AEA

QA/QC Data Ratification and Intercalibration Report for the Automatic Urban and Rural Network, July-September 2009

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Executive summary

Part A Data Ratification

AEA carries out the quality assurance and control (QA/QC) activities for the Automatic Urban and Rural Monitoring Network (AURN) on behalf of the UK Department for Environment, Food and Rural Affairs (Defra), Scottish Government, Welsh Assembly Government and DoE in Northern Ireland.

Ratified hourly average data capture for the network averaged 89.2% for all pollutants (O_3, NO_2, SO_2, CO, PM_{10} and $PM_{2.5}$) during the 3-month reporting period July-September 2009. Data capture rates for CO, O_3 and SO_2 were above 90%. There were 26 sites with data capture less than 90% for the period.

The number of monitoring sites in the AURN during this quarter was 129, of which 67 are Local Authority owned sites affiliated to the national network. Some are co-located gravimetric particulate analysers at sites with automatic analysers.

The main reasons for data loss at the sites have been provided and these were predominantly instrument faults, response instability or problems associated with the replacement of analysers and infrastructure. A summary of recommendations to help improve network performance is given in Appendix 1.

Substantial changes have been made to the AURN network since the end of September 2007, and these are summarised in this report. The changes are necessary to ensure compliance with European Air Quality Directive (2008/50/EC). Considerable progress has been made in implementing these changes though they will still take some time to complete, particularly where no new potential sites have been identified. Four additional analysers (including one new site) were commissioned this quarter.

Part B Intercalibration Summer 2009

A total of 127 sites in the AURN were calibrated by AEA during the summer 2009 Network Intercalibration exercise.

The results show that the majority of the network analysers are working satisfactorily and that data are generally of high quality. A total of 66 out of 381 analysers deviated by more than the appropriate acceptance criteria (see Section 7), and a further 3 NOx converters were found to be unacceptably inefficient. The concentrations of the on-site calibration gas cylinders were also checked. The certificate of calibration for the AURN is provided in Appendix 7.

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1 Introduction

This quarterly report covers the Quality Assurance and Control (QA/QC) activities undertaken by AEA to ratify automatic monitoring data from Defra and the Devolved Administrations' urban and rural air quality monitoring network (AURN) for the period July-September 2009. During this period there were 129 operational monitoring sites in the Network of which there are 94 urban sites, 27 rural sites and a further 8 sites in the London Air Quality Monitoring Network (LAQN) which are affiliated into the national network. There are currently 61 Defra-funded sites and 68 affiliate sites. Eleven sites have non-automatic particulate samplers (Partisols); some of these are co-located with FDMS analysers at Auchencorth Moss, Harwell, London North Kensington and Marylebone Road for both PM_{10} and PM_{25}.

1.1 Overview of Network Performance

Ratified hourly average data capture for the network averaged 89.2% for all pollutants (O_3, NO_2, SO_2, CO, PM_{10} and $PM_{2.5}$) during the 3 month reporting period July-September 2009 (see Table 1.1). Pollutants achieving 90% or higher data capture were CO, O_3 and SO_2. Data capture rates are calculated using the actual data capture as hourly averages (daily for Partisol) against the total number of hours (or days) in the relevant period; service and maintenance are counted as lost data in accordance with Annex 1 of Directive 2008/50/EC. For sites starting or closing, the data capture is based on the actual date starting or closing.

Table 1.1: AURN Ratified Data Capture (%) by Quarter, 2009 (Using the start date of any new site)

	CO	PM_{10}	$PM_{2.5}$	NO_2	O_3	SO_2	Mean
Q1 2009 %	92.1	87.9	86.5	90.2	94.4	96.5	91.1
Q2	96.5	89.4	85.8	93.3	97.2	97.2	92.7
Q3	92.0	85.9	86.1	89.0	93.1	90.7	89.2

Overall, 291 out of the 391 analysers (82%) achieved data capture levels above the required 90% target during this reporting period (See Table 1.2).

Table 1.2: Number of Analysers with Data Capture below 90%

Total Number Of Analysers		Q1 Jan-Mar 2009 (No. below 90%)	Q2 Apr-Jun 2009 (No. below 90%)	Q3 Jul-Sept 2009 (No. below 90%)
CO	26	7	2	6
NO_2	111	23	16	29
O_3	78	12	7	10
PM_{10}[1]	62	18	18	22
$PM_{2.5}$[1]	70	22	27	24
SO_2	44	2	3	9
Total <90%		81	71	100

1. Includes TEOM, FDMS, BAM and Partisol analysers.

In total, 26 out of the 129 operational network sites in the quarter (20%) had an average data capture rate below the required 90% level for the July-September 2009 period. This is influenced by the fact that new analysers at existing sites have data capture figures calculated from the start date of the quarter, not from the start of the analyser itself. The sites with overall data capture below 90% are

listed in Table 1.3. The main site operational and QA/QC issues giving rise to data capture below the required 90% level are summarised in Section 4.

Table 1.3: Sites with Average Data Capture < 90%, July-September 2009

Site	Site Average	Principle Reason For Loss
England		
Billingham	55.7	Poor performance of hot spare NOx analyser
Birmingham Tyburn Roadside	79.2	PM_{10} persistently lower than $PM_{2.5}$
Bury Roadside	81.9	NOx analyser fault
Camden Kerbside	40.6	Air conditioning faults
Coventry Memorial Park	87.1	Installation of new equipment
Harwell	83.6	FDMS $PM_{2.5}$ analyser performed poorly from installation on 13 August
Harwell PARTISOL	87.0	Data provisional
High Muffles	5.1	Power cut
Hull Freetown	87.3	PM_{10} cooler failure
Ladybower	59.9	NOx PMT (photomultiplier tube) fault
Leeds Centre	88.5	NOx converter fault
Leicester Centre	74.6	Problems with new analysers
London Harlington	88.2	Moisture in $PM_{2.5}$ analyser
London Harrow Stanmore	44.7	Poor $PM_{2.5}$ data, possibly due to high dewpoint
London Marylebone Road PARTISOL	68.5	See Appendix 4
London N. Kensington PARTISOL	82.6	See Appendix 4
Lullington Heath	89.3	NOx analyser fault
Manchester Piccadilly	80.2	SO_2 analyser fault
Market Harborough	68.5	CO analyser failure
Middlesbrough	84.3	FDMS and air conditioning faults
Oxford St Ebbes	82.9	NOx converter failure
Plymouth Centre	64.1	Air conditioning faults
Preston	82.1	Power supply problems
Rochester Stoke	87.0	Poor FDMS data
Sheffield Centre	76.9	Poor FDMS data
Sheffield Tinsley	50.6	Air conditioning faults
Stanford-le-Hope Roadside	83.3	Poor FDMS data
Stockton-on-Tees Eaglescliffe	88.5	NOx faults
Sunderland Silksworth	19.1	Power supply interruptions
Tower Hamlets Roadside	88.5	Persistent analyser faults
Weybourne	87.1	Power supply problems
Wirral Tranmere	83.8	Poor FDMS data
York Bootham	88.2	FDMS memory failure and dewpoints out of limits
Ireland		
N Ireland		
Armagh Roadside	49.9	NOx analyser faulty
Belfast Centre	70.3	Numerous analyser faults
Derry	78.0	Very poor FDMS performance
Scotland		
Auchencorth Moss PM_{10} PM_{25}	63.0	FDMS dryer problems
Bush Estate	89.0	NOx PMT fault
Dumfries	35.3	NOx converter fault
Wales		
Swansea Roadside	75.5	Negative $PM_{2.5}$ data deleted
Wrexham	88.4	Poor SO_2 data; Partisol data lost-see Appendix 4

The QA/QC Unit checks the incoming data on a daily basis, and alerts the CMCU should any spurious data be detected. Common problems include daily or monthly calibration data not being removed from the dataset, where data disseminated via the Data Dissemination Unit may result in a pollution alert. Problems highlighted by the CMCU or QA/QC Unit in this way are often referred to the relevant ESU for comment or analysis.

1.2 LSO Manual

The LSO Manual has been extensively updated in March 2009 to include a section on the FDMS analysers and updates to the Partisol section. Instructions for new analyser types recently introduced into the network are also available. LSOs who operate any of these analysers should now use the new version of the manual.

During the site upgrade process, many sites have been equipped with analysers of more than one manufacturer, and LSOs for these sites will need several of the individual sections to cover all their equipment. For this reason, and for environmental reasons, printed copies will no longer be provided, but all relevant sections are available on the UK Air Quality Archive at http://www.airquality.co.uk/reports/empire/lsoman/lsoman.html.

1.3 AURN Hub

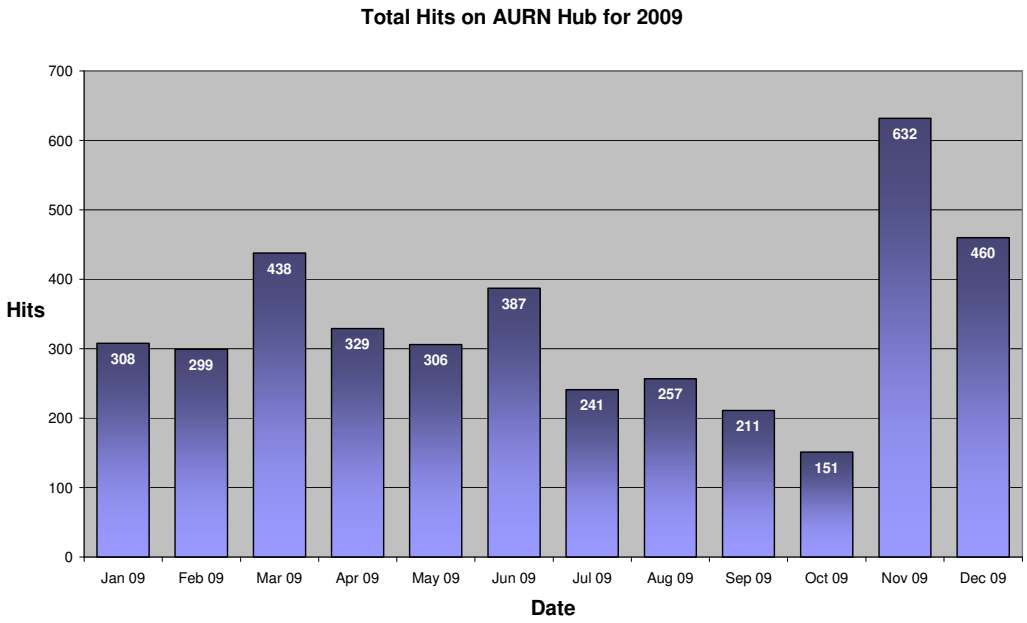
The AURN project information hub is located at[1]: http://www.aurnhub.co.uk/
The site is regularly updated and some of the more recent information includes:

- Monthly PM_{10} (Gravimetric) exceedences up to September 2009 (provisional);
- QA/QC Unit's Data Ratification Report April-June 2009
- CMCU Quarterly report, January-March 2009
- Recent news items; and
- Updated version of the LSO manual.
- Site cylinder concentrations and pressures updated weekly

The Hub has continued to provide a valuable source of information for interested organisations as shown in Figure 1.1. The hub attracted a significant increase in usage towards the end of 2009 following the AURN Annual LSO meeting, possibly due to LSOs accessing revised instructions for newly installed equipment.

[1] Password protected site: username and password available to LSOs and ESUs from rachel.yardley@aeat.co.uk

Figure 1.1: AURN Hub Hits 2009



1.4 AURN QA/QC Manual

The QA procedures used throughout the AURN network have been documented by AEA and BV. This document covers a wider range of procedures than covered in this report. The QA/QC manual can be downloaded at http://www.airquality.co.uk/reports/reports.php?report_id=574

1.5 Status of Ratified Data

1.5.1 Data Status

Once all the ratification checks and corrections have been made then the data are loaded to the Air Quality Archive with a status flag of "Ratified".

It should however be noted that there are occasionally circumstances where data which have been flagged as "Ratified" could be subject to further revision. This may be for example where:

- A QA/QC audit has detected a problem that affects data back into an earlier ratification period.
- Long-term analysis has detected an anomaly between expected and measured trends, which requires further investigation and possible data correction. This was the case with 2000-2008 gravimetric particulate monitoring data in the UK national network.
- Further research comes to light that indicates that new or tighter QA/QC criteria are required to meet the data quality objectives. This may require review and revision of historical data by applying the new criteria.

Any further necessary corrections to an annual data set are, as far as possible, made before the UK results are sent to the European Commission in September of the following year.

In the event that there is a strong case for modifying datasets already sent to the European Commission, this will usually require widespread consultation and agreement before implementation.

An example is the correction of UK gravimetric PM_{10} monitoring data from 2000 to 2008, which was widely consulted on. The corrected data are now on the Air Quality Archive database and the revised dataset was submitted to the Commission in September 2009.

Significant changes to ratified data will be described on the archive and in future QA/QC reports.

An initial description of the ratification procedures for FDMS data is given in the 2006 QA/QC Annual Report. Since then, procedures for ratification have been refined in light of experience by all parties involved; these are described in Section 12.3 of the 2008 Annual Report. On-site procedures by LSOs, ESUs and QA/QC Unit have also been revised for optimal instrument performance and reliability. LSOs should now follow these new procedures.

1.5.2 Changes to Ratified Data

Glasgow Centre NOx

As a result of anomalously high NO_2 levels at Glasgow Centre in November 2009, it was noted that the profiles of the NO and NO_2 measurements were inconsistent with other nearby sites. On closer examination, it was found that the logger channels on the analyser were set up incorrectly. The correct data were reloaded and ratified with no loss of data, but the ratified dataset for February (when the analyser was upgraded) to June 2009 has been changed on the archive.

Marylebone Road $PM_{2.5}$

On 1 May, the ESU found that the FDMS dryer flows had been installed upside down. The data from installation on 20 March to 1 May 2009 have therefore been deleted.

1.6 Zero Air Cylinders

The QA/QC Unit has commenced a programme of replacing zero air scrubbers with Laser (Zero) air cylinders supplied by Air Liquide. The advantages of this are better consistency of analyser zeros at LSO calibrations, and the removal of possible pressurisation problems where scrubbers impede the flow of gas. There is also no longer a need for handling dusty and potentially hazardous scrubber materials. The QA/QC Unit already use these air cylinders for 6-monthly audits.

Unfortunately, the installation of additional cylinders is not possible at some sites where the cylinder storage area is already fully occupied. Scrubbers will continue to be used at these sites.

2 Changes in the Network for Directive Compliance

The QA/QC Unit and the Central Management and Control Unit (CMCU), in conjunction with Defra and the DAs, have carried out a major review of the monitoring network. This was necessary to ensure the network is compliant with the European Directive (2008/50/EC). There is a requirement for a minimum level of monitoring in each agglomeration and zone, and there is a need to measure $PM_{2.5}$ at many sites. The need for additional monitoring has been met by affiliating suitable sites from other organisations, adding additional analysers at existing sites, or in a small number of cases, installing new sites. Note that as a result of these changes, the concept of critical sites is no longer meaningful and has been discontinued.

Sites that are no longer necessary for compliance have, in a number of cases, been closed down, or individual analysers at sites have been de-affiliated. Table 2.1 shows the sites commissioned as part of the review.

Table 2.1: Sites Added to the AURN Since 1 January 2009

Site	Pollutant	Date started
Armagh Kerbside	NO_2 PM_{10}	01/01/09
Birmingham Tyburn Roadside	NO_2 O_3 PM_{25} PM_{10}	11/02/09
Grangemouth Moray	NO_2	01/06/09
Blackburn Darwen Roadside	NO_2	15/06/09
Norwich Lakenfields	NO_2 O_3 PM_{25} PM_{10} SO_2	25/09/09
Peebles	NO_2 O_3	18/11/09

In addition, several existing sites have had additional analysers (mainly $PM_{2.5}$) installed to ensure compliance. The analysers are listed in Table 2.2:

Table 2.2: Additional Analysers installed for Directive Compliance from 1 Jan 2009

Site	Pollutant	Date started
Aberdeen	$PM_{2.5}$	20/02/09
Blackpool Marton	$PM_{2.5}$	28/01/09
Bournemouth	$PM_{2.5}$	01/01/09
Bury Roadside	$PM_{2.5}$	07/05/09
Camden Kerbside	$PM_{2.5}$	19/02/09
Carlisle Roadside	$PM_{2.5}$	17/03/09
Glasgow Kerbside	$PM_{2.5}$	28/05/09
Haringey Roadside	$PM_{2.5}$	18/02/09
Leeds Headingley Kerbside	$PM_{2.5}$	02/04/09
Manchester Piccadilly	$PM_{2.5}$	15/01/09
Preston	$PM_{2.5}$	27/01/09
Sandy Roadside	$PM_{2.5}$	27/01/09
Southend-on-Sea	$PM_{2.5}$	30/01/09
Stanford-le-Hope Roadside	$PM_{2.5}$	01/04/09
Stockton-on-Tees Eaglescliffe	$PM_{2.5}$	21/01/09
Wirral Tranmere	$PM_{2.5}$	28/01/09

.A full description of the changes necessary for compliance with the Directive is given in Part B Section 8 of the July-September 2007 Report.

An equipment upgrade programme is underway to provide equipment that is demonstrated to be an equivalent measurement to the reference method. Annex vi of the EU Directive 2008/50/EC defines the reference methods and the procedure for demonstration of equivalence with these.

The reference methods specified are those developed by the European Committee for Standardisation (CEN) and published in the UK through British Standards. In compliance with Annex vi, D, all new equipment introduced into the network complies with the reference method or has been demonstrated to be equivalent. Going forward, there is a rolling programme to replace all monitoring equipment in the network with reference or equivalent methods by June 2013 – as required by the Directive. For the gaseous analysers, the relevant Standard Methods include a requirement for type testing and approval. The mechanism in the UK to conform to this is described in Section 5.2 of the AURN QA/QC manual. Further details are available in Section 1.5.

A list of current approved equipment is available on the Sira website
http://www.siraenvironmental.com/UserDocs/mcerts/MCERTSCertifiedProductsCAMS.pdf

3 Generic Data Quality Issues

3.1 Gravimetric PM_{10} and $PM_{2.5}$ Data

Six Gravimetric PM_{10} analysers and ten gravimetric $PM_{2.5}$ analysers (Partisol 2025s) are currently located at eleven sites in the network. These are listed below. Ratified data capture for the gravimetric PM (Partisol) analysers for the period July-September 2009 is given in Table 3.1. Six of the gravimetric analysers for which data are available did not reach the 90% data capture target in this quarter.

Table 3.1: Gravimetric PM_{10} and $PM_{2.5}$ Data Capture (%) July-September 2009

Site	Provisional Data Capture, %
Auchencorth Moss $PM_{2.5}$	93
Auchencorth Moss PM_{10}	92
Bournemouth $PM_{2.5}$	95
Brighton Preston Park $PM_{2.5}$	93
Harwell $PM_{2.5}$	84
Harwell PM_{10}	91
Inverness $PM_{2.5}$	91
Inverness PM_{10}	83
London Marylebone Road $PM_{2.5}$	78
London Marylebone Road PM_{10}	59
London N Kensington $PM_{2.5}$	88
London N Kensington PM_{10}	75
London Westminster $PM_{2.5}$	97
Northampton $PM_{2.5}$	98
Port Talbot Margam $PM_{2.5}$	75
Wrexham PM_{10}	80

The reasons for data loss in the gravimetric analysers are given in Appendix A4. Bureau Veritas has supplied the measured data, undertaken the filter weighing and calculated the particulate concentrations.

In 2008, evidence emerged that the Partisol sampling and analysis method was overestimating ambient particle concentrations, despite the filters (Whatman QMA quartz) being conditioned (to a standard temperature and humidity level) before each weighing.

After investigation and consultation it was decided that a "field blank" correction - based on filters that had been placed in the sampler but not actually used - should be subtracted from the measured concentrations. For years up to and including 2007, a monthly field blank correction has been used.

This field blank correction has been applied retrospectively, resulting in changes to previously ratified data. ***Any daily-measured PM_{10} or $PM_{2.5}$ data downloaded from the Archive before 1st July 2009 might therefore have changed.***

From January 2008 onwards, blank filters have been routinely included with each fortnightly batch of filters sent to each site. This makes it possible to apply a field blank correction specific to each site and 2-week period, which should provide a more accurate value for the daily mean PM concentration. Again, this correction has been applied retrospectively, so any daily-measured PM_{10} or $PM_{2.5}$ data downloaded from the Archive before **1st July 2009** may have changed.

Only data for which
(i) the weighings have been carried out by the current laboratory (i.e. Bureau Veritas) and
(ii) the filter material was quartz (Whatman QMA)

- have had the blank correction applied. Both field-blank corrected data and uncorrected data are still available for download from the Air Quality Archive.

Finally, during January and February 2009 all AURN sites measuring particulate matter by this method changed to PTFE-bonded glass fibre filters (Emfab), which are expected to offer improved performance. It may prove unnecessary to apply a field blank correction to data obtained using filters of this type. However, pending further investigation, it has been agreed with Defra that both uncorrected and corrected data should be available for download from the Air Quality Archive.

As a result of this, improved QA/QC procedures for Partisol measurements have been implemented by BV and the QA/QC Unit. These include:

- Round-robin of blank filter weighings between BV, AEA and NPL. Three sets of filters and check weights were weighed by all three organisations in April 2009. For the check weights there was no significant difference in results of the three laboratories. Quartz filters, and to a lesser extent, PTFE-coated glass fibre filters, exhibited some issues with conditioning which meant that the three laboratories could not be reliably compared. These issues are currently under consideration within the UK and Europe
- As described above, each batch of 14 days' filters now include a travel (field) blank in the cannister, which is treated exactly the same as the other filters in the batch, but not exposed, to be used for the correction of quartz filters
- Each batch of pre-weighed filters has an associated lab blank, which does not go to the site but stays in a sealed container at the lab for the duration of the exposure period, and is weighed again when the final weighings are done
- Both field and lab blank values are communicated to the QA/QC Unit, who monitor them on a long-term basis and check for any step changes, trends, or deviations from the typical spread of results.

3.2 Auto-calibration Run-on

Autocalibration ”run-on” is a generic problem affecting many analysers in the network and is due to autocalibration gas leaking into the sampling system during the ambient measurement period immediately after the autocalibration cycle. The problem can be identified by examining the diurnal variation of pollutant concentrations for the individual sites. Invalid measurements (usually between 01:30 and 02:00) have been removed during data ratification. This can be a serious source of data loss resulting in one hour out of twenty four being deleted, which is 4% of the annual data capture. At some sites significantly more data are being lost resulting in data capture below the 90% data capture target for the period.

The Equipment Service Units (ESUs) have investigated the autocalibration run-ons at many of the sites and tried different ways to resolve the problem including thorough cleaning of the solenoid valves and installation of Permapure or silica gel dryers. In most cases this has improved the situation but it has not always eliminated the problem completely.

The 17 sites (17 analysers) showing continuing problems with the autocalibration run-on during July-September 2009 are given in Table 3.2. Any autocalibration run-on data that look visibly significant have been deleted from these data sets during ratification.

Table 3.2: Autocalibration Run-ons: July-September 2009

Site	Pollutant	Run-On Conc	Autocal Conc	Hours lost	Months
Barnsley Gawber	NO_2	2	200	1	July - Sept
Belfast Centre	NO_2	5	300	1	July - Sept
Bush Estate	NO_2	0.3	700	1	July
Coventry Memorial Park	NO_2	2	459	1	Aug - Sept
Hull Freetown	NO_2	3	200	1	July - Sept
Leeds Centre	NO_2	4	457	1	Aug - Sept
Liverpool Speke	NO_2	3	200	1	July - Sept
Market Harborough	NO_2	0.9	350	4	Aug - Sept
Newcastle Centre	NO_2	6	300	1	July - Sept
Norwich Lakenfields	NO_2	7	100	1	Sept
Oxford Centre Roadside	NO_2	5	200	1	July - Sept
Oxford St Ebbes	NO_2	2	300	1	Aug - Sept
Plymouth Centre	NO_2	5	275	1	July - Sept
Reading New Town	NO_2	7	250	1	July - Sept
Rochester Stoke	NO_2	2.1	200	2	July
Sheffield Centre	NO_2	9	280	2	July - Sept
Walsall Willenhall	NO_2	3	250	1	July - Sept
Yarner Wood	NO_2	1.9	200	2	July - Sept
Aston Hill	O_3	-3	200	1	Aug - Sept
Harwell	SO_2	0.2	175	1	July - Sept
Wicken Fen	SO_2	0.2	300	1	July - Aug

The Aston Hill ozone analyser is not set up correctly, resulting in a zero run-on.

3.3 FDMS Installations

There have been a number of issues affecting the collection of valid data from FDMS analysers as these have been introduced into the network. The CMCU, QA/QC and ESUs have put considerable effort into solving these issues. Several FDMS analysers have proved particularly problematic and considerable ESU effort has been required to rectify the problems. Some are as yet unresolved-see Section 4.

It is important that the correct operation of the FDMS dryers is checked and maintained. The QA/QC unit have been checking the dryer types at the summer 2009 intercalibration exercise, and the ESUs have been asked to provide records of dryer upgrades as they occur.

The concern over the Edinburgh PM_{10} concentrations during the summer of 2009 was described in the April-June 2009 report. The sample dew points of the PM_{10} and $PM_{2.5}$ became significantly different during May 2009, which may suggest that the efficiency of the dryer was reducing. The original C type dryers were replaced with CB types on 14 July ($PM_{2.5}$) and 24 July (PM_{10}); changes in the profiles of volatile concentrations were observed following the change. This has been observed at other sites in the network following dryer replacement. Investigations took some time to complete, and it was recommended that the PM_{10} sensor unit be replaced; this was carried out in January 2010.

High sample dewpoints can indicate that the dryer is not removing enough moisture from the sample flow. Moisture in the sample may affect measured volatile concentrations. The QA/QC Unit is currently looking into the implications of dryer performance and methods of measuring it.

4 Site Specific Issues

In this section, we now discuss in turn specific site issues for sites in the following geographic groupings – London, England (except London), Scotland, N. Ireland and Wales. Note that where analysers were commissioned during the period, the stated data capture for these instruments is calculated from the date of commissioning.

As part of the assessment of analyser performance during ratification, use is made of the documentation provided by the CMCU, LSO and ESU's as appropriate. This provides assurance that appropriate investigation and remedial action is either underway or complete. If it appears that such action has not been initiated, this information is passed to the CMCU for action.

4.1 London

4.1.1 Data Capture

The data capture for sites in London (within the M25) for the period July-September 2009 is given in Table 4.1:

Table 4.1: Data capture for London: July-September 2009 (%)

Site	Owner	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
England								
Camden Kerbside	Affiliate	-	35.6	46.1	40.2	-	-	40.6
Haringey Roadside	Affiliate	-	84.9	98.6	99.2	-	-	94.3
London Bexley	Affiliate	79.8	-	90.4	94.8	-	95.2	90.0
London Bloomsbury	DEFRA	97.6	97.0	96.0	97.6	97.5	97.6	97.2
L. Cromwell Road 2	DEFRA	93.5	-	-	94.4	-	96.5	94.8
London Eltham	Affiliate	-	-	97.3	82.2	97.4	-	92.3
London Haringey	Affiliate	-	-	-	98.3	98.9	-	98.6
London Harlington	Affiliate	-	98.0	62.4	94.2	98.3	-	88.2
London Harrow Stanmore	Affiliate	-	-	44.7	-	-	-	44.7
London Hillingdon	DEFRA	-	-	-	96.1	98.1	-	97.1
London Marylebone Road	Affiliate	97.5	98.1	99.2	98.2	95.4	98.1	97.8
London Marylebone Road PARTISOL	DEFRA	-	100.0	100.0	-	-	-	100.0
London N. Kensington	Affiliate	96.5	89.2	97.2	95.1	96.7	96.5	95.2
London N. Kensington PARTISOL	DEFRA	-	100.0	100.0	-	-	-	100.0
London Teddington	Affiliate	-	-	98.4	98.0	98.1	-	98.2

Site	Owner	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
London Westminster	DEFRA	98.5	-	100.0	98.4	98.5	98.4	98.7
Tower Hamlets Roadside	Affiliate	77.9	-	-	99.1	-	-	88.5
Number of sites		7	8	13	14	9	6	17
Number of sites < 90%		2	3	3	2	0	0	4
Network Mean (%)		91.6	87.9	86.9	91.8	97.7	97.0	89.2

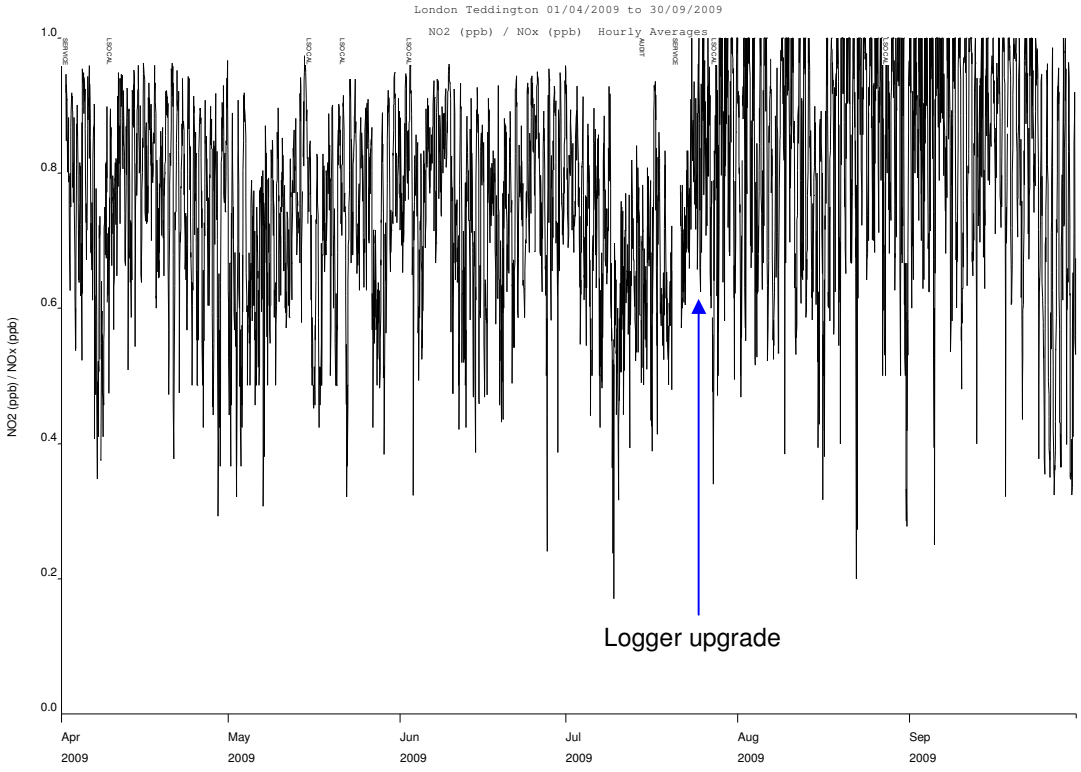
Shaded boxes are for data capture < 90%
Bold data captures are for data that are provisional and subject to further quality control

4.1.2 Site Specific Issues

London Harrow Stanmore
The FDMS dewpoints were too high on many occasions during the quarter, and the volatile $PM_{2.5}$ fraction was very unstable up to the service in August; a total of 55 days data were deleted.

Camden Kerbside
The FDMS analysers performed poorly during the summer due to excessive hut temperatures. Temperatures up to 42°C have been recorded during summer 2009. The site was turned off to avoid damage.

London Teddington
In common with many logger-equipped sites in the network, the equipment has been upgraded during 2009 to use the on-board analyser logging systems. This has many advantages, including the possibility to download diagnostic data. However, the change in logging systems has caused changes in the data itself. This can be clearly seen on the NO_2:NOx ratio. Figure 4.1



Tower Hamlets Roadside
The CO analyser has performed very poorly for much of the quarter, and ultimately was replaced by a temporary spare on 31 July. Some data have been deleted as a result.

4.2 England (excluding London)

4.2.1 Data Capture

The data capture for sites in England for the period July-September 2009 is given in Table 4.2:

Table 4.2: Data capture for England (except London): July-September 2009 (%)

Site	Owner	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
England								
Barnsley 12	DEFRA	-	-	-	-	-	96.6	96.6
Barnsley Gawber	Affiliate	-	-	-	95.3	99.7	84.1	93.0
Bath Roadside	Affiliate	-	-	-	98.3	-	-	98.3
Billingham	DEFRA	-	-	-	55.7	-	-	55.7
Birmingham Tyburn	Affiliate	-	98.1	98.1	97.8	97.9	98.0	98.0
Birmingham Tyburn Roadside	Affiliate	-	39.2	81.5	97.8	98.2	-	79.2

Site	Owner	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
Blackburn Darwen Roadside	Affiliate	-	-	-	96.3	-	-	96.3
Blackpool Marton	DEFRA	-	-	96.2	98.0	98.4	-	97.5
Bottesford	Affiliate	-	-	-	-	99.3	-	99.3
Bournemouth	DEFRA	-	-	**100.0**	98.5	98.6	-	**99.0**
Brighton Preston Park	DEFRA	-	-	**100.0**	98.5	98.4	-	**99.0**
Brighton Roadside	Affiliate	-	-	-	96.7	-	-	96.7
Bristol Old Market	Affiliate	96.0	-	-	95.7	-	-	95.9
Bristol St Paul's	DEFRA	95.5	97.8	93.7	98.4	98.6	98.5	97.1
Bury Roadside	Affiliate	89.3	97.7	96.3	44.2	-	-	81.9
Cambridge Roadside	Affiliate	-	-	-	95.3	-	-	95.3
Canterbury	Affiliate	-	-	-	97.0	-	-	97.0
Carlisle Roadside	Affiliate	-	96.8	94.7	83.5	-	-	91.7
Charlton Mackrell	Affiliate	-	-	-	97.4	97.4	-	97.4
Chesterfield	Affiliate	-	96.4	89.2	88.9	-	-	91.5
Chesterfield Roadside	Affiliate	-	88.9	95.3	96.0	-	-	93.4
Coventry Memorial Park	DEFRA	-	-	71.8	92.9	96.5	-	87.1
Exeter Roadside	Affiliate	-	-	-	99.3	98.2	-	98.8
Glazebury	DEFRA	-	-	-	87.1	94.0	-	90.6
Great Dun Fell	DEFRA	-	-	-	-	97.4	-	97.4
Harwell	DEFRA	-	83.5	46.7	96.9	98.0	92.8	83.6
Harwell PARTISOL	Affiliate	-	**100.0**	**100.0**	-	-	-	**100.0**
High Muffles	DEFRA	-	-	-	10.2	0.0	-	5.1
Horley	Affiliate	-	-	-	99.5	-	-	99.5
Hull Freetown	DEFRA	96.9	65.3	87.0	89.4	96.9	88.5	87.3
Ladybower	DEFRA	-	-	-	25.6	95.2	59.0	59.9
Leamington Spa	Affiliate	-	96.5	93.6	85.9	97.1	96.9	94.0
Leeds Centre	DEFRA	93.3	78.9	86.1	87.8	91.4	93.3	88.5
Leeds Headingley Kerbside	Affiliate	-	95.3	90.2	98.1	-	-	94.5
Leicester Centre	DEFRA	97.1	92.7	0.0	90.5	71.0	96.1	74.6
Leominster	DEFRA	-	-	-	98.3	98.5	98.4	98.4
Liverpool Queen's Drive Roadside	Affiliate	-	-	-	98.6	-	-	98.6
Liverpool Speke	DEFRA	97.0	89.5	96.8	92.4	96.6	97.1	94.9
Lullington Heath	DEFRA	-	-	-	85.4	85.0	97.5	89.3
Manchester Piccadilly	DEFRA	-	-	94.7	97.1	96.8	32.1	80.2
Manchester	Affiliate	-	-	-	95.7	97.3	-	96.5

Site	Owner	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
South								
Market Harborough	DEFRA	53.4	-	-	91.7	60.5	-	68.5
Middlesbrough	Affiliate	85.2	80.7	61.5	92.6	93.6	92.4	84.3
Newcastle Centre	DEFRA	94.1	92.3	89.8	82.0	93.9	93.4	90.9
Newcastle Cradlewell Roadside	Affiliate	-	-	-	97.4	-	-	97.4
Northampton	Affiliate	-	-	100.0	98.5	98.6	97.3	**98.6**
Norwich Lakenfields	Affiliate	-	-	-	89.6	93.1	93.1	91.9
Nottingham Centre	DEFRA	-	-	86.7	78.3	99.0	98.1	90.5
Oxford Centre Roadside	Affiliate	-	-	-	95.1	-	-	95.1
Oxford St Ebbes	Affiliate	-	99.9	99.6	49.2	-	-	82.9
Plymouth Centre	DEFRA	-	0.0	-	94.2	98.2	-	64.1
Portsmouth	Affiliate	-	95.8	81.4	94.0	98.5	-	92.4
Preston	DEFRA	-	-	86.9	79.7	79.8	-	82.1
Reading New Town	DEFRA	-	97.4	97.8	84.2	97.4	-	94.2
Rochester Stoke	Affiliate	-	80.4	73.6	88.0	96.6	96.4	87.0
Salford Eccles	Affiliate	99.2	98.6	89.7	93.2	99.2	98.7	96.4
Saltash Roadside	Affiliate	-	99.2	-	-	-	-	99.2
Sandwell West Bromwich	Affiliate	-	-	-	99.5	99.7	96.7	98.6
Sandy Roadside	Affiliate	-	77.9	99.0	94.6	-	-	90.5
Scunthorpe Town	Affiliate	-	98.3	-	98.4	-	98.4	98.4
Sheffield Centre	DEFRA	98.3	32.6	43.4	90.7	97.8	98.4	76.9
Sheffield Tinsley	DEFRA	-	-	-	50.6	-	-	50.6
Sibton	DEFRA	-	-	-	-	99.5	-	99.5
Southampton Centre	DEFRA	97.2	97.8	97.7	96.9	96.9	97.1	97.3
Southend-on-Sea	DEFRA	-	-	99.7	98.5	79.8	-	92.6
St Osyth	DEFRA	96.9	-	-	99.7	99.7	-	98.8
Stanford-le-Hope Roadside	Affiliate	-	65.6	77.2	98.2	-	92.0	83.3
Stockton-on-Tees Eaglescliffe	Affiliate	-	92.5	91.7	81.4	-	-	88.5
Stoke-on-Trent Centre	DEFRA	-	90.0	98.3	86.3	87.2	-	90.5
Sunderland Silksworth	Affiliate	-	-	11.3	21.6	21.6	21.6	19.1
Thurrock	Affiliate	-	97.6	-	94.8	98.4	89.9	95.2
Walsall Willenhall	Affiliate	-	-	-	93.9	-	-	93.9
Warrington	Affiliate	-	99.0	99.0	99.7	-	-	99.2

Site	Owner	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
Weybourne	Affiliate	-	-	-	-	87.1	-	87.1
Wicken Fen	DEFRA	-	-	-	98.1	97.4	95.6	97.0
Wigan Centre	Affiliate	-	-	98.9	97.8	96.2	-	97.6
Wirral Tranmere	DEFRA	-	-	63.5	94.0	94.0	-	83.8
Yarner Wood	DEFRA	-	-	-	86.6	93.7	-	90.1
York Bootham	Affiliate	-	77.4	99.1	-	-	-	88.2
York Fishergate	Affiliate	-	99.7	-	99.5	-	-	99.6
Number of sites		14	35	42	72	51	29	80
Number of sites < 90%		3	13	18	23	9	6	26
Network Mean (%)		92.1	85.4	84.7	88.2	91.2	89.2	88.8

Shaded boxes are for data capture < 90%
Bold data captures are for data that are provisional and subject to further quality control

4.2.2 Site Specific Issues

Birmingham Tyburn Roadside
The PM_{10} FDMS showed excessively high sample dewpoints from the service in August up to mid-October; these data were deleted during ratification. The $PM_{2.5}$ analyser lost its memory in September, resulting in some data loss.

Bury Roadside
An unspecified analyser fault was identified with the NOx analyser, resulting in the loss of NOx data from 26 June to 19 August. The QA/QC audit was carried out in this period, and the NOx results of this are therefore unreliable.

Harwell
The $PM_{2.5}$ FDMS analyser produced poor quality data during the quarter, and the tapered element broke in September. A substantial amount of data were deleted as a result.

High Muffles
The O_3 analyser was reported inoperative at the end of June. The power to the site was off from 28 July to 31 October.

Ladybower
The NOx and SO_2 analysers both developed flow problems, resulting in considerable loss of data during the quarter.

Leicester Centre
The analysers were upgraded on 8 September, with a gap in the gaseous analyser data of 22.6 days. The $PM_{2.5}$ analyser showed periods of instability in July (32.3 days) and August (31 days). The analyser was ultimately removed from site for repair in October.

Manchester Piccadilly
The SO_2 analyser has not been upgraded, due to confusion over its status in the network. The analyser showed unacceptable drift from the service on 29 July up to a call-out for a lamp problem on 25 September. These data have been deleted.

Market Harborough
The CO analyser was found to be inoperative at the service on 4 August, and was eventually replaced on 15 September.

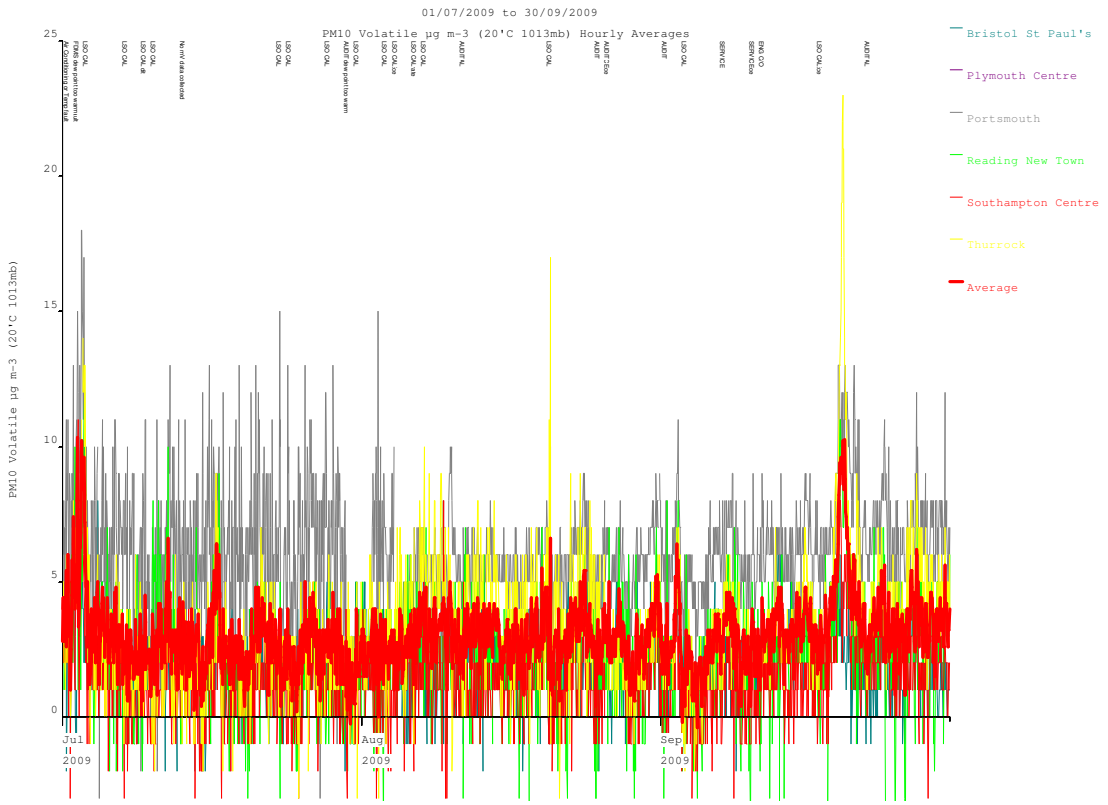
Middlesbrough
The air conditioning was unable to keep the temperature under control during hot weather in August. In addition, the FDMS analysers suffered several dryer and pump problems. During August (3^{rd}-11^{th}) , a period of $PM_{2.5}$ concentrations higher than PM_{10} was observed, and these were deleted.

Oxford St Ebbes
A converter fault identified at the QA/QC audit on 6 July caused the loss of 44 days NOx data. This has since been rectified.

Plymouth Centre
Long-running problems with the PM_{10} and $PM_{2.5}$ FDMS at Plymouth continued. Significant leaks were found in the analyser, as well as temperature problems due to air conditioning faults. This is still largely unresolved as of October 2009. All PM data for this quarter have been deleted.

Portsmouth
The PM_{10} FDMS analyser shows anomalously high concentrations during summer 2009. Figure 4.1 shows the daily average PM_{10} concentrations measured at Portsmouth and other selected southern sites. The concentrations at Portsmouth (grey) are consistently above the average for the sites selected.

Figure 4.1 Daily Average PM_{10} Concentrations at Selected Southern Sites



Until the cause of this is established, the data remain provisional for this quarter.

Sheffield Centre
The FDMS units suffered from numerous flow, temperature and valve problems throughout the quarter.

Sheffield Tinsley
The air conditioning unit caused repeated tripping of the power during July, and the site was switched off until a repair was carried out on 27 August.

Sunderland Silkworth
The power to the site was disconnected from 17 June to 11 September due to nearby building works.

Stanford-le-Hope Roadside
The PM_{10} and $PM_{2.5}$ analysers performed poorly during the quarter due to temperature, flow and power supply problems and significant amounts of data were deleted.

4.3 Scotland

4.3.1 Data Capture

The data capture for sites in Scotland for the period July-September 2009 is given in Table 4.3.

Table 4.3 Ratified Data Capture for Scotland, July-September 2009 (%)

Site	Owner	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
Scotland								
Aberdeen	Affiliate	-	96.4	97.6	99.1	99.4	-	98.1
Aberdeen Union Street Roadside	Affiliate	-	-	-	99.4	-	-	99.4
Auchencorth Moss	DEFRA	-	100.0	100.0	-	97.1	-	99.0
Auchencorth Moss PM_{10} PM_{25}	DEFRA	-	31.5	94.5	-	-	-	63.0
Bush Estate	DEFRA	-	-	-	81.9	96.2	-	89.0
Dumfries	DEFRA	-	-	-	35.3	-	-	35.3
Edinburgh St Leonards	DEFRA	98.7	95.4	95.4	97.8	93.2	98.6	96.5
Eskdalemuir	DEFRA	-	-	-	95.5	98.8	-	97.2
Fort William	DEFRA	-	-	-	98.6	98.7	-	98.6
Glasgow Centre	DEFRA	98.1	84.8	95.7	98.1	97.7	95.6	95.0
Glasgow City Chambers	DEFRA	-	-	-	99.5	-	-	99.5
Glasgow Kerbside	DEFRA	-	96.9	77.9	98.1	-	-	91.0
Grangemouth	Affiliate	-	97.4	96.5	99.0	-	88.7	95.4
Grangemouth Moray	Affiliate	-	-	-	99.4	-	-	99.4
Inverness	DEFRA	-	100.0	100.0	98.4	-	-	99.5
Lerwick	DEFRA	-	-	-	-	97.8	-	97.8
Strath Vaich	DEFRA	-	-	-	-	95.2	-	95.2
Number of sites		2	8	8	13	9	3	17
Number of sites < 90%		0	2	1	2	0	1	3
Network Mean (%)		98.4	87.8	94.7	92.3	97.1	94.3	91.1

Shaded boxes are for data capture < 90%
Bold data captures are for data that are provisional and subject to further quality control

4.3.2 Site Specific Issues

Auchencorth Moss PM_{10} $PM_{2.5}$
A dryer problem occurred with the PM_{10} FDMS on 3 August to 30 September, and data between these dates have been deleted.

Dumfries
The NOx analyser converter efficiency was found to be below the acceptable limit of 95% at the audit on 27 July. The ESU did not complete the repair until 24 September; 59.3 days data have been deleted.

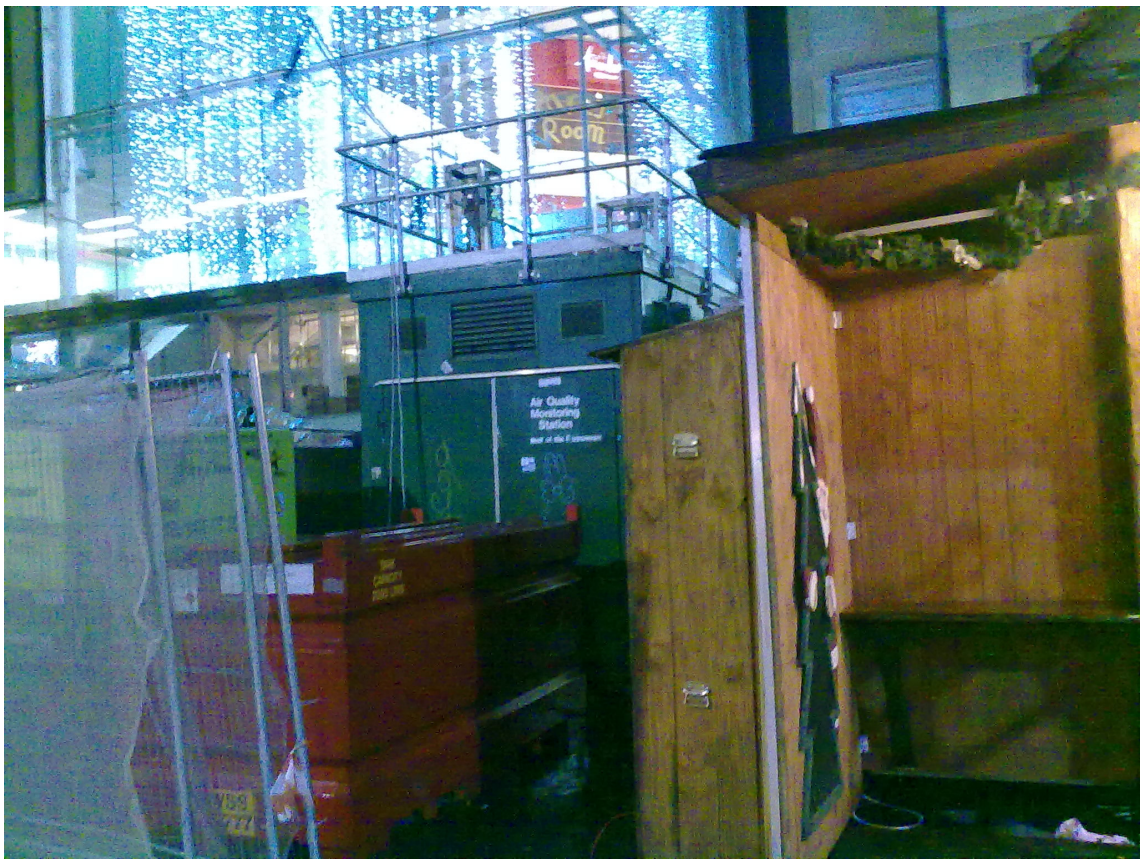
Edinburgh St Leonards
As reported in the April-June 2009 report, a step change in PM_{10} concentrations was observed following installation of a B type dryer.

Glasgow Centre
The replacement NOx analyser at Glasgow Centre was incorrectly configured, and the incorrect channels were recorded-see Section 1.5.2

In addition, the immediate vicinity around the site is being redeveloped during 2009, and construction work has surrounded the cabin, to the point where access for the LSO has proved difficult. This is

shown in a photograph taken by the LSO on 25 November-see Figure 4.1. This will be covered ion more detail in the October-December report.

Figure 4.1. Glasgow Centre Cabin, December 2009



A Christmas market also takes place around the site in the run-up to Christmas, and portable generators affect the measured data.

Glasgow Kerbside
There has also been a problem with the NOx converter efficiency at this site, determined in early July; this has been reviewed with the ESU and the matter resolved.

The $PM_{2.5}$ analyser was found to contain moisture on a number of occasions, resulting in noisy data which have been deleted. The cooler was replaced at the end of September.

4.4 Wales

4.4.1 Data Capture

The data capture for sites in Wales for the period July-September 2009 is given in Table 4.4.

Table 4.4 Data Capture for Wales, July-September 2009 (%)

Site	Owner	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
Wales								
Aston Hill	DEFRA	-	-	-	93.2	95.5	-	94.3

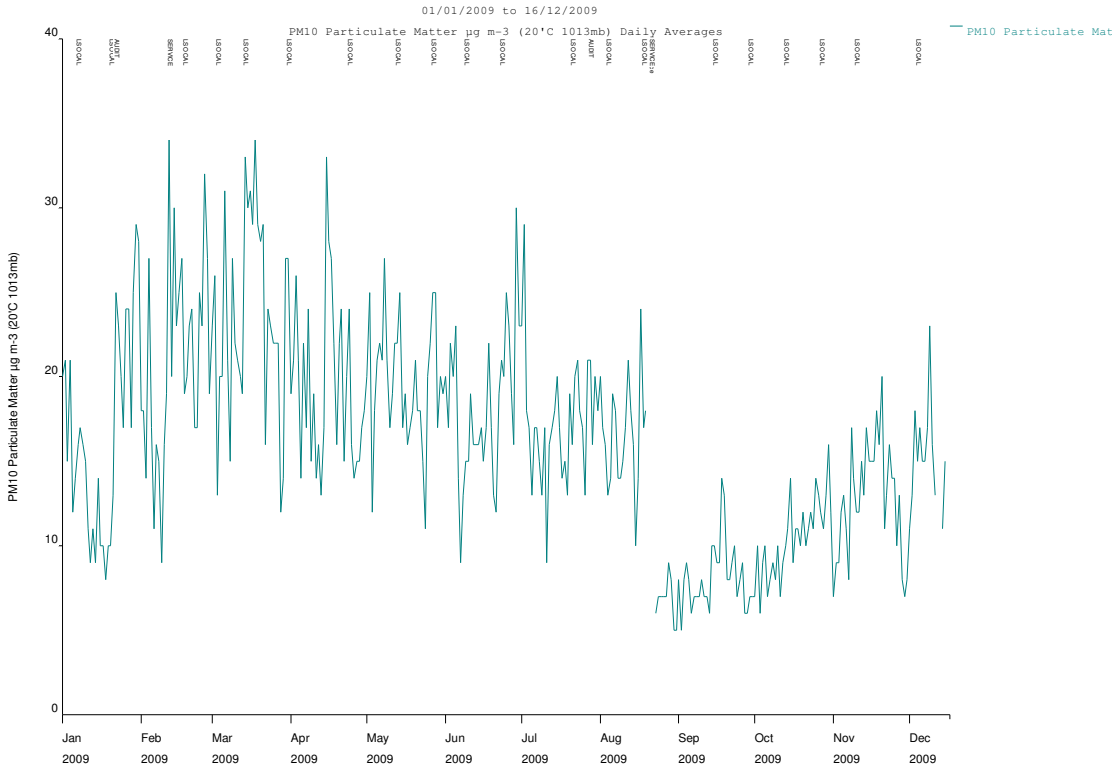
Site	Owner	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
Cardiff Centre	DEFRA	97.3	83.7	96.5	96.5	97.4	97.2	94.8
Chepstow A48	Affiliate	-	96.7	-	96.6	-	-	96.6
Cwmbran	Affiliate	-	-	-	98.5	98.8	-	98.6
Narberth	DEFRA	-	99.9	-	98.4	98.4	98.4	98.8
Newport	Affiliate	-	88.5	99.1	97.5	-	-	95.0
Port Talbot Margam	Affiliate	97.0	97.4	92.2	91.3	97.0	97.0	95.3
Port Talbot Margam $PM_{2.5}$	Affiliate	-	-	93.5	-	-	-	93.5
Swansea Roadside	Affiliate	-	97.5	31.5	97.4	-	-	75.5
Wrexham	DEFRA	-	80.4	-	98.0	-	86.8	88.4
Number of sites		2	7	5	9	5	4	10
Number of sites < 90%		0	3	1	0	0	1	2
Network Mean (%)		97.1	92.0	82.5	96.4	97.4	94.9	93.1

Shaded boxes are for data capture < 90%
Bold data captures are for data that are provisional and subject to further quality control

4.4.2 Site Specific Issues

Chepstow A48
Chepstow has one of the few remaining TEOM (non-FDMS) PM_{10} analysers left in the network. Following service in August, the measured concentrations dropped appreciably. Close inspection of the unit by the QA/QC Unit failed to identify any problems.

Figure 4.2 Chepstow PM_{10}



Swansea Roadside
Poor $PM_{2.5}$ FDMS performance in August resulted in the deletion of data from 15 May to September, though problems with noisy data and low vacuum persist into the next quarter.

4.5 Northern Ireland (including Mace Head)

4.5.1 Data Capture

The data capture for sites in Northern Ireland (including Mace Head) for the period July-September 2009 is given in Table 4.5.

Table 4.5: Data Capture for Ireland, July-September 2009 (%)

Site	Owner	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
Ireland								
Mace Head	Affiliate	-	-	-	-	100.0	-	100.0
N Ireland								
Armagh Roadside	Affiliate	-	99.8	-	0.0	-	-	49.9
Belfast Centre	DEFRA	70.7	64.6	65.9	78.5	81.9	59.9	70.3
Derry	Affiliate	-	**1.9**	**94.0**	96.8	98.7	98.4	78.0
Lough Navar	DEFRA	-	98.6	-	-	90.1	-	94.4
Number of sites		1	4	2	3	4	2	5
Number of sites < 90%		1	2	1	2	1	1	3
Network Mean (%)		70.7	66.2	79.9	58.5	92.7	79.1	78.5

Shaded boxes are for data capture < 90%
Bold data captures are for data that are provisional and subject to further quality control

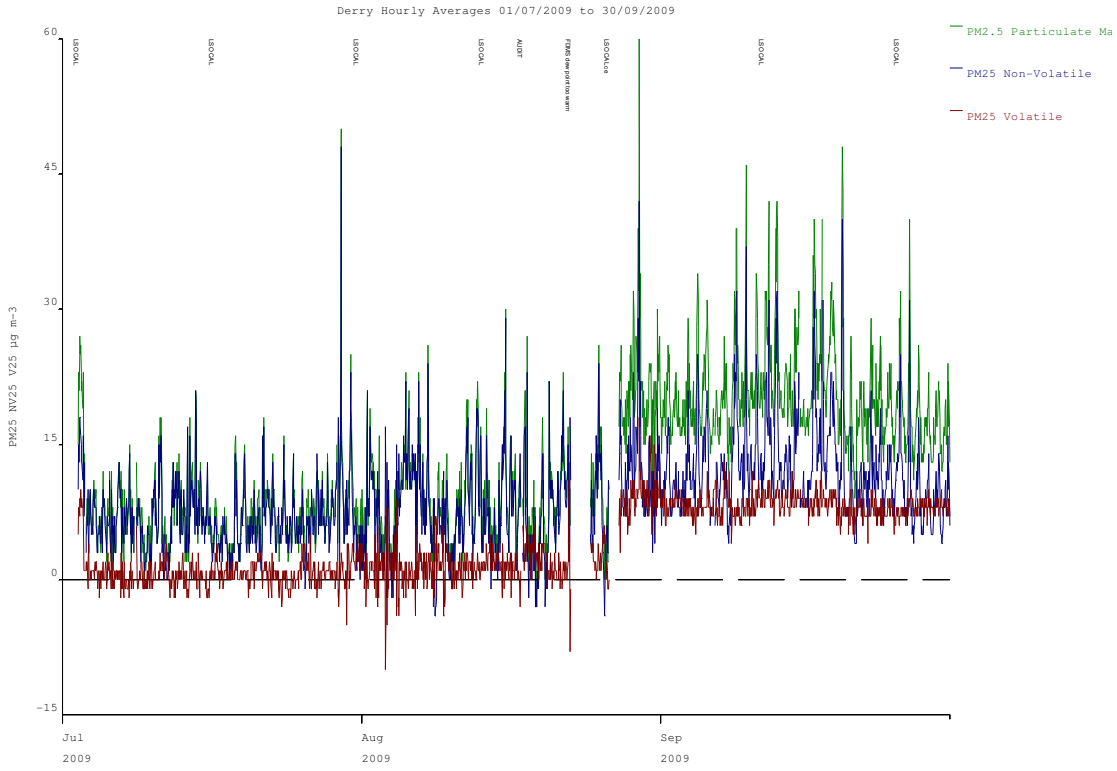
4.5.2 Site Specific Issues

Armagh Roadside
The Armagh Roadside site was retrospectively affiliated into the network on 1 December 2009, with a start date of 1 January 2009. However, the NOx analyser has been inoperative for much of the year, and there may be no NO_2 data for the whole of 2009. The PM_{10} (TEOM) analyser performance was acceptable for most of the year.

Belfast Centre
The site suffered several periods of overheating due to air conditioning problems during the quarter.

Derry
The FDMS instruments have continued to experience problems during this quarter. The PM_{10} analyser performed poorly and was removed for repair; all data for the quarter have been deleted. The $PM_{2.5}$ analyser shows a significant step change in August following a repair to fix a leak identified at audit. At the time of writing, the ESU is continuing investigations into the problems experienced with these two analysers. The data remain provisional pending the results of these tests. The step change is shown in Figure 4.3.

Figure 4.3 Step change in PM2.5 concentrations, Derry



4.6 Overall Data Capture

Overall data capture for each pollutant across the network is given in Table 4.6

Table 4.6: Data Capture by Pollutant, Entire Network

Site	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	
Number of sites	26	62	70	111	78	44	129
Number of sites < 90%	6	22	24	29	10	9	37
Network Mean (%)	92.0	85.9	86.1	89.0	93.1	90.7	89.2

A summary of the main site analyser operational problems, which have resulted in data capture below the required 90% level during the reporting period July-September 2009 is given in Appendix 2. The number of days and hours of data lost for each cause is also given. In some cases the data gap extends beyond this three-month reporting period. The table lists all gaps of 6 hours or more for each pollutant where overall data capture is below 90%. Note that data capture is calculated for the whole month for each pollutant (except for new sites, which are from the start date), so additional analysers installed during the period will have reduced data captures quoted.

4.7 Sites Highlighted in Previous Reports

Several analysers have been highlighted recently as being of concern to the QA/QC unit. An update is given in Table 4.7.

Table 4.7: Status of Analysers Highlighted in Previous Reports

Site	Analyser	Fault	Current status
Aston Hill	NOx	Autocalibration run-on	Now fixed
Auchencorth Moss	FDMS PM_{10} and $PM_{2.5}$		Negative data still observed, particularly $PM_{2.5}$
Camden Kerbside	PM_{10}	Leak	Still evident at summer QA/QC audit; frequent temperature problems
Derry	PM_{10} $PM_{2.5}$	Poor performance	Problems still continue-see Section 4.5.2
Exeter Roadside	Site	Closed for building work	Restarted, but work still continuing. Access difficult
Glasgow Centre	NOx	Faults with new analyser	Incorrectly configured-see Section 4.3.2
Grangemouth	Site	Air conditioning	Unknown
Haringey Roadside	PM_{10}	Noisy data	Significant problems reported in Q3
London Teddington	Site	Air conditioning	No progress reported
Rochester Stoke	$PM_{2.5}$	Noisy data	Now fixed; site turned off
St Osyth	Site	Air conditioning	No progress reported
Sunderland Silkworth	Logger	Frequent gaps	Now fixed; power problems experienced
Swansea Roadside	$PM_{2.5}$	Poor dryer performance	Fault continues in Q3; dryer removed for repair
Weybourne	O_3	No manual calibrations or IZS	No progress reported
Rural CO analysers	CO	Baseline drift	Analysers replaced

Part B Intercalibration Report, Summer 2009

5 Introduction

In July to September 2009, AEA undertook an intercalibration of 127 monitoring stations in operation in the Defra and the Devolved Administrations Automatic Urban and Rural Monitoring Network.

The intercalibration exercise is a vital step in the process of data ratification. The audits are used to undertake a number of analyser and infrastructure performance checks that cannot be performed by Local Site Operators, with a view to ensuring confidence in the accuracy, consistency and traceability of air pollution measurements made at all the monitoring stations.

The intercalibration requires the coordination and close cooperation of QA/QC unit, Management Units, ESUs and LSOs in making sure the entire operation runs smoothly and is the result of many months of planning.

Leading up to the intercalibration, a draft schedule of visits is prepared and circulated to management units and ESUs for approval. ESU ozone photometers are calibrated at AEA and all QA/QC equipment and cylinders are tested, calibrated and verified before use.

QA/QC visits are always undertaken before any ESU visits, to allow the performance of the sites to be quantified for the six month period prior to the visit. During the QA/QC visit, the LSO usually attends to demonstrate their competence in performing routine calibrations.

The audits are used to transport independent calibration standard gases and test apparatus to all of the sites, to quantify the performance of the entire measurement process at the monitoring stations. The results obtained from these tests are fed into the ratification process, where any correction of datasets can be applied to account for any performance anomalies.

ESU visits are normally undertaken within a three week period following the QA/QC visit. At this time, the analysers and sampling systems are all cleaned and serviced in accordance with manufacturer's specifications. The analysers are then set up ready for the following six month period, until the next round of intercalibrations and servicing.

This scheduling has proven to be very successful in delivering reliable operation of monitoring stations and high quality data. The programme is iterative: improvements and enhancements are continually added to further improve performance and analyse results.

During 2010, further changes will be made to the network QA/QC activities to ensure continued compliance with CEN. The most significant is traceable ozone calibrations by the QA/QC Unit every three months. Other changes planned are replacement of sample inlet manifolds with individual sample lines for analysers in order to more reliably assess sample losses. These lines will be regularly replaced by the ESUs.

6 Scope of Intercalibration Exercise

The QA/QC visits fulfil a number of important functions:

- A "health check" on the production of provisionally scaled data, which is rapidly disseminated to the public soon after collection.
- Identification of poorly performing analysers and infrastructure, together with recommendations for corrective action.
- A measure of network performance, by examining for example, how different NOx analysers around the network respond to a common gas standard. This test checks how "harmonised" UK measurements are; i.e. that a 200ppb NO_2 pollution episode in Edinburgh would be reported in exactly the same way at every other site in the UK, regardless of the location or the analyser used to record the event.
- Assessment of the area around the monitoring station: has the environment changed in the last six months? Is the location still representative of the site classification?
- Assessment of the safety issues surrounding the site
- Training of LSOs and identification of personal protective equipment required by site visitors

The QA/QC audits test the following aspects of analyser performance:

1. Analyser accuracy and precision. These are basic checks to ensure analysers respond to known concentrations of gases in a reliable manner.
2. Instrument linearity. This test refines the response checks on analysers, by assessing whether doubling a concentration of gas to the analyser results in a doubling of the analyser signal response. If an analyser's response characteristics are not linear, data cannot be reliably scaled into concentrations.
3. Instrument signal noise. This test checks that an analyser responds to calibration gases in a stable manner with time. A "noisy" analyser may not provide high quality data which may be difficult to process at lower concentrations.
4. Analyser response time. This test checks that the analyser responds quickly to a change in gas concentrations. If analyser response is too slow, data may not accurately reflect ambient concentrations.
5. Leak and flow checks. These tests ensure that ambient air reaches the analysers, without being compromised in any way. Leaks in the sampling system can affect the ability of the analyser to sample ambient air reliably.
6. NOx analyser converter efficiency. This test evaluates the ability of the analyser to measure NO_2. An inefficient converter severely compromises the data from the analyser.
7. TEOM k_o evaluation. The analyser uses this factor to calculate mass concentrations, so the value is calculated to determine its accuracy compared to the stated value.
8. Particulate analyser flow rate checks. These tests ensure that the flow rates through critical parts of the analyser are within specified limits. There are specific analyser flow rates that are set to make sure particle size fractions and mass concentration calculations are performed correctly.
9. SO_2 analyser hydrocarbon interference. This test evaluates the analyser's ability to remove interfering hydrocarbon gases from the sample gas. A failed test could have significant implications for analyser data.
10. Evaluation of site cylinder concentrations. These tests use a set of AEA certified cylinders that are taken to all the sites. The concentrations of the site cylinders are used to scale pollution datasets, so it is important to ensure that the concentrations of gases in the cylinders do not change.
11. Competence of Local Site Operators (LSO) in undertaking calibrations. As it is the calibrations by the LSOs that are used to scale pollution datasets, it is important to check that these are undertaken competently.

Once all data have been collected, a "network intercomparison" is conducted. This utilises the audit gas cylinders transported to each site in the Network. These cylinders are recently calibrated by the Calibration Laboratory at AEA, and allow us to examine how different site analysers respond when

they are supplied with the same gas used at other sites. For ozone analysers, the calibration is undertaken with recently calibrated ozone photometers.

The technique used to process the intercomparison results is broadly as follows:

- The analyser responses to audit gas are converted into concentrations, using provisional calibration factors obtained from the Management Units on the day of the intercalibration. These factors are also used for the provisional data supplied to the web/interactive TV services.
- These individual results are tabulated, and statistical analyses undertaken (e.g. network average result, network standard deviation, deviation of individual sites from the network mean etc.).

These results are then used to pick out problem sites, or "outliers", which are investigated further to determine reasons and investigate possible remedies for the outliers. The definition of an outlier is an analyser result that falls outside the following limits:

- ±10% of the network average for NOx, CO and SO_2 analysers,
- ±5% of the reference standard photometer for Ozone analysers,
- ±2.5 % of the stated ko value for TEOM analysers,
- ±10% for particulate analyser flow rates,
- ±10% for the recalculation of site cylinder concentrations.

Thus, the intercalibration investigates the quality of provisional data output by the Management Units for use in forecasting, interactive television services and the web. It also provides input into the ratification process by highlighting sites where close scrutiny of datasets is likely to be required.

Any outliers that are identified are rigorously checked to determine the cause, and any required corrective action to be taken, if necessary. There are a number of likely main causes for outlier results, as discussed below:

- Drift of an analyser between scheduled LSO calibrations. This is by far the most common cause of an outlier result, and one that is simply corrected for during ratification of data.
- Drift of site cylinder concentrations between intercalibrations. Site cylinders can sometimes become unstable, especially at low pressures. All site cylinder concentrations are checked every six months, and are replaced as necessary.
- Erroneous calibration factors. It can occasionally happen that an analyser calibration is unsuccessful, and results in unsuitable scaling factors being used to produce pollution datasets. These are identified and corrected during ratification.
- Pressurisation of the sampling system at the audit. Occasionally, an analyser can be very sensitive to small changes in applied flow rates of calibration gas. This is more difficult to identify and correct, and may have consequences for data quality.
- Leaks, sample switching valves, etc. Outliers can be generated if an analyser is not sampling ambient air properly. It is likely that if a leaking analyser is identified, data losses will result.

7 Results

The results section has been restructured to allow easier regional analysis. As well as a detailed national summary, a regional summary and breakdown outlier analysis is provided.

7.1 National Network Overview

The results of the intercalibration are summarised in Table 7.1 below:

Table 7.1 - Summary of audited analyser performance – 127 UK stations

Parameter	Number of outliers	Number in network	% outliers in total
NOx analyser	26	110	24%
CO analyser	0	25	0%
SO_2 analyser	9	43	21%
Ozone analyser	21	78	27%
TEOM and BAM analysers	3 k_0, 8 flow	20 TEOM PM_{10} 35 FDMS PM_{10} 1 BAM PM_{10} 2 TEOM $PM_{2.5}$ 50 FDMS $PM_{2.5}$ 1 BAM $PM_{2.5}$	6%
Gravimetric PM analysers	0	8 PM_{10} 9 $PM_{2.5}$	0%
Total	67	381	18%

In addition to these results, 22 of the 288 site cylinders (~7.5%) used to scale instrument data into concentrations appeared to have drifted by more than 10% from their certificated values.

Three NOx converters were found to be outside than the ±5% acceptance limit.

The number of analyser outliers identified is similar to the previous exercise. At the Winter 2009 intercalibration 18% of the analysers in use were identified as outliers.

The procedures used to determine network performance are documented in AEA Work Instructions. These methods are regularly updated and improved and are evaluated by the United Kingdom Accreditation Service (UKAS). AEA holds ISO17025 accreditation for the on-site calibration of all the analyser types (NOx, CO, SO_2, O_3) and for the determination of the TEOM ko factor and particulate analyser flow rates used in the network. An ISO17025 certificate of calibration (Calibration Laboratory number 0401) for the analysers in the AURN is appended to this report.

7.1.1 Network Intercomparisons

- Oxides of Nitrogen.

  A total of 26 outliers (24%) were identified during this intercalibration. This is slightly worse than the Winter exercise where 21% of the analysers were identified as outliers. In addition, there were three converters which fell outside the ±5% acceptance limits. Individual outliers will be discussed in detail in the following sections.

  Using the methodology detailed earlier, comparison of the network averages to audit cylinder

concentrations showed that the network measures concentrations of NOx and NO to within a maximum of 3% of the network standards. The percentage standard deviations of these results, which are an indication of how close the results are grouped together, were less than 5% in all cases. These are excellent results, and demonstrate that raw data from the vast majority of NOx analysers are accurate, harmonised and traceable to national metrology standards.

- Carbon Monoxide

  No analysers were identified as outliers at this intercalibration. This result is better than the Winter exercise, when 4 analysers fell outside the acceptance limits.

  Comparison of the network average to audit cylinder concentrations showed that the network measures concentrations of CO to within 1% of the network standards. The percentage standard deviation of these results, which are an indication of how close the results are grouped together, was less than 3%. This is an excellent result, and demonstrates that raw data from CO analysers are accurate, harmonised and traceable to national metrology standards.

- Sulphur Dioxide

  A total of 9 outliers (21%) were identified at this intercalibration. This is slightly worse than the winter 09 exercise, when 10 analysers were identified as outliers. Individual outliers will be discussed in detail in the following sections. All m-xylene interference tests were less than 30ppb.

  Comparison of the network averages to audit cylinder concentrations showed that the network measures concentrations of SO_2 to within 5% of the network standards. The percentage standard deviation of these results, which are an indication of how close the results are grouped together, was less than 5%. This is a very good result, and demonstrates that raw data from the vast majority of SO_2 analysers are accurate, harmonised and traceable to national metrology standards

- Ozone

  A total of 20 outliers (26%) were identified during the Winter 09 exercise. This is better than the previous intercalibration, where 27 analysers were found to be outside the ±5% acceptance criterion.

  Of the 20 outliers, 15 were within ±10%, 4 were within ±20% and one was significantly greater than ±20%. Individual outliers will be discussed in detail in the following sections.

- Particulate Analysers

  Three calculated TEOM and FDMS PM_{10} k_0 determinations were outside the required ±2.5% of their stated values. This is worse than the previous exercise - no outliers were identified in the Winter 09 intercalibration.

  Four TEOM PM_{10} main flows were found to be outside the ±10% acceptance limits, compared to six in total at the Winter 09 exercise. A single $PM_{2.5}$ main flow was outside the ±10% acceptance limits, there were none at the previous exercise.

  All Partisol analysers successfully passed the audit tests.

- Site Cylinder Concentrations

  22 of the 288 site cylinders used to scale ambient pollution data were found to be outside the ±10% acceptance limit. These outliers will be examined in detail in the following sections.

7.2 London Sites

The results of the intercomparison for the 14 London sites in operation at the time of the intercalibration are summarised in Table 7.2 below:

Table 7.2 - Summary of audited analyser performance – London Sites

Parameter	Number of outliers	Number in region
NOx analyser	3	14
CO analyser	0	7
SO_2 analyser	0	7
Ozone analyser	3	9
TEOM and BAM analysers	1 k_0, 1 flow	6 TEOM PM_{10} 2 FDMS PM_{10} 0 TEOM $PM_{2.5}$ 8 FDMS $PM_{2.5}$
Gravimetric PM analysers	0	2 PM_{10} 0 $PM_{2.5}$
Cylinders	3	42

The NOx outliers at Hillingdon and Westminster were attributed to drifts in the analyser responses between calibrations. No data were lost from either site during the ratification process.

The NOx outlier at Bexley was caused as a result of a drifting calibration cylinder. Careful examination of the data has confirmed no need for any rescaling or rejection of data from this analyser.

The minor ozone outliers at Harlington, Hillingdon and Marylebone Road were all successfully rescaled with no data rejection necessary.

The Haringey Roadside PM_{10} analyser had a brace of outliers; the k_0 was out by -3.4% and the total flow rate of the PM_{10} analyser at Haringey Roadside was found to be out of specification for the third successive audit. The data have been carefully examined and rescaled to account for the k_0, while the low flow result appears to only significantly affect a week of data at the beginning of August. This week of data has been rejected.

The Marylebone Road $PM_{2.5}$ Partisol was not operational at the time of the audit.

7.3 English Sites

The results of the intercomparison for the 77 English sites are summarised below:

Table 7.3 - Summary of audited analyser performance – English Sites

Parameter	Number of outliers	Number in region
NOx analyser	18	72
CO analyser	0	13
SO_2 analyser	5	27
Ozone analyser	13	52
TEOM and BAM analysers	3 k_0, 6 flow	12 TEOM PM_{10} 23 FDMS PM_{10} 1 BAM PM_{10} 0 TEOM $PM_{2.5}$ 38 FDMS $PM_{2.5}$ 1 BAM $PM_{2.5}$
Gravimetric PM analysers	0	3 PM_{10} 7 $PM_{2.5}$
Cylinders	16	179

Of the 18 NOx outliers, 4 can be attributed to changes in analyser responses between LSO calibrations (Carlisle, Middlesbrough, Liverpool Queen's Drive and Stockton-On-Tees Eaglescliffe). All of these outliers were corrected for with no rejection of data required.

7 outliers (Birmingham Tyburn Roadside, Brighton Roadside, Bury Roadside, Glazebury, Leicester, Stoke and Wigan) can be attributed to changes in site cylinder concentrations. The cylinders at all seven sites have been earmarked for urgent replacement. Data from all 7 sites have been successfully rescaled with no rejection required.

The NOx outliers at Newcastle Centre, Oxford Centre Roadside and Southend were found to be due to the factor and processing used by CMCU, compared to those used by QA/QC. The cylinder database at CMCU showed a different concentration for the site cylinder compared to the certified value. Ratified ambient data are unaffected and data quality has not been compromised.

The Bath, Plymouth and Sandy outliers were caused by poorly performing analysers on the day of the audit. Careful examination of the datasets revealed no obvious anomalies; no data were rejected from any of the sites on this occasion.

The analyser at Manchester South was exhibiting a fault at the time of the audit. A week of data has been rejected as a result.

Two NOx converters fell outside the ±5% acceptance limits:

Bury Roadside (91%) – 6 weeks of data rejected.
Oxford St Ebbes (88%) - 5 weeks of data rejected

Two of the five SO_2 outliers (Leicester and Northampton) were found to be due to changes in analyser responses between LSO calibrations. Both of these outliers were corrected for with no rejection of data required.

The SO_2 outlier at Southampton appears to be due to the factor and processing used by CMCU, compared to those used by QA/QC. Ambient data are unaffected and data quality has not been compromised.

The SO_2 outlier at Middlesbrough was found to be due to a drift in the site cylinder concentration. This was corrected during ratification with no rejection required. The cylinder will be carefully checked at the summer audit

The SO_2 outlier at Ladybower was due to a analyser fault. 6 weeks of data have been lost as a result of this fault.

Data from the thirteen Ozone outliers were successfully rescaled with no data rejection necessary. Due to an unrelated issue, 5 months of High Muffles data have been rejected this year.

Two TEOM k_0 outliers were identified;

Birmingham Tyburn Roadside PM_{10} (-2.7%)
Chesterfield PM_{10} (-2.7%)

All datasets were successfully rescaled with no loss of data required.

Six TEOM flow outliers were identified;

Newcastle PM_{10} Total (89% of required flow) – no data rejected, following careful examination
Hull PM_{10} Main (115%) – no data rejected, following careful examination
Plymouth PM_{10} Main (89%) – all data rejected, ongoing faults with site
Scunthorpe PM_{10} Main (116%) – no data rejected, following careful examination
Sheffield Centre PM_{10} Main (80%) – 2 weeks data rejected, ongoing faults with analyser

Manchester Piccadilly $PM_{2.5}$ Main (87%) and Total (89%) – no data rejected, following careful examination

The Leicester and Harwell FDMS analysers were not in operation at the time of the audit.

The Sunderland Silksworth site was not operational at the time of the audit.

7.4 Scottish Sites

The results of the intercomparison for the 16 Scottish sites are summarised below:

Table 7.4 - Summary of audited analyser performance – Scottish Sites

Parameter	Number of outliers	Number in region
NOx analyser	1	13
CO analyser	0	2
SO_2 analyser	1	3
Ozone analyser	5	9
TEOM and BAM analysers	0 k_0, 1 flow	0 TEOM PM_{10} 6 FDMS PM_{10} 0 TEOM $PM_{2.5}$ 4 FDMS $PM_{2.5}$
Gravimetric PM analysers	0	2 PM_{10} 1 $PM_{2.5}$
Cylinders	0	31

The NOx outlier at Aberdeen was traced to analyser drift in response between LSO calibrations. No data were rejected during ratification.

The NOx converter at Dumfries was found to be under the required 95% performance requirement (93%). Following careful examination, two months of data have been rejected.

The SO_2 outlier at Edinburgh appears to be due to a step change in zero response. The analyser data has been carefully examined, but no rejection was necessary on this occasion.

The minor Ozone outliers at Glasgow Centre and Eskdalemuir were successfully rescaled with no data rejection required.

The Ozone outliers at Lerwick, Strath Vaich and Edinburgh were all 20% or greater from the audit photometer. The calibration results, timeseries data and comparisons with other sites were all used to determine actions during ratification; all sites were successfully rescaled without data losses on this occasion.

The $PM_{2.5}$ total flow outlier at Grangemouth was minor in nature and does not appear to have affected ambient data in any way. No data have been rejected as a result of this finding.

The Aberdeen PM_{10} analyser was found to have significant leaks on both Main and Aux flows.

The FDMS analysers at Auchencorth Moss (PM_{10} and $PM_{2.5}$) and Edinburgh (PM_{10}) were not tested at audit, due to dryer warnings during the hot humid weather at the end of June.

7.5 Welsh Sites

The results of the intercomparison for the nine Welsh sites are summarised below:

Table 7.5 - Summary of audited analyser performance – Welsh Sites

Parameter	Number of outliers	Number in region
NOx analyser	4	9
CO analyser	0	2
SO_2 analyser	3	4
Ozone analyser	0	5
TEOM and BAM analysers	0 k_0, 0 flow	0 TEOM PM_{10} 6 FDMS PM_{10} 0 TEOM $PM_{2.5}$ 4 FDMS $PM_{2.5}$
Gravimetric PM analysers	0	1 PM_{10} 1 $PM_{2.5}$
Cylinders	2	24

The NOx outlier at Chepstow was again found to be due to a drift in the site cylinder concentration. Data have been successfully rescaled, no data rejection was required. The cylinder has been earmarked for urgent replacement.

The NOx outlier at Cwmbran was due to analyser drift between LSO calibrations. Data have been successfully scaled with no rejection required.

The NOx outliers at Narberth and Wrexham appear to be due to bad results from poorly performing instruments on the days of the audits. Both datasets have been carefully examined, no data were rejected from either of these analysers during ratification.

The SO_2 outliers at Narberth and Port Talbot were found to be due to the factor and processing used by CMCU, compared to those used by QA/QC. Ambient data are unaffected and data quality has not been compromised.

The SO_2 outlier at Wrexham was due to a noise fault with the analyser. One week of data have been rejected as a result of this finding.

The FDMS PM_{10} analyser at Narberth was not tested at audit, due to dryer warnings during the hot humid weather in August.

7.6 Northern Ireland Sites (incl. Mace Head)

The results of the intercomparison for the four Northern Irish and Mace Head sites are summarised in table 7.6:

Table 7.6 - Summary of audited analyser performance – Northern Irish Sites

Parameter	Number of outliers	Number in region
NOx analyser	0	2
CO analyser	0	1
SO_2 analyser	0	2
Ozone analyser	0	4
TEOM and BAM analysers	0 k_0, 0 flow	0 TEOM PM_{10} 3 FDMS PM_{10} 0 TEOM $PM_{2.5}$ 1 FDMS $PM_{2.5}$
Gravimetric PM analysers	0	0 PM_{10} 0 $PM_{2.5}$
Cylinders	1	7

All analysers were found to be operating satisfactorily at the summer 2009 audit.

The Belfast SO_2 analyser was not at site at the time of the audit.

8 Site Cylinder Concentrations

During the intercalibration, the concentrations of the on-site cylinders were evaluated using the audit cylinder standards. The calculated results showed that 22 of the 286 cylinders (~7.5%) used to scale analyser data into concentrations (NO, CO and SO_2) were outside the ±10% acceptance criterion. This is somewhat worse than the Winter 2009 exercise, where 4% of the scaling cylinders were outside the acceptance limits. There were 18 NO cylinders and six SO_2 cylinders identified as outliers.

In addition, the concentrations of 36 NO_2 cylinders appear to have drifted by more than 10%. NO_2 cylinders are not used for the scaling of data and so will not be replaced at this time. Hence, a total of 58 of the 288 cylinders (20%) were outside the acceptance limits. This is significantly worse than the previous intercalibration, where 12% of the total cylinder population were found to be out of specification. We will review this situation again at the Winter 2010 exercise and determine any necessary action.

The site cylinder evaluations are performed by calibrating the analysers with site and audit cylinder gas through the same inlet system, and using the conditioned site cylinder regulators, thus minimising any possible errors due to contaminated tubing or regulators.

In determining which cylinders should be replaced or reanalysed, the analyser and audit performance is taken into account, as well as previous audit results for each cylinder. During this exercise, all 22 poorly performing site cylinders used to scale data were investigated further:

15 of the 22 outlier cylinders were replaced as a matter of course and data rescaled as necessary.

Seven of the 18 NO cylinders appear to have been contaminated; a significant oxidation of the NO into NO_2 has occurred since the last intercalibration. A number of these NO cylinders are at sites where the cylinders are used as daily functional checks. One of the possible causes for the contamination could be oxygen permeation through the PTFE tubing of the gas delivery system and thus into the cylinder. QA/QC have demonstrated that replacing the PTFE tubing with high quality deactivated stainless steel tubing is an effective cure for this problem. **We therefore recommend that the permanently pressurised calibration cylinder systems at the following sites are urgently upgraded to use this stainless steel system:**

1. **Chesterfield Roadside**
2. **Northampton**
3. **Wigan Centre**
4. **Chepstow**

The remainder of the contaminated cylinders occurred at sites where the analysers and infrastructures have since been upgraded. This will hopefully prevent recurrence at these sites.

The NO cylinders at Lullington Heath and Chepstow and the SO_2 cylinder at Belfast were all identified as outliers for a second time. They have been replaced.

The remainder of the cylinders (SO_2 at Leeds Centre, Cromwell Road, Market Harborough and Thurrock) were all just outside the 10% limit. These will all be checked at the winter audits and appropriate action taken if necessary.

9 Site Information

All site information is now uploaded to CMCU and the Air Quality Archive for dissemination using Google Earth. QA/QC unit make considerable effort in ensuring that site locations are accurate on the new Google Earth site information and Air Quality Archive pages. All future additions to the AURN will include accurate positioning using Google Earth. Site location information is available in links from the AURNHUB.

10 CEN

The European Committee for Normalisation (CEN) have prepared a series of documents prescribing how analysers must be operated, to produce datasets that conform to the Data Quality Objectives of the EC Directives. The CEN documents for operation of air pollution analysers; BS EN14211 (NOx), BS EN14212 (SO2), BS EN14626 (CO) and BS EN14625 (O_3) set out a series of performance criteria for analysers which must be achieved, both in the field and under laboratory conditions. The test requirements have been extensively reported in previous intercalibration summaries and should be referenced for further information.

The CEN operating methodologies are now finalised and published and have been incorporated into the requirements of the air quality Directive 2008/50/EC. Member States have until June 2010 to ensure their monitoring networks are compliant. Older, non-compliant equipment still on site after this date will need to be replaced before June 2013. AEA have taken steps to ensure the procedures used in the UK comply with the requirements ahead of any imposed deadlines. To this end, the procedures used for the intercomparisons have been fully compliant with the CEN protocols since January 2006.

To comply with the Directive, the uncertainty for gaseous analyser measurements must be less than ±15%.

For sites that have CEN-compliant gaseous instrumentation, it is possible to calculate the overall uncertainty of measuring air quality. This information is site and analyser specific and presented in the table below:

Table 10.1 – Analyser measurement uncertainties (%)

Date	Site	NOx	NO	O_3	CO	SO_2
22-Jul	Barnsley 12					14.7
04-Sep	Bath Roadside	13.5	14			
08-Jul	Billingham	13.5	14			
06-Aug	Birmingham Tyburn Roadside	13.5	14	12.4		
11-Aug	Bournemouth	13.5	14	12.4		
02-Sep	Brighton Preston Park	13.5	14	12.4		
02-Sep	Brighton Roadside	13.5	14			
02-Sep	Bristol Old Market	13.5	14		9.5	
02-Sep	Bristol St Paul's	13.5	14	12.4	9.5	13.4
03-Sep	Canterbury	13.5	14			
27-Aug	Charlton Mackrell	13.5	14	12.4		
25-Aug	Exeter Roadside	11.8	11.8	8.7		
15-Jul	Glazebury	13.5	14	12.4		
30-Jul	Great Dun Fell			12.4		
21-Aug	Harwell	13.5	14			13.9
19-Jul	High Muffles	13.5	14	12.4		
23-Jul	Hull Freetown	10.5	10.5	11.8	13.9	12.5
24-Jul	Ladybower	13.5	14			
23-Jul	Leominster	13.5	14	12.4		13.4
12-Aug	Liverpool Queen's Drive Roadside	13.5	14			
21-Jul	Lullington Heath	10.5	10.5	11.8		11
14-Jul	Manchester South	13.5	14	12.4		
09-Jul	Middlesbrough			12.4		
07-Jul	Newcastle Centre	10.5	10.5	11.8	13.9	11.2
07-Jul	Newcastle Cradlewell Roadside	10.5	10.5			
20-Aug	Northampton	11.8	11.8	8.7		
07-Jul	Oxford Centre Roadside	10.5	10.5			
07-Jul	Oxford St Ebbes	10.5	10.5			
26-Aug	Plymouth Centre	10	10	10.7		
31-Jul	Portsmouth	11.8	11.8			
06-Aug	Sandwell West Bromwich	11.8	11.8	8.7		12.5
29-Jul	Sandy Roadside	13.5	14			
23-Jul	Scunthorpe Town	10.5	10.5			14.4
29-Jul	Sheffield Centre	10	10	10.7	9.5	14.6
29-Jul	Sheffield Tinsley	13.5	14			
08-Jul	Sibton			12.4		
12-Aug	Southampton Centre	10.5	10.5	11.8	13.9	11.5
04-Sep	Stanford-le-Hope Roadside	13.5	14			14.8

08-Jul	Stockton-on-Tees Eaglescliffe	13.5	14			
23-Jul	Stoke-on-Trent Centre	10	10	10.7		
27-Aug	Thurrock	13.5	14	12.4		16.1
07-Jul	Wicken Fen	13.5	14	12.4		13.7
22-Jul	Yarner Wood	13.5	14	12.4		
13-Aug	London Bexley	13.5	14		9.5	14.4
15-Aug	London Bloomsbury	13.5	14	12.4	9.5	13.6
19-Aug	London Cromwell Road 2	13.5	14		9.5	14.6
05-Aug	London Haringey	13.5	14			
18-Aug	London Harlington	13.5	14	12.4		
30-Jul	London Hillingdon	13.5	14			
20-Aug	London Marylebone Road	13.5	14	12.4	9.5	14.6
18-Aug	London Westminster	13.5	14	12.4	9.5	14.2
18-Aug	Tower Hamlets Roadside				9.5	
12-Aug	Belfast Centre	10.5	10.5	11.8	13.9	
18-Aug	Derry	13.5	14	12.4		
06-Aug	Lough Navar			12.4		
12-Aug	Aberdeen	13.6	14.1			
12-Aug	Aberdeen Union Street Roadside	13.7	14.2			
02-Jul	Auchencorth Moss			12.4		
28-Jul	Dumfries	13.5	14			
01-Jul	Edinburgh St Leonards	13.5	14		9.5	13.4
24-Jul	Fort William	13.5	14			
07-Jul	Glasgow Centre	13.5	14		9.5	14.4
08-Jul	Glasgow City Chambers	13.5	14			
07-Jul	Glasgow Kerbside	10	10			
13-Aug	Inverness	13.6	14.1			
13-Aug	Strath Vaich			12.4		
23-Jul	Aston Hill			12.4		
06-Aug	Cardiff Centre	13.5	14	12.4	9.5	15.4
05-Aug	Port Talbot Margam	13.5	14		9.5	15.1
05-Aug	Swansea Roadside	13.5	14			
13-Aug	Wrexham	13.5	14			13.6

This table will be extended to include upgraded sites and PM measurements in future intercomparison exercises.

11 Safety

AEA undertakes regular extensive risk assessments of all its activities on-site, to ensure that its staff are not exposed to unsafe practices while working.

The most significant risk to field operators remains safe access to PM sample inlets to perform flow tests. This gains increased importance with FDMS analysers, where meaningful flow tests are impossible if access to the sample inlet cannot be achieved. It is not currently possible to measure flows safely at the sample inlet at the following sites:

Table 11.1 Actions Required for Safe Roof Access

Site	Action required
Camden Kerbside	Needs ladder restraints
Haringey Roadside	Needs ladder restraints
London Harlington	Needs ladder restraints
London North Kensington	Needs ladder restraints
London Westminster (Partisol)	Needs ladder restraints
Birmingham Tyburn Roadside	Needs ladder restraints
Sandwell	Needs ladder restraints
Bury Roadside	Needs ladder restraints
Salford Eccles	Needs restraints
Liverpool Speke	Has half barrier - needs full barrier
Bristol St Paul's	Needs ladder restraints
Middlesbrough	Roof access required, needs barrier
Bournemouth (Partisol)	Needs ladder restraints
Coventry Memorial Park	Sloping roof - access not possible
Hull Freetown	Needs ladder restraints
Southampton Centre	Needs ladder restraints
Southend on Sea	Sloping roof - access not possible
Glasgow Kerbside	Needs new ladder support or railings
Swansea Roadside (FDMS TEOM)	Needs restraints
Thurrock	Sloping roof - access not possible
Plymouth Centre	Roof access required, needs barrier
Northampton (TEOM + Partisol)	Needs ladder restraints
Scunthorpe Town	Needs ladder restraints
Leamington Spa	Needs ladder restraints
Sunderland Silksworth	Needs ladder restraints
Grangemouth	Needs ladder supports or railings
Aberdeen	Needs ladder supports or railings
Cwmbran	Needs ladder restraints
Teddington	Several safety issues (access and manual handling) currently undergoing investigation

It is recommended that roof access at these sites is investigated, to determine whether safe access can be achieved.

In addition, all new $PM_{2.5}$ installations will need to be checked to ensure safe access to the inlets can be achieved. At present, none of the newly installed FDMS $PM_{2.5}$ analysers have had ladder restraints installed.

In addition to these required investigations, QA/QC will be evaluating modified telescopic ladders during the Winter intercalibration, to see if the need for ladder restraints can be avoided. If successful, these ladders could be deployed at all Defra-funded sites and recommended to affiliates.

12 Certification

The Network Certificate of Calibration is presented in Appendix 7. This certificate presents the results of the individual analyser scaling factors on the day of the audit, as calculated by AEA using the audit cylinder standards, in accordance with our ISO17025 accreditation.

13 Summary

The intercalibration exercise has demonstrated its value as an effective tool in determining overall site performance and assessing the reliability and traceability of air quality measurements from a large scale network. The results from this intercalibration have been used to assess data quality during the ratification of the network datasets for the period March to September 2009.

Appendices

Appendix 1: Recommendations for Upgrade or Replacement of Equipment

Appendix 2: Data Gaps Listing: July-September 2009

Appendix 3: Inventory of Defra-owned Equipment

Appendix 4: Partisol Data Report

Appendix 5: Information for New Sites

Appendix 6: Outliers Identified at Summer 2009 Intercalibration

Appendix 7: Certificate of Calibration

Appendix 1

Recommendations for Upgrade or Replacement of Equipment

As requested by the Department, QA/QC Unit has provided a list of suggestions for equipment that may need replacing or upgrading in the network. The following provides a summary of the outstanding issues to date since July 2005. Recommendations have been prioritised as follows:

Priority	Definition	Time-scale
High*	Immediate action necessary to avoid compromising data capture/quality or safety.	Within 2 weeks
Medium	Essential but not immediate	3-6 months
Low	Desirable but not essential	As appropriate

*Note – QA/QC Unit's practice is to notify CMCU immediately of any high priority issues at the time of the event.

	Recommendations January 2010	Priority	Action
30	All permanently pressurised cylinder calibration systems to be fitted with passivated stainless steel tubing-see Section 8	High	ESU
	Recommendations August 2008	**Priority**	**Action**
27	Many sites require modifications to permit safe roof access for measuring PM analyser flows	High	CMCU
	Recommendations January 2008	**Priority**	**Action**
25	It is recommended that LSO's continue to pay particular attention to the NO_2 calibration results, to see whether the NO response is significantly higher (>10ppb) than that obtained for the zero calibration. These observations should be reported to CMCU as soon as possible	High	LSO
24	It is strongly recommended that ESU's clean all NOx analyser switching valves during servicing, and ensure the valve is leak checked afterwards.	High	ESU
	Recommendations January 2007		
22	ESUs to ensure all NOx converter software settings to be 100%.	High	ESUs to check at service
	Recommendations July 2005		
13	Continuing problems with some autocal run-ons causing loss of up to 2 hours per day-see Section 3.2 **CMCU to ensure ESUs are asked to attend to offending sites (Action May 2008)**	High	Many sites now cured, but some need attention at next ESU visit

Appendix 2

Gaps listing July-September 2009

01/07/2009 to 30/09/2009 Gaps in 15-minute table >= 6 hours and data capture <= 90%

Pollutant	Data Capture (%)	Start date	End date	Reason	Comments	No of days	No of hours
N Ireland							
Armagh Roadside							
NO_2	0.00%	01-Apr-09	31-Oct-09	Analyser fault	All data deleted since affiliation of site	214	5136
Scotland							
Auchencorth Moss PM_{10} PM_{25} (FDMS)							
PM_{10}	31.50%	22-Jun-09	02-Jul-09	FDMS dew point too warm	Sample dew point >2C and dryer fault	10.5	253
		11-Jul-09	12-Jul-09	Power cut		1.4	33
		15-Jul-09	16-Jul-09	Power cut		1	24
		03-Aug-09	05-Oct-09	FDMS dew point too warm	sample dew point >2C	63.5	1525
England							
Barnsley Gawber							
SO_2	84.10%	23-Jul-09	26-Jul-09	Unstable response	Unstable data - temperature related?	2.3	56
		13-Aug-09	14-Aug-09	Unstable response	Unstable data - temperature related?	0.7	16
		16-Sep-09	27-Sep-09	Unstable response	Unstable data - temperature related?	11.1	266
N Ireland							
Belfast Centre							
CO	70.70%	21-Aug-09	31-Aug-09	Air Conditioning or Temp fault	Call out: The a/c is blowing out warm out instead of cold. 45C	10.5	253
		01-Sep-09	02-Sep-09	ESU service		1.5	36
		08-Sep-09	21-Sep-09	Air Conditioning or Temp fault	Call out: The LSO found the a/c unit not functioning	13.4	321
		28-Sep-09	29-Sep-09	Air Conditioning or Temp fault	Call out: The a/c is blowing out warm air instead of cold	0.8	20
NO_2	78.50%	01-Sep-09	03-Sep-09	ESU service	SERVICE New Thermo NOx and O3. Odessa removed	2.1	50
		08-Sep-09	21-Sep-09	Air Conditioning or Temp fault	Call out: The LSO found the a/c unit not functioning	13	313
O_3	81.90%	01-Sep-09	02-Sep-09	ESU service	SERVICE New Thermo NOx and O3. Odessa removed	1.6	38
		08-Sep-09	21-Sep-09	Air Conditioning or Temp fault	Call out: The LSO found the a/c unit not functioning	13	313
		28-Sep-09	29-Sep-09	Air Conditioning or Temp fault	Call out: The a/c is blowing out warm air instead of cold	0.8	20
PM_{10}	64.60%	11-Aug-09	12-Aug-09	QAQC audit	AUDIT and stabilisation period	1.3	32
		21-Aug-09	02-Sep-09	Air Conditioning or Temp fault	Call out: The LSO found the a/c unit not functioning	12.4	298
		07-Sep-09	22-Sep-09	Air Conditioning or Temp fault	Call out: The LSO found the a/c unit not functioning	14.7	352
		27-Sep-09	05-Oct-09	Air Conditioning or Temp fault	Call out: The LSO found the a/c unit not functioning	8.5	205
PM_{25}	65.90%	11-Jul-09	12-Jul-09	High noise	Data deleted	0.6	14
		03-Aug-09	03-Aug-09	High noise	Data deleted	0.3	6

		21-Aug-09	01-Sep-09	Air Conditioning or Temp fault	Call out: The LSO found the a/c unit not functioning	11.2	269
		07-Sep-09	22-Sep-09	Air Conditioning or Temp fault	Call out: The LSO found the a/c unit not functioning	14.6	350
		27-Sep-09	05-Oct-09	Air Conditioning or Temp fault	Call out: The LSO found the a/c unit not functioning	8.9	213
SO_2	59.90%	11-Aug-09	02-Sep-09	Instrument fault	Instrument not responding to gas	22.4	537
		08-Sep-09	21-Sep-09	Air Conditioning or Temp fault	Call out: The LSO found the a/c unit not functioning	13.3	318
		28-Sep-09	29-Sep-09	Air Conditioning or Temp fault	Call out: The LSO found the a/c unit not functioning	0.9	21
England							
Billingham							
NO_2	55.70%	27-Jul-09	03-Sep-09	Instrument fault	Service & analyser response fault in hot spare analyser	38.3	918
Birmingham Tyburn Roadside							
PM_{10}	39.20%	30-Jun-09	02-Jul-09	FDMS dryer	Dryer Fault - Dewpoint too high	1.7	41
		02-Jul-09	02-Jul-09	FDMS dew point too warm	Sample dew >2 C	0.6	15
		04-Aug-09	05-Aug-09	QAQC audit	Ko factor out by -2.65% compared to stated	0.8	18
		05-Aug-09	05-Aug-09	QAQC audit	Ko factor out by -2.65% compared to stated	0.5	13
		06-Aug-09	06-Aug-09	FDMS dew point too warm	Sample dew >2 C	0.6	15
		09-Aug-09	09-Aug-09	FDMS dew point too warm	Sample dew >2 C	0.4	9
		10-Aug-09	12-Oct-09	High noise	Noisy and negative volatiles	63.1	1514
PM_{25}	81.50%	26-Jun-09	03-Jul-09	FDMS dryer	Dryer Fault	7.5	181
		04-Jul-09	04-Jul-09	FDMS dew point too warm	Sample dew >2 C	0.7	16
		05-Jul-09	05-Jul-09	FDMS dew point too warm	Sample dew >2 C	0.3	6
		07-Jul-09	07-Jul-09	FDMS dew point too warm	Sample dew >2 C	0.3	7
		08-Jul-09	09-Jul-09	No mV data collected	Analyser Faults	1.2	28
		05-Aug-09	05-Aug-09	QAQC audit		0.3	6
		13-Aug-09	14-Aug-09	ESU service		1.2	29
		12-Sep-09	22-Sep-09	Instrument fault	$PM_{2.5}$ memory loss	10.2	245
Bury Roadside							
CO	89.30%	13-Jul-09	13-Jul-09	Instrument fault	Deleted low period after calibration	0.3	7
		12-Aug-09	20-Aug-09	Instrument fault	Suspect analyser fault	7.6	182
		17-Sep-09	19-Sep-09	Instrument fault	Deleted low period after calibration	1.5	37
NO_2	44.20%	26-Jun-09	19-Aug-09	Instrument fault	Analyser fault	54.2	1300
Scotland							
Bush Estate							
NO_2	81.90%	23-Jun-09	16-Jul-09	Air Conditioning or Temp fault	PMT overheating - Nulled until new analyser installed	23.4	562
		09-Sep-09	09-Sep-09	Switched out-of-service	ESU was setting up box temp on O3 to	0.3	8
England							
Camden Kerbside							
NO_2	40.20%	01-Jul-09	25-Aug-09	Air Conditioning or Temp fault	ENG C/O Air con is underrated - needs to be replaced	54.8	1316
PM_{10}	35.60%	21-Jun-09	28-Aug-09	Unstable response	Unstable response and removed from site	68	1631
		15-Sep-09	16-Sep-09	Unstable response	Unstable response	0.3	8
PM_{25}	46.10%	23-Jun-09	19-Aug-09	QAQC audit	AUDIT Leak test failed Poor 10/2.5 Main Flow Agreement? PM10 pres	56.5	1357

		10-Sep-09	10-Sep-09	Unstable response	Unstable response	0.3	7
Wales							
Cardiff Centre							
PM_{10}	83.70%	01-Aug-09	13-Aug-09	ESU service		12.3	296
		21-Sep-09	22-Sep-09	Low flow rate	Flow fault warning on FDMS.	1.7	40
England							
Carlisle Roadside							
NO_2	83.50%	15-Jun-09	15-Jul-09	Low flow rate	NOx leak -deleted all data	30.1	723
		02-Sep-09	02-Sep-09	No mV data collected	Possible power cut	0.3	7
Chesterfield							
NO_2	88.90%	03-Aug-09	06-Aug-09	Unstable response	Data deleted	3	73
		17-Aug-09	21-Aug-09	Instrument fault	Data deleted	3.7	88
		25-Sep-09	28-Sep-09	Instrument fault	Data deleted	2.9	70
PM_{25}	89.20%	22-Jun-09	10-Jul-09	Instrument fault	Call out: Poor correlation between $PM_{10/2.5.}$	18.2	436
Chesterfield Roadside							
PM_{10}	88.90%	22-Jun-09	03-Jul-09	FDMS volatile recovery or noisy	Data deleted-possible temperature problem	10.3	248
		04-Jul-09	04-Jul-09	FDMS volatile recovery or noisy	Data deleted	0.3	6
		11-Jul-09	12-Jul-09	FDMS volatile recovery or noisy	Data deleted	0.4	10
		29-Jul-09	31-Jul-09	FDMS volatile recovery or noisy	Data deleted	2.6	62
		19-Aug-09	19-Aug-09	ESU service		0.5	11
		07-Sep-09	09-Sep-09	FDMS volatile recovery or noisy	Data deleted	1.7	41
		17-Sep-09	17-Sep-09	Unstable response	Data deleted	0.4	9
		22-Sep-09	22-Sep-09	Unstable response	c/o to check analyser performance	0.5	13
Coventry Memorial Park							
PM_{25}	71.80%	26-Jun-09	03-Jul-09	FDMS dew point too warm	Sample dew point > 2C	7.4	178
		04-Jul-09	04-Jul-09	FDMS dew point too warm	Data deleted	0.6	15
		07-Jul-09	07-Jul-09	FDMS dew point too warm	Data deleted	0.4	9
		11-Jul-09	11-Jul-09	FDMS dew point too warm	Data deleted	0.6	14
		21-Jul-09	21-Jul-09	FDMS dew point too warm	Data deleted	0.5	13
		22-Jul-09	22-Jul-09	FDMS dew point too warm	Data deleted	0.3	6
		29-Jul-09	29-Jul-09	ESU service	Replaced Horibas with new instruments	0.4	9
		30-Jul-09	18-Aug-09	Instrument fault	O ring problem	19	456
N Ireland							
Derry							
PM_{10}	1.90%	03-Jul-09	01-Oct-09	High noise	Data deleted	90.5	2171
Scotland							
Dumfries							
NO_2	35.30%	27-Jul-09	24-Sep-09	NO2 converter fault	Converter 92.8% at audit - replaced end Sept	59.3	1422
Glasgow Centre							
PM_{10}	84.80%	27-Jun-09	07-Jul-09	FDMS volatile recovery or noisy	Unstable Volatiles	10.1	242

		07-Jul-09	07-Jul-09	FDMS volatile recovery or noisy	Unstable Volatiles probable moisture on filter	0.3	8
		11-Jul-09	15-Jul-09	FDMS volatile recovery or noisy	C/O moisture in purge filter	4	96
		20-Jul-09	21-Jul-09	ESU service		1.5	35
		14-Aug-09	15-Aug-09	FDMS dew point too warm	Data deleted	0.3	6
		19-Aug-09	19-Aug-09	FDMS dew point too warm	Data deleted	0.3	8
		30-Aug-09	31-Aug-09	FDMS dew point too warm	Data deleted	0.4	9
		08-Sep-09	08-Sep-09	FDMS dew point too warm	Data deleted	0.4	9
Glasgow Kerbside							
PM_{25}	77.90%	06-Jul-09	06-Jul-09	QAQC audit		0.3	7
		15-Jul-09	16-Jul-09	ESU service		1	25
		11-Aug-09	20-Aug-09	High noise	Moisture on filter causing noisy vol	9.2	220
		21-Sep-09	29-Sep-09	High noise	Cooler fault, data deleted	8.6	206
England							
Glazebury							
NO_2	87.10%	14-Jul-09	22-Jul-09	Pump fault	Pump fault	8.4	202
		31-Jul-09	03-Aug-09	Power cut		3.3	78
Scotland							
Grangemouth							
SO_2	88.70%	24-Aug-09	25-Aug-09	Pump fault	ENG C/O Sample pumps for FDMS and SO2 were off.	0.9	22
		31-Aug-09	08-Sep-09	Instrument fault	ENG C/O Peaked lamp. Data deleted	8.7	209
		13-Sep-09	13-Sep-09	Communication fault		0.3	6
England							
Haringey Roadside							
PM_{10}	84.90%	29-Jul-09	11-Aug-09	Unstable response	Data deleted	13.6	326
Harwell							
PM_{10}	83.50%	13-Aug-09	25-Aug-09	ESU service	Service- upgrade O3 analyser and comms.	12.2	293
		04-Sep-09	04-Sep-09	FDMS dew point too warm	Data deleted	0.3	7
		24-Sep-09	26-Sep-09	FDMS dew point too warm	Data deleted	1.8	44
PM_{25}	46.70%	13-Aug-09	31-Oct-09	QAQC audit	FDMS $PM_{2.5}$ k_0 +25%; data deleted	79.7	1912
High Muffles							
NO_2	10.20%	10-Jul-09	31-Oct-09	Air Conditioning or Temp fault	Power off	114	2727
O_3	0.00%	29-Jun-09	31-Oct-09	Instrument fault	Power off	124	2977
Hull Freetown							
NO_2	89.40%	02-Jul-09	04-Jul-09	Flat response	Data deleted	1.8	42
		13-Jul-09	14-Jul-09	Flat response	Data deleted	0.8	18
		02-Aug-09	02-Aug-09	Flat response	Data deleted	0.4	10
		10-Aug-09	12-Aug-09	ESU service	New analysers fitted	2.2	52
PM_{10}	65.30%	01-Jul-09	01-Jul-09	FDMS dew point too warm	Dew point error	0.4	10
		02-Jul-09	02-Jul-09	FDMS dew point too warm	Dew point error	0.5	11
		04-Jul-09	05-Jul-09	FDMS dew point too warm	Dew point error	0.5	12
		22-Jul-09	22-Jul-09	QAQC audit	AUDIT O_3 zero comparison fails main 15% Pump Vacuum too low PM_{10}	0.3	6

		04-Aug-09	14-Aug-09	ESU service	SERVICE All analyser replaced. Logger removed.	11	264
		19-Aug-09	19-Aug-09	Unstable response	Data deleted	0.3	8
		22-Aug-09	22-Aug-09	Unstable response	Data deleted	0.3	8
		23-Aug-09	23-Aug-09	Unstable response	Data deleted	0.4	9
		08-Sep-09	24-Sep-09	Instrument fault	ENG C/O Cooler failure	16.5	397
		28-Sep-09	28-Sep-09	FDMS dew point too warm	Data deleted	0.3	6
		29-Sep-09	29-Sep-09	FDMS dew point too warm	Data deleted	0.5	13
PM_{25}	87.00%	22-Jul-09	25-Jul-09	Unstable response	Unstable after audit	2.8	68
		10-Aug-09	12-Aug-09	ESU service	SERVICE All analysers replaced. Logger removed.	2.2	52
		23-Sep-09	29-Sep-09	FDMS dew point too warm	Data deleted	6.3	152
SO_2	88.50%	10-Aug-09	20-Aug-09	ESU service	SERVICE All analysers replaced. Logger removed.	10	241
Ladybower							
NO_2	25.60%	03-Jul-09	09-Sep-09	Instrument fault	PMT Fault	68	1631
SO_2	59.00%	15-Jun-09	01-Aug-09	ESU service	SERVICE New instruments and Odessa removed	46.4	1114
		03-Sep-09	09-Sep-09	Sampling fault	Step change in response. ESU, LSO and QA/QC auditor all on site	6.3	151
Leamington Spa							
NO_2	85.90%	06-Aug-09	17-Aug-09	No mV data collected	Unspecified analyser fault	11.1	267
		21-Sep-09	22-Sep-09	No mV data collected	Various failures reported	1.2	29
Leeds Centre							
NO_2	87.80%	03-Jul-09	06-Jul-09	Air Conditioning or Temp fault	ENG C/O Site too hot so turned off power.	3.3	80
		05-Aug-09	10-Aug-09	ESU service	SERVICE New instruments installed	5.1	122
PM_{10}	78.90%	01-Jul-09	06-Jul-09	Air Conditioning or Temp fault	ENG C/O Site too hot so turned off power.	5.4	129
		06-Aug-09	19-Aug-09	High noise	Noisy volatiles	13.5	323
PM_{25}	86.10%	01-Jul-09	06-Jul-09	Air Conditioning or Temp fault	ENG C/O Site too hot so turned off power.	5.3	126
		23-Jul-09	29-Jul-09	Flat response	Flat response after audit	6.4	154
		19-Aug-09	19-Aug-09	FDMS dew point too warm	Sample dew point >2C	0.3	7
Leicester Centre							
O_3	71.00%	30-Jul-09	18-Aug-09	Sampling fault	O_3 filter holder not screwed up correctly	19.2	461
		08-Sep-09	15-Sep-09	Communication fault	Service 8/9-10/9 & loss of comms up to 15/9	7.1	170
PM_{25}	0.00%	30-Jun-09	31-Oct-09	ESU service	Installed new instruments	123	2961
Liverpool Speke							
PM_{10}	89.50%	02-Jul-09	02-Jul-09	FDMS dew point too warm	Sample dew point >2C	0.4	9
		07-Jul-09	13-Jul-09	High noise	Rejection of very noisy	5.3	128
		13-Jul-09	14-Jul-09	High noise	Rejection of low volatile data	0.5	12
		11-Aug-09	12-Aug-09	High noise	Noisy data following audit	0.5	13
		24-Aug-09	25-Aug-09	ESU service	Service. Installed new Thermo O3 and NOx	1.2	28
		26-Aug-09	27-Aug-09	Communication fault	Possible comms failure	1	25
London Bexley							
CO	79.80%	13-Jul-09	30-Jul-09	Instrument fault	ENG C/O Return CO analyser after repair at ET	17	409
		18-Aug-09	19-Aug-09	ESU service	SERVICE	1.2	28

London Eltham							
NO_2	82.20%	26-Aug-09	10-Sep-09	Instrument fault	Chopper motor fault	15.5	372
London Harlington							
PM_{25}	62.40%	22-Jul-09	26-Aug-09	Instrument fault	Data deleted-moisture in purge filter	34.6	831
London Harrow Stanmore							
PM_{25}	44.70%	26-Jun-09	20-Aug-09	Unstable response	Erroneous data	55.5	1333
London N. Kensington							
PM_{10}	89.20%	01-Jul-09	02-Jul-09	FDMS volatile recovery or noisy	Volatiles unstable and noisy	1.4	34
		14-Jul-09	15-Jul-09	FDMS volatile recovery or noisy	Volatiles unstable and noisy	0.8	19
		29-Jul-09	01-Aug-09	FDMS volatile recovery or noisy	Volatiles unstable and noisy	3	73
		06-Aug-09	07-Aug-09	FDMS volatile recovery or noisy	Unstable data	0.9	21
		26-Aug-09	28-Aug-09	FDMS volatile recovery or noisy	Unstable volatiles	2	48
		02-Sep-09	02-Sep-09	Switched out-of-service	Eelectrical testing in AQMS	0.3	6
		15-Sep-09	16-Sep-09	Power cut		1	23
Lullington Heath							
NO_2	85.40%	30-Jul-09	31-Jul-09	QAQC audit	AUDIT Ozone out 7.1% Site NO cyl more than 10% from stated value	1.5	36
		20-Sep-09	01-Oct-09	Instrument fault	Data deleted	11.5	275
O_3	85.00%	30-Jul-09	11-Aug-09	ESU service	ML kit replaced with TAPI.	12	288
		05-Sep-09	06-Sep-09	No mV data collected		1	24
Manchester Piccadilly							
SO_2	32.10%	29-Jul-09	29-Sep-09	Unstable response	Temperature fault	62.2	1493
Market Harborough							
CO	53.40%	04-Aug-09	15-Sep-09	Instrument fault	Replaced with API instrument - Not working until October	42.3	1015
O_3	60.50%	22-Jun-09	05-Aug-09	Instrument fault	Instrument reading too after LSO cal	44.1	1058
		30-Aug-09	30-Aug-09	No mV data collected	Info requested from BV	0.4	9
Middlesbrough							
CO	85.20%	23-Jun-09	05-Jul-09	Unstable response	Deleted noisy data air con struggling humid hot weather	11.8	283
		22-Jul-09	29-Jul-09	ESU service		7.7	184
		19-Aug-09	20-Aug-09	Air Conditioning or Temp fault	a/c poor performance- analysers switched off to prevent damage	0.9	22
PM_{10}	80.70%	30-Jun-09	06-Jul-09	Unstable response	Erroneous data air con struggling / power cut	6.6	159
		17-Jul-09	17-Jul-09	Unstable response	Data deleted	0.7	16
		22-Jul-09	23-Jul-09	ESU service		1.4	33
		04-Aug-09	04-Aug-09	Unstable response	Data deleted	0.3	7
		19-Aug-09	21-Aug-09	FDMS volatile recovery or noisy	Unstable volatiles	2	48
		23-Sep-09	31-Oct-09	High noise	Noisy after LSO cal	38.2	917
PM_{25}	61.50%	22-Jun-09	08-Jul-09	High noise	FDMS dryer fault	16.1	387
		22-Jul-09	23-Jul-09	ESU service		1.5	37
		02-Aug-09	24-Aug-09	FDMS volatile recovery or noisy	Unstable volatiles & PM2.5>PM10	21.6	519

		31-Aug-09	01-Sep-09	QAQC audit		1.1	26
		08-Sep-09	08-Sep-09	FDMS volatile recovery or noisy	Unstable volatiles	0.5	12
		22-Sep-09	23-Sep-09	FDMS volatile recovery or noisy	Unstable volatiles	0.3	6
Newcastle Centre							
NO_2	82.00%	22-Jul-09	29-Jul-09	ESU service	Service and comms failure	7.5	179
		21-Aug-09	24-Aug-09	Communication fault	Comms or power failure	2.9	69
		01-Sep-09	01-Sep-09	Sampling fault	Erratic data accompanied by sample flow high alarm	0.3	6
PM_{25}	89.80%	30-Jun-09	02-Jul-09	Sampling fault	Dew point above 2 deg	2.1	51
		03-Jul-09	03-Jul-09	Sampling fault	Dew point above 2 deg	0.6	15
		06-Jul-09	07-Jul-09	QAQC audit		0.7	17
		21-Jul-09	24-Jul-09	ESU service	SERVICE Thermo NOx O_3 SO_2 CO API installed. Odessa removed	3	72
		21-Aug-09	24-Aug-09	Communication fault	Comms or power failure	3	71
Wales							
Newport							
PM_{10}	88.50%	25-Jun-09	03-Jul-09	FDMS dew point too warm	Data deleted	8.2	197
		04-Jul-09	05-Jul-09	FDMS dew point too warm	Data deleted	0.5	13
		11-Jul-09	11-Jul-09	FDMS dew point too warm	Data deleted	0.9	21
		13-Jul-09	13-Jul-09	FDMS dew point too warm	Data deleted	0.4	9
		21-Jul-09	21-Jul-09	FDMS dew point too warm	Data deleted	0.6	15
		27-Jul-09	27-Jul-09	QAQC audit		0.4	10
		04-Aug-09	05-Aug-09	FDMS dew point too warm	Data deleted	1.5	37
		10-Aug-09	11-Aug-09	FDMS dew point too warm	Data deleted	0.6	15
		11-Aug-09	11-Aug-09	FDMS dew point too warm	Data deleted	0.6	14
		12-Aug-09	13-Aug-09	FDMS dew point too warm	Data deleted	1.5	36
England							
Norwich Lakenfields							
NO_2	89.60%	01-Jan-09	25-Sep-09	Monitoring suspended	Site started	267	6418
Nottingham Centre							
NO_2	78.30%	29-Jun-09	03-Jul-09	Unstable response	Bad data deleted	3.6	87
		07-Sep-09	24-Sep-09	Instrument fault	Baseline skipped but no zeros to scale the data	17.2	412
PM_{25}	86.70%	22-Jun-09	03-Jul-09	Instrument fault	Call out: FDMS $PM_{2.5}$ dryer fault	11.4	273
		04-Jul-09	06-Jul-09	FDMS dew point too warm	Data deleted	1.5	36
		11-Jul-09	12-Jul-09	FDMS dew point too warm	Data deleted	0.4	10
		21-Jul-09	21-Jul-09	QAQC audit		0.3	8
		04-Aug-09	05-Aug-09	FDMS dew point too warm	Data deleted	0.7	17
		05-Aug-09	05-Aug-09	FDMS dew point too warm	Data deleted	0.3	7
		19-Aug-09	20-Aug-09	FDMS dew point too warm	Data deleted	0.9	22
		23-Aug-09	24-Aug-09	FDMS dew point too warm	Data deleted	0.6	15
		26-Aug-09	26-Aug-09	FDMS dew point too warm	Data deleted	0.4	9
		30-Aug-09	31-Aug-09	FDMS dew point too warm	Data deleted	0.9	21
		07-Sep-09	09-Sep-09	Instrument fault	ENG C/O Installation of new NOx, O_3 and SO_2 analysers	2.1	50
Oxford St Ebbes							
NO_2	49.20%	06-Jul-09	19-Aug-09	NO2 converter fault	CE 88% Data rejected from Audit to ESU c/o	44	1055

		02-Sep-09	03-Sep-09	Instrument fault	Converter temp fault - power supply faulty	1	23
Plymouth Centre							
PM_{10}	0.00%	04-Nov-08	13-Oct-09	Air Conditioning or Temp fault	FDMS switched off.	343	8233
Portsmouth							
PM_{25}	81.40%	01-Jul-09	01-Jul-09	FDMS dew point too warm	Data deleted	0.5	11
		02-Jul-09	03-Jul-09	FDMS dew point too warm	Data deleted	1.5	35
		04-Jul-09	04-Jul-09	FDMS dew point too warm	Data deleted	0.3	8
		21-Jul-09	21-Jul-09	FDMS dew point too warm	Data deleted	0.3	8
		30-Jul-09	01-Aug-09	QAQC audit		2.3	56
		04-Aug-09	05-Aug-09	ESU service	SERVICE Ozone needs a new lamp	1.9	46
		06-Aug-09	06-Aug-09	ESU service	SERVICE CD dryer	0.4	10
		10-Aug-09	10-Aug-09	FDMS dew point too warm	Data deleted	0.3	7
		11-Aug-09	11-Aug-09	FDMS dew point too warm	Data deleted	0.5	11
		12-Aug-09	13-Aug-09	FDMS dew point too warm	Data deleted	1.5	35
		15-Aug-09	15-Aug-09	FDMS dew point too warm	Data deleted	0.4	10
		19-Aug-09	19-Aug-09	FDMS dew point too warm	Data deleted	0.5	12
		23-Aug-09	23-Aug-09	FDMS dew point too warm	Data deleted	0.6	14
		26-Aug-09	26-Aug-09	FDMS dew point too warm	Data deleted	0.3	7
		31-Aug-09	31-Aug-09	FDMS dew point too warm	Data deleted	0.7	16
		07-Sep-09	09-Sep-09	FDMS dew point too warm	Data deleted	1.7	40
		19-Sep-09	19-Sep-09	FDMS dew point too warm	Data deleted	0.4	10
		22-Sep-09	23-Sep-09	FDMS dew point too warm	Data deleted	1	25
		29-Sep-09	29-Sep-09	FDMS dew point too warm	Data deleted	0.3	7
Preston							
NO_2	79.70%	04-Jul-09	09-Jul-09	Instrument fault	ENG C/O No power to the site had tripped. Restored power.	5.4	129
		28-Jul-09	01-Aug-09	Power cut		4.3	103
		12-Aug-09	20-Aug-09	QAQC audit		8	193
		21-Aug-09	22-Aug-09	Power cut		0.5	11
O_3	79.80%	04-Jul-09	09-Jul-09	Power cut	ENG C/O No power to the site had tripped. Restored power.	5.2	125
		28-Jul-09	01-Aug-09	Power cut		4.3	103
		11-Aug-09	20-Aug-09	QAQC audit		8.7	209
PM_{25}	86.90%	12-Jun-09	01-Jul-09	High noise	Noisy response until V seal replaced 1 July	19.5	469
		04-Jul-09	09-Jul-09	Instrument fault	ENG C/O No power to the site had tripped. Restored power.	5.3	127
		20-Jul-09	20-Jul-09	Instrument fault	ENG C/O Inlet on roof loose. Secured to prevent vibrations	0.4	9
		21-Aug-09	21-Aug-09	FDMS dew point too warm	Data deleted	0.3	6
		14-Sep-09	14-Sep-09	FDMS dew point too warm	Data deleted	0.3	6
Reading New Town							
NO_2	84.20%	13-Jul-09	24-Jul-09	Unstable response	Fragmented data rejected	10.7	257
Rochester Stoke							
NO_2	88.00%	04-Jul-09	07-Jul-09	Air Conditioning or Temp fault	Air con not working	2.7	65
		24-Aug-09	28-Aug-09	Low flow rate	Flow warning	4.1	99
PM_{10}	80.40%	29-Jun-09	14-Jul-09	FDMS dew point too warm	Data deleted	14.7	352
		04-Aug-09	04-Aug-09	FDMS dew point too warm	Data deleted	0.3	7

		06-Aug-09	06-Aug-09	FDMS dew point too warm	Data deleted	0.3	7
		06-Aug-09	07-Aug-09	FDMS dew point too warm	Data deleted	0.9	22
		10-Aug-09	11-Aug-09	FDMS dew point too warm	Data deleted	0.3	8
		12-Aug-09	13-Aug-09	FDMS dew point too warm	Data deleted	0.7	16
		03-Sep-09	04-Sep-09	Unstable response	Negative data deleted	0.9	21
PM_{25}	73.60%	26-May-09	14-Jul-09	Switched out-of-service	New FDMS installed	48.9	1173
		16-Jul-09	17-Jul-09	Unstable response	Data deleted	0.4	9
		01-Aug-09	01-Aug-09	FDMS dew point too warm	Data deleted	0.3	8
		04-Aug-09	05-Aug-09	FDMS dew point too warm	Data deleted	0.8	18
		05-Aug-09	05-Aug-09	FDMS dew point too warm	Data deleted	0.3	6
		06-Aug-09	06-Aug-09	FDMS dew point too warm	Data deleted	0.4	9
		06-Aug-09	07-Aug-09	FDMS dew point too warm	Data deleted	1.2	29
		08-Aug-09	08-Aug-09	FDMS dew point too warm	Data deleted	0.3	6
		09-Aug-09	09-Aug-09	FDMS dew point too warm	Data deleted	0.3	7
		10-Aug-09	11-Aug-09	FDMS dew point too warm	Data deleted	0.7	17
		11-Aug-09	13-Aug-09	FDMS dew point too warm	Data deleted	1.2	29
		15-Aug-09	16-Aug-09	FDMS dew point too warm	Data deleted	0.5	11
		26-Aug-09	27-Aug-09	FDMS dew point too warm	Data deleted	0.5	13
		31-Aug-09	31-Aug-09	FDMS dew point too warm	Data deleted	0.5	12
		02-Sep-09	03-Sep-09	FDMS dew point too warm	Data deleted	0.3	6
		03-Sep-09	03-Sep-09	Unstable response	Negative data deleted	0.7	17
		07-Sep-09	08-Sep-09	FDMS dew point too warm	Data deleted	0.9	21
Salford Eccles							
PM_{25}	89.70%	22-Jul-09	23-Jul-09	ESU service		1.2	28
		27-Aug-09	27-Aug-09	No mV data collected		0.3	6
		09-Sep-09	16-Sep-09	Instrument fault	FDMS $_{2.5}$ Lost memory. Replaced battery	7	168
Sandy Roadside							
PM_{10}	77.90%	28-Jul-09	29-Jul-09	QAQC audit	AUDIT Site NO_2 cyl more than 10% from stated value Audit NO_2 cyl	1	25
		19-Aug-09	07-Sep-09	High noise	Noisy volatiles after the service	19.2	460
Sheffield Centre							
PM_{10}	32.60%	22-Jun-09	17-Jul-09	FDMS volatile recovery or noisy	Very noisy data deleted	25.5	612
		10-Aug-09	24-Sep-09	Unstable response	Data deleted	45	1081
PM_{25}	43.40%	10-Aug-09	30-Sep-09	FDMS volatile recovery or noisy	Data deleted	51.7	1240
Sheffield Tinsley							
NO_2	50.60%	13-Jul-09	27-Aug-09	Air Conditioning or Temp fault	ENG C/O Site was switched off. Air con keeps tripping site	45	1081
Southend-on-Sea							
O_3	79.80%	19-Aug-09	19-Aug-09	Low flow rate	Filter fault	0.3	8
		20-Aug-09	21-Aug-09	Communication fault	Comms/data not collected	0.7	16
		23-Aug-09	09-Sep-09	Communication fault	Comms & possible analyser fault from BV	17.2	412
Stanford-le-Hope Roadside							
PM_{10}	65.60%	23-May-09	15-Jul-09	Unstable response	Unstable response volatiles	52.6	1263
		24-Jul-09	30-Jul-09	Unstable response	Unstable response	5.6	135
		01-Aug-09	10-Aug-09	Unstable response	C/O no power to shuttle motor in both units	9.1	219

		03-Sep-09	04-Sep-09	QAQC audit		0.9	21
		16-Sep-09	17-Sep-09	ESU service		1.4	34
PM_{25}	77.20%	28-May-09	01-Jul-09	Unstable response	Erroneous data air con struggling	33.5	805
		11-Jul-09	12-Jul-09	Unstable response	Data deleted	0.3	7
		13-Jul-09	15-Jul-09	Unstable response	Data deleted	2.4	57
		18-Jul-09	19-Jul-09	Unstable response	Data deleted	0.8	19
		27-Jul-09	10-Aug-09	Unstable response	Data deleted	13.8	332
		03-Sep-09	04-Sep-09	QAQC audit		0.8	20
		06-Sep-09	06-Sep-09	Unstable response	Data deleted	0.3	6
		17-Sep-09	17-Sep-09	ESU service		0.4	10
Stockton-on-Tees Eaglescliffe							
NO_2	81.40%	04-Jul-09	06-Jul-09	Instrument fault	PMT temp warning	2.7	64
		13-Jul-09	14-Jul-09	Instrument fault	PMT temp warning	2	48
		20-Jul-09	21-Jul-09	ESU service		1.7	41
		02-Aug-09	10-Aug-09	Instrument fault	PMT temp warning	8.5	204
		25-Aug-09	27-Aug-09	QAQC audit	PMT Temp warniing	1.9	45
Stoke-on-Trent Centre							
NO_2	86.30%	27-Jul-09	28-Jul-09	ESU service		1	23
		10-Sep-09	21-Sep-09	Pump fault	Blown fuse in sample pump	10.6	255
O_3	87.20%	27-Jul-09	28-Jul-09	ESU service		0.9	22
		21-Sep-09	25-Nov-09	Sampling fault	Internal sampling	65.1	1563
Sunderland Silksworth							
NO_2	21.60%	17-Jun-09	10-Sep-09	Power cut	Power supply problems	85.4	2050
O_3	21.60%	17-Jun-09	10-Sep-09	Power cut	Power supply problems	85.4	2050
PM_{25}	11.30%	25-Jun-09	14-Sep-09	FDMS volatile recovery or noisy	Power supply problems	80.8	1938
		15-Sep-09	15-Sep-09	FDMS volatile recovery or noisy	Noisy data deleted	0.5	13
		17-Sep-09	17-Sep-09	FDMS volatile recovery or noisy	Noisy data deleted	0.3	7
		19-Sep-09	19-Sep-09	Sampling fault	Flow problems	0.5	11
		20-Sep-09	20-Sep-09	FDMS volatile recovery or noisy	Noisy data deleted	0.5	13
		22-Sep-09	23-Sep-09	Sampling fault	Flow problems	0.7	16
		23-Sep-09	23-Sep-09	Sampling fault	Flow problems	0.4	9
		25-Sep-09	25-Sep-09	Sampling fault	Flow problems	0.6	15
		26-Sep-09	27-Sep-09	FDMS volatile recovery or noisy	Noisy data deleted	0.6	15
		27-Sep-09	27-Sep-09	Sampling fault	Flow problems	0.6	14
		28-Sep-09	28-Sep-09	Sampling fault	Flow problems	0.5	12
		29-Sep-09	29-Sep-09	Sampling fault	Flow problems	0.4	10
		30-Sep-09	30-Sep-09	Sampling fault	Flow problems	0.6	14
SO_2	21.60%	17-Jun-09	10-Sep-09	Power cut	Power supply problems	85.4	2050
Wales							
Swansea Roadside							
PM_{25}	31.50%	14-May-09	31-Aug-09	Instrument fault	ENG C/O FDMS $PM_{2.5}$ Dryer Fault . Removed to ET for new dryer	110	2631
		07-Sep-09	07-Sep-09	High noise	Highly negative data deleted	0.3	7
England							
Thurrock							

SO_2	89.90%	10-Sep-09	18-Sep-09	ESU service		9	216
Tower Hamlets Roadside							
CO	77.90%	16-Jul-09	03-Aug-09	High noise	ENG C/O Instrument removed from site. SU hotswap installed.	18.4	442
		26-Aug-09	27-Aug-09	High noise	Rejection of rather high data.	1.5	36
Weybourne							
O_3	87.10%	06-Jul-09	15-Jul-09	No mV data collected		8.8	211
		17-Jul-09	20-Jul-09	Flat response		3.1	74
Wirral Tranmere							
PM_{25}	63.50%	22-Jun-09	01-Jul-09	Unstable response	Data deleted	9.5	227
		10-Aug-09	11-Aug-09	Unstable response	Data deleted	0.8	19
		17-Aug-09	17-Sep-09	ESU service	Upgrade of NOx & O3 analysers	31.5	755
Wales							
Wrexham							
SO_2	86.80%	06-Aug-09	18-Aug-09	High noise	Data deleted	11.8	283
England							
Yarner Wood							
NO_2	86.60%	07-Jul-09	07-Jul-09	Flat response		0.4	9
		03-Aug-09	07-Aug-09	ESU service		4.1	98
		09-Sep-09	11-Sep-09	High noise	Noisy negative data nulled	1.5	36
York Bootham							
PM_{10}	77.40%	01-Jul-09	01-Jul-09	FDMS dew point too warm	Data deleted	0.5	13
		02-Jul-09	02-Jul-09	FDMS dew point too warm	Data deleted	0.5	13
		04-Jul-09	04-Jul-09	FDMS dew point too warm	Data deleted	0.5	12
		05-Jul-09	05-Jul-09	FDMS dew point too warm	Data deleted	0.3	8
		16-Jul-09	16-Jul-09	FDMS dew point too warm	Data deleted	0.3	8
		23-Jul-09	24-Jul-09	QAQC audit	AUDIT Site NO cyl more than 10% from stated value NOx Site NO cyl	1	25
		03-Aug-09	03-Aug-09	FDMS dew point too warm	Data deleted	0.3	6
		05-Aug-09	12-Aug-09	Instrument fault	ENG C/O Service FDMS PM_{10} and $PM_{2.5}$	7.2	173
		14-Aug-09	14-Aug-09	FDMS dew point too warm	Data deleted	0.3	7
		15-Aug-09	15-Aug-09	FDMS dew point too warm	Data deleted	0.4	9
		17-Aug-09	17-Aug-09	FDMS dew point too warm	Data deleted	0.3	7
		18-Aug-09	18-Aug-09	FDMS dew point too warm	Data deleted	0.3	7
		19-Aug-09	19-Aug-09	FDMS dew point too warm	Data deleted	0.5	13
		23-Aug-09	23-Aug-09	FDMS dew point too warm	Data deleted	0.5	11
		27-Aug-09	27-Aug-09	FDMS dew point too warm	Data deleted	0.4	9
		31-Aug-09	31-Aug-09	FDMS dew point too warm	Data deleted	0.4	10
		04-Sep-09	09-Sep-09	Instrument fault	ENG C/O	5.5	132

Appendix 3

Inventory of Defra owned Equipment

An up-to-date inventory of Department-owned equipment used by the QA/QC Unit is provided below:

QA/QC Unit's inventory of Department-owned equipment, January 2010

Computer software	The HIS (Heuristic Information System) software suite used for all data management. A few specific capabilities of HIS were developed in order to meet specific Department deliverables or requirements (examples include software for annual report analysis/compilation, for formatting/transmitting network data to archive or DDU and for reporting Directive compliance data to the EC).
Field support equipment	Field support equipment: 1 intercalibration equipment set (includes mass flow controllers and read-out unit) A second intercalibration (commissioned January 2001) UV photometers: API model M401 s/n 123- purchased April 1999 API model 401 s/n 151 - purchased October 2000 API model 401 s/n 176 – purchased December 2002 API model 401 s/n 290 – purchased May 2004 API model 401 s/n 291 – purchased May 2004 API model 401 s/n 292 purchased May 2004 API model 401 s/n 293 purchased May 2004 API Model 703 s/n 254 purchased Jan 2010 API Model 703 s/n 255 purchased Jan 2010 Mass flow controllers - purchased April 2002 (incorporated into existing audit dilution apparatus) 3 Drycal flow meters - purchased September 2002 1 Mass flow controller read-out unit to be incorporated in the audit dilution apparatus – purchased September 2002. A third intercalibration kit (commissioned May 2004) Drycal flow meter – purchased March 2004 Sabio 2010 dilution calibrator – purchased February 2005 Sabio 2020 zero air generator – purchased February 2005 Sabio 2030 ozone photometer – purchased February 2005 Sabio 2010 dilution calibrator – purchased June 2006 Sabio 2020 zero air generator – purchased June 2006 Sabio 2030 ozone photometer – purchased June 2006 Sabio 2020 zero air generator – purchased March 2008 Sabio 2030 ozone photometer – purchased March 2008 Sabio 2010 dilution calibrator – purchased March 2008
Zero air pumps	6 spare zero air pumps for routine maintenance/repair of zero air generators in the AURN.
Analysers	AC31 dual chamber NO_x analyser TEI 43C SO_2 analyser TEI 48C CO analyser M265 chemiluminescent ozone analyser (All of the above purchased on behalf of Defra by Casella Stanger in March 2003 and transferred to QA/QC Unit)

Appendix 4

Partisol Data: July-September 2009

AURN Partisol Data: July-September 2009

Partisol data have been ratifed for the following sites and measurement periods.

Site	Start date	End date	Provisional Data Capture, %
Auchencorth Moss $PM_{2.5}$	1st Jul	30th Sep	93
Auchencorth Moss PM_{10}	1st Jul	30th Sep	92
Bournemouth $PM_{2.5}$	1st Jul	30th Sep	95
Brighton Preston Park $PM_{2.5}$	1st Jul	30th Sep	93
Harwell $PM_{2.5}$	1st Jul	30th Sep	84
Harwell PM_{10}	1st Jul	30th Sep	91
Inverness $PM_{2.5}$	1st Jul	30th Sep	91
Inverness PM_{10}	1st Jul	30th Sep	83
London Marylebone Road $PM_{2.5}$	1st Jul	30th Sep	78
London Marylebone Road PM_{10}	1st Jul	30th Sep	59
London N Kens $PM_{2.5}$	1st Jul	30th Sep	88
London N Kens PM_{10}	1st Jul	30th Sep	75
London Westminster $PM_{2.5}$	1st Jul	30th Sep	97
Northampton $PM_{2.5}$	1st Jul	30th Sep	98
Port Talbot Margam $PM_{2.5}$	1st Jul	30th Sep	75
Wrexham PM_{10}	1st Jul	30th Sep	80

Bureau Veritas carry out the following:

- Filter conditioning and weighing.
- Calculation of ambient particulate concentrations using the Partisol download data and the filter weighings.
- Providing a field blank correction based on filters supplied with each batch, which travel to the Partisol site in the canister with the other filters, but are not actually exposed.
- Checking that the correct filter ID is matched with the correct day's sampling data.
- Checking that the PM_{10} and $PM_{2.5}$ datasets "track" each other.
- Do a comparison of ambient concentrations with those from collocated or nearby FDMS-TEOM sites.

The raw data and calculated concentrations are supplied to AEA in a spreadsheet, which is uploaded to AEA's Partisol processing system.

AEA complete the ratification process by

- Independently checking BV's calculation of the ambient PM_{10} concentration.
- Ensuring that data with a Partisol fault code or filter fault are rejected.
- Checking site audit data where available.
- Carrying out a more detailed quarterly comparison of Partisol data with co-located or nearby FDMS-TEOM data.

Data Rejection

Data codes are recorded during ambient measurement, and filter faults are recorded during filter weighings. Some codes indicate a fatal fault and are used to automatically reject data during ratification.

Measurement codes are shown below.

The measurement codes reported by BV are as follows:

New Code	Meaning	Reject
0	OK	No
8	Power Failure	Only if < 18h data.
4	System re-set	Only if < 18h data.
10	Flow 1out of range	Yes
20	Flow 2 out of range	Yes
40	Flow 3 out of range	Yes
2000	Difference between ambient T and filter T > $\pm 5^{o}C$	No
10000	Elapsed sample period out of range/out of filters	Reject if < 18h data.
40000	Coefficient of variation of average flow too high (i.e. too much variation in flow)	If not caused by "audit" status e.g. inlet cleaning. Or if < 18h data.
100000	Elapsed Sample Period out of range (< 23 hours or >25 hours).	Reject if < 18h data.
102000	Difference between ambient T and filter T > $\pm 5^{o}C$, causing Elapsed Sample Period out of range (< 23 hours or >25 hours).	Reject only if < 18h valid data or vol < 18 m^3.
100008	Elapsed Sample Period out of range (< 23 hours or >25 hours), *and* Power Failure.	Yes (power failure)

The following faults should also be recorded during filter weighings and should be indicated by BV in their spreadsheet under "Lab Comments". All are fatal except "filter inverted".

Filter faults

Filter exposed inverted
Filter cut inside edge
Filter damaged some missing
Filter appears unexposed
Filter not returned
Filter inverted and in reverse order in canister

Site Audits

Site audit results for the AURN Partisols are shown in the table below. Audits take place every six months, so there may not necessarily have been an audit during the "quarter" currently being ratified. The table below therefore shows the two most recent audits. The flowrate must be within +/-10% of

the nominal value (16.7 m^3/h).

Site Audits – Winter 2008 and Summer 2009 periods.

Site	Audit date	Flowrate m^3/h	% out from 16.7 m^3/h
Auchencorth Moss PM_{10} (serial no. 21550)	10 Dec 2008 1 Jul 2009	16.7 17.2	0 3.42
Auchencorth Moss $PM_{2.5}$ (serial no. 21548)	10 Dec 2008 1 Jul 2009	0 16.6	100 -0.54
Bournemouth PM_{10} (serial no. 21257)	11 Feb 2009 10 Aug 2009	16.90 17.20	1.38 3.18
Brighton Preston Park $PM_{2.5}$ (212200001)	02 Mar 2009 01 Sep 2009	16.62 16.87	-0.3 1.20
Harwell PM_{10}	23 Feb 2009	16.99	1.92
Harwell $PM_{2.5}$	23 Feb 2009	16.86	1.14
Inverness PM_{10} (serial no. 21255)	05 Feb 2009 12 Aug 2009	16.7 16.58	0.54 -0.54
Inverness $PM_{2.5}$ (serial no. 21861)	05 Feb 2009 12 Aug 2009	16.7 16.62	0 -0.48
London Marylebone Road PM_{10} (serial no. 21306)	17 Feb 2009 19 Aug 2009	17.2 Partisol out of action.	2.9 Partisol out of action.
London Marylebone Road $PM_{2.5}$ (serial no. 21493)	17 Feb 2009 19 Aug 2009	Not tested, no safe ladder access.	Not tested, no safe ladder access.
London N Kens PM_{10} (serial no. 21722)	6 Mar 2009 13 Jul 2009	Not tested, no safe ladder access.	- -
London N Kens $PM_{2.5}$	6 Mar 2009 13 Jul 2009	Not tested, no safe ladder access.	- -
London Westminster PM_{10}	18 Feb 2009 17 Aug 2009	No access. 17.36	No access 4.14
Northampton $PM_{2.5}$	19 Feb 2009 19 Aug 2009	Not tested, no safe ladder access.	- -
Port Talbot Margam $PM_{2.5}$	19 Feb 2009 4 Aug 2009	not tested not tested	not tested not tested
Wrexham PM_{10} (serial no. 212240)	10 Feb 2009 12 Aug 2009	not tested 16.06	not tested -3.66

Flowrate test results in all cases where it was possible to carry out a flowrate test on the Partisol were normal (i.e. within 10%).

Auchencorth Moss

$PM_{2.5}$: Data capture was 93% for this quarter. Data losses as follows:

- 11th Jul – power failure
- 16th Jul – incorrect date and time had been entered. Sampler stopped and reset.
- 2nd Sep – uncorrected value was negative.
- 3rd – 4th Sep & 7th Sep – low sample volume.

The persistent filter exchange failures etc. that affected this sampler in Q1 and Q2 appear to have been rectified.

PM_{10}: Data capture was 92% for this quarter. Data losses as follows:

- 15th, 16th Jul – power interruptions leading to < 18 hours sampled.
- 22nd Jul - < 18h and 18m^3 sampled.
- 23rd – 25th Jul: PM10 was less than $PM_{2.5}$: BV's advice was that the $PM_{2.5}$ data were probably reliable and should be kept: the PM_{10} were probably faulty and should be discarded.
- 7th Sep – no reason given by BV.

Bournemouth

$PM_{2.5}$: Data capture was 95% for this quarter. Data losses as follows:

- 7th Jul – filter exchange failure (FEF)
- 15th Jul – ran out of filters
- 19th – 20th Jul & 19th Aug - < 18h and 18m^3 sampled.

Brighton Preston Park

$PM_{2.5}$ only: Data capture was 93% for this quarter.

- 10-15th Sep – pump failure (leak on pump outlet).

Harwell

$PM_{2.5}$: 84% data capture. Data losses:

- 14th Jul: < 18m^3 sampled.
- 22nd – 24th Jul – no reason provided
- 27th Jul – 7th Aug – SCC (sharp cut cyclone) needed replacement.

PM_{10}: Data capture 91%. Data losses:

- 2nd – 8th Jul: not operational – no reason given.
- 26th Aug - < 18h valid sampling, < 18m^3 sampled.

Inverness

$PM_{2.5}$: Data capture = 91%. Data losses:

- 6th – 11th Aug – delayed filter changeover
- 27th Aug – power cut
- 28th Sep – "nonsense" value (1194228) entered in "volume" cell. BV had rejected the value as it was not possible to be sure what the actual sampled volume was.

PM_{10}: Data capture = 83%. Data losses:

- 6th – 11th Aug – delayed filter changeover (as for $PM_{2.5}$).
- 21st - 27th Aug – flow, temperature and pump failure.
- 2nd – 4th – failed to re-connect pneumatic line.

London Marylebone Road

$PM_{2.5}$: Data capture 78%. Data losses:

- 1st -15th Jul: filter exchange and pump failures. Partisol removed from site for repair and testing, returned on 15th Jul.

- 21st – 25th Aug: pump & filter exchange failure.

PM_{10}: Data capture = 59%. Data losses:
- 7th – 10th Jul – unit set up incorrectly
- 5th – 8th Aug – FEF
- 19th – 31st Aug – filter reported as "not weighed".
- 1st – 4th Sep – Partisol failure
- 11th – 21st Sep – reportedly could not contact Partisol (comms failure?)
- 25th – 28th Sep – no reason given.

London North Kensington

$PM_{2.5}$: Data capture was 88%. Data losses:
- 7th Jul – incorrect initial weighing.
- 20th Jul - < 18m^3 sampled
- 15th – 21st Sep – power failure. Unit off.

PM_{10}: data capture 75%. Data losses:
- 1st Jul – 21st Jul (part of a longer breakdown period beginning 21st May) PM10 < PM2.5 and < FDMS. Split v-seal replaced in July. All data from 21st May – 21st July suspect.

London Westminster

$PM_{2.5}$ only. Data capture = 97%. Data losses –
- 10th Sep - < 18h sampled.
- 16th – 18th Sep – pneumatic line not attached.

Northampton

$PM_{2.5}$ only: Data capture was 98%. Data losses:
- 26th Aug – service reduced sampling time.
- 28th Aug – FEF.

Port Talbot Margam

$PM_{2.5}$ only: data capture = 75%. Data losses:
- 16th – 28th May – FEF
- 11th – 12th May – pneumatic line disconnected.
- 17th Jun – 2 filters sampled.

Wrexham

PM_{10} only: Data capture was 80%. Data losses:
- 12th – 29th Jul: filters "double exposed". – possibly canister of exposed filters was installed instead of fresh ones.

Appendix 5

Site Details for New Sites

Site Name	Pollutants	Region Name	Grid	Latitude	Longitude	Altitude m	Type
Armagh K/S	NO_2 PM_{10}	N Ireland	H87600 45800	54°21'12.7"N	6°39'16.3W	41m	Roadside
Norwich Lakenfields	NO_2 O_3 PM_{10} $PM_{2.5}$ SO_2	East Anglia					
Peebles	NO_2 O_3	Scotland	NT24812 41083	55°39'26.9"N	03°11'47.5"W	167m	Urban B/Ground

Appendix 6

Outliers Identified at Summer 2009 Intercalibration

England

SITE	NO_x	CO	SO_2	O_3	PM_{10}	$PM_{2.5}$
Barnsley 12			OK			
Barnsley Gawber	OK		OK	OK		
Bath Roadside	Outlier -20%					
Billingham	OK					
Birmingham Centre	OK			OK	OK	OK
Birmingham Tyburn	Outlier +13%		OK	OK	OK	OK
Birmingham Tyburn Roadside	OK			Outlier -7%	OK	OK
Blackburn Roadside	OK					
Blackpool Marton	OK			OK		OK
Bottesford				OK		
Bournemouth	OK			OK		OK
Brighton Preston Park	OK			OK		OK
Brighton Roadside	OK					
Bristol Old Market	OK	OK				
Bristol St Paul's	OK	OK	OK	OK	OK	OK
Bury Roadside	Outlier -40% Converter 91%	OK			OK	OK
Cambridge Roadside	OK					
Canterbury	OK			OK		
Carlisle Roadside	Outlier +27%				OK	OK
Charlton Mackrell	OK			OK		
Chatham Roadside	OK				OK	OK
Chesterfield	OK				OK	OK
Chesterfield Roadside	OK				OK	OK
Coventry Memorial Park	OK			Outlier +6%	OK	OK
Eastbourne	Not operational				-	-
Exeter Roadside	OK			Outlier +16%		
Glazebury	Outlier -44%			Outlier -9%		
Great Dun Fell				OK		
Harwell	OK		OK	OK	OK	Not operational
Harwell Partisols					OK	OK
High Muffles	OK			Outlier -9%		
Horley	OK					
Hull Freetown	OK	OK	OK	OK	Main flow +15%	OK
Ladybower	OK		Outlier -14%	Outlier +10%		

SITE	NO_x	CO	SO_2	O_3	PM_{10}	$PM_{2.5}$
Leamington Spa	OK		OK	OK	OK	OK
Leeds Centre	OK	OK	OK	Outlier +7%	OK	OK
Leeds Headingley Roadside	OK				OK	OK
Leicester Centre	Outlier +11%	OK	Outlier -15%	OK	OK	Not operational
Leominster	OK			OK		
Liverpool Queen's Drive Roadside	Outlier -16%					
Liverpool Speke	OK	OK	OK	OK	OK	OK
Lullington Heath	OK		OK	Outlier +7%		
Manchester Piccadilly	OK			OK		Main flow -19% total flow -11%
Manchester South	Outlier -41%			OK		
Market Harborough	OK	OK		OK		
Middlesbrough	Outlier +19%	OK	Outlier +15%	OK	OK	OK
Newcastle Centre	Outlier -14%	OK	OK	OK	Total flow -11%	OK
Newcastle Cradlewell Roadside	OK					
Northampton	OK		Outlier -24%	OK	OK	
Norwich Centre	OK		OK	OK	OK	OK
Nottingham Centre	OK		OK	OK	OK	OK
Oxford Centre Roadside	Outlier +20%					
Oxford St Ebbes	Converter 88%			OK	OK	OK
Plymouth Centre	Outlier +13%			OK	Main flow -17%	Ok
Portsmouth	OK			OK	OK	OK
Preston	OK			OK		OK
Reading New Town	OK		OK	Outlier -16%	OK	OK
Rochester Stoke	OK		OK	OK	OK	OK
Salford Eccles	OK	OK	OK	OK	OK	OK
Saltash Roadside					OK	OK
Sandwell West Bromwich	OK		OK	Outlier +6%		OK
Sandy Roadside	Outlier -20%					OK
Scunthorpe Town	OK		OK		Main flow +17%	
Sheffield Centre	OK	OK	OK	OK	Main flow -20%	OK
Sheffield Tinsley	OK					
Sibton				OK		
Southampton Centre	OK	OK	Outlier +24%	OK	OK	OK
Southend-on-Sea	Outlier +30%			Outlier +6%		OK
St Osyth	OK	OK		OK		
Stanford-le-Hope Roadside	OK		OK		OK	OK
Stockton-on-Tees Eaglescliffe	Outlier -15%				OK	OK
Stoke-on-Trent Centre	Outlier +21%			Outlier +14%	OK	OK
Storrington Roadside					OK	OK

SITE	NO_x	CO	SO_2	O_3	PM_{10}	$PM_{2.5}$
Sunderland Silksworth	Not operational			Not operational		Not operational
Thurrock	OK		OK	OK	OK	OK
Walsall Willenhall	OK			OK		
Warrington	OK				OK	OK
Weybourne				OK		
Wicken Fen	OK		OK	Outlier -6%		
Wigan Centre	Outlier +14%			OK		OK
Wirral Tranmere	OK			OK		OK
Yarner Wood	OK			OK		
York Bootham					OK	OK
York Fishergate	OK				OK	OK

London

SITE	NO_x	CO	SO_2	O_3	PM_{10}	$PM_{2.5}$
Camden Kerbside	OK				OK	OK
Haringey Roadside	OK				k_0 -3.4%	Total flow -45%
London Bexley	Outlier -18%	OK	OK		OK	OK
London Bloomsbury	OK	OK	OK	OK	OK	OK
London Cromwell Road 2	OK	OK	OK			
London Eltham	OK		OK	OK	OK	OK
London Haringey	OK			OK		
London Harlington	OK			Outlier -9%	OK	OK
London Hillingdon	Outlier -12%			Outlier +7%		
London Marylebone Road	OK	OK	OK	Outlier -6%	OK	OK
London Marylebone Road Partisols					OK	Not operational
London N. Kensington	OK	OK	OK	OK	OK	OK
London N. Kensington Partisols					OK	OK
London Stanmore						OK
London Teddington	OK			OK		OK
London Westminster	Outlier -12%	OK	OK	OK		OK
Tower Hamlets Roadside	OK	OK				

Wales

SITE	NO_x	CO	SO_2	O_3	PM_{10}	$PM_{2.5}$
Aston Hill	OK			OK		
Cardiff Centre	OK	OK	OK	OK	OK	OK
Chepstow A48	Outlier +20%				OK	OK
Cwmbran	Outlier -22%			OK		
Narberth	Outlier -13%		Outlier -11%	OK	Not tested	
Newport	OK				OK	OK

SITE	NO_x	CO	SO_2	O_3	PM_{10}	$PM_{2.5}$
Port Talbot Margam	OK	OK	Outlier -13%	OK	OK	OK
Swansea Roadside	OK				OK	OK
Wrexham	Outlier -21%		Outlier +30%		OK	OK

Scotland

SITE	NO_x	CO	SO_2	O_3	PM_{10}	$PM_{2.5}$
Aberdeen	Outlier -20%			OK	Total flow -45%	OK
Aberdeen Union St Roadside	OK					
Auchencorth Moss	OK			OK	Not tested	Not tested
Auchencorth Moss Partisols					OK	OK
Bush Estate	OK			OK		
Dumfries	Converter 93%					
Edinburgh St Leonards	OK	OK	Outlier +15%	Outlier -29%	Not tested	OK
Eskdalemuir	OK			Outlier -12%		
Fort William	OK			OK		
Glasgow Centre	OK	OK	OK	Outlier +6%	OK	OK
Glasgow Centre Partisols					OK	OK
Glasgow City Chambers	OK					
Glasgow Kerbside	OK				OK	OK
Glasgow Kerbside Partisols					OK	OK
Grangemouth	OK		OK		OK	Total Flow -11%
Inverness	OK				OK	
Lerwick				Outlier +20%		
Strath Vaich				Outlier +20%		

Ireland

SITE	NO_x	CO	SO_2	O_3	PM_{10}	$PM_{2.5}$
NORTHERN IRELAND						
Belfast Centre	OK	OK	Not operational	OK	OK	OK
Derry	OK		OK	OK	OK	OK
Lough Navar				OK	OK	
IRELAND						
Mace Head				OK		

Appendix 7

Certificate of Calibration

CERTIFICATE OF CALIBRATION

551.11, Harwell, Didcot, Oxfordshire OX11 0QJ. Telephone 0870 1906465 Fax 0870 1906377

0401

Certificate Number: 02211
AEA Identification Number: ED42523030

Approved Signatories: K. Stevenson
S. Eaton

Signed:

Date of issue: 25 January 2009

Customer Name and Address: Dr Emily Nicholl

AEQ Division
Department for Environment, Food and Rural Affairs
Ashdown House (Zone E14)
123 Victoria Street
London SW1E 6DE

Description: Calibration factors for monitoring stations in the Automatic Urban Monitoring Network

1. Northern Ireland Sites (including Mace Head)

Carbon Monoxide

Date Year = 2009	Site	Analyser number	[1]Zero output	Uncertainty (ppm)	[2]Calibration Factor	Uncertainty (%)	*Maximum Residual (%)
11-Aug	Belfast Centre	M1811-M491	50	0.3	0.050	3	1.1

Sulphur Dioxide

Date Year =2009	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)	*m-xylene interference (ppb)
11-Aug	Belfast Centre	M637	not	operational	at audit			
17-Aug	Derry	1697	18	4.2	1.103	9.3	4.0	-0.2

Ozone

Date Year =2009	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)
11-Aug	Belfast Centre	M1626-M335	243	5	0.098	3.9	0.8
17-Aug	Derry	1586	0	5	0.980	3.1	0.8
05-Aug	Lough Navar	1640	0	5	0.981	3.2	0.3
04-Aug	Mace Head	77490-386	2	5	1.003	3.3	2.8

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2 providing a level of confidence of approximately 95% The uncertainty evaluation has been carried out in accordance with UKAS requirements.

A business name of AEA Technology plc.
Registered office 329 Harwell, Didcot, Oxfordshire OX11 0QJ
Registered in England and Wales no 3095862

AEA

CERTIFICATE OF CALIBRATION

UKAS CALIBRATION

0401

Certificate Number: 02211
AEA Identification Number: ED42523030

Oxides of Nitrogen

Date Year =2009	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
11-Aug	Belfast Centre	NO NOx	M1804- M733	250 253	5 5.3	0.440 0.436	5 5	3.8 3.3	96.3
17-Aug	Derry	NO NOx	2130	7 13	5 5.3	1.148 1.136	5 5	2.2 2.1	99.5

Particulate Analysers

Date Year =2009	Site		Analyser number	Calculated Spring Constant k_0	Uncertainty (%)	[4]k_0 accuracy (%)	[3]Measured Main Flow (l/min)	Uncertainty (%)	[3]Measured Total Flow /**Aux Flow** (l/min)	Uncertainty (%)
24-Aug	Armagh Kerbside	PM10	23945	13549	1	-0.2	3.21	2.2	17.37	2.2
11-Aug	Belfast Centre	PM10	24423	14154	1	-0.3	3.05	2.2	16.31	2.2
11-Aug	Belfast Centre	PM25	26565	15424	1	-1.9	2.99	2.2	16.21	2.2
17-Aug	Derry	PM10	21313	10900	1	0.1	2.99	2.2	15.89	2.2
17-Aug	Derry	PM25	27016	16037	1	1.5	2.77	2.2	15.70	2.2
05-Aug	Lough Navar	PM10	221196	12829	1	0.1	3.17	2.2	16.65	2.2

2. Scottish Sites

Carbon Monoxide

Date Year = 2009	Site	Analyser number	[1]Zero output	Uncertainty (ppm)	[2]Calibration Factor	Uncertainty (%)	*Maximum Residual (%)
30-Jun	Edinburgh St Leonards	240	0	0.3	0.977	3	2.9
06-Jul	Glasgow Centre	241	1	0.3	0.557	3	1.0

Sulphur Dioxide

Date Year =2009	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)	*m-xylene interference (ppb)
30-Jun	Edinburgh St Leonards	71	39	4.2	1.006	5	0.5	26.2
06-Jul	Glasgow Centre	1630	0	4.1	0.540	6.4	2.1	8.2
07-Jul	Grangemouth	703B-274	0	4.2	0.976	14.3	4.0	14.8

Ozone

Date Year =2009	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)
11-Aug	Aberdeen	800	0	5	1.047	3.3	1.5
01-Jul	Auchencorth Moss	646	-2	5	0.980	3.3	0.4
01-Jul	Bush Estate	77087-395	14	5	0.498	3.1	2.9
30-Jun	Edinburgh St Leonards	136	-5	5	1.414	3.2	0.8
13-Oct	Eskdalemuir	158	1.1	5	1.132	3.1	0.6
23-Jul	Fort William	1023	1	5	1.000	3.1	1.8
06-Jul	Glasgow Centre	CM08060029	0	3	0.946	3.1	1.1
29-Jul	Lerwick	841B-176	1	5	0.840	3.2	1.6
12-Aug	Strath Vaich	801	-1	5	0.831	3.1	0.3

The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor k = 2 , providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

AEA

CERTIFICATE OF CALIBRATION

UKAS CALIBRATION
0401

Certificate Number: 02211
AEA Identification Number: ED42523030

Oxides of Nitrogen

Date Year =2009	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
11-Aug	Aberdeen	NO NOx	519	1 1	5 5.4	1.444 1.421	5 5.2	0.3 0.5	98.4
11-Aug	Aberdeen Union Street Roadside	NO NOx	984	-35 -36	5 5.3	1.176 1.154	5.1 5.4	1.6 2.7	99.1
01-Jul	Bush Estate	NO NOx	42c-58112-316	1 1	5 5.3	0.980 0.969	5 5	0.8 0.0	97.3
27-Jul	Dumfries	NO NOx	1494	1 6	5 5.4	0.889 0.893	5 5	1.3 1.2	92.8
30-Jun	Edinburgh St Leonards	NO NOx	73	-6 -22	5 5.3	0.891 0.845	5 5	1.2 1.1	100.0
13-Oct	Eskdalemuir	NO NOx	347	0.6 -0.2	5 5	1.106 1.106	5 5	0.7 1.1	98.0
23-Jul	Fort William	NO NOx	344	1 1	5 5.3	0.828 0.830	5 5	0.3 0.4	99.7
06-Jul	Glasgow Centre	NO NOx	1713	1 1	5 5.3	1.009 1.011	5 5	2.1 1.4	97.2
07-Jul	Glasgow City Chambers	NO NOx	575	0 3	5 5.3	1.052 1.060	5 5	1.9 2.0	99.6
06-Jul	Glasgow Kerbside	NO NOx	08050061	0 -11	5 5.3	0.968 0.958	5 5	2.8 2.9	105.4
07-Jul	Grangemouth	NO NOx	700B-312	0 3	5 5.6	1.072 1.078	5 5	1.0 1.2	98.3
08-Jul	Grangemouth Moray	NO NOx	912011	0 1	5 5.3	0.975 0.940	5 5	2.4 2.5	95.2
12-Aug	Inverness	NO NOx	1489	1 2	5 5.3	1.167 1.160	5 5.2	0.2 0.4	97.1

Particulate Analysers

Date Year =2009	Site		Analyser number	Calculated Spring Constant k_0	Uncertainty (%)	[4]k_0 accuracy (%)	[3]Measured Main Flow (l/min)	Uncertainty (%)	[3]Measured Total Flow /**Aux Flow** (l/min)	Uncertainty (%)
11-Aug	Aberdeen	PM10	24427	11705	1	1.2	Failed	Test	9.84	2.2
11-Aug	Aberdeen	PM25	27368	12165	1	0.4	3.03	2.2	16.14	2.2
01-Jul	Auchencorth Moss	PM10	Not	tested	drier	warning				
01-Jul	Auchencorth Moss	PM25	Not	tested	drier	warning				
	Auchencorth Moss Partisol	PM10	22550						17.24	2.2
	Auchencorth Moss Partisol	PM25	21548						16.61	2.2
30-Jun	Edinburgh St Leonards	PM10	21308	11537	1	-0.3	3.08	2.2	15.80	2.2
30-Jun	Edinburgh St Leonards	PM25	Not	tested	drier	warning				
06-Jul	Glasgow Centre	PM10	27331	15452	1	-1.2	3.13	2.2	15.24	2.2
06-Jul	Glasgow Centre	PM25	22980	13043	1	-0.8	3.10	2.2	15.82	2.2
06-Jul	Glasgow Kerbside	PM10	27344	14881	1	-0.9	Not	tested	unsafe	access

The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor k = 2 , providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

AEA

CERTIFICATE OF CALIBRATION

UKAS CALIBRATION

0401

Certificate Number: 02211
AEA Identification Number: ED42523030

Date Year =2009	Site		Analyser number	Calculated Spring Constant k_0	Uncertainty (%)	[4]k_0 accuracy (%)	[3]Measured Main Flow (l/min)	Uncertainty (%)	[3]Measured Total Flow /**Aux Flow** (l/min)	Uncertainty (%)
06-Jul	Glasgow Kerbside	PM25	27337	14993	1	-0.8	Not	tested	unsafe	access
07-Jul	Grangemouth	PM10	27228	15710	1	-1.3	2.93	2.2	15.78	2.2
07-Jul	Grangemouth	PM25	27259	13535	1	-1.6	2.91	2.2	14.93	2.2
12-Aug	Inverness	PM10	212550 003						16.58	2.2
12-Aug	Inverness	PM25	218610 603						16.62	2.2

3. Welsh Sites

Carbon Monoxide

Date Year = 2009	Site	Analyser number	[1]Zero output	Uncertainty (ppm)	[2]Calibration Factor	Uncertainty (%)	*Maximum Residual (%)
05-Aug	Cardiff Centre	14333	-1	0.3	0.995	3	5.3
04-Aug	Port Talbot Margam	10787	-3	0.3	0.053	3	3.8

Sulphur Dioxide

Date Year =2009	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)	*m-xylene interference (ppb)
05-Aug	Cardiff Centre	14319	23	4.2	1.033	8.4	5.1	6.2
03-Aug	Narberth	26	76	4.1	0.760	5.8	1.4	32.7
04-Aug	Port Talbot Margam	11669	12	4.2	1.024	7.9	4.7	12.3
12-Aug	Wrexham	12183	-5	4.2	0.940	5	1.1	21.1

Ozone

Date Year =2009	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)
22-Jul	Aston Hill	144	8	5	0.490	3.1	1.3
05-Aug	Cardiff Centre	14348	-2	5	0.997	3.2	1.1
14-Aug	Cwmbran	205004	1	5	0.973	3.1	0.9
03-Aug	Narberth	27	1	5	0.980	3.2	1.7
04-Aug	Port Talbot Margam	94754	8	5	0.525	3.1	1.2

Oxides of Nitrogen

Date Year =2009	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
22-Jul	Aston Hill	NO NOx	m2068- m853	102 102	5 5.3	1.242 1.245	5 5	0.7 1.2	98.2
05-Aug	Cardiff Centre	NO NOx	14325	1 1	5 5.3	1.140 1.145	5 5	1.3 0.6	97.7
27-Jul	Chepstow A48	NO NOx	1	100 106	5 5.4	1.027 1.046	5 5	2.7 3.1	99.6
14-Aug	Cwmbran	NO NOx	406003	1 1	5 5.5	1.83 1.772	5 5	1.1 0.6	99.3
03-Aug	Narberth	NO NOx	aea25	92 92	5 5.2	0.576 0.579	5 5	3.0 2.4	100.7

The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor k = 2 , providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

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CERTIFICATE OF CALIBRATION

UKAS CALIBRATION

0401

Certificate Number: 02211
AEA Identification Number: ED42523030

Date Year =2009	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
27-Jul	Newport	NO	M1639-	1	5	1.033	5	4.5	
		NOx	M671	3	5.4	1.057	5	5.3	98.7
04-Aug	Port Talbot Margam	NO	12811	5	5	1.17	5	1.0	
		NOx		7	5.3	1.163	5	0.6	101.4
04-Aug	Swansea Roadside	NO	16695	0	5	1.002	5	0.9	
		NOx		-1	5.3	0.951	5	0.8	98.5
12-Aug	Wrexham	NO	12185	1	5	1.229	5	1.1	
		NOx		1	5.3	1.209	5	1.0	99.2

Particulate Analysers

Date Year =2009	Site		Analyser number	Calculated Spring Constant k_0	Uncertainty (%)	[4]k_0 accuracy (%)	[3]Measured Main Flow (l/min)	Uncertainty (%)	[3]Measured Total Flow /**Aux Flow** (l/min)	Uncertainty (%)
05-Aug	Cardiff Centre	PM10	24449	10874	1	-1.1	2.96	2.2	15.60	2.2
05-Aug	Cardiff Centre	PM25	26499	13541	1	-2.4	2.90	2.2	15.20	2.2
27-Jul	Chepstow A48	PM10	2128	10623	1	-0.1	**2.89**	**2.2**	**14.09**	**2.2**
03-Aug	Narberth	PM10	Not	tested	drier	warning				
27-Jul	Newport	PM10	22589	11873	1	-1	3.07	2.2	16.02	2.2
27-Jul	Newport	PM25	27252	15833	1	-1.3	3.01	2.2	15.74	2.2
04-Aug	Port Talbot Margam	PM10	22588	14427	1	-0.4	3.01	2.2	15.59	2.2
04-Aug	Port Talbot Margam	PM25	25081	10435	1	-1.2	not	measured	15.68	2.2
04-Aug	Port Talbot Margam Partisol	PM25								
04-Aug	Swansea Roadside	PM10	26293	15253	1	-2.2	**2.84**	**2.2**	**12.80**	**2.2**
04-Aug	Swansea Roadside	PM25	26292	14090	1	-2.4	**3.08**	**2.2**	**12.90**	**2.2**
12-Aug	Wrexham	PM10	212240 001						16.06	2.2

4. London Sites

Carbon Monoxide

Date Year = 2009	Site	Analyser number	[1]Zero output	Uncertainty (ppm)	[2]Calibration Factor	Uncertainty (%)	*Maximum Residual (%)
12-Aug	London Bexley	14871	-1	0.3	1.035	3	1.9
14-Aug	London Bloomsbury	239	0	0.3	1.015	3	1.2
18-Aug	London Cromwell Road 2	10776	16	0.3	0.050	3	3.7
19-Aug	London Marylebone Road	10073	0	0.3	0.946	3	3.7
13-Jul	London N. Kensington	360	3	0.3	1.265	3	0.6
17-Aug	London Westminster	867	0	0.3	1.012	3	3.1
17-Aug	Tower Hamlets Roadside	1434	1	0.3	0.973	3	0.9

Sulphur Dioxide

Date Year =2009	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)	*m-xylene interference (ppb)
12-Aug	London Bexley	14869	3	4.2	1.076	6.4	2.9	10.8
14-Aug	London Bloomsbury	74	3	4.2	1.031	5	1.0	16.2
18-Aug	London Cromwell	10779	3	4.2	1.143	6.9	5.1	14.9

The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor k = 2 , providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

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UKAS CALIBRATION

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Certificate Number: 02211
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Date Year =2009	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)	*m-xylene interference (ppb)
	Road 2							
19-Aug	London Marylebone Road	10071	3	4.2	1.165	6.6	2.3	10.5
13-Jul	London N. Kensington	1020	49	4.7	1.618	9.4	2.5	23.5
17-Aug	London Westminster	705	7	4.1	0.726	5.9	1.7	18.7

Ozone

Date Year =2009	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)
14-Aug	London Bloomsbury	435	2	5	1.039	3.6	1.0
06-Aug	London Eltham	375	8	5	1.018	3.1	1.2
04-Aug	London Haringey	538	10	5	0.996	3.2	1.3
17-Aug	London Harlington	14309	0	5	1.097	3.7	2.0
29-Jul	London Hillingdon	gr012	13	5	0.093	3.1	3.3
19-Aug	London Marylebone Road	10074	3	5	1.064	3.1	1.0
13-Jul	London N. Kensington	497	10	5	0.980	3.1	1.0
14-Jul	London Teddington	58811	1	5	0.994	3.1	1.2
17-Aug	London Westminster	879	0	5	0.982	3.2	1.2

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Oxides of Nitrogen

Date Year =2009	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	[*]Max residual (%)	[*]Converter efficiency (%)
18-Aug	Camden Kerbside	NO NOx	623	3 21	5 5.7	0.488 0.531	5 5	1.5 1.5	99.1
04-Aug	Haringey Roadside	NO NOx	397	2 2	5 5.4	0.971 1.052	5 5	1.8 1.3	98.0
12-Aug	London Bexley	NO NOx	14870	2 2	5 5.3	1.475 1.100	5 5	3.0 3.9	98.3
14-Aug	London Bloomsbury	NO NOx	74	1 2	5 5.4	1.392 1.382	5 5	0.3 0.7	98.3
18-Aug	London Cromwell Road 2	NO NOx	10775	0 2	5 5.9	2.629 2.701	5 5	5.0 5.0	96.5
06-Aug	London Eltham	NO NOx	307	1 4	5 5.3	1.073 1.004	5 5	1.2 0.8	98.8
04-Aug	London Haringey	NO NOx	11392	1 2	5 5.4	1.287 1.285	5 5	0.7 0.3	99.0
17-Aug	London Harlington	NO NOx	11491	1 3	5 5.3	1.046 1.042	5 5	0.4 1.3	99.2
29-Jul	London Hillingdon	NO NOx	14311	13 13	5 5.2	0.226 0.226	5 5	1.3 1.3	98.2
19-Aug	London Marylebone Road	NO NOx	10072	0 1	5 5.5	1.709 1.711	5 5	0.6 0.7	102.0
13-Jul	London N. Kensington	NO NOx	459	3 6	5 5.4	1.039 1.077	5 5	3.3 1.9	99.6
14-Jul	London Teddington	NO NOx	287	3 3	5 5.3	0.919 0.881	5 5	0.8 2.5	99.0
17-Aug	London Westminster	NO NOx	573	0 1	5 5.5	1.584 1.659	5 5	0.4 1.0	100.2
17-Aug	Tower Hamlets Roadside	NO NOx	306	2 7	5 5.4	1.000 0.986	5 5	0.2 0.1	99.6

Particulate Analysers

Date Year =2009	Site		Analyser number	Calculated Spring Constant k_0	Uncertainty (%)	[4]k_0 accuracy (%)	[3]Measured Main Flow (l/min)	Uncertainty (%)	[3]Measured Total Flow /**Aux Flow** (l/min)	Uncertainty (%)
18-Aug	Camden Kerbside	PM10	21159	11926	1	-0.5	2.95	2.2	15.09	2.2
18-Aug	Camden Kerbside	PM25	21391	15855	1	-0.8	3.15	2.2	15.16	2.2
04-Aug	Haringey Roadside	PM10	27338	15277	1	0.1	failed	test	9.25	2.2
04-Aug	Haringey Roadside	PM25	27278	14671	1	-0.6	3.05	2.2	15.47	2.2
12-Aug	London Bexley	PM25	25007	11588	1	-0.1	3.02	2.2	15.64	2.2
14-Aug	London Bloomsbury	PM10	24446	13708	1	-0.2	**3.07**	**2.2**	**13.25**	**2.2**
14-Aug	London Bloomsbury	PM25	27240	14595	1	-1.1	**3.04**	**2.2**	**13.35**	**2.2**
06-Aug	London Eltham	PM25	27048	13910	1	0.7	3.07	2.2	15.88	2.2
17-Aug	London Harlington	PM10	22835	14070	1	-0.9	3.04	2.2	15.82	2.2
17-Aug	London Harlington	PM25	23959	12720	1	-0.7	3.11	2.2	16.28	2.2
19-Aug	London Marylebone Road	PM10	27230	16658	1	-1.7	3.01	2.2	15.83	2.2
19-Aug	London Marylebone Road	PM25	27239	14011	1	-2.1	2.99	2.2	15.03	2.2

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UKAS CALIBRATION

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Date Year =2009	Site		Analyser number	Calculated Spring Constant k_0	Uncertainty (%)	[4]k_0 accuracy (%)	[3]Measured Main Flow (l/min)	Uncertainty (%)	[3]Measured Total Flow /**Aux Flow** (l/min)	Uncertainty (%)
19-Aug	London Marylebone Road Partisol	PM10							16.8	2.2
19-Aug	London Marylebone Road Partisol	PM25							Not in	operation
13-Jul	London N. Kensington	PM10	27391	12665	1	-0.1	**2.99**	**2.2**	**13.88**	**2.2**
13-Jul	London N. Kensington	PM25	21342	15726	1	-0.4	**2.99**	**2.2**	**12.9**	**2.2**
13-Jul	London N. Kensington Partisol	PM10							15.68	2.2
13-Jul	London N. Kensington Partisol	PM25							16.78	2.2
28-Sep	London Harrow Stanmore	PM25	27274	15995	1	-1.5	3.15	2.2	15.66	2.2
14-Jul	London Teddington	PM25	27265	15304	1	-0.4	**3.23**	**2.2**	**13.38**	**2.2**
17-Aug	London Westminster	PM25	209399 811						17.36	2.2

5. English Sites

Carbon Monoxide

Date Year = 2009	Site	Analyser number	[1]Zero output	Uncertainty (ppm)	[2]Calibration Factor	Uncertainty (%)	*Maximum Residual (%)
01-Sep	Bristol Old Market	10429	0	0.3	0.958	3	4.3
01-Sep	Bristol St Paul's	14417	0	0.3	0.995	3	1
27-Jul	Bury Roadside	1357	0	0.3	0.904	3	2.5
22-Jul	Hull Freetown	m1809-m409	51	0.3	0.051	3	1.1
23-Jul	Leeds Centre	207003	0	0.3	1.145	3	1.2
18-Aug	Leicester Centre	h	0	0.3	1.040	3	1.9
11-Aug	Liverpool Speke	M1807-M487	57	0.3	0.050	3	1.1
28-Jul	Market Harborough	60983	296	0.3	0.005	7.3	2.3
08-Jul	Middlesbrough	2287	0	0.3	0.883	3	2.3
06-Jul	Newcastle Centre	M1805-M488	51	0.3	0.049	3	0.7
14-Jul	Salford Eccles	2386	0	0.3	0.952	3	2.1
28-Jul	Sheffield Centre	14864	-1	0.3	1.015	3	0.9
11-Aug	Southampton Centre	m940	8	0.3	0.049	3	1.4
17-Sep	St Osyth	60872	616	0.3	0.491	10.0	4.5

Sulphur Dioxide

Date Year =2009	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)	*m-xylene interference (ppb)
21-Jul	Barnsley 12	10781	3	4.4	1.092	7.3	3.8	6.0
21-Jul	Barnsley Gawber		189	4.4	1.146	5	1.6	7.4
05-Aug	Birmingham Tyburn	301003	1	4.2	1.056	5.3	1.8	4.1
01-Sep	Bristol St Paul's	14322	27	4.2	1.007	5	0.8	17.0

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Date Year =2009	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)	*m-xylene interference (ppb)
20-Aug	Harwell	14350	5	4.2	1.013	5.6	3.2	4.1
22-Jul	Hull Freetown	m868	244	4.1	0.185	7.1	4.7	17.0
23-Jul	Ladybower	m793	51	4.1	0.630	5	1.3	10.3
24-Jul	Leamington Spa	53	1	4.2	0.913	5.1	3.6	21.9
23-Jul	Leeds Centre	214004	2	4.2	1.057	6.2	2.1	2.1
18-Aug	Leicester Centre	h	0	4.2	1.041	5	0.6	1.7
22-Jul	Leominster	85	1	4.2	0.994	5	0.6	18.9
11-Aug	Liverpool Speke	M626	231	4.5	0.373	5	1.3	16.5
20-Jul	Lullington Heath	m690	99	4.1	0.517	5	0.9	18.3
13-Jul	Manchester Piccadilly	447-011	60	4	0.190	5.3	1.0	23.3
08-Jul	Middlesbrough	1660	1	4.1	0.768	5	1.8	7.7
06-Jul	Newcastle Centre	M1814-M699	48	4.1	0.887	5	2.0	19.5
19-Aug	Northampton	890563033	1	4.2	1.007	5.5	1.3	21.1
21-Jul	Nottingham Centre		3	4.1	0.204	6	2.1	3.4
3-Sep	Rochester Stoke	414	7	4.2	1.165	7.3	2.0	10.5
14-Jul	Salford Eccles	2346	1	4.2	1.150	6.7	2.4	9.2
05-Aug	Sandwell West Bromwich	14322	1	4.3	1.056	5	2.5	14.3
22-Jul	Scunthorpe Town	468	9	4.2	1.121	6.3	2.1	3.4
28-Jul	Sheffield Centre	12182	-4	4.2	0.886	6.8	2.4	1.2
11-Aug	Southampton Centre	m676	599	4.1	0.084	5.2	3.0	17.7
03-Sep	Stanford-le-Hope Roadside	1828	0	4.2	1.047	7.2	2.9	15.2
	Sunderland Silksworth		Not	audited -	site not	operational		
26-Aug	Thurrock	555	19	4.1	0.914	9.6	4.6	6.4
06-Jul	Wicken Fen	82	-15	4.1	0.447	5	4.3	14.9

Ozone

Date Year =2009	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)
21-Jul	Barnsley Gawber	ambirak	-1	5	0.971	3.1	1.8
05-Aug	Birmingham Tyburn	301002	4	5	1.010	3.2	0.8
05-Aug	Birmingham Tyburn Roadside	154	-1	5	1.084	3.1	0.9
13-Aug	Blackpool Marton		0	5	0.970	3.4	1.4
21-Jul	Bottesford	357	-1	5	0.998	3.1	0.3
10-Aug	Bournemouth	17503	-1	5	1.024	3.2	0.8
01-Sep	Brighton Preston Park	542	6	5	0.499	3.3	1.3
01-Sep	Bristol St Paul's	14358	-1	5	1.011	3.2	1.1
26-Aug	Charlton Mackrell	95249	0	5	0.994	3.1	0.8
23-Jul	Coventry Memorial Park	4	-1	5	0.948	3.7	1.8
24-Aug	Exeter Roadside		-9	5	0.864	3.2	0.6
14-Jul	Glazebury	138	18	5	0.555	3.1	2.7
29-Jul	Great Dun Fell	163	3	5	0.512	3.1	1.0
20-Aug	Harwell	199	-2	5	0.518	3.1	3.4
18-Jul	High Muffles	1641	1	5	1.092	3.2	3.1
22-Jul	Hull Freetown	m1819-m356	248	5	0.104	3.2	2.8
23-Jul	Ladybower	125b-101	51	5	0.458	3.1	0.9
24-Jul	Leamington Spa	1459	1	5	1.009	3.7	0.1
23-Jul	Leeds Centre	206003	0	5	0.940	3.1	1.1
18-Aug	Leicester Centre	h	0	5	0.970	4.1	2.6
22-Jul	Leominster	170	4	5	0.963	3.1	0.3
11-Aug	Liverpool Speke	M1584-M331	253	5	0.102	3.4	2.6

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AEA

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Date Year =2009	Site	Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max Residual (%)
20-Jul	Lullington Heath	m337	98	5	0.466	3.1	1.2
13-Jul	Manchester Piccadilly		-13	5.8	0.193	4.9	4.6
13-Jul	Manchester South	1317	-3	5	1.026	3.2	1.0
28-Jul	Market Harborough	60894	18	5	0.049	3.1	0.4
08-Jul	Middlesbrough	944	-1	5	1.011	3.1	1.1
06-Jul	Newcastle Centre	M1357	0	5	0.471	3.2	1.3
19-Aug	Northampton		0	5	0.943	3.1	0.5
21-Jul	Nottingham Centre	0427-011	-2	5	0.098	3.2	0.7
25-Aug	Plymouth Centre	cm08060027	0	5	0.988	3.1	0.7
30-Jul	Portsmouth	360-205002	0	5	0.997	3.3	1.5
17 Sep	Preston	cm08060042	-2	3	0.958	3.3	0.6
09-Jul	Reading New Town	n00461	4	5.3	1.194	4.3	1.7
3-Sep	Rochester Stoke	378	2	5	1.112	3.2	1.3
14-Jul	Salford Eccles	2363	-2	5	1.046	3.2	0.9
05-Aug	Sandwell West Bromwich	14358	1	5	0.947	3.2	1.2
28-Jul	Sheffield Centre	8060024	2	5	0.997	3.2	2.6
07-Jul	Sibton	146	-22	5	0.532	3.1	0.7
11-Aug	Southampton Centre	m354	235	5	0.099	3.1	0.2
27-Aug	Southend-on-Sea	205005	1	5	0.943	3.7	1.8
17-Sep	St Osyth	60860	-2	5	0.491	3.1	0.3
22-Jul	Stoke-on-Trent Centre	8060026	-8	5	0.882	3.8	1.1
	Sunderland Silksworth		Not	audited -	site not	operational	
26-Aug	Thurrock	1040	5	5	0.519	3.8	4.6
7-Jul	Weybourne	AEA0030	0	3	1.001	3.5	0.4
06-Jul	Wicken Fen	165	-11	5	0.535	3.1	1.0
15-Jul	Wigan Centre		-2	5	0.983	3.1	1.2
10-Aug	Wirral Tranmere	I-ar-012	0	5	1.003	3.3	1.6
21-Jul	Yarner Wood	176	32	5	0.510	3.1	0.9

Oxides of Nitrogen

Date Year =2009	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
21-Jul	Barnsley Gawber	NO NOx		19 19	5 5.8	1.716 1.726	5 5	1.1 1.2	94.7
03-Sep	Bath Roadside	NO NOx	12758	6 7	5 5.3	1.248 1.233	5 5	4.7 5.7	99.5
07-Jul	Billingham	NO NOx	574	-1 -2	5 5.4	1.399 1.379	5 5	0.4 0.1	99.0
05-Aug	Birmingham Tyburn	NO NOx	209006	1 0	5 5.3	1.039 1.026	5 5	1.9 2.2	95.8
05-Aug	Birmingham Tyburn Roadside	NO NOx	68	-2 0	5 5.4	1.307 1.310	5 5	1.1 1.1	96.7
15-Jul	Blackburn Darwen Roadside	NO NOx	688b-303	1 2	5 5.6	1.023 1.091	5 5	1.7 0.6	100.4
13-Aug	Blackpool Marton	NO NOx		28 29	5 6.5	2.654 2.669	5 5	2.7 2.4	100.0
10-Aug	Bournemouth	NO NOx	17507	0 0	5 5.3	1.176 1.160	5 5	1.9 2.8	99.5
01-Sep	Brighton Preston Park	NO NOx	2222	4 5	5 5.7	1.030 1.039	5 5	2.2 2.2	96.0
01-Sep	Brighton Roadside	NO NOx	1225	-1 2	5 5.3	1.190 1.214	5 5	0.6 0.7	96.4
01-Sep	Bristol Old Market	NO NOx	10510	0 1	5 5.3	1.174 1.158	5 5	1.7 2.9	95.2
01-Sep	Bristol St Paul's	NO NOx	14353	1 2	5 5.6	2.167 2.136	5 5	1.1 0.6	96.4

The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor k = 2 , providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

AEA

CERTIFICATE OF CALIBRATION

UKAS CALIBRATION

0401

Certificate Number: 02211
AEA Identification Number: ED42523030

Date Year =2009	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
27-Jul	Bury Roadside	NO	1357	-1	6.6	6.125	5.5	4.0	
		NOx		0	8.3	6.429	5.3	3.4	90.5
06-Jul	Cambridge Roadside	NO	9545	-1	5	1.165	5	1.6	
		NOx		-1	5.3	1.158	5	1.3	97.9
02-Sep	Canterbury	NO	1147	0	5	1.277	5	1.4	
		NOx		1	5.4	1.249	5	2.1	96.9
27-Jul	Carlisle Roadside	NO		-1	5	1.346	5	2.6	
		NOx		8	5.8	1.429	5	1.1	96.3
26-Aug	Charlton Mackrell	NO	12895	1	5	1.123	5	1.1	
		NOx		1	5.3	1.116	5	0.6	96.8
29-Jul	Chesterfield	NO	m528	1	5	1.129	5	1.2	
		NOx		3	5.3	1.148	5	0.8	97.5
29-Jul	Chesterfield Roadside	NO		100	5	0.913	5	1.4	
		NOx		102	5.3	0.924	5	2.5	98.2
23-Jul	Coventry Memorial Park	NO	7	0	5	0.938	5	0.4	
		NOx		1	5.3	0.946	5	1.4	98.3
24-Aug	Exeter Roadside	NO		-1	5	0.999	5	2.1	
		NOx		0	5.3	0.987	5	2.0	101.3
14-Jul	Glazebury	NO	78	1	5	0.834	5	2.6	
		NOx		-10	5.4	0.807	5	2.8	98.4
20-Aug	Harwell	NO	14355	18	5	1.068	5	1.1	
		NOx		15	5.3	1.044	5	0.7	99.6
18-Jul	High Muffles	NO	1783	0	5	1.061	5	1.8	
		NOx		0	5.3	1.085	5	1.4	97.2
03-Aug	Horley	NO	m525	0	5	0.950	5	3.2	
		NOx		2	5.3	0.950	5	3.9	100.0
22-Jul	Hull Freetown	NO	m1803-m732	258	5	0.391	5	0.4	
		NOx		268	5.2	0.402	5	0.6	97.1
23-Jul	Ladybower	NO	72	-1	5	1.133	5	1.5	
		NOx		-2	5.3	1.117	5	1.8	100.5
24-Jul	Leamington Spa	NO	1705	1	5	1.613	5	4.3	
		NOx		6	6.1	1.671	5	3.6	96.5
23-Jul	Leeds Centre	NO	210005	3	5	0.988	5	1.5	
		NOx		3	5.4	0.969	5	1.5	97.2
23-Jul	Leeds Headingley Kerbside	NO	696b-308	50	5	1.213	5	3.1	
		NOx		53	5.5	1.217	5	1.8	99.5
18-Aug	Leicester Centre	NO	h	0	5	1.005	5	0.5	
		NOx		-1	5.3	0.979	5	1.3	98.0
22-Jul	Leominster	NO	346	0	5	0.871	5	1.9	
		NOx		-3	5.3	0.814	5	2.9	98.1
11-Aug	Liverpool Queen's Drive Roadside	NO	1734	4	5	1.186	5	1.5	
		NOx		9	5.3	1.205	5	1.8	100.1
11-Aug	Liverpool Speke	NO	M1805-M734	243	5	0.436	5	2.6	
		NOx		250	5.3	0.436	5	2.4	97.3
20-Jul	Lullington Heath	NO	m1657-m675	100	5	1.112	5	1.8	
		NOx		100	5.4	1.041	5	1.8	97.9
13-Jul	Manchester Piccadilly	NO	g-ra477-013	11	5	0.555	5	1.6	
		NOx		10	5.2	0.566	5	2.0	95.8
13-Jul	Manchester South	NO	1447	1	5	1.184	5	2.7	
		NOx		4	5.3	1.057	5	3.3	98.3
28-Jul	Market Harborough	NO	61963	0	5	0.538	5	2.5	
		NOx		17	5.2	0.553	5	1.2	97.4
08-Jul	Middlesbrough	NO	204	1	5	0.980	5	1.3	
		NOx		2	5.3	0.976	5	1.3	99.0
06-Jul	Newcastle Centre	NO	M1800-M736	49	5	2.368	5	0.9	
		NOx		50	5.7	2.373	5	0.8	98.2
06-Jul	Newcastle Cradlewell Road	NO	m2106-m860	0	5	1.033	5	3.5	
		NOx		11	5.3	1.060	5	2.4	97.6
19-Aug	Northampton	NO	8512250201	1	5	1.014	5	1.6	
		NOx		3	5.3	1.011	5	0.7	99.2

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AEA

CERTIFICATE OF CALIBRATION

UKAS CALIBRATION

0401

Certificate Number: 02211
AEA Identification Number: ED42523030

Date Year =2009	Site		Analyser number	[1]Zero output	Uncertainty (ppb)	[2]Calibration Factor	Uncertainty (%)	*Max residual (%)	*Converter efficiency (%)
21-Jul	Nottingham Centre	NO NOx	G-RA0447-009	-29 -31	5 5.7	0.556 0.552	5 5	0.8 1.2	98.3
06-Jul	Oxford Centre Roadside	NO NOx	m947	106 109	5 5.5	1.108 1.132	5 5	0.5 0.6	98.2
06-Jul	Oxford St Ebbes	NO NOx	1	105 104	5 5.3	1.116 1.139	5 5	2.6 3.5	88.3
25-Aug	Plymouth Centre	NO NOx	08050062	3 3	5 5.4	1.004 1.008	5 5	2.7 0.6	102.6
30-Jul	Portsmouth	NO NOx	apna-370	0 1	5 5.3	1.009 1.013	5 5	1.5 2.3	97.9
17-Sep	Preston	NO NOx	08050064	2 2	5 5.3	0.911 0.890	5	2.9 2.9	98.3
09-Jul	Reading New Town	NO NOx	n00434	-4 -4	5 5.5	1.834 1.835	5 5	2.5 2.3	97.8
3-Sep	Rochester Stoke	NO NOx	473	1 -1	5 5.7	0.866 0.855	5 5	1.3 2.0	100.8
14-Jul	Salford Eccles	NO NOx	2381	0 1	5 5.7	1.061 1.071	5 5	2.5 1.4	96.5
05-Aug	Sandwell West Bromwich	NO NOx	14355	0 1	5 5.3	0.989 0.987	5 5	2.2 1.8	99.6
28-Jul	Sandy Roadside	NO NOx	2585	0 1	5 5.3	1.256 1.244	5 5	3.7 3.6	98.7
22-Jul	Scunthorpe Town	NO NOx	m1225-m526	31 47	5 5.8	2.497 2.636	5 5	2.2 2.4	98.9
28-Jul	Sheffield Centre	NO NOx	8050055	2 2	5 5.3	0.966 0.933	5 5	3.9 3.2	98.8
28-Jul	Sheffield Tinsley	NO NOx	189	9 9	5 5.6	2.061 2.027	5 5	0.7 0.6	100
11-Aug	Southampton Centre	NO NOx	m723	287 282	5 5.2	0.114 0.117	5 5	0.4 0.9	101
27-Aug	Southend-on-Sea	NO NOx	210002	1 2	5 5.3	0.996 1.004	5 5	3.2 3.1	98.5
17-Sep.2	St Osyth	NO NOx	60988	-1 -2	5 5.2	0.528 0.539	5 5	2.9 2.7	99.2
03-Sep	Stanford-le-Hope Roadside	NO NOx	2570	1 0	5 5.3	0.999 1.003	5 5	0.7 1.1	95.6
07-Jul	Stockton-on-Tees Eaglescliffe	NO NOx	10448	5 7	5 5.3	1.217 1.219	5 5	0.4 0.4	96.9
22-Jul	Stoke-on-Trent Centre	NO NOx	8050070	-3 -4	5 5.4	0.845 0.897	5 5	0.5 0.5	96.4
	Sunderland Silksworth	NO NOx		Not	audited -	site not	operational		
26-Aug	Thurrock	NO NOx	920	2 4	5 5.2	0.698 0.721	5 5	3.1 4.6	99.4
25-Aug	Walsall Willenhall	NO NOx	2	0 1	5 5.3	0.749 0.753	5 5	0.6 1.3	99.1
15-Jun	Warrington	NO NOx	450b-198	-1 1	5 5.4	1.07 1.082	5 5	3.1 3.6	100.5
06-Jul	Wicken Fen	NO NOx	2223	23 16	5 5.3	0.576 0.539	5 5	0.4 0.8	
15-Jul	Wigan Centre	NO NOx		0 0	5 5.3	0.983 0.915	5 5	1.9 1.8	99.6
10-Aug	Wirral Tranmere	NO NOx	l-ar-012	25 25	5 6.3	2.132 2.23	5 5	1.7 2.4	98.4
21-Jul	Yarner Wood	NO NOx	1784	12 10	5 5.3	1.081 1.054	5 5	1.1 1.4	102.1
23-Jul	York Fishergate	NO NOx	622b-272	-1 1	5 5.4	1.299 1.314	5 5	2.8 2.3	100.5

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AEA

CERTIFICATE OF CALIBRATION

UKAS CALIBRATION

0401

Certificate Number: 02211
AEA Identification Number: ED42523030

Particulate Analysers

Date Year =2009	Site		Analyser number	Calculated Spring Constant k_0	Uncertainty (%)	[4]k_0 accuracy (%)	[3]Measured Main Flow (l/min)	Uncertainty (%)	[3]Measured Total Flow /**Aux Flow** (l/min)	Uncertainty (%)
05-Aug	Birmingham Tyburn	PM10	27255	14790	1	-1.0	3.10	2.2	15.53	2.2
05-Aug	Birmingham Tyburn	PM25	21372	14607	1	-0.5	3.09	2.2	15.44	2.2
05-Aug	Birmingham Tyburn Roadside	PM10	2000	12048	1	-2.7	2.99	2.2	15.58	2.2
05-Aug	Birmingham Tyburn Roadside	PM25	26567	13900	1	-1.2	2.97	2.2	15.24	2.2
13-Aug	Blackpool Marton	PM25	24424	12856	1	-0.3	2.94	2.2	15.83	2.2
10-Aug	Bournemouth	PM25							17.20	2.2
01-Sep	Brighton Preston Park	PM25	212200 001						16.87	2.2
01-Sep	Bristol St Paul's	PM10	24426	13180	1	0.0	**3.00**	**2.2**	**13.40**	**2.2**
01-Sep	Bristol St Paul's	PM25	26495	13595	1	-2.3	**3.12**	**2.2**	**13.47**	**2.2**
27-Jul	Bury Roadside	PM10	27335	16000	1	-1.2	3.06	2.2	16.58	2.2
27-Jul	Bury Roadside	PM25	27334	14900	1	-1.1	3.00	2.2	16.12	2.2
27-Jul	Carlisle Roadside	PM10	27257	14420	1	-0.5	3.02	2.2	15.57	2.2
27-Jul	Carlisle Roadside	PM25	27272	13817	1	-0.8	2.95	2.2	15.60	2.2
29-Jul	Chesterfield	PM10	22989	12516	1	-2.7	3.03	2.2	16.36	2.2
29-Jul	Chesterfield	PM25	27314	12401	1	-0.3	**3.10**	**2.2**	**13.53**	**2.2**
29-Jul	Chesterfield Roadside	PM10	22299	11085	1	-2.3	3.03	2.2	16.08	2.2
23-Jul	Coventry Memorial Park	PM25	25026	13020	1	-1.3	**3.26**	**2.2**	**13.37**	**2.2**
20-Aug	Harwell	PM10	21489	14408	1	-3.4	**3.01**	**2.2**	**13.59**	**2.2**
20-Aug	Harwell	PM25		Not in	operation	at audit				
20-Aug	Harwell Partisol	PM10							16.62	2.2
20-Aug	Harwell Partisol	PM25							16.81	2.2
22-Jul	Hull Freetown	PM10	24445	14178	1	0.5	3.45	2.2	16.87	2.2
22-Jul	Hull Freetown	PM25	26498	13963	1	-1.6	not	tested	unsafe	access
24-Jul	Leamington Spa	PM10	27295	14976	1	-0.1	2.96	2.2	15.60	2.2
24-Jul	Leamington Spa	PM25	27248	14180	1	0.0	3.05	2.2	15.90	2.2
23-Jul	Leeds Centre	PM10	24451	13371	1	-0.2	3.16	2.2	16.01	2.2
23-Jul	Leeds Centre	PM25	27254	16953	1	-0.5	3.15	2.2	15.89	2.2
23-Jul	Leeds Headingley Kerbside	PM10	27287	15013	1	-1.0	not	tested	unsafe	access
23-Jul	Leeds Headingley Kerbside	PM25	27249	14576	1	-0.9	not	tested	unsafe	access
18-Aug	Leicester Centre	PM10	24442	14117	1	-2.4	2.97	2.2	15.65	2.2
18-Aug	Leicester Centre	PM25		analyser	not	in	service			
11-Aug	Liverpool Speke	PM10	24450	15837	1	0.2	2.81	2.2	16.39	2.2
11-Aug	Liverpool Speke	PM25	26564	14697	1	-1.4	2.84	2.2	15.38	2.2
13-Jul	Manchester Piccadilly	PM25	26038	12776	1	-2.3	2.62	2.2	14.86	2.2
08-Jul	Middlesbrough	PM10	24325	13940	1	-1.4	3.21	2.2	16.62	2.2
08-Jul	Middlesbrough	PM25	27195	15822	1	-1.2	3.20	2.2	15.60	2.2
06-Jul	Newcastle Centre	PM10	24448	13866	1	0.3	2.81	2.2	14.82	2.2
06-Jul	Newcastle Centre	PM25	24447	14932	1	0.7	3.16	2.2	16.17	2.2
19-Aug	Northampton	PM25							not	tested
21-Jul	Nottingham Centre	PM25	25025	12083	1	-0.8	3.03	2.2	16.25	2.2
06-Jul	Oxford St Ebbes	PM10	21350	14688	1	-0.9	3.08	2.2	17.01	2.2
06-Jul	Oxford St Ebbes	PM25	27235	17038	1	-0.8	2.99	2.2	16.04	2.2
25-Aug	Plymouth Centre	PM10	t	12954	1	0.1	2.65	2.2	15.10	2.2
30-Jul	Portsmouth	PM10	2000	13200	1	-0.9	2.9	2.2	16.03	2.2

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AEA

CERTIFICATE OF CALIBRATION

UKAS CALIBRATION

0401

Certificate Number: 02211
AEA Identification Number: ED42523030

Date Year =2009	Site		Analyser number	Calculated Spring Constant k_0	Uncertainty (%)	[4]k_0 accuracy (%)	[3]Measured Main Flow (l/min)	Uncertainty (%)	[3]Measured Total Flow /**Aux Flow** (l/min)	Uncertainty (%)
30-Jul	Portsmouth	PM25	21358	18273	1	-1.5	**3.0**	**2.2**	**13.32**	**2.2**
12-Aug	Preston	PM25	22881	12747	1	-1.6	3.10	2.2	16.07	2.2
09-Jul	Reading New Town	PM10	21315	13155	1	-0.3	2.87	2.2	17.00	2.2
09-Jul	Reading New Town	PM25	25090	13915	1	-1.6	2.95	2.2	16.31	2.2
23-Jul	Rochester Stoke	PM10	27330	14019	1	-0.9	3.09	2.2	15.68	2.2
23-Jul	Rochester Stoke	PM25	23140	15880	1	-0.4	3.03	2.2	15.79	2.2
14-Jul	Salford Eccles	PM10	21168	14515	1	0.7	3.00	2.2	15.21	2.2
14-Jul	Salford Eccles	PM25	27205	14480	1	-1.1	3.04	2.2	15.01	2.2
25-Aug	Saltash Roadside	PM10	24328	13997	1	-1.0	**2.93**	**2.2**	**14.03**	**2.2**
28-Jul	Sandy Roadside	PM10	22018	13760	1	-1.3	3.14	2.2	16.62	2.2
28-Jul	Sandy Roadside	PM25	27260	13686	1	-0.8	3.05	2.2	15.65	2.2
22-Jul	Scunthorpe Town	PM10	2000	12605	1	-0.5	**3.50**	**2.2**	**15.78**	**2.2**
28-Jul	Sheffield Centre	PM10	25024	12094	1	-1.3	2.39	2.2	15.54	2.2
28-Jul	Sheffield Centre	PM25	27253	15470	1	-1.1	3.06	2.2	16.07	2.2
11-Aug	Southampton Centre	PM10	24448	13894	1	0.1	**2.93**	**2.2**	**13.21**	**2.2**
11-Aug	Southampton Centre	PM25	27256	16441	1	-0.5	**2.98**	**2.2**	**12.68**	**2.2**
27-Aug	Southend-on-Sea	PM25	22927	12438	1	0.0	**3.14**	**2.2**	**13.05**	**2.2**
03-Sep	Stanford-le-Hope Roadside	PM10	24397	13508	1	0.5	2.76	2.2	15.35	2.2
03-Sep	Stanford-le-Hope Roadside	PM25	27226	15367	1	-0.9	3.06	2.2	16.48	2.2
07-Jul	Stockton-on-Tees Eaglescliffe	PM10	17691						16.90	2.2
07-Jul	Stockton-on-Tees Eaglescliffe	PM25	17805						16.80	2.2
22-Jul	Stoke-on-Trent Centre	PM10	25028	12319	1	-1.5	3.08	2.2	16.71	2.2
22-Jul	Stoke-on-Trent Centre	PM25	27262	13313	1	-1.4	3.05	2.2	15.44	2.2
	Sunderland Silksworth	PM25	27247	not	audited	site	not	operational		
26-Aug	Thurrock	PM10	27329	14000	1	-0.4	3.08	2.2	not	tested
15-Jun	Warrington	PM10	27183	17217	1	-1.2	3.01	2.2	16.02	2.2
15-Jun	Warrington	PM25	27269	16244	1	-0.7	3.05	2.2	16.19	2.2
15-Jul	Wigan Centre	PM25	27291	15101	1	-0.8	3.16	2.2	15.64	2.2
10-Aug	Wirral Tranmere	PM25	22883	13286	1	-0.1	3.16	2.2	16.20	2.2
23-Jul	York Bootham	PM10	28177	14598	1	-0.9	3.07	2.2	15.64	2.2
23-Jul	York Bootham	PM25	27209	16416	1	-1.2	3.03	2.2	15.66	2.2
23-Jul	York Fishergate	PM10	22101	13445	1	2.0	**3.28**	**2.2**	**14.80**	**2.2**

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AEA

CERTIFICATE OF CALIBRATION

UKAS CALIBRATION

0401

Certificate Number: 02211
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The above factors have been calculated using certified standards. The analysers listed above have been tested for zero response, calibration factor, linearity, converter efficiency (NOx analysers), m-xylene interference (SO_2 analysers), k_0 / main flow rate (for TEOM analysers) and total flow rate (for particulate analysers), by documented methods. Note that the test results are valid on the day of test only, as analyser drift over time cannot be quantified.

The calibration results for NOx, NO, CO, SO_2, O_3 and Particulates are those that fall within our scope of accreditation. Results marked with an asterisk (*) on this certificate fall outside our accreditation, but have been included for completeness.

[1] The zero response is the zero reading on the logging system of the analyser when audit zero gas was introduced to the analysers under test.
[2] The calibration factor is the multiplying factor required to scale the reading on the data logging system into concentration units (ppb for NO, NOx and SO_2, ppm for CO – 1ppm = 1000 ppb). It should be used in conjunction with the analyser output and the zero response, according to the following equation:

Concentration = (output – zero response) x Calibration factor

The scaling factor for gaseous analysers is calculated using mole fraction concentrations.

[3] The measured main flow rate (where this is applicable) is the flow rate through the sensor unit of a TEOM analyser. The measured aux flow rate (where this is applicable) is the flow rate through the bypass tubing of the TEOM particulate analyser under test. The measured total flow rate is the total flow rate through the particulate analyser under test. Units of flow are $l.min^{-1}$. Measurements shown in **bold** are not made at the normal sample inlet and may not therefore accurately represent the actual flow through the inlet.
[4] The k_0 accuracy value (specifically for TEOM analysers) indicates the closeness of the calculated result to the manufacturer's specified value of k_0.

* The maximum residual is the percentage maximum deviation of the worst linearity point from the line of best fit
* Converter is the measured efficiency of the NO_2 to NO converter in the Nitrogen Oxides analyser
* meta-xylene interference is the response of the SO_2 analyser when supplied with approx 1ppm meta-xylene.

This certificate is an electronic representation of a certificate signed by Stewart Eaton and held by AEA at the above address. Hard copies are available on request.

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