sites only).

4.5.2 Scotland

Smoke in Scotland: Annual mean smoke concentrations measured in Scotland were all less than $10 \mu\text{g m}^{-3}$. The annual mean smoke concentration for all Scottish sites was $5 \mu\text{g m}^{-3}$, lower than the Network average of $6.9 \mu\text{g m}^{-3}$.

Net acidity in Scotland: By contrast, net acidity concentrations at Network sites in Scotland were typically higher than the Network average. The highest annual mean was $46 \mu\text{g m}^{-3}$, measured at ARMADALE 2. This site is close to industrial and domestic emission sources; high net acidity concentrations have been measured here in previous years. The mean for Scotland was $22 \mu\text{g m}^{-3}$ – considerably higher than that measured for the whole Network. However, it is not necessarily the case that net acidity concentrations in Scotland are higher than in the rest of the UK: the number of sites is relatively small, and they are located in Scotland's most built-up areas.

4.5.3 Wales

Smoke in Wales: There were only four sites in Wales during 2002, of which only three had at least 75% data capture. The limited number of sites in Wales means that these statistics are unlikely to be representative of all urban areas in Wales. However, annual means at all three sites were less than $7 \mu\text{g m}^{-3}$.

Net acidity in Wales: Annual mean net acidity concentrations at the three sites in Wales ranged from $6 \mu\text{g m}^{-3}$ to $14 \mu\text{g m}^{-3}$.

4.5.4 Northern Ireland

Smoke in Northern Ireland: Annual mean smoke concentrations in Northern Ireland (with one exception) ranged from $5 \mu\text{g m}^{-3}$ to $17 \mu\text{g m}^{-3}$. The average for Northern Ireland was $9 \mu\text{g m}^{-3}$; higher than the Network average of $6.8 \mu\text{g m}^{-3}$. One site, STRABANE 2, measured a substantially higher annual mean smoke concentration of $27 \mu\text{g m}^{-3}$. This site has recorded unusually high smoke concentrations ever since it started operation in 2000, and investigations indicate that the results are genuine. The site is located on a housing estate with considerable domestic coal and oil burning, and local topography may impede dispersion.

Net acidity in Northern Ireland: Relatively high concentrations of net acidity have been measured in Northern Ireland, particularly Belfast, for many years. Availability of natural gas has historically been limited in this region, so greater use is made of coal and oil. However, the overall annual mean net acidity for all Network sites in Northern Ireland appears to be falling: from $27 \mu\text{g m}^{-3}$ in 2000, $22 \mu\text{g m}^{-3}$ in 2001, to $18 \mu\text{g m}^{-3}$ in 2002.

4.6 SEASONAL ANALYSIS

Smoke and net acidity can exhibit a seasonal variation. Concentrations of both pollutants, but particularly black smoke, are typically higher in the winter months. The combustion of coal and oil is a major source of both pollutants; this increases during winter, mainly because of domestic and industrial heating requirements. Also cold, still weather conditions may impede dispersion of locally emitted pollutants, giving rise to "winter pollution" episodes when concentrations of smoke and net acidity may be especially high.

Figures 4a and 4b are time series graphs of daily mean concentrations of smoke and net acidity respectively, averaged over all sites in each region: England, Scotland, Wales and Northern Ireland. They are intended to illustrate seasonal variation in these pollutants, and also allow comparison of the seasonal patterns between these four regions.

In the case of smoke (Figure 4a), all four regions show a similar pattern. Highest smoke concentrations occur during the winter months, with several peaks indicating periods of high pollution. Several specific "episodes" of high pollutant concentrations are apparent. The first occurred around 7th–8th January 2002, affecting England and Northern Ireland. The second episode was around 17th–21st December 2002, and affected Northern Ireland, Scotland and parts of England. Defra's Automatic Urban and Rural Network (AURN), which measures particulate matter as PM_{10} , also recorded high concentrations across the UK at these times.

In the case of net acidity, (Figure 4b), there were no clearly defined seasonal patterns in 2002. All four regions showed a slight peak in early January, corresponding to that observed for smoke. England, Scotland and Northern Ireland also showed a peak around 17th–21st December, again corresponding to that observed for smoke.

For the second year running, Scotland's network average SO_2 concentrations in 2002 showed an unexpected pattern, with the highest concentrations occurring during summer, rather than winter, months. A period of high net acidity occurred between mid-August and mid-September, where average net acidity concentrations remained consistently above $25 \mu\text{g m}^{-3}$, with a peak of over $40 \mu\text{g m}^{-3}$ on 14th September. These high measurements occurred at sites in Glasgow and surrounding areas. This is the second year running when this Network has identified high levels of net acidity in Scottish sites during summer. It is possible that what is being detected is not SO_2 , but another acidic, gaseous compound. Data from Scottish sites in Defra's Automatic Urban and Rural Network showed no similar period of high concentration, for SO_2 or any of the other pollutants.

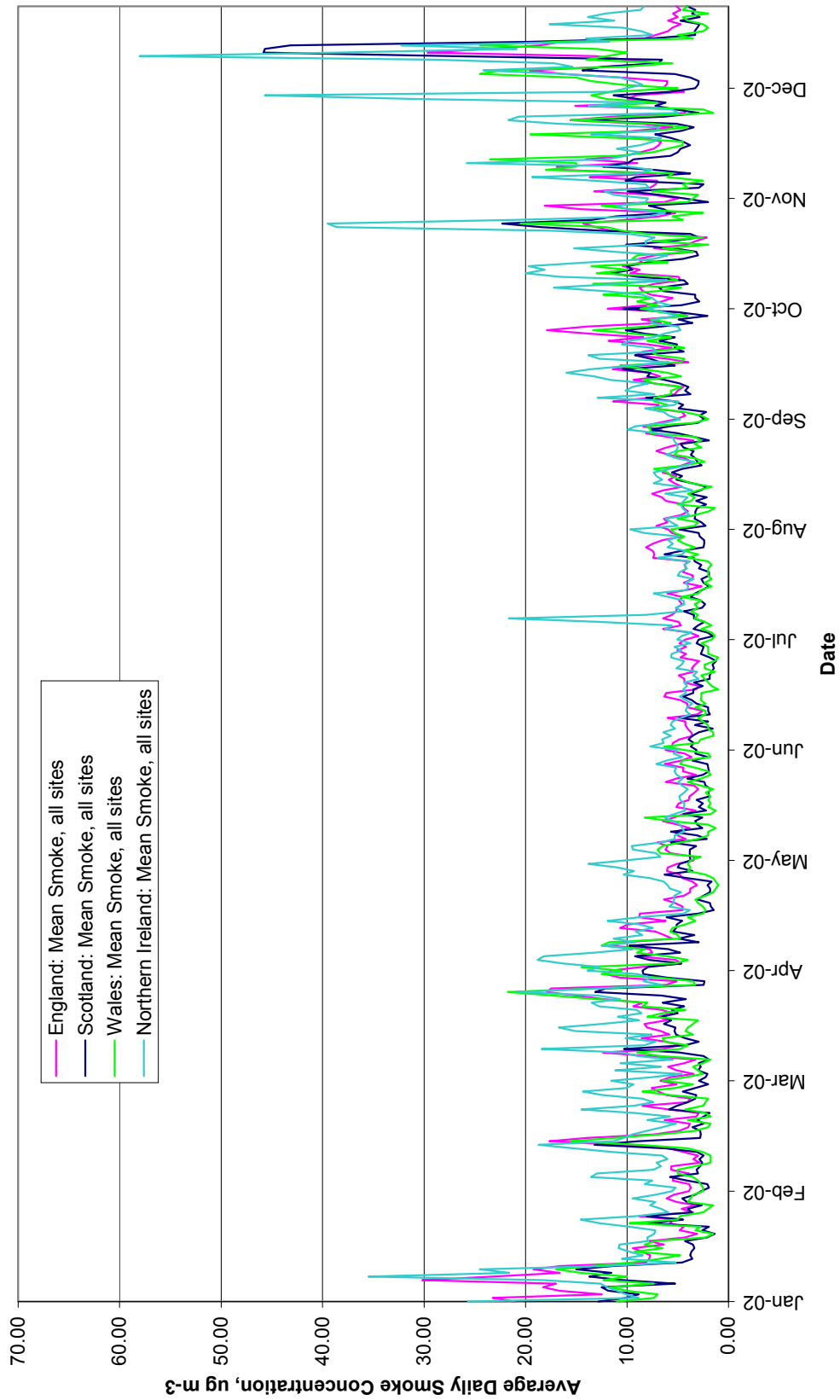


Figure 4a. Seasonal Variation in Average Daily Smoke Concentration

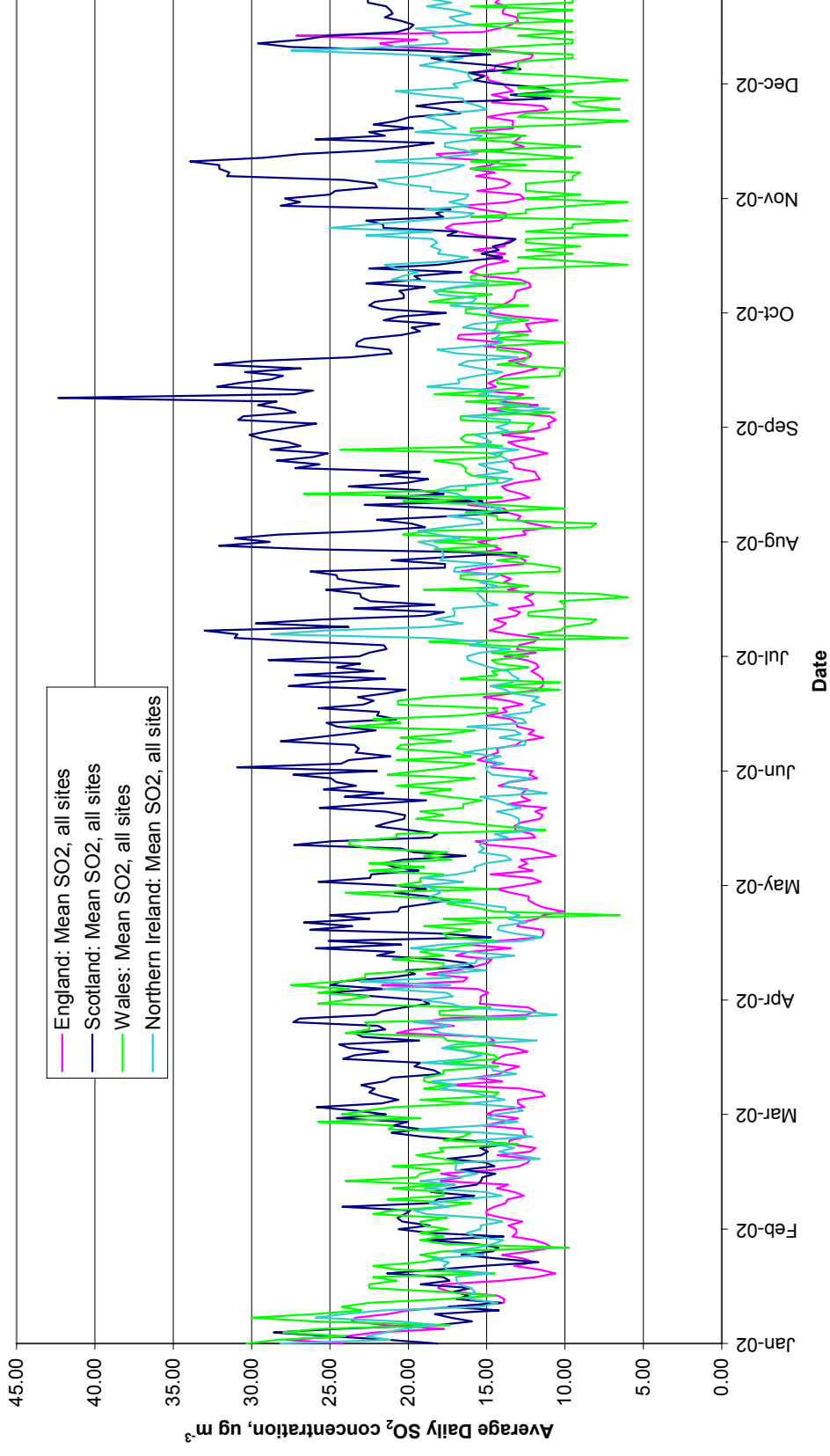


Figure 4b. Seasonal Variation in Average Daily Net Acidity Concentration

5 Comparison with Air Quality Limit Values and Objectives

In previous years, data from the UK Smoke and SO₂ Network have been compared with the European Council Directive¹ 80/779/EEC on sulphur dioxide and suspended particulates. Although the limits of this older Directive remain in force until they are fully repealed in 2005, they are less stringent than those in the later 1st Daughter Directive and have been fully met throughout the UK since the early 1990s. Now that Network data are reported on a calendar year basis, comparison of results from the Smoke and SO₂ Network with this original Directive are reported separately to Defra each year. This report therefore compares results from the Smoke and SO₂ Network, for calendar year 2001, with applicable parts of the First Daughter Directive (1999/30/EEC).

In both the 1st Daughter Directive and the Air Quality Strategy, an "exceedence" of an air quality limit or guide value is defined as a concentration "greater than" the limit or guide value, as opposed to "greater than or equal to". This definition - "greater than" is therefore used in this report.

5.1 LIMITS AND OBJECTIVES FOR SO₂

Within Europe, sulphur dioxide is covered by the 1st Daughter Directive (1999/30/EC)³. This Directive, covering SO₂, NO₂, PM₁₀ and lead was published in April 1999 and came into force in July 2001. In the UK, the Air Quality Regulations (2000) for England⁷, Wales⁸, and Scotland⁹, and (2001) for Northern Ireland¹⁰ include standards and objectives for SO₂. These are explained in the Air Quality Strategy (January 2000)¹¹. The EC limit values, and Air Quality Strategy standards and objectives, are shown in Table 3. All these limits are for protection of human health except where stated.

Table 3. Limit Values and Objectives for Sulphur Dioxide

Averaging period	Limit Value	No. of Permitted exceedences	To be achieved by
EC 1st Daughter Directive (1999/30/EC)			
1 hour	350 $\mu\text{g m}^{-3}$	24 per year	1 January 2005
24 hour	125 $\mu\text{g m}^{-3}$	3 per year	1 January 2005
Calendar year and winter (1st October – 31st March), for protection of vegetation (relevant in rural areas)	20 $\mu\text{g m}^{-3}$	-	19 July 2001
Air Quality Strategy Objectives			
15 minute	266 $\mu\text{g m}^{-3}$	35 per year	31 December 2005
1 hour	350 $\mu\text{g m}^{-3}$	24 per year	31 December 2004
24 hour	125 $\mu\text{g m}^{-3}$	3 per year	31 December 2004
Calendar year and winter (1st October – 31st March), for protection of vegetation (relevant in rural areas)	20 $\mu\text{g m}^{-3}$	-	31 December 2000

It is clearly not possible to compare data from the Smoke and SO₂ Network with the limit values or objectives relating to the 15-minute or hourly average SO₂ concentration. Nor is it relevant to compare data from this urban network with the annual and winter limits for protection of ecosystems, which are intended for protection of rural areas. However, it is possible to compare the daily net acidity data from the Network with the 24 hour limit. The calendar year January to December 2002 was the first in which no sites had more than three days where the 24-hour average net acidity was greater than the Daughter Directive Limit Value and AQS Standard for SO₂ of 125 µg m⁻³.

By convention, a factor of 1.25 should be applied to *peak* data obtained using the net acidity method, when comparing it with limit values relating specifically to SO₂. This is intended to take into account any additional uncertainty of the net acidity method at higher concentrations. After application of this factor, just three additional sites had over three daily mean net acidity concentrations greater than the limit value in calendar year 2002: these were as follows: ARMADALE 2, which as discussed in section 4.5.2 is close to both industrial and domestic sources, BARNSELEY 8, and BRAMPTON 1 near Rotherham.

Most of the days on which the Daughter Directive Limit Value and AQS Standard of 125 µg m⁻³ was exceeded at BARNSELEY 8 and BRAMPTON 1 occurred during January and early February 2002. At ARMADALE 2 however, they occurred during August 2002, in the Scottish "summer net acidity episode" identified in Section 4.6.

5.2 LIMITS AND OBJECTIVES FOR SMOKE

The Daughter Directive particulate limits relate to PM₁₀, not black smoke, and therefore Network data cannot be directly compared with these. However, particularly in areas where domestic coal and oil combustion are prevalent, black smoke measurements can be useful for highlighting areas where high concentrations of PM₁₀ may occur: these areas can then be targeted for more detailed investigation.

The Air Quality Strategy¹¹ also provides objectives for suspended particulate matter. These objectives also specifically apply to PM₁₀, not black smoke, and the Strategy acknowledges that these two techniques are not the same. Following a recent consultation process, in August 2002 Defra announced some changes to the AQS objectives, including the setting of further PM₁₀ objectives for 2010. The new objectives include separate PM₁₀ objectives specifically for London, (in acknowledgement of the capital's higher levels of industrial and transport activity), and for Scotland where PM₁₀ concentrations are generally lower.

The EC Directive limit values and AQS objectives are shown in Table 4. All limits and objectives are based on European reference method for PM₁₀ (a gravimetric technique), or equivalent. Black smoke data are not directly comparable.

**Table 4. Limit Values and Objectives for Particulate Matter as PM₁₀.
All limit values refer to gravimetric equivalent measurements.**

Averaging period	Limit Value	Number of Permitted Exceedences	To be achieved by
EC 1st Daughter Directive (1999/30/EC) Stage 1			
24 hour	50 $\mu\text{g m}^{-3}$	35 per year	1 st January 2005
Annual Mean	40 $\mu\text{g m}^{-3}$	-	1 st January 2005
EC 1st Daughter Directive (1999/30/EC) Stage 2 (to be confirmed)			
24 hour	50 $\mu\text{g m}^{-3}$	7 per year	1 st January 2010
Annual Mean	20 $\mu\text{g m}^{-3}$	-	1 st January 2010
Air Quality Strategy			
24 hour	50 $\mu\text{g m}^{-3}$	35 per year	31 st December 2004
Annual Mean	40 $\mu\text{g m}^{-3}$	-	31 st December 2004
Air Quality Strategy, England (except London) and Wales			
24 hour	50 $\mu\text{g m}^{-3}$	7 per year	31 st December 2010
Annual Mean	20 $\mu\text{g m}^{-3}$	-	31 st December 2010
Air Quality Strategy, Scotland			
24 hour	50 $\mu\text{g m}^{-3}$	7 per year	31 st December 2010
Annual Mean	18 $\mu\text{g m}^{-3}$	-	31 st December 2010
Air Quality Strategy, London			
24 hour	50 $\mu\text{g m}^{-3}$	10 per year	31 st December 2010
Annual Mean	23 $\mu\text{g m}^{-3}$	-	31 st December 2010

LAQM.TG(03), available via the Defra web site <http://www.defra.gov.uk/environment/airquality/laqm/guidance/index.htm>, does not recommend that black smoke data are routinely used to assess compliance with the AQS Objectives above. This is because there is no simple relationship between black smoke and PM₁₀ which is applicable to every site. However, as black smoke can be considered a subset of PM₁₀, if black smoke exceeds either of the above limits, it is very likely that total PM₁₀ has also done so. This was not the case for any Network sites during 2002.

6 Trends and Comparison with Emission Estimates

The timeseries of the annual mean smoke and net acidity concentrations for the UK as a whole are provided in Figure 5a and 5b respectively. The values shown in Figure 5a and 5b are averages from all sites in the network up to 1980, and thereafter from all sites in the core subset only. As explained in Section 2, this subset is intended to provide a representative selection of monitoring sites in urban areas throughout the UK. For consistency with previous years, the annual means shown in these figures are based upon the old "pollution calendar" years, which ran from April to March. The most recent annual means shown are for years April 2002-March 2003, which are 7.4 $\mu\text{g m}^{-3}$ and 14.7 $\mu\text{g m}^{-3}$ for smoke and net acidity respectively. (It should be noted that these are slightly different from the calendar year means discussed previously). The resulting graphs show the rapid decrease in concentrations in the 1960s and 1970s and the more

gradual decrease through the 1980s and 1990s. Figure 5a and 5b also show estimated total UK annual emissions of smoke and SO₂ for calendar years 1970 - 2001 (data for 2002 are not yet available), taken from the National Atmospheric Emissions Inventory. The graphs clearly show that ambient concentrations of these pollutants reflect declining emissions over this 30-year period.

The relationships between estimated annual emissions and measured annual mean concentrations have been explored further.

- **Smoke:** The plot shows a clear relationship between these two parameters over the 28 years. Regression analysis of the two parameters was carried out, giving a correlation coefficient (R^2) of 0.91. This is close to 1 and therefore indicates a very strong correlation.
- **SO₂:** The relationship between the two parameters is also strong in the case of SO₂: the correlation coefficient (R^2) of the regression equation is 0.88. The correlation is slightly weaker than for smoke, which may reflect the fact that the peroxide bubbler method used by the Network measures net acidity rather than specifically SO₂.

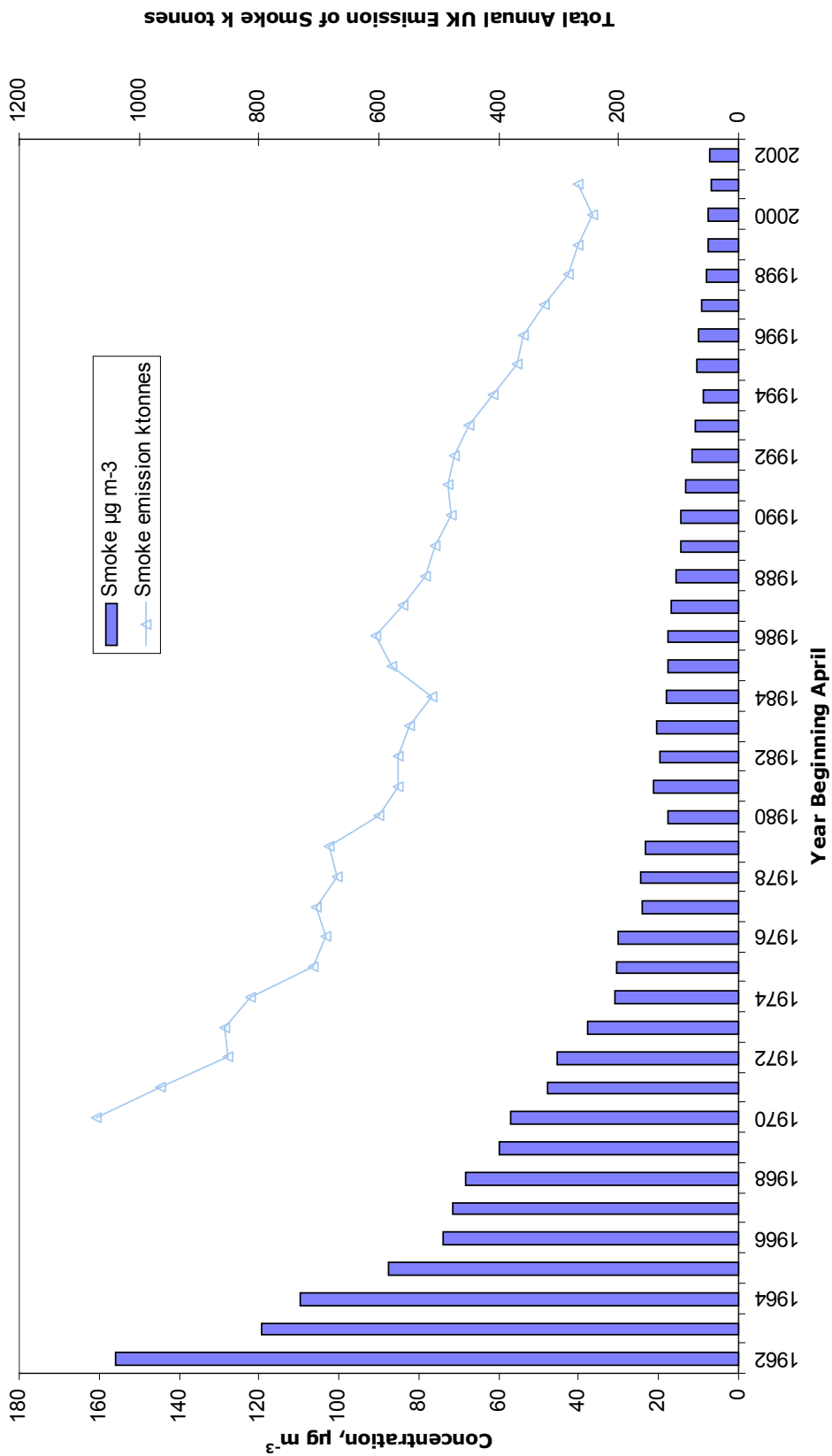


Figure 5a. Annual UK Emissions, and Annual Mean Ambient Concentrations of Smoke.

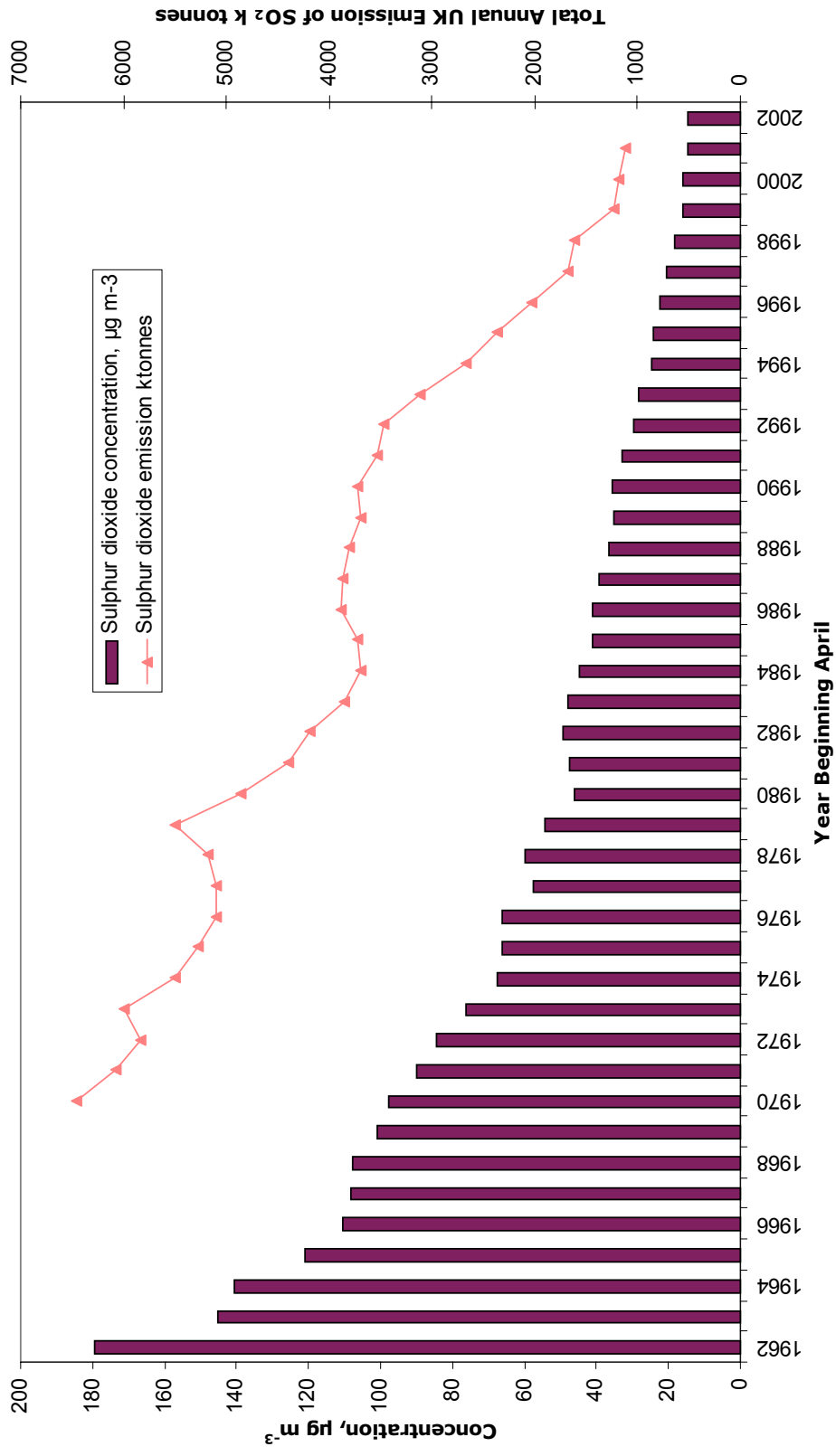


Figure 5b. Annual UK Emissions of SO_2 and Annual Mean Concentrations of Net Acidity.

7 Comparison of Net Acidity and SO₂

Readers familiar with this series of annual reports may notice that this report makes more frequent mention of net acidity, as distinct from sulphur dioxide. The reason for this is as follows. During the earlier years of the Network, ambient levels of sulphur dioxide were considerably higher than they are now, and SO₂ comprised a larger proportion of the total concentration of strongly acidic gases in ambient air. Therefore, peroxide bubbler measurements of net acidity, conventionally expressed as SO₂ equivalent, were usually a good indicator of actual SO₂ concentration¹².

However, total UK emissions of SO₂ have decreased by approximately 60% between 1991 and 2001. Ambient concentrations of SO₂ have also fallen, and other strongly acidic gases, such as NO₂, make a significant contribution to the net acidity measurement. It can no longer be assumed that net acidity is equivalent to SO₂ at all sites. UK and regional annual means from the Smoke and SO₂ Network are typically higher than those from the Automatic Urban Network sites, which use the SO₂-specific ultra violet fluorescence technique.

Only a small number of Smoke and SO₂ Network sites are co-located with AURN sites. Data from these sites indicate that:

1. annual mean net acidity is typically substantially higher than annual mean SO₂. The net acidity method tends to overestimate the annual mean SO₂, and thus in many locations it is no longer a good measurement of annual mean SO₂ concentrations. For this reason, the present report makes it clear that annual mean statistics in particular are net acidity data.
2. By contrast, net acidity measurements appear still to provide a useful indication of highest daily average SO₂ concentrations. This is because these peak measurements usually correspond to winter pollution episodes, where the majority of the gaseous acidity measured is in fact SO₂.

The net acidity method remains a useful indicative technique for peak 24-hour mean SO₂ concentrations, particularly in areas where coal and oil use are still widespread. However, with SO₂ concentrations still decreasing in the UK, its application is likely to become more limited in the longer term.

8 Acknowledgements

All data presented in this report have been obtained by participating Local Authorities and supplied to **netcen** as part of this study. This contribution and cooperation from the Local Authorities is gratefully acknowledged. The central organisation of the study, analysis and quality assurance of the data by **netcen** has been funded by the Department for Environment, Food and Rural Affairs, the Scottish Executive, the Welsh Assembly Government and Department of the Environment in Northern Ireland as part of their Air and Environmental Quality research programme (Contract No. EPG 1/3/71 (A)).

9 References

1. Council of European Communities Directive on Air Quality Limit Values and Guide Values for Sulphur Dioxide and Suspended Particulates (80/779/EEC)
2. Council Directive 96/62/EC on Ambient Air Quality Assessment and Management.
3. Council Directive 1999/30/EEC relating to limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air. 22 April 1999.
4. Establishing a Reciprocal Exchange of Information and of Data from the Network and Individual Stations Measuring Ambient Air Pollution in Member States. Decision 97/101/EEC.
5. Defra Digest of Environmental Statistics (produced annually). The Stationery Office.
6. Part IV of Environment Act 1995: Local Air Quality Management. Technical Guidance LAQM.TG(03). Defra, Feb 2003.
7. The Air Quality (England) Regulations 2000 (Statutory Instrument 2000 No. 928), March 2000.
8. The Air Quality (Wales) Regulations 2000 (Statutory Instrument 2000 No. 1940 (W.138)), July 2000.
9. The Air Quality (Scotland) Regulations 2000 (Scottish Statutory Instrument 2000 No. 97), March 2000.
10. The Air Quality Limit Values Regulations (Northern Ireland) 2002 (Statutory Rule 2002 No. 94), May 2002.
11. The Air Quality Strategy for England, Scotland, Wales and Northern Ireland. Working Together for Clean Air. The Stationery Office, January 2000.
12. Report on the assessment of the comparability of the United Kingdom's net acidity method for monitoring sulphur dioxide against the UV-fluorescence method. G McInnes, Warren Spring Laboratory report LR653, February 1988.

Table 1.1 Summary of Smoke and Net Acidity (SO₂ equivalent) Results for Scotland, 2002. All concentrations in µg m⁻³.

Code	Site Name	Authority	OS Grid Ref to 100m		Summary of Smoke Data in 2002					Summary of SO ₂ Data 2002				
			East	North	Data Capt. %	Arith. Mean	Median	98th %ile	Max. Day	Data Capt. %	Arith. Mean	Median	98th %ile	Max. Day
SCOTLAND														
110003	ABERDEEN 3	Aberdeen	3931	8062	88	3	2	12	21	88	22	24	43	54
1100025	EDINBURGH 25	City of Edinburgh	3258	6731	43	9	8	24	33	42	25	24	41	42
1300051	GLASGOW 51	City of Glasgow	2533	6641	93	7	5	25	63	96	27	26	59	79
1300069	GLASGOW 69	City of Glasgow	2568	6663	91	7	4	26	130	93	32	33	75	101
1300073	GLASGOW 73	City of Glasgow	2612	6627	82	6	3	26	44	83	22	20	53	61
1300095	GLASGOW 95	City of Glasgow	2679	6642	78	7	4	28	114	79	30	26	86	116
1300098	GLASGOW 98	City of Glasgow	2611	6678	58	8	7	27	43	57	20	19	51	70
1725008	KIRKINTILLOCH 8	East Dumbartonshire	2670	6741	100	5	3	22	62	100	10	12	24	66
1725009	KIRKINTILLOCH 9	East Dumbartonshire	2654	6732	100	6	4	25	71	100	15	13	25	56
1725010	KIRKINTILLOCH 10	East Dumbartonshire	2659	6741	94	5	3	22	56	93	14	12	25	67
820301	COWDENBEATH 1	Fife	3165	6912	100	2	2	3	4	100	17	14	27	34
1721006	KIRKCALDY 6	Kirkcaldy	3265	6933	93	4	3	15	28	93	12	12	30	44
760011	COATBRIDGE 11	North Lanarkshire	2738	6652	100	7	5	27	82	99	20	19	44	57
760012	COATBRIDGE 12	North Lanarkshire	2715	6637	61	5	4	19	50	58	16	18	40	47
69502	ARMADALE 2	West Lothian	2945	6681	93	2	2	6	15	93	46	44	96	122
3559003	WHITBURN 3	West Lothian	2948	6650	86	3	2	14	30	86	21	19	45	97

The following abbreviations are used in Table 1:

1. "Data Capt. %" is the percentage of the year for which valid data was obtained.
2. "Arith. Mean" is the arithmetic mean of all daily values, calculated as described in Appendix 1.
3. "Median" is the median, or 50th percentile, of all daily values, calculated as described in Appendix 1.
4. "98th %ile" is the 98th percentile of all daily values, see Appendix 1.
5. "Max. Day" is the maximum daily value measured during the year.

Table 1.2 Summary of Smoke and Net Acidity (SO₂ equivalent) Results for the North East, 2002.
All concentrations in µg m⁻³.

Code	Site Name	Authority	OS Grid Ref to 100m		Summary of Smoke Data in 2002				Summary of SO ₂ Data 2002					
			East	North	Data Capt. %	Arith. Mean	Median	98th %ile	Max. Day	Data Capt. %	Arith. Mean	Median	98th %ile	Max. Day
NORTH EAST														
915013	DARLINGTON 13	Darlington	4291	5145	90	3	3	12	15	89	8	6	19	24
1290010	GATESHEAD 10	Gateshead	4256	5619	60	3	2	9	13	54	18	18	27	37
2370003	NEWBURN 3	Newcastle Upon Tyne	4195	5674	84	11	8	32	50	84	7	7	21	46
2390024	NEWCASTLE UPON TYNE 24	Newcastle Upon Tyne	4285	5650	99	5	3	22	60	100	8	7	26	59
2390027	NEWCASTLE UPON TYNE 27	Newcastle Upon Tyne	4251	5645	100	7	5	24	46	100	11	6	37	58
3170008	SUNDERLAND 8	Sunderland	4391	5585	34	7	5	30	47	33	17	18	30	31

The following abbreviations are used in Table 1:

1. "Data Capt. %" is the percentage of the year for which valid data was obtained.
2. "Arith. Mean" is the arithmetic mean of all daily values, calculated as described in Appendix 1.
3. "Median" is the median, or 50th percentile, of all daily values, calculated as described in Appendix 1.
4. "98th %ile" is the 98th percentile of all daily values, calculated as described in Appendix 1.
5. "Max. Day" is the maximum daily value measured during the year.

Table 1.3 Summary of Smoke and Net Acidity (SO₂ equivalent) Results for the North West and Merseyside, 2002. All concentrations in µg m⁻³.

Code	Site Name	Authority	OS Grid Ref to 100m		Summary of Smoke Data in 2002				Summary of SO ₂ Data 2002					
			East	North	Data Capt. %	Arith. Mean	Median	98th %ile	Max. Day	Data Capt. %	Arith. Mean	Median	98th %ile	Max. Day
NORTH WEST & MERSEYSIDE														
3700003	WORKINGTON 3	Allerdale	2999	5287	60	3	2	14	17	60	12	12	29	31
3800006	BLACKPOOL 6	Blackpool	3317	4367	100	5	4	20	43	100	6	6	13	19
400024	BOLTON 24	Bolton	3715	4092	91	6	5	19	31	87	15	13	32	38
1230008	FARNWORTH 8	Bolton	3739	4061	92	16	13	37	42	94	13	12	31	38
1550001	HORWICH 1	Bolton	3637	4118	96	14	10	33	38	94	13	13	33	40
500012	BURNLEY 12	Burnley	3841	4324	33	6	5	16	23	33	11	12	20	20
555014	CARLISLE 14	Carlisle City Council	3397	5551	33	4	3	14	22	33	0	0	0	0
715006	CHORLEY 6	Chorley	3685	4178	97	8	6	24	34	78	6	7	19	33
3563005	WHITEHAVEN 5	Copeland	2974	5178	11	2	1	5	6	13	7	6	12	12
840009	CREWE 9	Crewe and Nantwich	3703	3550	43	5	4	23	33	42	14	12	30	41
1130012	ELLESMERE PORT 12	Ellesmere Port & Neston	3398	3759	96	6	4	19	26	96	14	13	25	56
2781510	RUNCORN 10	Halton	3511	3833	100	10	8	28	43	100	10	7	26	27
20005	ACCRINGTON 5	Hyndburn	3758	4285	96	7	5	24	40	96	11	12	19	32
2232507	MACCLESFIELD 7	Macclesfield	3926	3733	15	7	7	11	13	15	19	18	37	37
2280011	MANCHESTER 11	Manchester	3838	3981	99	13	11	34	49	99	10	12	23	31
2280015	MANCHESTER 15	Manchester	3875	3985	100	7	5	22	41	100	10	6	22	37
2280021	MANCHESTER 21	Manchester	3847	4023	100	7	5	24	45	100	7	6	13	13
2470013	OLDHAM 13	Oldham	3920	4057	99	13	12	23	27	99	36	38	71	77
2320003	MIDDLETON 3	Rochdale	3871	4063	55	13	12	33	40	51	12	13	31	44
1500005	BACUP 5	Rossendale	3868	4231	78	5	4	15	22	78	8	6	13	18
2650007	RAWTENSSTALL 7	Rossendale	3812	4229	81	5	4	13	49	81	9	18	20	20
855003	CROSBY 3	Sefton	3321	3990	90	5	3	20	29	90	24	25	38	52
2800036	ST HELENS 36	St Helens	3534	3936	87	7	5	24	44	82	10	7	24	36
2800043	ST HELENS 43	St Helens	3512	3955	88	6	4	20	36	82	8	7	21	39
625006	CHEADLE & GATLEY 6	Stockport	3859	3886	98	5	4	19	28	98	7	6	19	25
90008	ASHTON-UNDER-LYNE 8	Tameside	3939	3992	100	7	7	20	26	100	7	6	19	21
3314601	TRAFFORD 1	Trafford	3810	3958	100	4	3	15	30	95	27	25	43	55
3430017	WARRINGTON 17	Warrington	3607	3890	95	8	6	27	48	98	13	13	25	83
88201	ASHTON-IN-MAKERFIELD 1	Wigan	3576	3991	88	2	2	5	7	88	1	0	6	39
1800004	LEIGH 4	Wigan	3662	3999	87	2	2	5	8	87	1	0	7	19
3610008	WIGAN 8	Wigan	3592	4056	89	2	2	5	7	89	1	0	7	13
3532002	WEST KIRBY 2	Wirral	3212	3874	99	2	2	7	14	96	7	6	13	25

The following abbreviations are used in Table 1:

1. "Data Capt. %" is the percentage of the year for which valid data was obtained.
2. "Arith. Mean" is the arithmetic mean of all daily values, calculated as described in Appendix 1.
3. "Median" is the median, or 50th percentile, of all daily values, calculated as described in Appendix 1.
4. "98th %ile" is the 98th percentile of all daily values, see Appendix 1.
5. "Max. Day" is the maximum daily value measured during the year.

Table 1.4 Summary of Smoke and Net Acidity (SO₂ equivalent) Results for Yorkshire and the Humber, 2002.
All concentrations in µg m⁻³

Code	Site Name	Authority	OS Grid Ref to 100m		Summary of Smoke Data in 2002				Summary of SO ₂ Data 2002					
			East	North	Data Capt. %	Arith. Mean	Median	98th %ile	Max. Day	Data Capt. %	Arith. Mean	Median	98th %ile	Max. Day
YORKSHIRE & THE HUMBER														
190008	BARNESLEY 8	Barnsley	4348	4094	99	12	7	48	91	99	37	33	105	139
190012	BARNESLEY 12	Barnsley	4342	4067	100	7	4	27	62	100	28	24	54	80
877502	CUDWORTH 2	Barnsley	4387	4091	96	9	6	32	69	96	29	31	63	95
1308701	GOLDTHORPE 1	Barnsley	4462	4043	100	8	6	25	73	100	27	21	76	168
2208502	LUNDWOOD (BARNESLEY) 2	Barnsley	4372	4067	100	12	8	53	110	100	27	26	66	108
430006	BRADFORD 6	Bradford	4163	4329	83	9	8	32	53	83	11	12	25	37
1650011	KEIGHLEY 11	Bradford	4061	4412	76	8	6	26	59	77	15	12	29	53
1120002	ELLAND 2	Calderdale	4109	4209	60	9	8	27	37	59	15	13	25	35
1360016	HALIFAX 16	Calderdale	4093	4254	65	19	17	47	77	72	15	13	30	50
962512	DEWSBURY 12	Kirkstee	4235	4212	97	7	5	25	49	97	18	19	33	56
1515005	HOLMFIRTH 5	Kirkstee	4144	4085	93	6	4	19	34	94	26	26	52	65
1570019	HUDDERSFIELD 19	Kirkstee	4143	4164	93	8	6	28	52	95	19	19	39	57
445001	BRAMPTON 1	Rotherham	4414	4019	95	8	5	31	87	95	32	25	102	173
965004	DINNINGTON 4	Rotherham	4528	3861	99	6	4	18	31	99	13	12	36	97
2270002	MALBY 2	Rotherham	4530	3922	91	6	5	20	33	91	19	20	51	59
3465006	WATH-UPON-DEARNE 6	Rotherham	4433	4009	99	7	5	28	76	99	18	18	60	128
2839001	SCARBOROUGH 1	Scarborough	5036	4885	82	7	5	22	53	79	10	12	25	56
2872505	SELBY 5	Selby	4612	4322	98	3	2	15	39	98	11	12	19	26
22501	ACKWORTH 1	Wakefield	4440	4167	95	8	5	30	67	95	13	12	30	53
580011	CASTLEFORD 11	Wakefield	4519	4255	100	9	6	36	84	100	12	12	49	92
1235001	FEATHERSTONE 1	Wakefield	4429	4195	97	8	6	29	67	96	15	12	42	66
1450003	HEMSWORTH 3	Wakefield	4428	4134	100	8	6	30	58	100	13	12	41	67
1732003	KNOTTINGLEY 3	Wakefield	4497	4239	98	8	5	30	66	98	15	13	39	45
2415004	NORMANTON 4	Wakefield	4388	4228	95	8	5	34	66	95	9	6	37	70
2966301	SOUTH KIRKBY 1	Wakefield	4456	4112	100	12	9	36	81	100	14	13	33	51
3350026	WAKEFIELD 26	Wakefield	4331	4208	37	7	5	25	73	37	9	6	31	37
2533510	PONTEFRACT 10	Wakefield	4473	4217	100	6	4	28	51	100	10	7	30	47

The following abbreviations are used in Table 1:

1. "Data Capt. %" is the percentage of the year for which valid data was obtained.
2. "Arith. Mean" is the arithmetic mean of all daily values, calculated as described in Appendix 1.
3. "Median" is the median, or 50th percentile, of all daily values, calculated as described in Appendix 1.
4. "98th %ile" is the 98th percentile of all daily values, see Appendix 1.
5. "Max. Day" is the maximum daily value measured during the year.

Table 1.5 Summary of Smoke and Net Acidity (SO₂ equivalent) Results for the East Midlands, 2002. All concentrations in µg m⁻³.

Code	Site Name	Authority	OS Grid Ref to 100m		Summary of Smoke Data in 2002					Summary of SO ₂ Data 2002				
			East	North	Data Capt. %	Arith. Mean	Median	98th %ile	Max. Day	Data Capt. %	Arith. Mean	Median	98th %ile	Max. Day
EAST MIDLANDS														
40004	ALFRETON 4	Amber Valley	4417	3555	96	8	4	26	56	96	31	31	49	56
348001	BIRCOTES 1	Bassettlaw	4627	3920	100	7	4	26	108	100	17	13	44	92
2677503	RETIFORD 3	Bassettlaw	4707	3811	100	6	4	20	41	100	16	13	32	65
3710012	WORKSOP 12	Bassettlaw	4585	3787	84	7	6	25	44	83	13	12	49	61
2967002	SOUTH NORMANTON 2	Bolsover	4442	3564	7	10	8	25	25	6	5	6	10	13
960024	DERBY 24	Derby	4354	3369	95	9	7	29	39	83	10	7	41	55
1790019	LEICESTER 19	Leicester	4588	3041	65	22	26	47	54	67	10	12	19	20
1840005	LINGCOLN 5	Lincoln	4974	3714	95	5	4	17	33	93	7	6	19	50
2281010	MANSFIELD 10	Mansfield	4532	3607	75	6	5	19	44	74	25	25	52	78
2281102	MANSFIELD WOODHOUSE 2	Mansfield	4538	3642	98	6	4	24	37	98	26	25	60	87
2364502	NEW OLLERTON 2	Newark	4664	3682	94	6	4	22	39	93	15	12	37	80
577501	CASTLE DONINGTON 1	NW Leicestershire	4448	3275	35	8	6	28	36	35	9	7	24	34
2324001	MOIRA (LEICS) 1	NW Leicestershire	4328	3168	2	9	8	15	15	2	17	14	26	27
2440020	NOTTINGHAM 20	Nottingham	4575	3403	47	7	7	17	31	47	17	13	37	42

The following abbreviations are used in Table 1:

1. "Data Capt. %" is the percentage of the year for which valid data was obtained.
2. "Arith. Mean" is the arithmetic mean of all daily values, calculated as described in Appendix 1.
3. "Median" is the median, or 50th percentile, of all daily values, calculated as described in Appendix 1.
4. "98th %ile" is the 98th percentile of all daily values, see Appendix 1.
5. "Max. Day" is the maximum daily value measured during the year.

Table 1.6 Summary of Smoke and Net Acidity (SO₂ equivalent) Results for the West Midlands, 2002. All concentrations in µg m⁻³.

Code	Site Name	Authority	OS Grid Ref to 100m		Summary of Smoke Data in 2002					Summary of SO ₂ Data 2002				
			East	North	Data Capt. %	Arith. Mean	Median	98th %ile	Max. Day	Data Capt. %	Arith. Mean	Median	98th %ile	Max. Day
WEST MIDLANDS														
995002	DUDLEY 2	Dudley	3940	2897	81	6	4	18	41	81	12	12	24	30
507513	BURTON-UPON-TRENT 13	East Staffordshire	4242	3233	3	5	6	10	10	3	21	14	69	78
2752503	ROWLEY REGIS 3	Sandwell	3964	2879	94	7	5	24	36	94	12	12	31	38
3090020	STOKE-ON-TRENT 20	Stoke-On-Trent	3888	3475	61	9	8	27	33	0				0
3380018	WALSALL 18	Walsall	4014	2987	83	8	7	21	27	83	4	6	18	30
3470002	WEDNESFIELD 2	Wolverhampton	3946	3002	95	4	3	13	20	95	10	6	36	67

The following abbreviations are used in Table 1:

1. "Data Capt. %" is the percentage of the year for which valid data was obtained.
2. "Arith. Mean" is the arithmetic mean of all daily values, calculated as described in Appendix 1.
3. "Median" is the median, or 50th percentile, of all daily values, calculated as described in Appendix 1.
4. "98th %ile" is the 98th percentile of all daily values, see Appendix 1.
5. "Max. Day" is the maximum daily value measured during the year.

Table 1.7 Summary of Smoke and Net Acidity (SO₂ equivalent) Results for Wales, 2002. All concentrations in µg m⁻³.

Code	Site Name	Authority	OS Grid Ref to 100m		Summary of Smoke Data in 2002				Summary of SO ₂ Data 2002					
			East	North	Data Capt. %	Arith. Mean	Median	98th %ile	Max. Day	Data Capt. %	Arith. Mean	Median	98th %ile	Max. Day
WALES														
540012	CARDIFF 12	Cardiff	3193	1773	99	6	5	20	28	99	20	19	32	44
1305301	GLYNNEATH 1	Neath	2880	2066	47	4	3	14	18	47	31	33	50	52
2400026	NEWPORT (MON) 26	Newport	3313	1878	98	6	4	19	27	97	6	7	14	14
3732510	WREXHAM 10	Wrexham Maelor	3324	3501	78	4	3	17	26	78	17	18	31	49

The following abbreviations are used in Table 1:

1. "Data Capt. %" is the percentage of the year for which valid data was obtained.
2. "Arith. Mean" is the arithmetic mean of all daily values, calculated as described in Appendix 1.
3. "Median" is the median, or 50th percentile, of all daily values, calculated as described in Appendix 1.
4. "98th %ile" is the 98th percentile of all daily values, see Appendix 1.
5. "Max. Day" is the maximum daily value measured during the year.

Table 1.8 Summary of Smoke and Net Acidity (SO₂ equivalent) Results for the Eastern region, 2002. All concentrations in µg m⁻³.

Code	Site Name	Authority	OS Grid Ref to 100m		Summary of Smoke Data in 2002				Summary of SO ₂ Data 2002					
			East	North	Data Capt. %	Arith. Mean	Median	98th %ile	Max. Day	Data Capt. %	Arith. Mean	Median	98th %ile	Max. Day
EASTERN														
2430007	NORWICH 7	Norwich	6233	3099	57	5	3	18	31	57	19	20	33	39
3265013	THURROCK 13	Thurrock	5622	1791	99	6	5	18	26	99	14	12	25	37

The following abbreviations are used in Table 1:

1. "Data Capt. %" is the percentage of the year for which valid data was obtained.
2. "Arith. Mean" is the arithmetic mean of all daily values, calculated as described in Appendix 1.
3. "Median" is the median, or 50th percentile, of all daily values, calculated as described in Appendix 1.
4. "98th %ile" is the 98th percentile of all daily values, see Appendix 1.
5. "Max. Day" is the maximum daily value measured during the year.

Table 1.9 Summary of Smoke and Net Acidity (SO₂ equivalent) Results for London, 2002. All concentrations in µg m⁻³.

Code	Site Name	Authority	OS Grid Ref to 100m		Summary of Smoke Data in 2002				Summary of SO ₂ Data 2002					
			East	North	Data Capt. %	Arith. Mean	Median	98th %ile	Max. Day	Data Capt. %	Arith. Mean	Median	98th %ile	Max. Day
	LONDON													
1140014	TENFIELD 14	Enfield	5338	1958	91	4	3	14	23	85	13	13	25	31
1343709	GREENWICH 9	Greenwich	5382	1773	97	7	6	18	24	97	9	6	18	31
3696009	WOOLWICH 9	Greenwich	5441	1769	77	6	5	14	28	76	14	12	26	33
1950016	LONDON CITY 16	City of London	5324	1814	92	8	8	21	28	81	11	6	38	45
1590006	ILFORD 6	Redbridge	5440	1864	97	8	7	23	41	97	19	18	31	39
3541517	WESTMINSTER 17	Westminster	5298	1789	85	8	6	25	36	48	4	6	13	13

The following abbreviations are used in Table 1:

1. "Data Capt. %" is the percentage of the year for which valid data was obtained.
2. "Arith. Mean" is the arithmetic mean of all daily values, calculated as described in Appendix 1.
3. "Median" is the median, or 50th percentile, of all daily values, calculated as described in Appendix 1.
4. "98th %ile" is the 98th percentile of all daily values, see Appendix 1.
5. "Max. Day" is the maximum daily value measured during the year.

Table 1.10 Summary of Smoke and Net Acidity (SO₂ equivalent) Results for the South East, 2002. All concentrations in µg m⁻³.

Code	Site Name	Authority	OS Grid Ref to 100m		Summary of Smoke Data in 2002				Summary of SO ₂ Data 2002				
			East	North	Data Capt. %	Arith. Mean	Median	98th %ile	Max. Day	Data Capt. %	Arith. Mean	Median	98th %ile
SOUTH EAST													
390302	BLETCHLEY 2	Milton Keynes	4857	2337	42	4	3	15	21	42	12	7	28
2560010	PORTSMOUTH 10	Portsmouth	4652	1019	45	4	3	12	17	45	20	18	43
2940016	SLOUGH 16	Slough	4962	1819	88	7	6	19	23	88	7	6	12

The following abbreviations are used in Table 1:

1. "Data Capt. %" is the percentage of the year for which valid data was obtained.
2. "Arith. Mean" is the arithmetic mean of all daily values, calculated as described in Appendix 1.
3. "Median" is the median, or 50th percentile, of all daily values, calculated as described in Appendix 1.
4. "98th %ile" is the 98th percentile of all daily values, see Appendix 1.
5. "Max. Day" is the maximum daily value measured during the year.

Table 1.1.1 Summary of Smoke and Net Acidity (SO₂ equivalent) Results for the South West, 2002. All concentrations in µg m⁻³.

Code	Site Name	Authority	OS Grid Ref to 100m		Summary of Smoke Data in 2002				Summary of SO ₂ Data 2002					
			East	North	Data Capt. %	Arith. Mean	Median	98th %ile	Max. Day	Data Capt. %	Arith. Mean	Median	98th %ile	Max. Day
SOUTH WEST														
205006	BATH 6	Bath	3754	1656	82	6	5	16	34	81	12	13	20	26
470026	BRISTOL 26	Bristol	3634	1763	93	3	2	9	12	93	13	13	32	51
1305004	GLOUCESTER 4	Gloucester	3832	2179	93	5	4	20	42	93	10	7	20	33
453003	BRIDGWATER 3	Sedgemoor	3298	1373	5	2	2	6	6	5	23	21	33	35
3220002	SWINDON 2	Swindon	4147	1858	91	5	4	15	28	91	7	6	13	13

The following abbreviations are used in Table 1:

1. "Data Capt. %" is the percentage of the year for which valid data was obtained.
2. "Arith. Mean" is the arithmetic mean of all daily values, calculated as described in Appendix 1.
3. "Median" is the median, or 50th percentile, of all daily values, calculated as described in Appendix 1.
4. "98th %ile" is the 98th percentile of all daily values, see Appendix 1.
5. "Max. Day" is the maximum daily value measured during the year.

Table 1.12 Summary of Smoke and Net Acidity (SO₂ equivalent) Results for Northern Ireland, 2002. All concentrations in µg m⁻³.

Code	Site Name	Authority	Irish Grid Ref to 100m		Summary of Smoke Data in 2002					Summary of SO ₂ Data 2002				
			East	North	Data Capt. %	Arith. Mean	Median	98th %ile	Max. Day	Data Capt. %	Arith. Mean	Median	98th %ile	Max. Day
NORTHERN IRELAND														
68851	ANTRIM 1	Antrim BC	3162	3869	32	16	12	89	130	32	21	18	44	67
69701	ARMAGH 1	Armagh	2877	3450	90	13	13	36	57	87	13	13	20	20
1637001	KEADY 1	Armagh	0845	0341	25	16	14	32	43	25	1	0	13	13
160005	BALLYMENA 5	Ballymena	3109	4053	75	10	10	20	23	73	12	24	24	30
160006	BALLYMENA 6	Ballymena	3120	4026	93	10	9	25	39	89	12	12	28	55
161504	BALLYMONEY 4	Ballymoney	2954	4259	99	8	7	29	76	100	12	13	20	26
270012	BELFAST 12	Belfast	3324	3737	95	8	6	40	90	95	16	13	37	63
270013	BELFAST 13	Belfast	3357	3740	100	7	5	23	61	100	30	32	51	90
270033	BELFAST 33	Belfast	3346	3765	100	9	7	31	51	100	32	32	51	90
270042	BELFAST 42	Belfast	3322	3748	98	7	5	27	40	98	29	26	50	96
270044	BELFAST 44	Belfast	3338	3740	100	6	4	15	43	100	28	26	45	96
270045	BELFAST 45	Belfast	3335	3723	100	6	5	21	51	100	28	26	51	70
270046	BELFAST 46	Belfast	3303	3334	100	5	4	17	31	100	22	19	38	58
768003	COLERAINE 3	Coleraine	2961	4328	6	12	11	36	44	6	15	15	19	19
797501	COOKSTOWN 1	Cookstown	2774	3806	40	16	8	115	151	35	reject	reject	reject	reject
2551504	PORTADOWN 4	Portadown	3012	3538	6	14	9	43	48	0	-	-	-	0
2551506	PORTADOWN 6	Craigavon	3004	3548	36	4	3	11	27	35	8	6	27	30
2190012	LONDONDERRY 12	Derry	2438	4200	2	18	16	32	34	2	30	35	52	54
2190014	LONDONDERRY 14	Derry	2443	4174	80	6	5	16	25	76	19	14	48	74
1025001	DUNGANNON 1	Dungannon	2802	3629	86	9	6	31	50	98	14	12	25	31
1757703	LARNE 3	Larne	3400	4029	15	9	7	34	45	15	18	19	26	26
1757704	LARNE 4	Larne	3386	4037	48	5	4	20	96	48	22	24	30	30
1757705	LARNE 5	Larne	3401	4033	48	6	4	27	45	48	24	26	33	33
1032503	DUNMURRY 3	Lisburn	3287	3875	65	10	7	43	95	64	19	18	34	41
1845003	LISBURN 3	Lisburn	3263	3636	93	10	7	45	138	92	14	13	26	54
3325001	TWINBROOK 1	Lisburn	3281	3689	77	7	4	29	46	75	16	14	28	35
2233501	MAGHERAFELT 1	Magherafelt	2896	3901	99	7	4	34	55	99	11	13	20	27
512601	BUSHMILLS 1	Moyle District Council	2941	4409	16	14	13	34	50	14	3	0	12	18
2410003	NEWRY 3	Newry and Mourne	3078	3288	89	8	5	28	68	83	7	6	18	19
2412502	NEWTOWNABBEY 2	Newtownabbey	3318	3825	10	9	5	34	40	10	13	13	19	19
2412503	NEWTOWNABBEY 3	Newtownabbey	3321	3851	96	6	5	25	44	96	reject	reject	reject	reject
2412504	NEWTOWNABBEY 4	Newtownabbey	3283	3907	79	7	4	34	54	78	reject	reject	reject	reject
165005	BANGOR (CO DOWN) 5	North Down	3497	3810	100	17	13	61	110	97	14	13	29	48
1517501	HOLYWOOD 1	North Down	3397	3784	93	6	4	22	35	92	12	13	26	33
3111502	STRABANE 2	Strabane	2351	3972	82	27	21	75	172	82	10	7	20	20

Net acidity data from COOKSTOWN 1 and NEWTOWNABBEY 3, 4 were rejected because of suspected alkaline interference.

The following abbreviations are used in Table 1:

1. "Data Capt. %" is the percentage of the year for which valid data was obtained.
2. "Arith. Mean" is the arithmetic mean of all daily values, calculated as described in Appendix 1.
3. "Median" is the median, or 50th percentile, of all daily values, calculated as described in Appendix 1.
4. "98th %ile" is the 98th percentile of all daily values, calculated as described in Appendix 1.
5. "Max. Day" is the maximum daily value measured during the year.

Appendices

CONTENTS

Appendix 1	Calculation of Results and Statistics
Appendix 2	Data Files for 2002
Appendix 3	Sites Comprising "Core" Subset

Appendix 1

Calculation of Results and Statistics

CONTENTS

Period Covered by Observations
Derivation of Results
Significance of Results
Formulae used in Calculating Concentrations
Formulae used in Calculating Annual Statistics
Units

Period Covered by Observations

This report covers the calendar year 1st January to 31st December 2002.

The UK Smoke and Sulphur Dioxide Network is operated on the basis of the "Pollution Calendar". The pollution year always begins on the Tuesday nearest to 1 April, and contains twelve months, each of exactly 4 or 5 weeks, all beginning on Tuesdays. Pollution months April to September make up the summer period, and October to March constitute the winter period. While this "Pollution Calendar" is for operational purposes, to conveniently divide the year up into 'months' comprising whole numbers of weeks (as the samplers are normally visited weekly), data are now reported on a calendar year basis, in line with all other Networks operated on behalf of Defra. Details of the pollution calendar are available from netcen on request.

Derivation of Results

The data are processed by computer, from daily measurements made by the participating Local Authorities and other organisations. The formulae used for calculation of smoke concentrations, i.e. for relating blackness of the filter to the mass of smoke per unit volume of air sampled, have been used since winter 1961-62. The formula used for calculating SO₂ equivalent concentrations has never been changed.

As in previous years, the validity of the original readings has been checked by means of an editing program.

Significance of Results

It is important to note that in making comparisons of pollution in different towns, careful account must be taken of the details of the sites for which measurements are available in relation to the geographical structure of the town. That is, to the situation, extent and types of industrial, residential and commercial areas. Local variations in fuel type and quality can also have a significant effect on the measurements.

Formulae used in Calculating Concentrations

(a) Smoke

Smoke concentrations have been calculated by the use of the British Standard Smoke Calibration Curve (BS 1747: Part 2: 1991).

For reflectometer readings of 40 to 99 the following formula is used:

$$C = \frac{F}{V} (91,679.22 - 3,332.0460 R + 49.618884 R^2 - 0.35329778 R^3 + 0.0009863435 R^4)$$

Where:

- C = concentration in microgrammes per cubic metre
V = volume of air sampled, in cubic feet (in the majority of cases, a metric meter is used, and the volume in cubic metres is converted to cubic feet by multiplying by 35.315)
F = a factor relating to the sampler clamp size, as follows:
 0.288 for $\frac{1}{2}$ inch clamp,
 1.00 for 1 inch clamp,
 3.68 for 2 inch clamp, or
 12.80 for 4 inch clamp
R = reflectometer reading

This formula represents the calibration curve to within $\pm 1.3\%$ over the range of reflectometer readings between 40 and 90. When used to calculate concentrations from reflectometer readings between 91 and 98 the results may be underestimated by as much as 6%.

For darker stains with reflectometer readings between 40 and 20 the formula used is:

$$C = \frac{F}{V} (214,245.1 - 15,130.512 R + 508.181 R^2 - 8.831144 R^3 + 0.0628057 R^4)$$

For stains with reflectometer readings of less than 20 this formula gives only an approximation to the concentration, the result being well below the true value. Reflectometer readings of less than 10 are impossible to assess accurately and hence the results are calculated as if the reading had been 10, which at least gives a minimum value. However, such low reflectometer readings, corresponding to very high smoke concentrations, are now rare in the UK.

(b) Sulphur Dioxide

Sulphur dioxide concentrations have been calculated by the method described in BS 1747: Part 3: 1991. The formula used to calculate sulphur dioxide concentrations is:

$$C = \frac{4520 \times m}{V}$$

where

C = concentration in microgrammes per cubic metre

m = volume of 0.002M (N/250) di-sodium tetraborate used, in millilitres,

V = volume of air sampled, in cubic feet (again, in the majority of cases, a metric meter is used, and the volume in cubic metres is converted to cubic feet by multiplying by 35.315)

Formulae Used In Calculating Annual Statistics

(a) Arithmetic Mean (AM)

$$AM = \frac{\sum_{i=1}^N C_i}{N}$$

where

AM is annual arithmetic mean

C_i is daily concentration for day i

N is number of results available for the year

(b) Percentiles (50%, 98% etc.) Note - the median is the 50th percentile.

Daily concentrations are sorted into ascending order of concentration value, C₁, C₂, C₃, ..., C_i, ..., C_N and the associated percentile value for each concentration value is found from

$$P_i = \left(\frac{i}{N+1} \right) 100$$

where

P_i is the percentile for the ith concentration in the sorted set, that is, P_i% of the concentrations will be **equal to or less than** C_i

N is the number of results available for the year

The concentration values for the fixed percentile values quoted are obtained by linear interpolation between the concentration values for the nearest percentile values on either side.

For example, in the sets

$P_1, P_2, \dots, P_i, \dots, 98.8, 99.3, \dots, P_N$

$C_1, C_2, \dots, C_i, \dots, 150, 160, \dots, C_N$

the 99th percentile would be $154 \mu\text{g m}^{-3}$

Units

The unit employed for expressing both smoke and sulphur dioxide concentrations from this Network, both in this report and on the disk, is the microgramme per cubic metre ($\mu\text{g m}^{-3}$). However, concentrations of gaseous pollutants such as SO_2 are sometimes expressed as parts per billion by volume (abbreviated to "ppb").

For SO_2 , the conversion factor is as follows:

1 ppb = 2.62 microgrammes per cubic metre (for SO_2 only)

- at a temperature of 25°C and 1013 mb pressure.

1 ppb = 2.66 microgrammes per cubic metre (for SO_2 only)

- at a temperature of 20°C and 1013 mb pressure.

The conversion factor is different for other gaseous pollutants.

Appendix 2

Data Files for 2002

Data Files

The full year's dataset, for all Network sites, is supplied on the same CD as this report (or for printed copies, on the disk inside the back cover). The data are presented in **comma separated value** (CSV) format, a form which can be read into most spreadsheets. The data are provided in several files;

1. file "site2002": a summary of site details. The data are tabulated in rows, one per site, with columns as follows.

- Site code - the site's unique identification number of upto 7 digits.
- Site name and number - the name and number by which the site is usually known, eg. "ABERDEEN 3".
- Grid reference easting, given to the nearest 100m.
- Grid reference northing, given to the nearest 100m. Note; for sites in Northern Ireland the grid reference refers to the Irish Grid, and both the easting and northing are preceded by a "9" to indicate this.
- Site address.
- Site Environment. The surroundings of each site are classified by a code according to the following scheme:

- A1 Residential area with high-density housing (probably terraced), or with medium-density housing in multiple occupation, in either case surrounded by other built-up areas.
- A2 Predominantly A1, but interspersed with some industrial undertakings.
- A3 Residential area with high-density housing or medium-density housing in multiple occupation surrounded by, or interspersed with, other areas with low potential air pollution output (parks, fields, coast).
- B1 Residential area with medium-density housing, typically an inner suburb or housing estate, surrounded by other built-up areas.
- B2 Predominantly B1, but interspersed with some industrial undertakings.
- B3 Residential area with medium-density housing surrounded by or interspersed with areas with low potential air pollution output (parks, fields, coast), or any residential area with low-density housing.
- C1 Industrial area without domestic premises.
- C2 Industrial area interspersed with domestic premises of high density or in multiple occupation.
- D1 Commercial area or one with predominantly central heating.
- D2 Town centre with limited commercial area, possibly mixed with old residential housing and/or minor industry.
- E Smoke control area or smokeless zone (the letter to be added to the primary classification).
- R Rural community.
- O1 Open country but not entirely without source(s) of pollution, e.g. airfields.
- O2 Completely open country; no sources within at least 400 metres.
- X Unclassified site, or mixed area.

- Equivalent Defra Site Type. The Smoke and SO₂ Network site classifications differ considerably from those used by Defra to categorise their automatic sites. However, the nearest equivalent is given here. Smoke and SO₂ sites of types A1, A2, and A3 will mostly fall into Defra site types Suburban (SU) or Urban Background (U4), being predominantly in urban residential areas. B1, B2 and B3 will be Suburban (SU). C1 and C2 will be roughly equivalent to Urban Industrial (U5), and D1 and D2 Urban Centre (U3) or Urban Background (U4). R, O1 and O2 sites can all be treated as Rural (R).
- Unitary Authority. The name of the Local or Unitary Authority in whose area the site lies. In most cases this Authority is responsible for the operation of the site, although a small number of sites are operated by other organisations such as universities.
- Government Region Code. The twelve regions are assigned code numbers from 1 to 12.
- Government Region Name.
- County name. The name of the county in which the site lies.

2. file "smk2002": full daily black smoke data, 1st January to 31st December 2002, for all sites. One column per site, with one row per day. Values are in $\mu\text{g m}^{-3}$. Black smoke concentrations have been calculated according to the British Standard calibration, as used in the UK. For communications with organisations elsewhere in Europe, the concentrations should be converted to the OECD calibration, by dividing by 0.85

3. file "so22002": full daily net acidity data, as sulphur dioxide equivalent, 1st January to 31st December 2002, for all sites. One column per site, with one row per day. Values are in $\mu\text{g m}^{-3}$.

4. file "smksumm2002": this contains the smoke summary data as in Table 1, but in CSV format. The data are tabulated as follows. The top row contains column headings.

- Site code number
- Site name.
- Region name (e.g. North East).
- Local or Unitary Authority in whose area the site lies.
- Grid reference easting.
- Grid reference northing.
- Number of valid days' smoke data
- Data capture expressed as a percentage
- Arithmetic mean of daily smoke measurements
- Median (50th percentile) of daily smoke measurements
- 98th percentile of daily smoke measurements
- Maximum daily value.

There is one row of data per site, and they are presented by region.

5. file "so2summ2002": this contains the net acidity summary data (expressed as SO₂ equivalent) as in Table 1, but in CSV format. The data are tabulated in the same manner as the smoke data in "smksumm2002.csv" described above. Again, the top row contains column headings. All these details are also given in the text file "readme.txt" which is also provided on disk.

Appendix 3

Sites Comprising “Core” Subset

10003 ABERDEEN 3
20005 ACCRINGTON 5
40004 ALFRETON 4
69701 ARMAGH 1
90008 ASHTON-UNDER-LYNE 8
150005 BACUP 5
160005 BALLYMENA 5
190012 BARNESLEY 12
205006 BATH 6
270013 BELFAST 13
270042 BELFAST 42
270046 BELFAST 46
380006 BLACKPOOL 6
390302 BLETCHLEY 2
400024 BOLTON 24
430006 BRADFORD 6
453003 BRIDGWATER 3
470026 BRISTOL 26
500012 BURNLEY 12
507513 BURTON-UPON-TRENT 13
540012 CARDIFF 12
555014 CARLISLE 14
580011 CASTLEFORD 11
625006 CHEADLE & GATLEY 6
715006 CHORLEY 6
760011 COATBRIDGE 11
840009 CREWE 9
855003 CROSBY 3
915013 DARLINGTON 13
960024 DERBY 24
995002 DUDLEY 2
1025001 DUNGANNON 1
1032503 DUNMURRY 3
1100025 EDINBURGH 25
1130012 ELLESMERE PORT 12
1140014 ENFIELD 14
1230008 FARNWORTH 8
1290010 GATESHEAD 10
1300051 GLASGOW 51
1300073 GLASGOW 73
1300095 GLASGOW 95
1300098 GLASGOW 98
1305004 GLOUCESTER 4
1305301 GLYNNEATH 1
1343709 GREENWICH 9
1360016 HALIFAX 16
1450003 HEMSWORTH 3
1515005 HOLMFIRTH 5

1550001	HORWICH 1
1570019	HUDDERSFIELD 19
1590006	ILFORD 6
1650011	KEIGHLEY 11
1757703	LARNE 3
1757704	LARNE 4
1790019	LEICESTER 19
1800004	LEIGH 4
1840005	LINCOLN 5
1845003	LISBURN 3
1950016	LONDON CITY 16
2190012	LONDONDERRY 12
2232507	MACCLESFIELD 7
2270002	MALTBY 2
2280011	MANCHESTER 11
2280015	MANCHESTER 15
2280021	MANCHESTER 21
2281010	MANSFIELD 10
2320003	MIDDLETON 3
2370003	NEWBURN 3
2390024	NEWCASTLE UPON TYNE 24
2390027	NEWCASTLE UPON TYNE 27
2400026	NEWPORT (MON) 26
2410003	NEWRY 3
2412503	NEWTOWNABBEY 3
2430007	NORWICH 7
2440020	NOTTINGHAM 20
2470013	OLDHAM 13
2533510	PONTEFRACT 10
2551504	PORTADOWN 4
2551506	PORTADOWN 6
2560010	PORTSMOUTH 10
2650007	RAWTENSTALL 7
2677503	RETFORD 3
2752503	ROWLEY REGIS 3
2781510	RUNCORN 10
2800036	ST HELENS 36
2800043	ST HELENS 43
2839001	SCARBOROUGH 1
2872505	SELBY 5
2940016	SLOUGH 16
3090020	STOKE-ON-TRENT 20
3170008	SUNDERLAND 8
3220002	SWINDON 2
3265013	THURROCK 13
3314601	TRAFFORD 1
3350026	WAKEFIELD 26
3380018	WALSALL 18
3430017	WARRINGTON 17

3470002	WEDNESFIELD 2
3532002	WEST KIRBY 2
3541517	WESTMINSTER 17
3610008	WIGAN 8
3696009	WOOLWICH 9
3700003	WORKINGTON 3
3710012	WORKSOP 12
3732510	WREXHAM 10