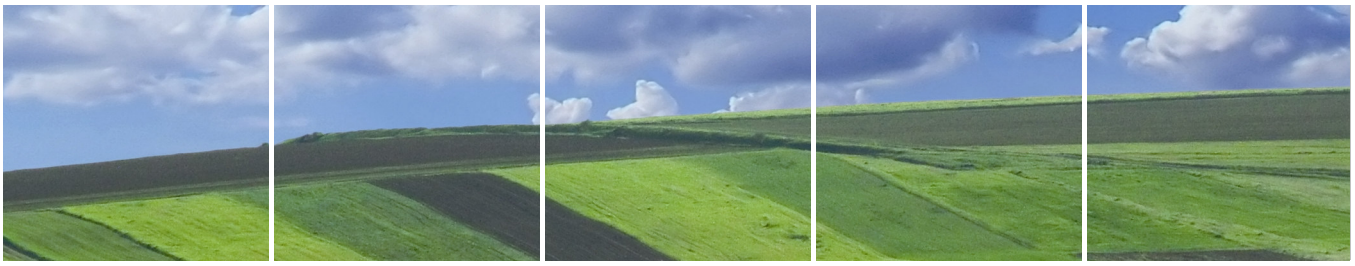
AEA



QA/QC Data Ratification Report for the Automatic Urban and Rural Network, October-December 2009, and Annual Review 2009

Report produced for the Department for Environment, Food and Rural Affairs, Scottish Government, Welsh Assembly Government and the DoE in Northern Ireland

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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 90.3% for all pollutants (O_3, NO_2, SO_2, CO, PM_{10} and $PM_{2.5}$) during the 3-month reporting period October-December 2009. Data capture rates for CO, NO_2, O_3 and SO_2 were above 90%. There were 31 sites with data capture less than 90% for the period.

The number of monitoring sites in the AURN during this quarter was 132, of which 70 are Local Authority owned sites affiliated to the national network. Some are colocated gravimetric particulate analysers at sites with automatic analysers.

The main reasons for data loss at the sites have been provided and these were predominantly due to 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 those implemented during 2009 are summarised in this report. The changes are necessary to ensure compliance with the new European Air Quality Directive (2008/50/EC). Considerable progress has been made in implementing these changes though they will still take some more time to complete. Eight additional analysers (including two new sites) were commissioned this quarter.

Part B Annual Review 2009

The network has continued to undergo changes as a result of the requirements of the European Air Quality Directive. A number of new sites have been affiliated into the network, and a programme of upgrading TEOM particle analysers to FDMS has made significant progress, A considerable number of FDMS $PM_{2.5}$ analysers have also been installed. Full details are given in Part B. There were a total of 132 sites operating during the year.

The overall data capture for 2009 was 90.4%, with all pollutants except $PM_{2.5}$ and PM_{10} more than 90%. There were 45 sites with data capture less than 90%

Considerable progress has been made towards replacing non-CEN compliant equipment with approved analysers at Defra-funded sites. A large procurement exercise has been undertaken by the Central management and Control Unit (CMCU) and the Equipment Service Units (ESUs) have installed the equipment predominantly during the routine service visits. The Quality Assurance/Quality Control Unit (QA/QC Unit) have produced manuals and carried out commissioning audits and training for the new equipment.

Problems have been identified with gravimetric particulate measurements over recent years. There has been considerable investigation carried out into the apparent overestimation of concentrations. As a result, the gravimetric data remained provisional for the whole of 2008. The issues have now been resolved and the data published as ratified.

QA/QC Unit continues to maintain a watching brief on new methodologies and technical advances in air quality measurement in order to keep pace with any changes that may be required in the coming years, particularly in view of the recently published European CEN standards. Procedures used in the UK network intercomparison now fully conform to the CEN requirements. In addition, the QA/QC Unit has undertaken a series of meetings with the Equipment Support Units (ESUs) to discuss data quality issues and to highlight changes required to fully implement CEN procedures

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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 October-December 2009. During this period there were 132 operational monitoring sites in the Network of which there are 96 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 62 Defra-funded sites and 70 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 90.3% for all pollutants (O_3, NO_2, SO_2, CO, PM_{10} and $PM_{2.5}$) during the 3 month reporting period October-December 2009 (see Table 1.1). All gaseous pollutants achieved 90% or higher data capture. 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. 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
Q4	96.1	87.0	89.1	90.4	92.1	91.8	90.3

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%)	Q4 Oct-Dec 2009 (No. below 90%)
CO	26	7	2	6	3
NO_2	113	23	16	29	19
O_3	80	12	7	10	11
PM_{10}[1]	64	18	18	22	15
$PM_{2.5}$[1]	73	22	27	24	22
SO_2	44	2	3	9	5
Total <90%		81	71	100	75

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

In total, 32 out of the 132 operational network sites in the quarter (24%) had an average data capture rate below the required 90% level for the October-December 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%, October-December 2009

Site	Owner	Site Average	Principle Reason for Data Loss
England			
Barnsley Gawber	Affiliate	61.5	Poorly performing analyser replaced, but data quality still poor.
Birmingham Tyburn R/S	Affiliate	89.9	Poor performance of PM_{10} FDMS analyser
Bristol Old Market	Affiliate	66.6	Failed NOx converter
Camden Kerbside	Affiliate	74.6	Faults in NOx and $PM_{2.5}$ analysers
Chesterfield	Affiliate	88.4	Power cuts and FDMS fault
Exeter Roadside	Affiliate	49.4	Unspecified ozone analyser fault resulted in poor data
High Muffles	DEFRA	25.2	Power supply problems
Leicester Centre	DEFRA	84.8	Long term $PM_{2.5}$ analyser problems, and sampling problems associated with equipment replacement
London Harlington	Affiliate	79.7	Poor performance of $PM_{2.5}$ and PM_{10} FDMS analysers
London Marylebone Road Partisol	Affiliate	45.1	$PM_{2.5}$ internally sampling
Manchester Piccadilly	DEFRA	85.6	$PM_{2.5}$ FDMS flow/filter/leak problems
Middlesbrough	Affiliate	65.0	Analysers turned off on occasions due to air conditioning problems
Oxford St Ebbes	Affiliate	87.1	Air conditioning problems
Portsmouth	Affiliate	74.0	Very poor $PM_{2.5}$ data deleted back to 1 March 2009
Reading New Town	DEFRA	66.9	Unexplained step change in NO_2 data following replacement of analyser; data deleted.
Rochester Stoke	Affiliate	22.8	Site turned off due to water leak
Southend-on-Sea	DEFRA	64.7	Unexplained step change in NO_2 data following replacement of analyser; data deleted.
Stanford-le-Hope R/S	Affiliate	82.2	SO_2 and $PM_{2.5}$ analysers faulty and removed for repair
Stoke-on-Trent Centre	DEFRA	84.6	Ozone analyser sampling internally following equipment upgrade
Sunderland Silksworth	Affiliate	87.2	Air conditioning problems
Yarner Wood	DEFRA	89.6	O3 analyser faulty following power cut
Ireland			
N Ireland			
Armagh Roadside	Affiliate	49.8	NO_2 analyser faulty since start of 2009
Derry	Affiliate	78.9	Ongoing long-term performance issues with $PM_{2.5}$ FDMS analyser. Leak in PM_{10} analyser at winter 2010 audit
Scotland			
Aberdeen Union Street R/S	Affiliate	0.0	Suspected NOx converter fault
Auchencorth Moss PM_{10} PM_{25}	DEFRA	49.3	PM_{10} data deleted
Edinburgh St Leonards	DEFRA	86.7	PM_{10} data deleted from installation of new dryer in July up to replacement of analyser in January 2010-see Section 10.3
Lerwick	DEFRA	66.3	Period of very low data deleted
Wales			
Chepstow A48	Affiliate	81.7	Spurious PM_{10} data
Cwmbran	Affiliate	84.0	NOx analyser failed and replacement took some time
Newport	Affiliate	84.0	Poor performance of PM_{10} FDMS analyser

P. Talbot Margam PM_{10} $PM_{2.5}$	Affiliate	67.4	Various Partisol faults
Swansea Roadside	Affiliate	78.3	$PM_{2.5}$ FDMS faults ultimately leading to removal for repair

There is a relatively high proportion of affiliate sites with data capture below 90%; this may reflect the different contractual arrangements for service and repair.

1.2 LSO Manual

As noted in Section 1.1, 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.

Recent updates include changes to FDMS procedures, use of zero air cylinders for monthly calibrations, and the removal of the requirement for LSOs to perform monthly calibrations of the ozone analyser.

1.3 AURN Hub

The AURN project information hub is located at[1]: http://aurnhub.defra.gov.uk/login.php

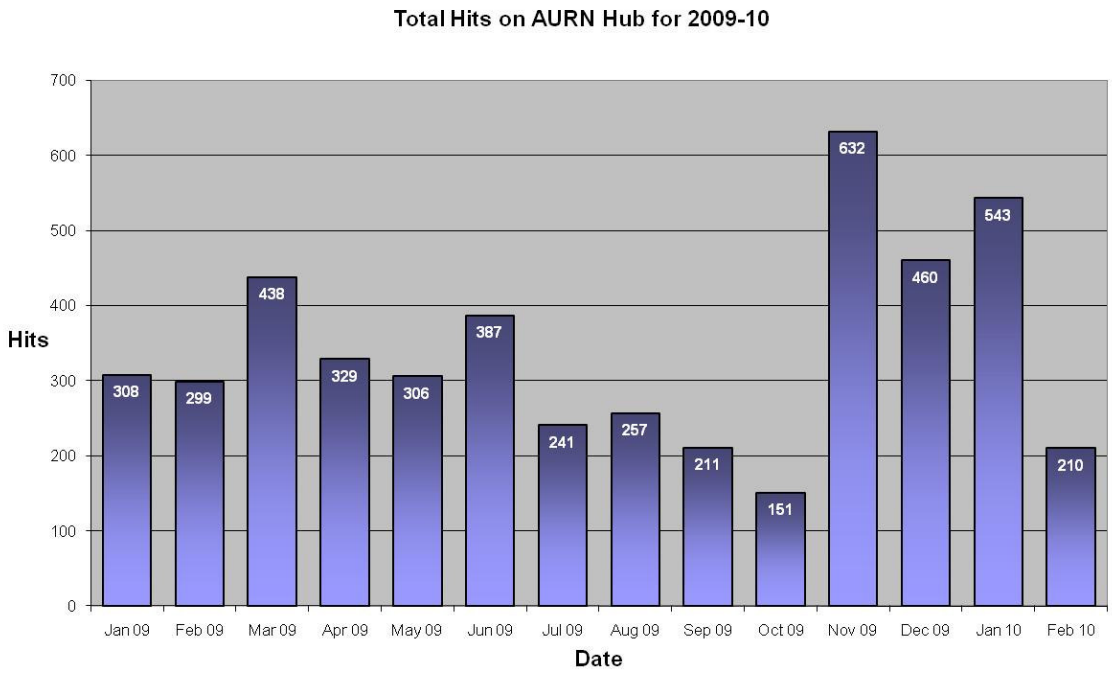
The site is regularly updated and some of the more recent information includes:

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

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.

[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

During ratification of the October-December data, a number of issues were discovered which affect data already reported as ratified in previous quarters. As a result, the following data already reported as ratified have been deleted.

- Blackpool Marton-following the installation of upgraded equipment, the data for some weeks prior to installation was identified as unsatisfactory. NOx data from 24 May to 28 August have been deleted.
- Chepstow A48-PM_{10} data too low following service; data deleted from 20 August to 31 October
- Edinburgh- PM_{10} data deleted from installation of B type dryer on 24 April to 20 November
- Exeter- suspected O_3 sampling fault from 1 May to 31 December
- London Harlington-some periods of $PM_{2.5}$ data higher than PM_{10} were observed in December; some data have been deleted.
- London Marylebone Road $PM_{2.5}$ Partisol-all data from 2009 deleted due to missing pipe in analyser
- Portsmouth -Poorly performing PM_{10} FDMS resulted in anomalously high data deleted back to 1 May.
- Reading-excessively high NO_2 data deleted from 13 July to 31 December
- Sandy Roadside -probable internal sampling of NO_2; data deleted from 19 August.
- Southend on Sea-excessively high NO_2 data deleted from 8 September to 31 December

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 during 2009

Site	Pollutant	Date started
Armagh Roadside	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
Mold	NO_2 O_3	02/12/09

The $PM_{2.5}$ Partisol at Inverness has been affiliated into the network backdated to 1 June 2008. 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
Chesterfield Roadside	$PM_{2.5}$	01/07/09
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
Plymouth Centre	$PM_{2.5}$	13/10/09
Preston	$PM_{2.5}$	27/01/09
Sandy Roadside	$PM_{2.5}$	27/01/09
Southend-on-Sea	$PM_{2.5}$	30/01/09

Site	Pollutant	Date started
Stanford-le-Hope Roadside	$PM_{2.5}$	01/04/09
Stockton-on-Tees Eaglescliffe	NO_2	21/01/09
Wirral Tranmere	$PM_{2.5}$	28/01/09
Wrexham	$PM_{2.5}$	09/12/09

In addition, PM_{10} measurements at Nottingham Centre recommenced on 1 November, following installation of a second FDMS unit.

The rural CO analysers at St Osyth and Market Harborough were discontinued from 31 Dec 2009.

A full description of the changes necessary for compliance with the Directive is given in Part B Section 8 of the October-December 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 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 Jun 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 October-December 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. The data remain provisional whilst the necessary QA checks are completed.

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

Site	Data Capture, %
Auchencorth Moss $PM_{2.5}$	99
Auchencorth Moss PM_{10}	85
Bournemouth $PM_{2.5}$	99
Brighton Preston Park $PM_{2.5}$	87
Harwell $PM_{2.5}$	100
Harwell PM_{10}	100
Inverness $PM_{2.5}$	100
Inverness PM_{10}	89
London Marylebone Road $PM_{2.5}$	0
London Marylebone Road PM_{10}	100
London N Kensington $PM_{2.5}$	100
London N Kensington PM_{10}	93
London Westminster $PM_{2.5}$	95
Northampton $PM_{2.5}$	96
Port Talbot Margam $PM_{2.5}$	69
Wrexham $PM_{2.5}$	89
Wrexham PM_{10}	25 (100% of operational period: started up 9th Dec.)

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 new Thermo i-Series analysers are equipped with valves to allow the use of calibration cylinder gas to be used for autocalibrations. These should be less prone to run-on through internal contamination, provided the integrity of the valve seals is maintained.

The 30 sites (32 analysers) showing continuing problems with the autocalibration run-on during October-December 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: October-December 2009

Site	Pollutant	Run-On Conc	Autocal Conc	Hours lost	Months
Aston Hill	NO_2	0.5	500	1	Nov
Bath Roadside	NO_2	9	500	1	Dec
Belfast Centre	NO_2	5	300	1	Oct-Dec
Blackpool Marton	NO_2	5	250	1	Oct-Dec
Coventry Memorial Park	NO_2	4	459	1	Oct-Dec
Hull Freetown	NO_2	4	200	1	Non-Dec
Leeds Centre	NO_2	6	300	1	Oct-Dec
Leicester Centre	NO_2	5	455	1	Oct-Dec
Liverpool Speke	NO_2	3	200	1	Oct-Dec
London Hillingdon	NO_2	5	175	1	Oct-Dec
Lullington Heath	NO_2	3.8	300	**2**	Oct-Dec
Manchester Piccadilly	NO_2	3	100	1	Nov-Dec
Market Harborough	NO_2	5	350	**2**	Oct-Nov
				1	Dec
Mold	NO_2	3	500	1	Dec
Newcastle Centre	NO_2	4	300	1	Oct-Dec
Norwich Lakenfields	NO_2	6	200	**2**	Oct-Dec
				1	Dec
Oxford Centre Roadside	NO_2	4	200	1	Oct-Dec
Port Talbot Margam	NO_2	2	200	1	Oct and Dec
Preston	NO_2	5	250	1	Oct-Dec
Reading New Town	NO_2	4	250	1	Oct-Dec
Sheffield Centre	NO_2	7	280	1	Oct-Dec
Southampton Centre	NO_2	4	300	1	Oct-Dec
Southend-on-Sea	NO_2	7	200	1	Oct
				2	Nov-Dec
St Osyth	NO_2	3.6	200		Oct and
				1	Dec
				2	Nov
Walsall Willenhall	NO_2	3	250	1	Oct-Dec
Wicken Fen	NO_2	2	200	1	Oct-Dec
Wirral Tranmere	NO_2	2	250	1	Oct-Dec
Yarner Wood	NO_2	1.2	200	1	Oct
				2	Nov-Dec
Aberdeen	O_3	-2	200	1	Oct-Dec
Aston Hill	O_3	-4	200	1	Oct-Dec
Ladybower	SO_2	0.5	500	1	Oct-Nov
Lullington Heath	SO_2	0.2	450	1	Oct-Dec

3.3 FDMS Installations

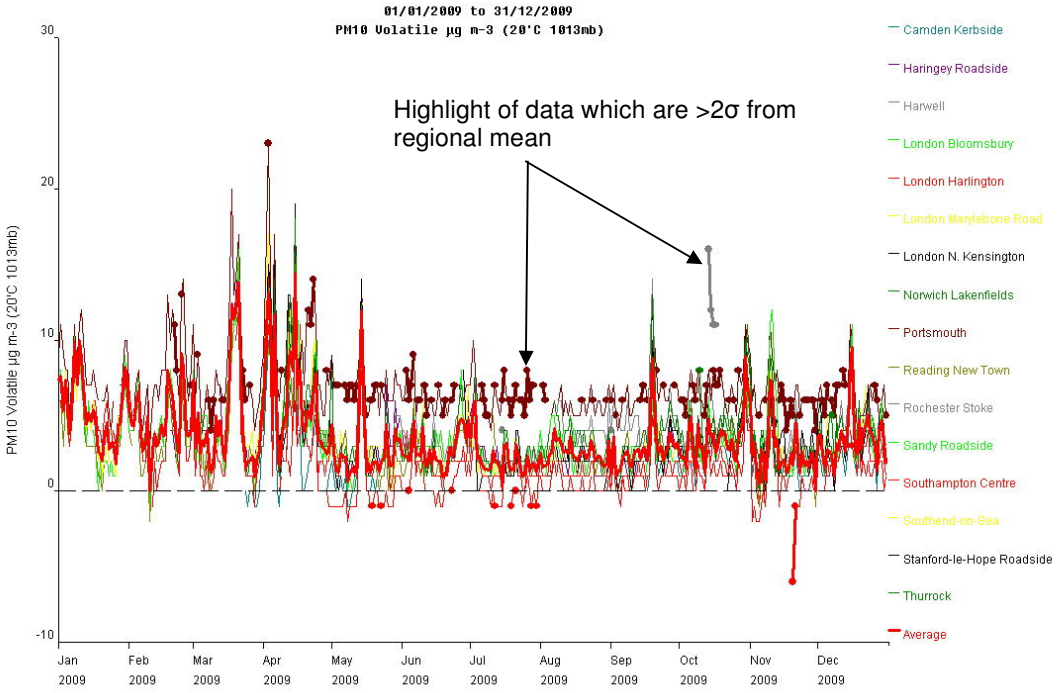
There have been a number of issues affecting the collection of valid data from FDMS analysers as these have been introduced into the network. The CMCU, QA/QC and ESUs have put considerable effort into solving these issues. Several FDMS analysers have proved particularly problematic and considerable ESU 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 and winter 2010 intercalibration exercises, and the ESUs have been asked to provide records of dryer upgrades at they occur.

Several FDMS units have suffered from long-term problems during 2009, and these are described in more detail in the Annual Review. Considerable effort has been put into resolving these problems, and the experience gained by the QA/QC Unit, the CMCU and the ESUs will help ensure improved performance in the future.

The QA/QC Unit in particular, has developed a range of the techniques and statistical analyses of the data from FDMS units to more fully understand the problems encountered with these analysers. These include

- Improved on-site leak checks during QA/QC audits
- Calculation of dryer efficiency on an hourly basis
- Comparison of volatile fractions over a regional basis to check for outliers, building on the principles of the Volatile Correction Model (VCM) developed by KCL. (see below)



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.

4.1 London

4.1.1 Data Capture

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

Table 4.1: Data capture for London: October-December 2009 (%)

Site	Owner	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
England								
Camden Kerbside	Affiliate	-	99.1	62.4	62.5	-	-	74.6
Haringey Roadside	Affiliate	-	99.1	99.5	85.1	-	-	94.6
London Bexley	Affiliate	99.8	-	99.8	99.7	-	100.0	99.8
London Bloomsbury	DEFRA	90.8	98.5	99.6	99.9	99.9	99.9	98.1
London Cromwell Road 2	DEFRA	99.6	-	-	99.5	-	99.5	99.6
London Eltham	Affiliate	-	-	99.0	99.6	92.1	-	96.9
London Haringey	Affiliate	-	-	-	99.5	99.7	-	99.6
London Harlington	Affiliate	-	66.0	82.8	83.7	86.3	-	79.7
London Harrow Stanmore	Affiliate	-	-	99.0	-	-	-	99.0
London Hillingdon	DEFRA	-	-	-	94.7	98.8	-	96.8
London Marylebone Road	Affiliate	99.6	92.0	88.0	99.6	99.6	99.7	96.4
London Marylebone Road PARTISOL	DEFRA	-	90.2	0.0	-	-	-	45.1
London N. Kensington	Affiliate	99.2	97.5	93.6	99.5	99.5	99.3	98.1
London N. Kensington PARTISOL	DEFRA	-	100.0	93.5	-	-	-	96.7
London Teddington	Affiliate	-	-	99.9	99.4	99.4	-	99.6
London Westminster	DEFRA	99.8	-	94.6	99.7	96.5	99.9	98.1
Tower Hamlets Roadside	Affiliate	99.7	-	-	99.4	-	-	99.6
Number of sites		7	8	13	14	9	6	17
Number of sites < 90%		0	1	4	3	1	0	2
Network Mean (%)		98.4	92.8	93.2	94.4	96.9	99.7	95.4

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

Camden Kerbside
The $PM_{2.5}$ FDMS analyser was found to have a significant leak at the audit (main flow down 34%) and the pump vacuum was insufficient. Data have therefore been deleted from early December. Further data loss on 2010 is likely.

London Harlington
The site suffered a power cut from 13 to 26 November, and the PM_{10} FDMS analyser suffered damage from water ingress from 2 to 14 December. Some periods where $PM_{2.5}$ concentrations were significantly higher than PM_{10} have been deleted in December.

London Marylebone Road $PM_{2.5}$ Partisol
Anomalous results from the $PM_{2.5}$ Partisol prompted a detailed investigation into the analyser performance in April 2010. It was found that a pipe on the sample inlet was missing, and so the instrument was sampling internally, bypassing the size selective head. No clear change point can be identified when the tube was removed, and so based on the agreement with the FDMS, all 2009 data from the Partisol have been deleted.

4.2 England (excluding London)

4.2.1 Data Capture

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

Table 4.2: Data capture for England (except London): October-December 2009 (%)

Site	Owner	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
England								
Barnsley 12	DEFRA	-	-	-	-	-	97.1	97.1
Barnsley Gawber	Affiliate	-	-	-	93.8	90.7	0.0	61.5
Bath Roadside	Affiliate	-	-	-	98.0	-	-	98.0
Billingham	DEFRA	-	-	-	99.7	-	-	99.7
Birmingham Tyburn	Affiliate	-	91.4	89.8	92.7	92.7	92.8	91.9
Birmingham Tyburn Roadside	Affiliate	-	87.3	80.8	93.0	98.3	-	89.9
Blackburn Darwen Roadside	Affiliate	-	-	-	94.7	-	-	94.7
Blackpool Marton	DEFRA	-	-	99.1	92.4	97.1	-	96.2
Bottesford	Affiliate	-	-	-	-	99.2	-	99.2
Bournemouth	DEFRA	-	-	98.9	99.7	100.0	-	99.5
Brighton Preston Park	DEFRA	-	-	87.0	99.8	99.9	-	95.5
Brighton Roadside	Affiliate	-	-	-	98.5	-	-	98.5
Bristol Old Market	Affiliate	99.6	-	-	33.6	-	-	66.6
Bristol St Paul's	DEFRA	99.9	100.0	98.2	99.5	99.9	99.9	99.6
Bury Roadside	Affiliate	96.5	99.4	87.0	97.9	-	-	95.2
Cambridge Roadside	Affiliate	-	-	-	93.5	-	-	93.5
Canterbury	Affiliate	-	-	-	99.3	-	-	99.3
Carlisle Roadside	Affiliate	-	96.9	98.6	99.7	-	-	98.4

Site	Owner	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
Charlton Mackrell	Affiliate	-	-	-	92.2	92.3	-	92.3
Chesterfield	Affiliate	-	73.2	96.0	96.0	-	-	88.4
Chesterfield Roadside	Affiliate	-	98.6	99.3	97.5	-	-	98.4
Coventry Memorial Park	DEFRA	-	-	99.5	95.5	75.5	-	90.1
Exeter Roadside	Affiliate	-	-	-	98.8	0.0	-	49.4
Glazebury	DEFRA	-	-	-	99.9	99.9	-	99.9
Great Dun Fell	DEFRA	-	-	-	-	96.8	-	96.8
Harwell	DEFRA	-	98.5	59.6	99.9	99.9	99.9	91.5
Harwell PARTISOL	Affiliate	-	100.0	100.0	-	-	-	100.0
High Muffles	DEFRA	-	-	-	25.2	25.3	-	25.2
Horley	Affiliate	-	-	-	99.7	-	-	99.7
Hull Freetown	DEFRA	99.4	80.8	99.5	95.7	98.6	99.7	95.6
Ladybower	DEFRA	-	-	-	98.5	100.0	77.8	92.1
Leamington Spa	Affiliate	-	98.6	99.7	98.6	99.2	98.6	98.9
Leeds Centre	DEFRA	97.7	97.7	97.7	92.4	93.8	94.8	95.7
Leeds Headingley Kerbside	Affiliate	-	99.1	99.8	99.5	-	-	99.5
Leicester Centre	DEFRA	97.1	94.5	57.6	81.0	78.6	99.8	84.8
Leominster	DEFRA	-	-	-	99.2	99.7	99.0	99.3
Liverpool Queen's Drive Roadside	Affiliate	-	-	-	98.9	-	-	98.9
Liverpool Speke	DEFRA	93.4	99.2	84.0	95.2	99.1	94.8	94.3
Lullington Heath	DEFRA	-	-	-	93.1	99.1	90.3	94.2
Manchester Piccadilly	DEFRA	-	-	52.8	96.2	97.8	95.6	85.6
Manchester South	Affiliate	-	-	-	95.8	95.4	-	95.6
Market Harborough	DEFRA	100.0	-	-	86.0	98.4	-	94.8
Middlesbrough	Affiliate	59.8	17.3	54.1	99.4	59.8	99.6	65.0
Newcastle Centre	DEFRA	99.9	99.4	99.6	94.2	99.7	99.7	98.8
Newcastle Cradlewell Roadside	Affiliate	-	-	-	99.8	-	-	99.8
Northampton	Affiliate	-	-	95.7	99.7	99.8	99.7	98.7
Norwich Lakenfields	Affiliate	-	98.9	97.6	92.5	99.4	62.9	90.3
Nottingham Centre	DEFRA	-	65.4	99.7	99.2	99.0	99.7	92.6
Oxford Centre Roadside	Affiliate	-	-	-	95.2	-	-	95.2
Oxford St Ebbes	Affiliate	-	88.0	87.6	85.6	-	-	87.1
Plymouth Centre	DEFRA	-	86.2	96.0	99.3	98.8	-	95.1
Portsmouth	Affiliate	-	0.0	96.2	99.8	99.9	-	74.0
Preston	DEFRA	-	-	91.1	93.2	97.1	-	93.8
Reading New Town	DEFRA	-	99.8	99.7	0.0	68.0	-	66.9
Rochester Stoke	Affiliate	-	5.9	27.6	28.4	29.7	22.6	22.8
Salford Eccles	Affiliate	99.1	99.3	99.0	99.0	99.0	99.0	99.1
Saltash Roadside	Affiliate	-	97.5	-	-	-	-	97.5
Sandwell West Bromwich	Affiliate	-	-	-	99.7	99.9	99.5	99.7
Sandy Roadside	Affiliate	-	99.0	99.5	73.7	-	-	90.7

Site	Owner	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
Scunthorpe Town	Affiliate	-	95.5	-	98.0	-	98.0	97.2
Sheffield Centre	DEFRA	85.2	99.5	99.5	94.0	97.9	99.9	96.0
Sheffield Tinsley	DEFRA	-	-	-	98.7	-	-	98.7
Sibton	DEFRA	-	-	-	-	99.8	-	99.8
Southampton Centre	DEFRA	96.6	93.6	94.9	91.3	96.3	93.8	94.4
Southend-on-Sea	DEFRA	-	-	99.9	0.0	94.2	-	64.7
St Osyth	DEFRA	87.4	-	-	87.2	97.7	-	90.8
Stanford-le-Hope Roadside	Affiliate	-	99.2	73.6	99.2	-	56.9	82.2
Stockton-on-Tees Eaglescliffe	Affiliate	-	95.9	93.9	98.7	-	-	96.2
Stoke-on-Trent Centre	DEFRA	-	99.5	99.7	99.8	39.5	-	84.6
Sunderland Silksworth	Affiliate	-	-	77.0	82.5	94.7	94.7	87.2
Thurrock	Affiliate	-	98.3	-	99.1	99.3	98.9	98.9
Walsall Willenhall	Affiliate	-	-	-	95.6	-	-	95.6
Warrington	Affiliate	-	99.7	99.5	99.9	-	-	99.7
Weybourne	Affiliate	-	-	-	-	93.8	-	93.8
Wicken Fen	DEFRA	-	-	-	95.5	99.6	99.7	98.3
Wigan Centre	Affiliate	-	-	99.5	99.9	95.9	-	98.4
Wirral Tranmere	DEFRA	-	-	93.8	89.3	93.6	-	92.2
Yarner Wood	DEFRA	-	-	-	91.3	87.9	-	89.6
York Bootham	Affiliate	-	99.8	99.7	-	-	-	99.8
York Fishergate	Affiliate	-	100.0	-	99.9	-	-	99.9
Number of sites		14	37	44	72	51	29	80
Number of sites < 90%		3	9	13	12	9	5	18
Network Mean (%)		93.7	87.9	90.0	90.3	89.6	88.4	90.8

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

Barnsley Gawber
The SO_2 analyser at Barnsley Gawber produced very noisy data from early September, which were deleted during ratification. The analysers were replaced at service on 16 November, but the SO_2 analyser also performed poorly; all SO_2 data for this quarter have been deleted.

Bristol Old Market
The NOx converter was found to be 87.5% at the QA/QC audit on 23 February. The NO_2 data have been deleted from 1 November to the end of 2009; further data will be deleted in 2010.

Exeter Roadside
The ozone data from Exeter Roadside appears to be too low compared to other sites. The reason for this is not clear, but data have been deleted from 1 May to 1 December.

High Muffles
The power supply problems continued during this quarter; the supply was restored on 8 December.

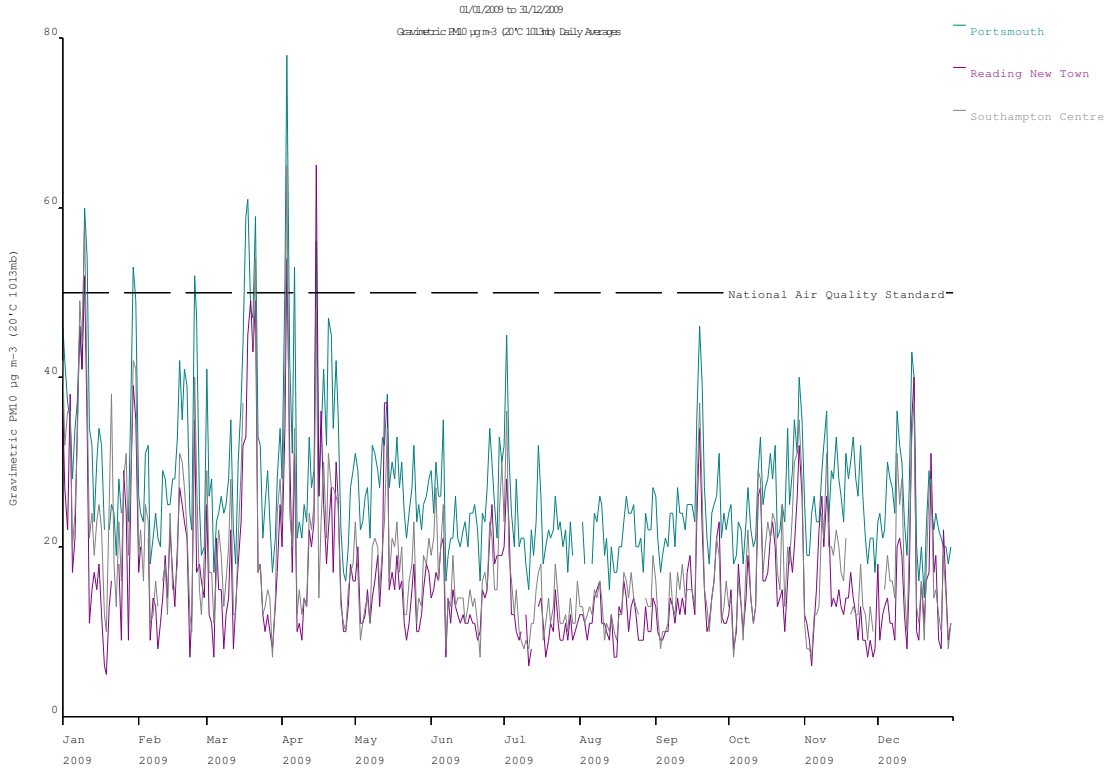
Leicester Centre
There were numerous problems at Leicester as a result of the upgrade of the equipment. There were significant leaks in the sampling system, and some NOx and ozone data were lost. The $PM_{2.5}$ FDMS analyser also suffered problems following the QA/QC audit on 23 September; the analyser was removed for repair, eventually being reinstated on 6 November.

Manchester Piccadilly
The $PM_{2.5}$ FDMS analyser suffered persistent flow and leak problems during the quarter; 60 days were lost.

Middlesbrough
The PM_{10} FDMS analyser suffered from excessive noise during the quarter, possibly due to air conditioning problems which persisted during this period. The analysers were turned off from 19 October to 25 November in order to prevent damage through overheating.

Portsmouth
The PM_{10} FDMS analyser shows anomalously high concentrations during summer 2009 onwards. Figure 4.1 shows the daily average PM_{10} concentrations measured at Portsmouth, Reading New Town and Southampton Centre.

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



The PM_{10} data for Portsmouth have been deleted from 1 May until 31 December 2009; further data in 2010 may be deleted.

Reading New Town
The NOx analyser had a large offset for much of the second half of the year. This was possibly caused by a sampling fault, which was apparently fixed in early 2010. No information on the nature of the fault was recorded, and it may have been inadvertently cured during an ESU callout. Data from 13 July to 31 December have been deleteted.

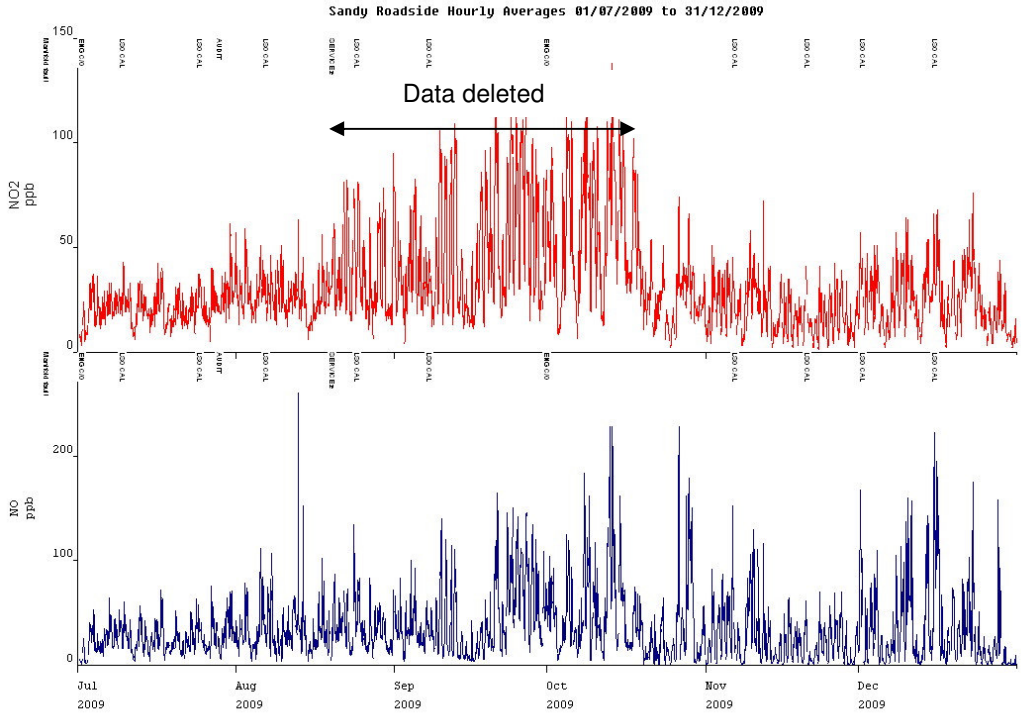
Rochester Stoke

The site has been closed since early November due to a water leak in the cabin. A replacement cabin is being purchased by the LSO. The $PM_{2.5}$ FDMS analyser had earlier been damaged by water ingress.

Sandy Roadside

Unusual elevated levels of NO_2 were noted at Sandy Roadside between August and October, possibly due to internal sampling-see Figure 4.2. Data between 19 August and 21 October have been deleted.

Figure 4.2 Sandy Roadside NO_2, July-December2009



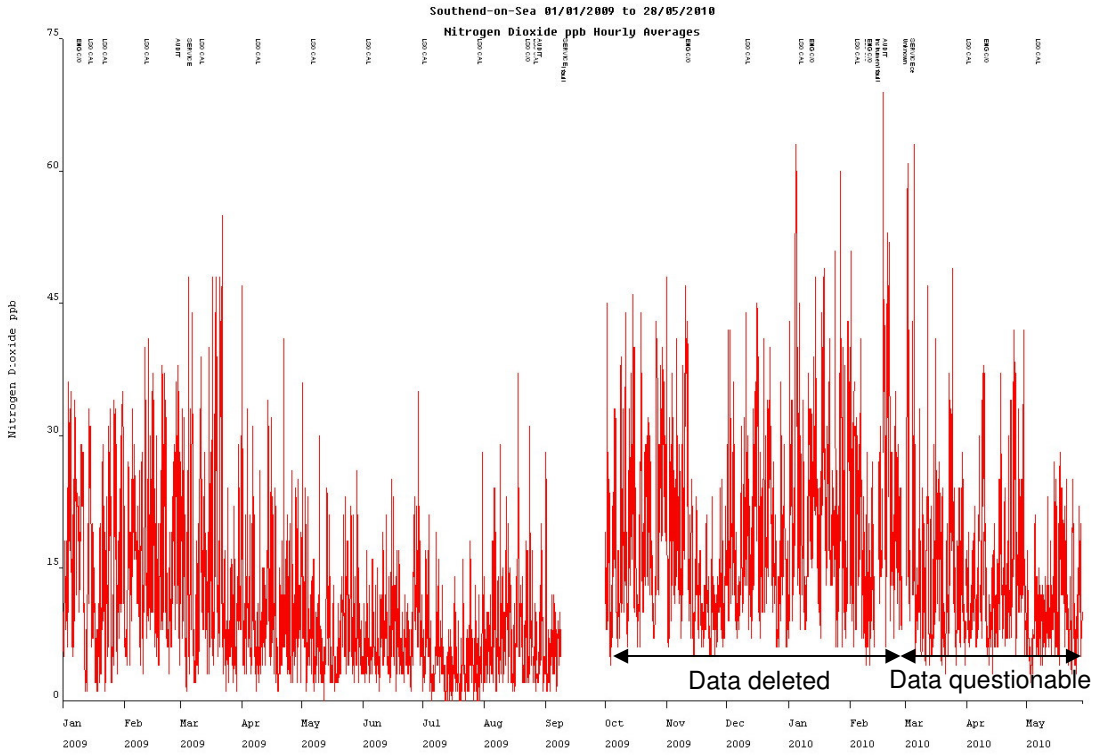
Stanford-le-Hope Roadside

The $PM_{2.5}$ analyser continued to perform poorly during the quarter, and significant amounts of data were deleted. The $PM_{2.5}$ analyser was removed for repair from 14-22 October due to repeated damaged seals. In addition, considerable SO_2 data loss occurred due to a photomultiplier fault.

Southend-on-Sea

The new NOx analyser at Southend had a suspected sampling fault (similar symptoms to Reading, described above) from 8 September to 11 January 2010. In both cases, the QA/QC audits showed no problems. This can be seen in Figure 4.3. Investigations are ongoing into the reasons for this are ongoing.

Figure 4.3 Southend-on-Sea NO_2



Stoke on Trent Centre
Following upgrade of the analysers on 21 September, the ozone analyser was left sampling internally for 65 days.

Sunderland Silkworth
The site suffered from air conditioning faults up to 29 October, when the air conditioning unit was replaced. The $PM_{2.5}$ data continued to be poor after this, however, and a considerable amount of data have been deleted.

Yarner Wood
Some ozone data were lost during November and December due to an electronic fault with the analyser.

4.3 Scotland

4.3.1 Data Capture

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

Table 4.3 Ratified Data Capture for Scotland, October-December 2009

Site	Owner	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
Scotland								
Aberdeen	Affiliate	-	99.5	96.4	99.2	95.2	-	97.6
Aberdeen Union	Affiliate	-	-	-	0.0	-	-	0.0

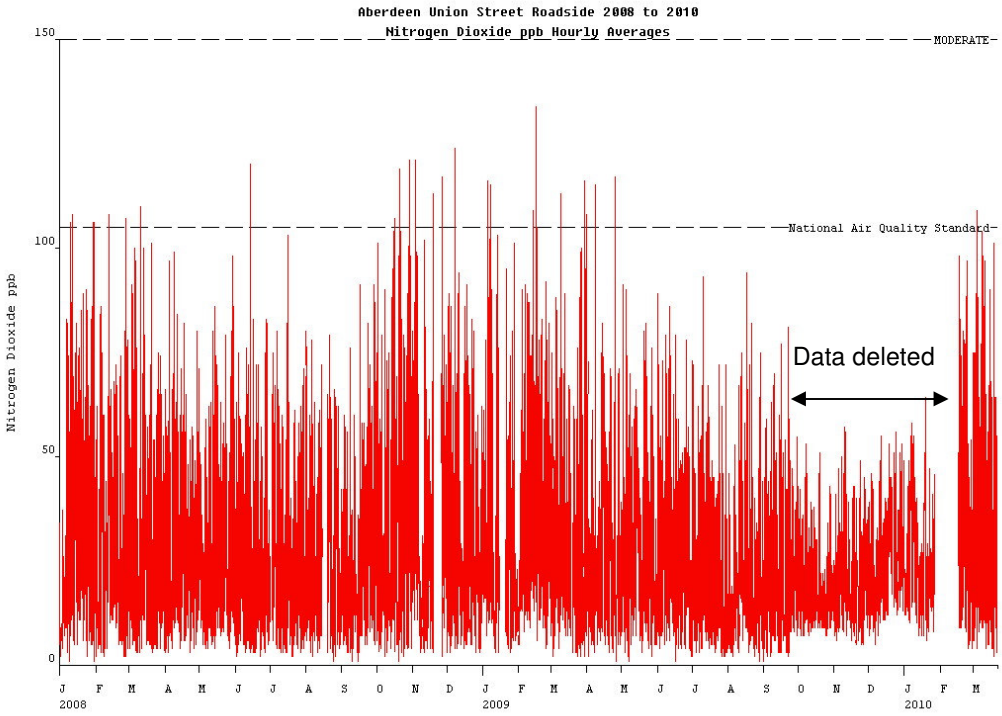
Site	Owner	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
Street Roadside								
Auchencorth Moss	DEFRA	-	98.9	83.7	-	99.8	-	94.1
Auchencorth Moss PM_{10} PM_{25} (FDMS)	DEFRA	-	0.0	98.6	-	-	-	49.3
Bush Estate	DEFRA	-	-	-	99.8	99.9	-	99.8
Dumfries	DEFRA	-	-	-	99.4	-	-	99.4
Edinburgh St Leonards	DEFRA	99.8	40.2	90.4	99.8	99.7	90.4	86.7
Eskdalemuir	DEFRA	-	-	-	99.6	99.1	-	99.4
Fort William	DEFRA	-	-	-	92.3	92.8	-	92.6
Glasgow Centre	DEFRA	99.7	91.7	98.8	99.6	98.8	99.4	98.0
Glasgow City Chambers	DEFRA	-	-	-	91.1	-	-	91.1
Glasgow Kerbside	DEFRA	-	98.3	99.7	99.1	-	-	99.0
Grangemouth	Affiliate	-	94.7	99.5	99.6	-	99.5	98.3
Grangemouth Moray	Affiliate	-	-	-	99.3	-	-	99.3
Inverness	DEFRA	-	100.0	89.1	89.4	-	-	92.8
Lerwick	DEFRA	-	-	-	-	66.3	-	66.3
Peebles	DEFRA	-	-	-	99.2	99.3	-	99.3
Strath Vaich	DEFRA	-	-	-	-	99.7	-	99.7
Number of sites		2	8	8	14	10	3	18
Number of sites < 90%		0	2	2	2	1	0	4
Network Mean (%)		99.8	77.9	94.5	90.5	95.1	96.4	86.8

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

Aberdeen Union Street Roadside
A period of low NO_2 concentrations along with a raised baseline was observed at Aberdeen Union Street Roadside from late September up to a gap in the data in February 2010. This can be seen in Figure 4.4. The ESU reports a converter fault (outgassing NO_2) during February; the converter was replaced on 15 February 2010. This will be investigated in Quarter 1 of 2010.

Figure 4.4 NO_2 concentrations at Aberdeen Union Street, Jan 2008-March 2010



The data for this period have been deleted.

Auchencorth Moss PM_{10} $PM_{2.5}$
A dryer problem occurred with the PM_{10} FDMS on 3 August, and all PM_{10} data from then up to the end of 2009 have been deleted. The $PM_{2.5}$ analyser continues to be very noisy with significant negative periods.

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. This is discussed fully in the Annual Report in Section B of this document.

Lerwick

The ozone analyser at Lerwick showed an unexplained drop in measured concentrations along with a baseline shift on 23 October to 23 November. These data have been deleted.

4.4 Wales

4.4.1 Data Capture

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

Table 4.4 Data Capture for Wales, October-December 2009

Site	Owner	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
Wales								
Aston Hill	DEFRA	-	-	-	98.3	95.2	-	96.7
Cardiff Centre	DEFRA	99.8	56.4	94.9	99.5	99.8	99.8	91.7
Chepstow A48	Affiliate	-	64.1	-	99.2	-	-	81.7
Cwmbran	Affiliate	-	-	-	68.2	99.8	-	84.0
Mold	Affiliate	-	-	-	92.1	98.1	-	95.1
Narberth	DEFRA	-	94.6	-	90.9	91.3	96.5	93.4
Newport	Affiliate	-	52.6	99.7	99.8	-	-	84.0
Port Talbot Margam	Affiliate	98.7	98.6	99.2	93.6	99.2	95.4	97.5
Port Talbot Margam PM_{10} $PM_{2.5}$ (Partisol)	Affiliate	-	-	67.4	-	-	-	67.4
Swansea Roadside	Affiliate	-	99.9	35.3	99.8	-	-	78.3
Wrexham	DEFRA	-	91.3	100.0	99.9	-	98.7	97.5
Number of sites		2	7	6	10	6	4	11
Number of sites < 90%		0	3	2	1	0	0	5
Network Mean (%)		99.3	79.7	82.8	94.1	97.2	97.6	87.9

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

Cardiff Centre
There were a number of problems with the Cardiff PM_{10} FDMS during the quarter, including erratic data and incorrect valve position; the analyser ultimately being removed from site for repair.

Cwmbran
There are no NOx data from Cwmbran from 19 October to 17 November. The site NOx analyser failed on 19 October and was deemed beyond economic repair; the ESU supplied a loan instrument on 17 November prior to permanent replacement in December.

Newport
The FDMS PM_{10} analyser became unstable following an LSO visit on 18 November. Data have been deleted until the end of the year, and possibly into 2010.

Swansea Roadside
Poor $PM_{2.5}$ FDMS performance resulted in the deletion of data from 15 May to September, though problems with noisy data and low vacuum persisted into the fourth quarter. The analyser was eventually removed for repair by the ESU.

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 October-December 2009 is given in Table 4.5.

Table 4.5: Data Capture for Ireland, October-December 2009

Site	Owner	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
N Ireland								
Armagh Roadside	Affiliate	-	99.7	-	0.0	-	-	49.8
Belfast Centre	DEFRA	99.7	94.9	82.9	91.0	96.7	99.6	94.1
Derry	Affiliate	-	97.0	0.0	99.4	99.7	98.3	78.9
Lough Navar	DEFRA	-	99.8	-	-	99.9	-	99.8
Number of sites		1	4	2	3	3	2	4
Number of sites < 90%		0	0	2	1	0	0	2
Network Mean (%)		99.7	97.8	41.4	63.5	98.8	99.0	80.7

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 affiliated into the network commencing on 1 January 2009. However, the NOx analyser was faulty, and there are no data up to a replacement of the analyser in 2010.

Derry
The FDMS instruments have continued to experience problems during this quarter. The PM_{10} analyser was found to be leaking badly at the QA/QC audit on 15 February; this will be examined closely in the next quarterly report. The $PM_{2.5}$ analyser shows a significant step change in August following a repair to fix a leak identified at audit. All data have been deleted up to 31 December 2009, and continuing into 2010.

4.6 Overall Data Capture

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

Table 4.6: Data Capture by Pollutant, Entire Network

Site	Owner	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
Number of sites		26	64	73	113	80	44	131 (total)
Number of sites < 90%		3	15	22	19	11	5	
Network Mean (%)		96.1	87.0	89.1	90.4	92.1	91.8	90.3

A summary of the main site analyser operational problems, which have resulted in data capture below the required 90% level during the reporting period October-December 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
Auchencorth Moss	FDMS PM_{10} and $PM_{2.5}$	Temperature control problems	Negative $PM_{2.5.}$ data still observed. PM_{10} data deleted this quarter
Derry	PM_{10} $PM_{2.5}$	Poor performance	Problems still continue-see Section 4.5.2
Haringey Roadside	PM_{10}	Noisy data	Now fixed
London Teddington	Site	Air conditioning	No progress reported
Rochester Stoke	All channels	No data	Site turned off for repairs
Sunderland Silkworth	Logger	Frequent gaps	Now fixed
Swansea Roadside	$PM_{2.5}$	Poor dryer performance	Fault continues in Q3; dryer removed for repair. See section 4.4.2
Weybourne	O_3	No manual calibrations or IZS	No progress reported

Part B Annual Review 2009

5 Introduction

The QA/QC Unit has produced detailed quarterly reports giving an overview of network performance, reasons for data losses and data capture statistics.

Recommendations for equipment and site upgrades and replacements have also been made. A list of the reports for 2009 is given in Table 5.1.

Table 5.1 QA/QC Data Ratification and Intercalibration Reports, 2009

	Type	Report Title	Reference
1	Ratification and Intercalibration	QA/QC Data Ratification and Intercalibration Report for the Automatic Urban and Rural Network, January-March 2009	AEAT/ENV/R/2830
2	Ratification	QA/QC Data Ratification Report for the Automatic Urban and Rural Network, April-June 2009	AEAT/ENV/R/2884
3	Ratification and Intercalibration	QA/QC Data Ratification and Intercalibration Report for the Automatic Urban and Rural Network July-September 2009	AEAT/ENV/R/2925
4	Ratification and Annual Review	QA/QC Data Ratification Report for the Automatic Urban and Rural Network October-December 2009 and Annual Review for 200.	AEAT/ENV/R/2949

All reports are available on the Air Quality Information Archive (www.airquality.co.uk) and on the AURN Hub.

Data are routinely ratified on a 3-monthly basis. 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 which 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 which 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.

6 Network Review

The QA/QC Unit and the CMCU Unit 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 new European Air Quality Directive. 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. This process is still ongoing.

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. Many of these closures occurred in 2007.

The new site locations are selected in line with the requirements of the EC Air Quality Directive (2008/50/EC)as described below:

AGREED REQUIREMENTS FOR NEW SITES: (for modelling and Directive compliance (ANNEX 3))

ROADSIDE: Must be on A road - preferably with “simple” layout. Traffic-orientated sampling probes shall be at least 25 m from the edge of major junctions and no more than 10 m from the kerbside. The flow around the inlet sampling probe shall be unrestricted (free in an arc of at least 270m) without any obstructions affecting the airflow in the vicinity of the sampler, normally some metres away from buildings, balconies, trees and other obstacles and at least 0,5 m from the nearest building in the case of sampling points (representing air quality at the building line).

URBAN BACKGROUND: Locations shall be located so that their pollution level is influenced by the integrated contribution from all sources upwind of the station. The pollution level should not be dominated by a single source unless such a situation is typical for a larger urban area. Those sampling points shall, as a general rule, be representative for several square kilometres.

For the purposes of deciding where new sites are to be located, the Directive is interpreted as requiring that $PM_{2.5}$ exposure reduction sites in zones should be in conurbations (pop. 100,000 - 250,000)- but there is no explicit requirement for this.

7 Network Intercalibrations

Two complete network intercomparisons were carried out at 6-monthly intervals during 2009. These are an important part of the overall QA/QC programme for the AURN network. The purpose of these intercomparisons is to determine the network measurement accuracy, consistency and intercomparability across the entire network. The latest exercise covered 127 sites, which has been closed for some time). The procedures used, and a summary of the results obtained, are provided in the January-March and July-September QA/QC reports.

A summary of the number of analysers in the network found to be providing provisional data outwith the defined accuracy limits (the "outlier" sites) is given in Figure 7.1. A full definition of what constitutes an outlier site for the different pollutants is given in the appropriate Quarterly Reports .Note also that, for the vast majority of these outlier sites, the data will have been fully corrected as part of the subsequent data ratification process.

Figure 7.1 Outliers identified during 2009 intercalibration exercises.

Analyser	Winter 2009 intercalibration			Summer 2009 intercalibration		
	No. in network	No. of outliers	%	No. in network	No. of outliers	%
NOx	109	23	21%	110	26	24%
CO	25	4	16%	25	0	0%
SO_2	43	10	23%	43	9	21%
Ozone	78	27	35%	78	21	27%
TEOM & BAM articles	25 TEOM PM_{10} 33 FDMS PM_{10} 2 TEOM $PM_{2.5}$ 46 FDMS $PM_{2.5}$	0 k_0, 6 flow	6%	20 TEOM PM_{10} 35 FDMS PM_{10} 1 BAM PM_{10} 2 TEOM $PM_{2.5}$ 50 FDMS $PM_{2.5}$ 1 BAM $PM_{2.5}$	3 k_0, 8 flow	6%
Gravimetric particles	8 PM_{10} 9 $PM_{2.5}$	0	0%	8 PM_{10} 9 $PM_{2.5}$	0	0%

The overall fraction of outliers has remained fairly constant during 2009.

Sites which have been commissioned, recommissioned in new locations or have had new analysers installed have been audited by the QA/QC Unit prior to the publication of the data from the site.

The intercalibration visits are also used to ensure information about network sites and analysers are correct and up to date. For example, at recent network intercalibration exercises, information has been gathered on the sample manifold systems used at all sites, the detailed set-up parameters for the TEOM particle analysers, and how site locations compare to the requirements listed in the EC Directives.

In addition to the network intercalibrations, the QA/QC Unit carries out pre-commissioning audits on new sites and analysers introduced to the network. Although these audits are not included in the summary above, these provide a vital role in ensuring the overall data quality; data are not disseminated from new sites or analysers until a satisfactory performance has been verified by the QA/QC Unit. The installation timetable for FDMS PM_{10} and $PM_{2.5}$ analysers, and new CEN-compliant gas analysers has meant the QA/QC Unit has had to make numerous replicate visits to sites to ensure data may be disseminated in time for Directive Compliance, for example.

8 ESU, CMCU, LSO and QA/QC Meetings

During 2009, the QA/QC Unit continued to liase closely with the ESUs to ensure optimal performance of the network through service and maintenance arrangements. The QA/QC Unit have provided the ESUs with spreadsheets to calculate various analyser performance parameters (eg converter efficiency, linearity) in line with the CEN requirements; ESUs have been requested to integrate the principles into their routine site tests.

All parties were in agreement that work undertaken by the ESUs is a vitally important part of the overall data quality management process for the network, and it is planned to repeat the meetings at regular intervals. Regular meetings between Defra and the devolved administrations, CMCU and the QA/QC Unit have also been initiated.

The QA/QC Unit has worked closely with the CMCU to agree the specification of the new contracts for LSO and ESU contracts awarded in spring 2009.

The QA/QC Unit has attended the AURN LSO meeting, and presented network updates as appropriate. These presentations are available on the AURN Hub.

The QA/QC Unit has continued to provide ESUs with ozone photometer calibrations prior to the start of each 6-monthly service schedule. In addition, weighed TEOM filters have been supplied to ESUs as required, to enable reliable Ko measurements to be made.

9 TEOM Upgrades to FDMS and Installation of new FDMS

The initial upgrade programme for TEOMs has been completed, and there are now 137 operational FDMS analysers, of which. 73 of these units (as at April 2010) are configured for $PM_{2.5}$. The FDMS units installed in 2009 are listed in Table 12.1 (see later)

The upgrade programme was generally very good, although problems with analyser performance did delay the dissemination of data from several sites. A description of some of the faults encountered is given in Section 12.2. In several cases, however, there were delays in installing new FDMS units and so In order to meet the requirements of the Directive, some PM_{10} analysers were converted to $PM_{2.5}$ at the end of 2008. Where appropriate, the new FDMS (configured as PM_{10}) are being installed as resources allow.

The ESUs have been instructed to ensure that all FDMS units are fitted with B type dryers, and a programme of replacement of the less satisfactory C types has been undertaken. The B type dryer is currently the only dryer which has demonstrated equivalence with the reference (gravimetric) method. To ensure that this process is completed as soon as possible, the QA/QC unit has been checking dryer types at intercalibration visits, and the ESUs have been asked to provide documentation when dryers are replaced.

There has been significant discussion and debate on problems encountered during commissioning and operation of FDMS analysers. The QA/QC Unit has gratefully received valuable input from the Management Units, ESUs, the manufacturer and from INERIS in France, amongst others.

10 Network Data Capture

The overall network data capture for 2009 was 90.4%, which is above the 90% target level. However, not all sites achieved >90% and a table of data capture for the 45 sites with less than 90% capture is given in Table 10.1.

Table 10.1 Sites with Annual Average Data Capture Below 90%for 2009

Network Data Capture for 01/01/2009 to 31/12/2009 from start date of any new site
Just sites with average data capture < 90%

Site	Owner	Site Average
England		
Barnsley Gawber	Affiliate	85.0
Billingham	DEFRA	88.0
Birmingham Centre	DEFRA	80.2
Birmingham Tyburn Roadside	Affiliate	83.6
Blackpool Marton	DEFRA	86.9
Camden Kerbside	Affiliate	68.8
Exeter Roadside	Affiliate	66.0
Great Dun Fell	DEFRA	88.7
Haringey Roadside	Affiliate	86.3
High Muffles	DEFRA	54.5
Ladybower	DEFRA	84.0
Leicester Centre	DEFRA	88.5
London Harlington	Affiliate	76.7
London Harrow Stanmore	Affiliate	82.1
London Marylebone Road PARTISOL	DEFRA	45.1
London N. Kensington PARTISOL	DEFRA	85.1
Manchester Piccadilly	DEFRA	88.4
Market Harborough	DEFRA	84.9
Middlesbrough	Affiliate	83.7
Nottingham Centre	DEFRA	79.1
Oxford St Ebbes	Affiliate	89.1
Plymouth Centre	DEFRA	74.2
Portsmouth	Affiliate	80.6
Preston	DEFRA	87.2
Reading New Town	DEFRA	84.5
Rochester Stoke	Affiliate	71.0
Sandy Roadside	Affiliate	85.2
Sheffield Centre	DEFRA	88.2
Sheffield Tinsley	DEFRA	85.4
Southend-on-Sea	DEFRA	89.0
Stanford-le-Hope Roadside	Affiliate	80.1
Sunderland Silksworth	Affiliate	69.8
Yarner Wood	DEFRA	89.5
Ireland		
N Ireland		
Armagh Roadside	Affiliate	61.0
Belfast Centre	DEFRA	88.9
Derry	Affiliate	74.4
Scotland		
Aberdeen	Affiliate	89.5
Aberdeen Union Street Roadside	Affiliate	70.0
Auchencorth Moss PM10 PM25	DEFRA	75.8
Dumfries	DEFRA	81.6

Fort William	DEFRA	88.0
Glasgow Kerbside	DEFRA	89.8
Wales		
Chepstow A48	Affiliate	87.8
Port Talbot Margam PM_{10} $PM_{2.5}$	Affiliate	85.5
Swansea Roadside	Affiliate	81.5
Number of sites < 90%		45

Numbers in bold indicate some or all data remain provisional pending further investigation

A summary of data capture by pollutant for the year 2009 is given in Table 10.2

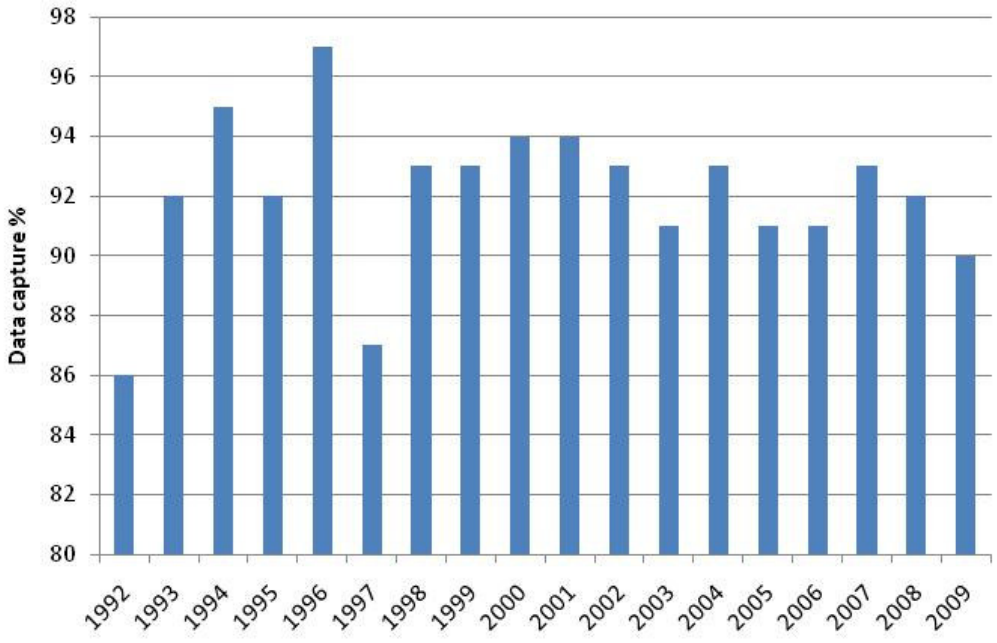
Table 10.2 Summary of data capture by pollutant, 2009

Site	Owner	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Site Average
Number of sites < 90%		4	28	33	32	13	8	45
Network Mean (%)		94.1	86.3	86.8	90.4	93.6	93.4	90.4

For these sites, pollution statistics calculated for analysers with data capture above 75% or modelled data have to be used. However, neither of these approaches is entirely satisfactory. Hence, the QA/QC unit continues to make the recommendation that greater attention needs to be paid to minimising data loss from all sites.

The network annual average data capture of 90.4% is close to the previous year. The network is clearly operating in a steady-state level of operation, despite some ageing analysers and sites closed, sometimes for extended periods, for relocation or refurbishment. Figure 10.1 shows the annual network data capture since the start of the AURN in 1992.

Figure 10.1 Annual Average Data Capture 1992-2009



10.1 Investigation of Spurious Data

The data ratification process involves checking many millions of 15-minute average concentrations every year. Although the majority of analysers operate satisfactorily, there are inevitably some problems that require more detailed investigation by the QA/QC unit during the ratification process. The QA/QC Unit works closely with the LSOs, the ESUs and the CMCU in order to resolve these issues and process the data accordingly. All parties involved are encouraged to provide sufficient information to streamline this process as much as possible. Unfortunately, there are still instances where instruments faults remain undetected and large quantities of data are lost. Summaries of the more common reasons for data loss are discussed below.

NOx converters

At each QA/QC intercomparison, a small number of NOx converters are found to be less than the required 95% efficient. Where this is the case, the information from ESU service and repairs are checked to try to find the last date at which an acceptable converter test result has been obtained, or to identify an event which may indicate when the fault actually occurred (eg substitution of a replacement analyser). In some cases, no relevant information is available, and in the worst-case situation, data will be rejected back to the previous service visit (often 6 months previous). To minimise the risk of this, the QA/QC Unit has repeatedly requested that ESU's carry out converter tests at all service visits, and at relevant repair call-outs.

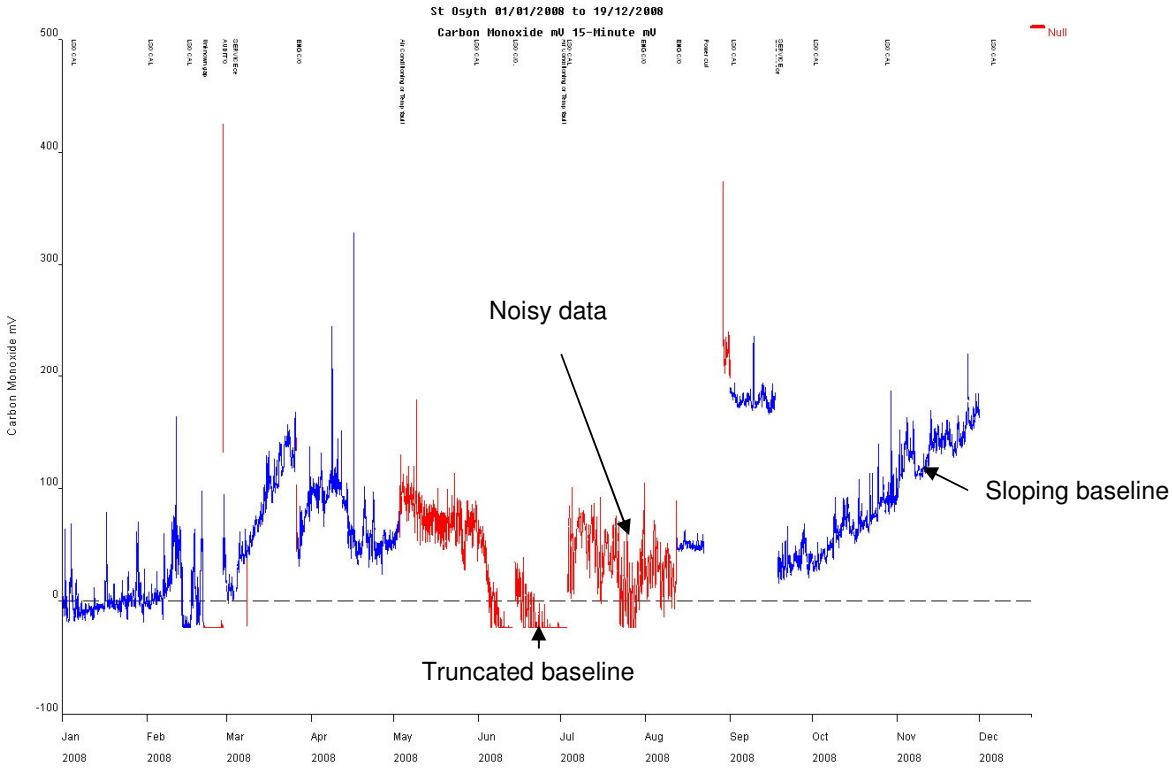
In a limited number of cases, the analyser software has been altered by the ESU to correct the NO_2 output where the measured converter efficiency is less than 100%. This does not correctly scale both NOx and NO channels, and could potentially lead to erroneous data which cannot be corrected. ESU's have been asked to ensure settings (where adjustable) are set to 100%.

With effect from June 2010, it will be necessary for CEN compliance to rescale NO_2 data where the converter efficiency is below 98% or above 102%. As many measured efficiencies are currently in the range 95-98%, this rescale will result in slightly higher reported concentrations of NO_2. The QA/QC unit is adopting this approach with data from 1 January 2010 to ensure a consistent approach for the whole years dataset.

Noisy analyser outputs

There are several analysers on the network that produce very noisy signal outputs. Many of these have been highlighted in previous reports, and ESUs have been made aware of them. The most common offenders are CO and SO_2 analysers, although with the replacement of older equipment during 2009, this problem has significantly reduced.. An example is shown in Figure 12.2

Figure 10.2 Example of Poor Quality Data



Rapid drifts or erratic changes in zero or calibration factor

Some analysers have a tendancy to drift over time. In most cases, these can be accommodated using manual calibration values, assisted by daily autocalibration data. However, some drift so rapidly that it is difficult to establish where the signal baseline actually lies. Figure 10.2 also shows erratic changes in baseline, both step-changes and baseline drift.

Leaks

Both gaseous and particle analysers are susceptible to leaks. The analysers are tested for this at 6-month QA/QC visits, and at ESU visits. Where leaks are identified, information is sought as to when this might have occurred, and an assessment is made of the likely effect on data quality. Small leaks are unlikely to have a major effect on measured data; where the leak is more substantial, the effect is often visible in the measured data, particularly when compared with data from other nearby sites.

Leaks in the bypass flow on a TEOM or FDMS analyser may affect the particle size fraction of the analyser inlet.

Air conditioning faults

Most of the sites have air conditioning units to control internal temperature. If these units fail, the internal temperature may rise significantly, or may vary by an unacceptable degree. Varying temperatures often cause analysers output signal to change, and the reliability of analysers is significantly reduced when exposed to elevated temperatures. CO analysers in particular suffer from signal drift when the temperature is not well controlled. The relatively poor summer in 2009 did mean

that data losses were lower than might have been expected. In other cases, the failure of the air conditioning unit causes frequent or prolonged disruption to the site power supply.

Automatic calibration run-on
As described in Section 2.4, there have been persistent problems across the network with the daily span checks for NO_2 (and less so for SO_2) causing run-on into the ambient data. This only occurs where the span check is provided by a permeation tube, and commonly results in the loss of up to one hour's data each day. This problem has been raised with the ESUs, and considerable progress has been made to reduce the problem. In many cases, the run-on is reduced to acceptable levels by reducing the concentration of the span check gas, and several ESUs are now installing permeation tubes with lower permeation rates.

10.2 FDMS Data

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 ESU have put considerable effort into solving these issues.

These issues may be summarised in the following general areas:

- Poor pump performance. The vacuum is critical to maintaining correct analyser function, and it is noted that some pumps have failed prematurely. These were found to be of the incorrect mains frequency, and the supplier is working on replacing these with units more appropriate to UK mains supply. It is also important that where $PM_{2.5}$ and PM_{10} FDMS units are co-located, the flows must be within 3% of each other. This is now checked at QA/QC audits.

- Filter changes during reference cycle. It was found that opening the FDMS unit during the reference cycle allowed excessive moisture to enter the cooler unit, resulting in considerable analyser instability. The procedures have been updated to ensure the unit is locked in base mode whilst the door is open. LSOs have been issued with spare filter cartridges to allow filter changes to be carried out more rapidly.

- Temperature instability. There have been several issues with air conditioning and heating being inadequate to maintain a constant temperature.

- $PM_{10}/PM_{2.5}$ comparison. With the introduction of $PM_{2.5}$ analysers, it is possible to compare concentrations with PM_{10}. In some cases, measured $PM_{2.5}$ concentrations have been higher than the PM_{10}, which is of course illogical. Careful examination of the data are required to establish which, if either, is correct.

- The performance of the FDMS dryer is also critical to the quality of data. In some cases these have failed, resulting in poor quality data. The performance of the dryer needs to be carefully monitored to ensure optimal data quality. The measured sample dew point must always be below –2C, and there must be a minimum of 10C between the ambient temperature and the sample dewpoint. As the dryer fails, these parameters are frequently not met, and the measured volatile concentration may be seen to be anomalously high. This is easier to spot where $PM_{2.5}$ and PM_{10} instruments are co-located.

- Anomalous volatile concentrations. The concentration of the volatile component varies relatively little between local sites, and is mainly in the $PM_{2.5}$ fraction, so a comparison between two collocated FDMS instruments is a useful way to check analyser problems.

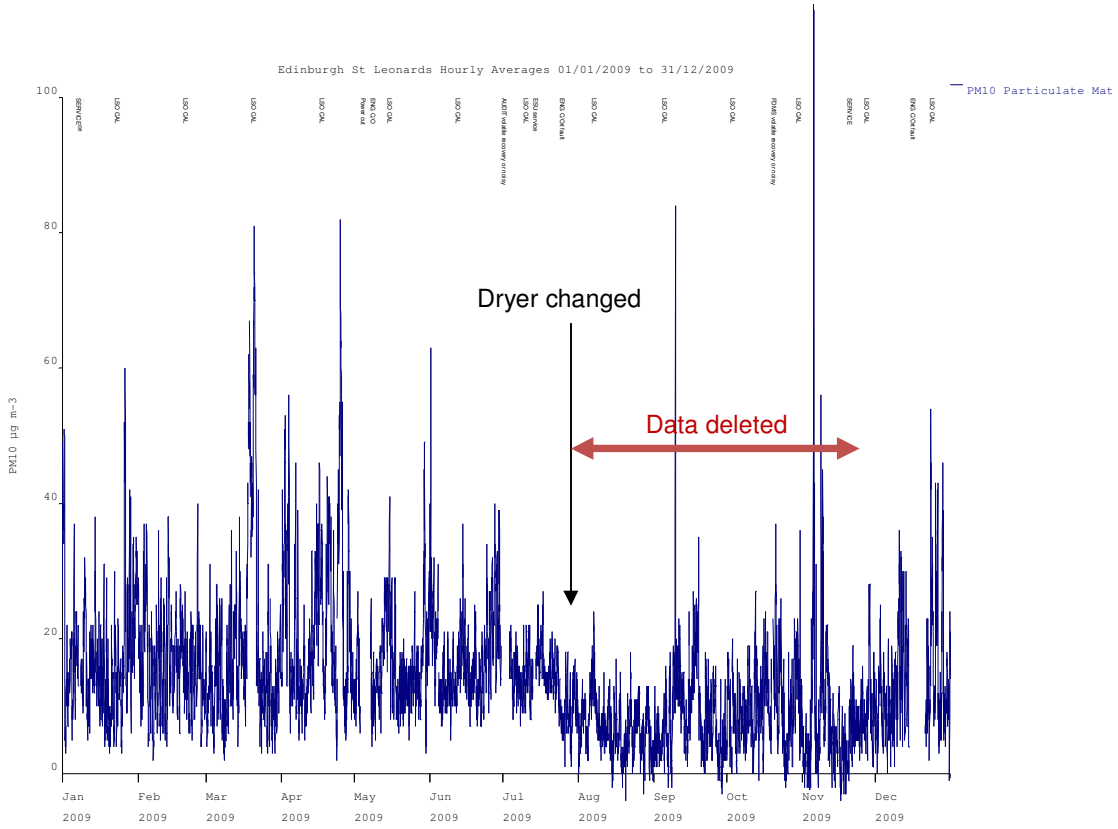
10.3 Significant Problems Experienced During 2009

Several sites have experienced persistent and serious performance problems during 2009, requiring detailed investigation by the QA/QC Unit, CMCU and the ESUs concerned. These are described below.

10.3.1 Edinburgh St Leonards

The PM_{10} FDMS dryer was changed to a B-type dryer on 24 July. This resulted in a significant decrease in measured PM_{10} concentrations. After detailed investigation, it was decided to convert the $PM_{2.5}$ analyser to PM_{10} for a two-week period in December to check for acceptable agreement between the two analysers.

Figure 10.3: PM_{10} concentrations at Edinburgh St Leonards, 2009

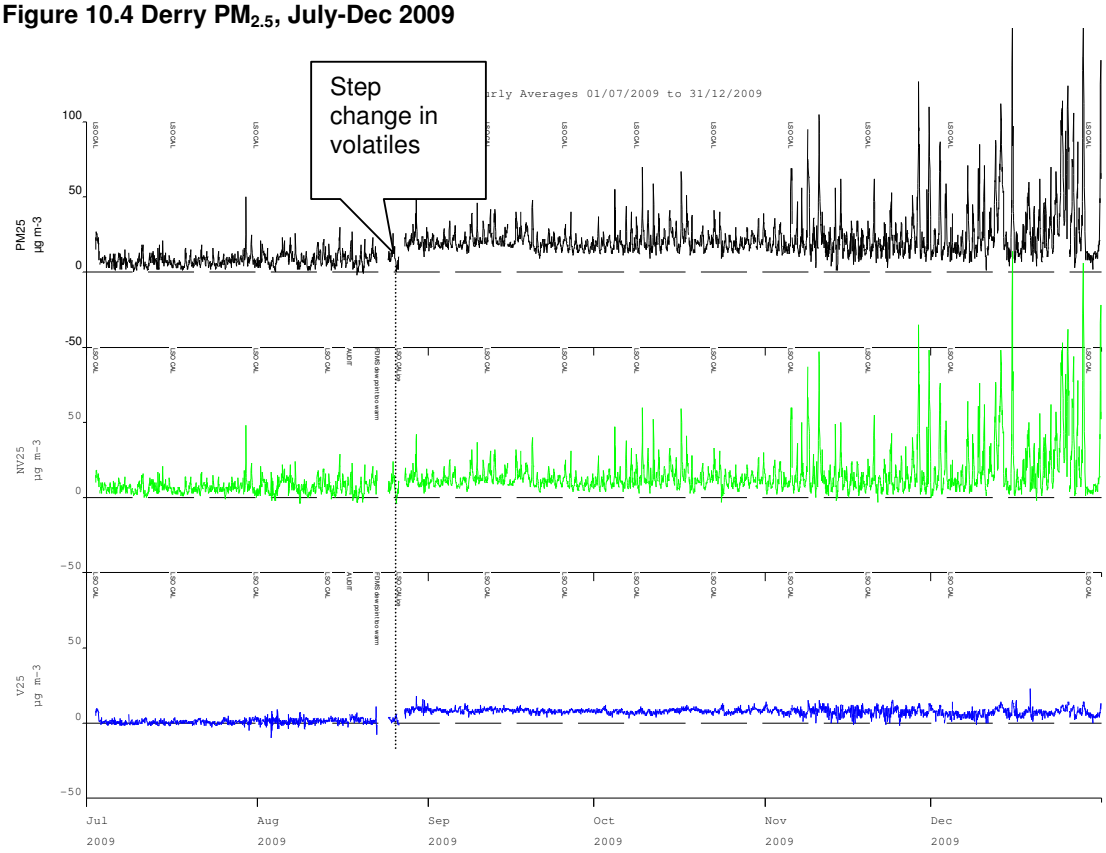


As a result of this, the PM_{10} sensor and control units were replaced on 13 January 2010, and measured concentrations returned to levels similar to those prior to the dryer change. The data for the period 24 July to 13 January have been deleted and data in quarter 1 of 2010 will be examined closely during ratification.

10.3.2 Derry

Problems with the $PM_{2.5}$ and PM_{10} data from Derry have been reported in previous quarterly reports. The PM2.5 volatile fraction appears to be too high following an unspecified site visit on 22 August 2009. The change in the volatile fraction can be seen in Figure 10.4

Figure 10.4 Derry $PM_{2.5}$, July-Dec 2009



All of the $PM_{2.5}$ data for the period January-June 2009 period have already been deleted due to a number of instrument problems; data capture at this site is therefore very poor. The problem has not been rectified as at March 2010.

The PM_{10} FDMS has also performed poorly, with the entire July-September 2009 period deleted, and a major leak identified at the winter 2010 audit resulting in further data loss.

10.3.3 Portsmouth

The FDMS analysers have continued to perform poorly during most of 2009, and as a result, all $PM_{2.5}$ and PM_{10} data have been deleted from 1 March 2009 to the end of the year.

10.4 Partisol Gravimetric Particulate Data

During 2008, an analysis of Partisol gravimetric particulate matter data showed a over-read of measured concentrations from 2006 and 2007, particularly at sites where concentrations are low. A thorough investigation by Bureau Veritas (as filter weighing contractor) led to the 2008 data being held as provisional until April 2009. A full description of the findings is given in "Trends in Gravimetric Particulate Matter in the United Kingdom" which can be found at http://www.airquality.co.uk/archive/reports/cat09/0901221659_Trends_in_Gravimetric_PM_Measurements_in_the_UK_v210109.pdf

Potential reasons considered for the discrepancy between gravimetric and other methods of particle measurements include:

- Filter media used
- Environmental conditions used for conditioning the filters
- Storage conditions in the sampler
- Differences in equipment used

As a result of the investigation, the following actions have been taken:

1. A field blank sent in the cartridge with sample filters. This allows correction of Partisol data for blank values obtained from blank filters conditioned alongside the sample filters but not themselves exposed. Correction of 2008 data has been carried out during ratification.
2. Round-robin of filter weighings between BV, AEA and NPL, where a set of filters is conditioned and weighed by each organisation.
3. Long-term analysis of blank filter weight data by QA/QC Unit to establish any trends, step changes or deviations
4. Change of filter medium used from quartz to Emfab (PTFE coated glassfibre) with effect from January 2009

10.5 Site calibration cylinders

The site cylinder concentrations are reassessed at each QA/QC audit. Any outliers (>10% from certified value) are investigated and where necessary, replaced. If the recalculated concentration casts doubt on the validity of the calibrations, the cylinders may be returned to the QA/QC Unit for recertification; alternatively, the site audit may be repeated. Not all outliers are due to cylinder drift; noisy or faulty analysers can give results which cast doubt on cylinder concentrations. In extreme cases, reanalysis of the cylinder is the only reliable way to confirm the nature of the problem.

Following the summer 2009 intercalibration exercise, a small number of cylinders were returned to AEA for recalibration. Unfortunately, several more cylinders were already empty before recertification could take place. The QA/QC Unit now routinely checks that the CMCU has the correct concentrations to ensure that scaled data released to the Data Dissemination Unit (DDU) is as accurate as possible.

Although many NO_2 cylinders are identified as outliers during the intercalibration exercise, these are not recalibrated as the concentrations are not used directly for data scaling purposes.

11 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 (SO_2), 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.

By way of example, the performance of an analyser in the field must pass a number of tests, including:

- Linearity – the analyser must have a maximum error at any point of less than 6% of the predicted value. AEA now reports maximum residuals from linearity tests, to evaluate the performance of current analysers against these tougher requirements.

- NOx converter efficiency must be better than 95%. Data must be rescaled for efficiencies between 95 and 99.9%, but rejected if below 95%. Again, this is tighter than currently, where we accept "borderline" failures.In addition, specific procedures for undertaking converter efficiencies tests have been prescribed; AEA already use the CEN method for undertaking converter tests.

- The sampling system that delivers air to the analyser must remove no more than 2% of the pollutant to be analysed. AEA continue to evaluate systems to calibrate sampling systems, but this is not currently undertaken on a routine basis in the UK. In order to simplify the testing, many sites have had sample manifolds replaced with individual sample lines which can be regularly replaced.

  A report on the evaluation of methodologies to test losses of gases to sampling manifolds has been completed by QA/QC Unit and this is available on the AURN Hub and Air Quality Archive. "Evaluation of Methodologies to Test Losses of Gases to Sampling Systems" B Stacey, netcen/ED45077030/R/1820/Issue1, August 2004

- The concentration of the site cylinders will need to be determined every six months, and the revised values used to scale ambient data. This is a change to our current procedures, where no action is taken until a cylinder deviates from its stated value by more than 10%. AEA have introduced a new procedure for handling drifting cylinder concentrations. In future, the uncertainty of these calculations will need to be substantially lower than the current 10% limit (in the order of 4-5% maximum).

- The determination of an SO_2 analyser response to meta xylene will not be required for ongoing field tests. For the AURN, AEA will continue to assess the performance of the hydrocarbon kickers, but action will not be recommended unless the result is very high (greater than 50ppb response to a 1ppm m xylene cylinder), indicating that the kicker has failed completely.

The CEN operating methodologies are now finalised and published and are, at present, being incorporated into the requirements of the Directive. Member States will have 2 years to ensure their monitoring networks are compliant. 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 network intercomparison were fully compliant with the CEN protocols. ESU's have also been instructed to ensure pre and post service tests are compliant with the procedure; AEA have supplied them with spreadsheets to ensure the correct data are recorded.

12 Site Closures, Refurbishments and Infrastructural Repairs

During 2009, a relatively little data were lost through site closures for relocation or refurbishment. The sites worst affected are given in Table 12.1. The programme of replacing non-compliant monitoring equipment caused some minor data losses.

Table 12.1 Sites/Pollutants Subject to Closure or Relocation, 2009

Site	Monitoring stopped	Monitoring restarted	Reason
St Osyth (CO only)	31/12/09	-	No longer required
Market Harborough (CO)	31/12/09	-	No longer required

The major infrastructural changes across the AURN during 2009 was the replacement of non-CEN compliant analysers at Defra fully funded sites. The majority of this was undertaken at scheduled services. As part of this, the sampling and calibration systems were modified where possible to incorporate individual sampling lines and the use of zero air cylinders for monthly LSO calibrations. In general, this went smoothly, and many of the more elderly and unreliable analysers have now been replaced with new equipment. However, there were some issues with installations resulting in leaks or incorrect sample line configurations. The QA/QC unit have investigated a number of possible problems with new installations, and unfortunately some data have been lost as a result (eg Stoke-on-Trent ozone).

In addition, the sample manifolds at Defra-owned sites have been progressively changed for individual sampling lines where physically possible. This has the following benefits:

- Testing of sample losses is easier as flowrates are lower
- Cleaning and maintenance is easier, as there bis no need to dismantle fragile sample inlet systems. Sample lines may be regularly replaced to ensure lines are clean.
- The risk of loss of data through manifold fan failure is minimised.

13 Changes to the Network

There have been several changes to network sites during 2009. Most of these were as a result of the network review (see Section 8). Other changes are listed in Table 13.1

Table 13.1 Significant Changes to the Network, 2009

Site	Pollutant	Date started
Aberdeen	$PM_{2.5}$	20/02/09
Armagh Roadside	NO_2 PM_{10}	01/01/09
Birmingham Tyburn Roadside	NO_2 O_3 PM_{25} PM_{10}	11/02/09
Blackburn Darwen Roadside	NO_2	15/06/09
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
Chesterfield Roadside	$PM_{2.5}$	01/07/09
Glasgow Kerbside	$PM_{2.5}$	28/05/09
Grangemouth Moray	NO_2	01/06/09
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
Mold	NO_2 O_3	02/12/09
Norwich Lakenfields	NO_2 O_3 PM_{25} PM_{10} SO_2	25/09/09
Peebles	NO_2 O_3	18/11/09
Plymouth Centre	$PM_{2.5}$	13/10/09
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	NO_2	21/01/09
Wirral Tranmere	$PM_{2.5}$	28/01/09
Wrexham	$PM_{2.5}$	09/12/09

14 ISO17025 Accreditation

The QA/QC Unit has maintained its ISO17025 accreditation for site calibrations and calibration of ambient gas mixtures. A copy of the schedule can be found at http://www.ukas.org.uk/calibration/lab_detail.asp?lab_id=902&vMenuOption=3

A total of four surveillance and assessment visits were carried out by UKAS- two at monitoring sites, one at Harwell and one at Glengarnock.

15 Usage of AURN Data

The primary aims and objectives of the AURN are listed as follows:

- Meeting statutory requirements (e.g. EC Directives)
- Informing the public about air quality
- Providing information for local air quality review and assessment
- Identifying long term trends
- Assessment of policy effectiveness

The data collected from the AURN sites in 2009 have now been fully ratified and quality assured. – this ensures that the data are of high quality and reliable and hence can be used to fulfil these objectives.

The data will be assessed in relation to the EC Air Quality Directives to determine any areas of exceedence of limit values etc, which will be reported to the European Commission in September 2009, as required by the Directives. In addition, the full dataset for 2009 will be uploaded to the European Air Quality database http://airbase.eionet.eu.int/

The public has been kept informed of air quality concentrations through direct access to the AURN data via the UK Air Quality Information website (www.airquality.co.uk). Provisional data are updated onto this website every hour and the ratified data are uploaded every 3-months following the quarterly ratification cycle described in these Data Ratification reports. A full annual summary of the data for 2009 will also be published later in 2010 as part of the "Air Pollution in the UK" series of reports.

The data are widely used by Local Authorities as part of their review and assessment process. Data from individual stations are used in the specific local area and the full AURN dataset is used within the preparation of the Pollution Climate maps of the UK which provide background concentration maps for the whole of the UK.

Occasionally, data marked as ratified may be returned to provisional status if some material fact comes to light which casts doubt over the reliability of the data. The data will be clearly identified on the archive..

Long-term trend analysis is included in the Air Pollution in the UK series of reports and the AURN data are also used to calculate the UK Air Quality Indicator for Sustainable Development. The indicators based on the final dataset for 2009 are available at
http://www.airquality.co.uk/what_are_we_doing.php

Previous years AURN data were extensively used in the development and current updating of the UK Air Quality Strategy. In addition, AURN data, along with other UK data sets, have been extensively used by the UK Air Quality Expert Group (AQEG) in the development of a series of reports –
Trends in primary nitrogen dioxide in the UK - December 2007
Air quality and climate change: a UK perspective - April 2007
Particulate Matter in the UK – 2005
Nitrogen Dioxide in the UK – 2004

AQEG has circulated a further report for consultation on Ozone in the UK and this will also make extensive use of AURN data.

16 Safety

Safety is clearly an important aspect of network operation. 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. Any items deemed to pose an unacceptable risk are brought to the attention of the site owner or the CMCU.

There are no issues identified that presented significant risk during the winter 2010 intercalibration exercise, except for some issued surrounding working at heights and manual handling at Teddington. . The issue of safe roof access, to audit PM_{10} analyser flow rates has largely been worked around. This has been achieved either by installing ladder securing points on the outside of the huts, or by auditing flow rates inside the monitoring station. However, performing flow measurements inside means that we are unable to perform satisfactory leak tests on the entire sampling systems of these analysers.

It is important that safe access to the TEOM head is possible where FDMS TEOMs are employed, as it is not possible to fully leak check the system from inside the monitoring enclosure. As at April 2010, there are a number of sites where this is not the case. The access to roof-mounted equipment should be considered when acquiring or upgrading monitoring stations.

Recommendation

Safe roof access to the TEOM head should be provided at sites where FDMS units are deployed

The Gas Supply Contractor undertakes regular inspection and maintenance of the gas regulators on site to ensure compliance with the relevant pressure systems regulations.

The CMCU have organised electrical testing of equipment and site infrastructure at fully funded sites.

17 Suitability Assessments

AEA carry out an annual Suitability Assessment of air quality monitoring carried out by Local Authorities at sites which are not part of the national network, but which have reported an exceedence of an applicable EU Limit Value.

The objectives of this Suitability Assessment are changing this year, and for the 2010 assessment of 2009 data are likely to be as follows:

(i) To provide Defra with information on exceedences of EU Limit Values at sites outside the AURN
(ii) To identify Local Authority monitoring sites which may be suitable candidates for affiliation into the AURN.

The Suitability Assessment also provides important input into the Defra Pollution Climate Mapping project, the objective of which is to provide Defra and the Devolved Administrations with the best possible understanding of current (and predicted future) air quality.

Potential exceedences are identified via two routes: firstly, by screening data already available to AEA (either from sites whose data are managed by AEA, or publicly-available datasets). Secondly, exceedences reported by Local Authorities in their annual Local Air Quality Management Review and Assessment reports, produced by the end of April each year. Air Quality Consultants (AQC) are responsible for appraisal of these reports and collating a list of reported exceedences.

The Pollution Climate Mapping team will

(i) identify any potential exceedences which would a) change the status of a zone or agglomeration, from not exceeding to exceeding, or b) change the status of a zone or agglomeration from a modelled to a measured exceedence.
(ii) identify any zones or agglomerations where a LA site exceeds, and the AURN or modelled data exceeds, and the LA site shows higher concentrations than the exceeding AURN site or the modelled data in the zone.

Exceedences which do not fall into any of the above categories will not be investigated further. For exceedences falling into categories 1a, 1b or 2 above, the relevant Local Authorities will be contacted and the datasets requested. Where AEA already have access to the data, the LA's permission will be sought, to use the data in the study. The data will only be used with permission of the Local Authorities concerned.

AEA's data management team will undertake a review of the data sets. This is likely to include the following checks and processes for each data set:

(i) Assessment of the site's compliance with the specified siting criteria in the Directive on Ambient Air and Cleaner Air for Europe. This will be based on information provided by the Local Authority and publicly available information (for example from Google Earth Data capture information
(ii) Data quality, based on information obtained from the LA on data ratification procedures, on screening the data for any anomalies, Time-series plots of data sets and nearby sites are used for comparison
(iii) The suitability of the instrument or method used.

The aim of this is to assess the suitability of the site for inclusion in the AURN (should Defra decide to do this), the reliability of the data, and the extent to which we can be confident that what was reported is in fact a genuine exceedence which changes the status of a zone or agglomeration. It should be noted that from 2010 only exceedences which fall into categories 1a, 1b and 2 above will be assessed.

Each potential exceedence will be assessed on the basis of site criteria, data capture, ratification status, data quality issues. A suitability score will be assigned for each of the above criteria. A summary report will be produced for Defra and the Devolved Administrations by the end of the calendar year.

It is not intended that the findings be included in the UK's submission to the European Commission. It is our understanding that sites used in this submission must be identified in advance of the reporting year.

Last year, AEA carried out Suitability Assessment for 169 potential exceedences from Local Authority-operated monitoring stations. It is expected that the number of sites meeting the criteria to undergo suitability assessment in 2010 (on the basis of their 2009 data) will be about half of this total, i.e. approximately 80 sites.

18 Other QA/QC Activities

18.1 AQUILA (EU Association of National reference Laboratories)

Brian Stacey has replaced Ken Stevenson on AQUILA, and two meetings were held in 2009.

18.2 AQEG

There has been no AQEG activity during 2009, other than the appointment of a new Charirman, Paul Monks.

18.3 CEN Membership

Brian Stacey has continued to contribute to the CEN committee TC264 EH/2/3 Working Group 12 and 15 on air pollution standards. This allows the QA/QC Unit to have direct input into the European air quality standards, and help ensure the QA/QC unit is fully compliant with the requirements of these standards.

18.4 QA/QC Manual

The QA/QC Unit, with cooperation from Richard Maggs from the CMCU, have produced a manual describing the quality assurance procedures employed across the whole AURN network. This includes sections on the following:

- Monitoring site numbers and location
- Measurement methods
- Establishing new monitoring sites
- Data telemetry and validation
- Ongoing QA/QC including network inter-comparisons and data ratification
- Traceability of the measurements to national and international standards.

The full document may be downloaded at
http://www.airquality.co.uk/reports/cat13/0910081142_AURN_QA_QC_Manual_Sep_09_FINAL.pdf

The calculation of the overall uncertainty of the measurements is then presented and compared with the Data Quality Objectives specified in the appropriate EU Directive. The report also briefly discusses how data from non-AURN monitoring in the UK and from the extensive UK air quality modelling undertaken within the Pollution Climate Mapping project are merged with the AURN data to provide the overall assessment of air quality in the UK, as required by the EU Directive.

18.5 Assessment of Siting Criteria

The sites currently in the Automatic Urban and Rural Network (AURN) have been assessed in September 2009 for compliance with the requirements of the EU Directive on ambient air quality 2008/50/EC. This places requirements on site location and sampling criteria, which must be met by all sites used to ensure the UK's compliance with the Directive.

Of the 127 sites in the network as of July 2009 and several which have yet to be commissioned into the network, eight have been identified as not fully meeting the requirements. These are listed, along with the reasons for non-compliance, in Table 18.1 below.

Table 18.1 Sites not compliant with EU Directive 2008/50/EC

Site	Reason for noncompliance	Comments
Brighton Roadside	Site on major road junction	Location not representative of area
Bristol Old Market	Site on major road junction	Location not representative of area
Bury Roadside	Site within major road junction	Site also too far from carriageway to be Roadside
Great Dun Fell	Site in elevated location (900m asl)	Site originally intended for reseach purposes
Leicester Centre	Site between two large office blocks preventing free air movement	Location not representative of area
London Cromwell Road 2	Site on major road junction	Site relocated from more suitable location in 1998
Sandwell West Bromwich	Site in car park on top floor	Not representative of local area; may be affected by traffic in car park
Weybourne	Site on coast	Prevailing weather conditions so near sea may affect concentrations

The report is available for download at
http://www.airquality.co.uk/reports/cat13/0909101231_Siting_Criteria_Report_Sept09.pdf

Appendices

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 October-December 2009

01/10/2009 to 31/12/2009 Gaps in 15-minute table >= 6 hours and data capture <= 90%

Pollutant	Data Cap.	Start date	End date	Reason	Comments	No. of days	No. of hours
England							
Barnsley Gawber							
SO2	0.00%	16-Sep-09	31-Dec-09	Unstable response	Unstable data - temperature related?	107	2560
Birmingham Tyburn							
PM25	89.80%	08-Oct-09	12-Oct-09	Power cut		4.2	101
		26-Oct-09	27-Oct-09	Power cut		0.9	21
		03-Nov-09	04-Nov-09	Instrument fault		1.3	30
		28-Nov-09	30-Nov-09	Power cut		2.8	68
Birmingham Tyburn Roadside							
PM10	87.30%	10-Aug-09	12-Oct-09	High noise	Noisy and negative volatiles	63.1	1514
PM25	80.80%	10-Oct-09	12-Oct-09	Power cut		1.6	39
		16-Dec-09	31-Dec-09	Monitoring suspended	PM2.5 installed	15.6	374
Bournemouth							
PM25	0.00%	01-Oct-09	31-Dec-09	Switched out-of-service	See Appendix 4	92	2208
		30-Dec-09	30-Dec-09	Switched out-of-service	See Appendix 4	1	24
Brighton Preston Park							
PM25	0.00%	21-Nov-09	27-Nov-09		See Appendix 4	7	168
		10-Dec-09	14-Dec-09		See Appendix 4	5	120
Bristol Old Market							
NO2	33.60%	01-Nov-09	28-Feb-10	NO2 converter fault	Nox converter fault	120	2880
Bury Roadside							
PM25	87.00%	07-Oct-09	09-Oct-09	Instrument fault	Mass transducer fault	1.6	39
		10-Nov-09	17-Nov-09	High noise	Data deleted	7.3	176
		29-Dec-09	19-Jan-10	Sampling fault	Leak in system	21.2	509
Camden Kerbside							
NO2	62.50%	27-Nov-09	14-Jan-10	Instrument fault	Various faults reported	48.1	1154
PM25	62.40%	22-Oct-09	30-Oct-09	Instrument fault	ENG C/O Could not fix. Removed from site	8.1	194
		05-Dec-09	08-Jan-10	Instrument fault	Noisy data deleted	34.3	822

Chesterfield							
PM10	73.20%	02-Oct-09	15-Oct-09		ENG C/O Call out for noise on PM10 FDMS	13.3	318
		30-Oct-09	02-Nov-09	Power cut		3.1	75
		16-Nov-09	24-Nov-09	Instrument fault	Replaced controller and sensor unit	8.2	197
Coventry Memorial Park							
O3	75.50%	10-Dec-09	05-Feb-10	Sampling fault	ENG C/O Fitted ozone filter holder. Calibration system incorrectly conflgured	57.3	1376
Exeter Roadside							
O3	0.00%	01-May-09	31-Dec-09	Sampling fault	Low data compared to nearby sites	245	5880
Haringey Roadside							
NO2	85.10%	18-Dec-09	05-Jan-10	Instrument fault	call out 05/01 Fixed Peltier cooler	18.1	435
Harwell							
PM25	59.60%	13-Aug-09	06-Nov-09	Low flow rate	Major leak	85.2	2044
High Muffles							
NO2	25.20%	10-Jul-09	08-Dec-09	Switched out-of-service	Power supply off	151	3632
O3	25.30%	29-Jun-09	08-Dec-09	Switched out-of-service	Power supply off	162	3883
Hull Freetown							
PM10	80.80%	20-Nov-09	07-Dec-09	Instrument fault	Replaced cooler 7th Dec	17	407
		24-Dec-09	24-Dec-09	FDMS volatile recovery or noisy	Unstable volatiles	0.3	6
Ladybower							
SO2	77.80%	30-Nov-09	17-Dec-09	Instrument fault	UV Lamp fault	17.6	423
Leicester Centre							
NO2	81.00%	05-Oct-09	08-Oct-09	No mV data collected		2.7	65
		12-Oct-09	16-Oct-09	Unstable response	Instability - assume temperature related	3.7	89
		04-Dec-09	11-Dec-09	Sampling fault	Wrong filter and loose connection found	7.5	179
O3	78.60%	05-Oct-09	06-Oct-09	Communication fault		0.8	19
		13-Nov-09	30-Nov-09	Sampling fault	ENG C/O Fixed IZS. Removed panel covers to cool instrument	18	431
		05-Dec-09	06-Dec-09	Communication fault		0.5	11
PM25	57.60%	30-Jun-09	06-Nov-09	ESU service	SERVICE Installed new instruments	129	3097
		07-Dec-09	09-Dec-09	No mV data collected		2.2	53
Liverpool Speke							

PM25	84.00%	19-Nov-09	01-Dec-09	Unstable response	call out 01/12 tear in filter unstable data/replaced	12.5	301
London Harlington							
NO2	83.70%	13-Nov-09	26-Nov-09	Monitoring suspended	Power cable problems.	12.5	300
		01-Dec-09	02-Dec-09	Instrument fault	Eng C/O replaced pre amp and Tec board.	0.9	22
O3	86.30%	13-Nov-09	26-Nov-09	Monitoring suspended	Power cable problems.	12.5	300
PM10	66.00%	13-Nov-09	14-Dec-09	Monitoring suspended	Power cable problems and water found in FDMS removed from site.	31	743
PM25	82.80%	11-Nov-09	26-Nov-09	Monitoring suspended	Power cable problems.	15.1	362
		01-Dec-09	01-Dec-09	Unstable response	following filter change.	0.3	8
London Marylebone Road							
PM25	88.00%	28-Oct-09	31-Oct-09	FDMS volatile recovery or noisy	Unstable volatiles after visit	3.5	83
		23-Dec-09	30-Dec-09	Sampling fault	Sampling fault after filter change	7	169
Manchester Piccadilly							
PM25	52.80%	07-Oct-09	07-Oct-09	High noise	Rejection of low data	0.3	6
		19-Nov-09	18-Jan-10		ENG C/O FDMS pump vacuum low. Serviced pump	60.3	1447
Market Harborough							
NO2	86.00%	08-Oct-09	09-Oct-09	No mV data collected	info requested from BV	1	25
		02-Dec-09	07-Dec-09	No mV data collected	info requested from BV	4.9	118
Middlesbrough							
CO	59.80%	19-Oct-09	24-Nov-09	Air Conditioning or Temp fault	Analyser turned off due to faulty air con	36.6	879
O3	59.80%	19-Oct-09	25-Nov-09	Air Conditioning or Temp fault	Analyser turned off due to faulty air con	36.7	880
PM10	17.30%	23-Sep-09	07-Dec-09	High noise	Noisy data; site overheating	75.2	1805
		24-Dec-09	04-Jan-10	High noise	Very noisy data	12	288
PM25	54.10%	16-Oct-09	26-Nov-09	Air Conditioning or Temp fault	Analyser turned off due to faulty air con	41.4	993
Norwich Lakenfields							
SO2	62.90%	19-Nov-09	23-Dec-09	Instrument fault	lamp fault flat data and Unstable baseline analyser replaced	33.7	809
Nottingham Centre							
PM10	65.40%	19-Dec-08	31-Oct-09	Switched out-of-service	Converted to PM2.5	316	7594
		23-Nov-09	23-Nov-09	FDMS volatile recovery or	Volatile recovery	0.5	11

				noisy			
Oxford St Ebbes							
NO2	85.60%	19-Oct-09	20-Oct-09	No mV data collected	no data collected	1.2	29
		29-Oct-09	03-Nov-09	Air Conditioning or Temp fault	airconditioning problem	5.1	123
		01-Dec-09	07-Dec-09	Air Conditioning or Temp fault	airconditioning problem	6.3	150
		12-Dec-09	12-Dec-09	No mV data collected	no data collected	0.3	7
PM10	88.00%	29-Oct-09	03-Nov-09	Air Conditioning or Temp fault	air conditioning problems in hut	5.2	124
		01-Dec-09	07-Dec-09	Power cut	a/c temp issue 18.00 to 15.00 on 7 Dec	5.8	140
PM25	87.60%	29-Oct-09	03-Nov-09	Air Conditioning or Temp fault	airconditioning problem	5.1	123
		01-Dec-09	07-Dec-09	Air Conditioning or Temp fault	a/c temp issue 18.00 to 15.00 on 7 Dec	6	144
Plymouth Centre							
PM10	86.20 %	04-Nov-08	13-Oct-09	Air Conditioning or Temp fault	FDMS switched off .	343	8233
Portsmouth							
PM10	0.00%	01-May-09	31-Dec-09	QAQC audit		245	5880
Reading New Town							
NO2	0.00%	13-Jul-09	31-Dec-09	Instrument fault	NOx baseline far too high	172	4119
O3	68.00%	05-Oct-09	03-Nov-09	Sampling fault	Internal sampling from audit to 3 Nov	29.2	701
Rochester Stoke							
NO2	28.40%	19-Oct-09	20-Oct-09	ESU service	ENG C/O Install new analyser	0.9	22
		23-Oct-09	29-Oct-09	Power cut	Power failures due to leak from roof	6.1	147
		03-Nov-09	28-Feb-10	Switched out-of-service	Site offline	117	2819
O3	29.70%	23-Oct-09	28-Oct-09	Power cut	Power failures due to leak from roof	5.3	127
		29-Oct-09	29-Oct-09	Power cut	Power failures due to leak from roof	0.5	12
		03-Nov-09	28-Feb-10	Switched out-of-service	LSO turned off site due to water leak	117	2819
PM10	5.90%	06-Oct-09	31-Jan-10	Instrument fault	Cooler fault & sensor unit full of water	118	2822
PM25	27.60%	06-Oct-09	07-Oct-09	FDMS dryer	Dryer fault	0.8	20
		22-Oct-09	28-Oct-09	Power cut	Power failures due to leak from roof	6.6	158
		03-Nov-09	31-Jan-10	Switched out-of-service	LSO turned off site due to water leak	89.6	2151
SO2	22.60%	21-Oct-09	31-Jan-10	Power cut	Power failures due to leak from roof	102	2451

Sandy Roadside							
NO2	73.70%	19-Aug-09	21-Oct-09	Sampling fault	Internal sampling after service	63.3	1518
Sheffield Centre							
CO	85.20%	06-Nov-09	20-Nov-09	Sampling fault	Sample flow and source warnings	13.5	325
Southend-on-Sea							
NO2	0.00%	08-Sep-09	31-Dec-09	Instrument fault	NOx baseline far too high	114	2747
St Osyth							
CO	87.40%	01-Oct-09	12-Oct-09	ESU service	Offline until replacement API analyser stalled.	11.3	270
NO2	87.20%	01-Oct-09	07-Oct-09	ESU service	Replaced O3 and NOx. Removed logger	6.1	147
Stanford-le-Hope Roadside							
PM25	73.60%	14-Oct-09	01-Nov-09	Instrument fault	Analyser removed for repair; data deleted	18.3	439
		18-Nov-09	22-Nov-09	Unstable response	Spurious data deleted	4.2	101
		26-Nov-09	26-Nov-09	Unstable response	Spurious data deleted	0.3	8
		22-Dec-09	22-Dec-09	Unstable response	Spurious data deleted	0.3	7
SO2	56.90%	01-Oct-09	09-Nov-09	High noise	PMT temp warn. Replaced themistor	39.6	950
Stoke-on-Trent Centre							
O3	39.50%	21-Sep-09	25-Nov-09	Sampling fault	Internal sampling	65.1	1563
Sunderland Silksworth							
NO2	82.50%	29-Oct-09	11-Nov-09	Power cut	Air conditioning replaced	13.2	316
		08-Dec-09	11-Dec-09	No mV data collected	Air con problems	2.8	67
PM25	77.00%	01-Oct-09	11-Oct-09	Unstable response	instability continues from last quarter	11	264
		29-Oct-09	05-Nov-09	Air Conditioning or Temp fault	Air conditioning replaced	7.6	182
		09-Nov-09	09-Nov-09	Unstable response	Spurious data deleted	0.4	9
		12-Nov-09	12-Nov-09	Unstable response	Spurious data deleted	0.3	8
Wirral Tranmere							
NO2	89.30%	18-Nov-09	24-Nov-09	Operator error	Ozonator switched off somehow	5.9	142
Yarner Wood							
O3	87.90%	05-Nov-09	12-Nov-09	Instrument fault	UV Ref fault	6.6	158
		14-Nov-09	14-Nov-09	Power cut		0.4	9
		30-Nov-09	04-Dec-09	Power cut	Ozone analyser dead after powercut	3.7	88

N Ireland							
Armagh Roadside							
NO2	0.00%	01-Apr-09	09-Feb-10	Long-standing analyser fault prior to affiliation		315	7549
Belfast Centre							
PM25	82.90%	27-Sep-09	05-Oct-09	Air Conditioning or Temp fault	Air con failure	8.9	213
		23-Oct-09	02-Nov-09	Sampling fault	Call out: PM2.5 volatiles data poor	10.6	254
Derry							
PM25	0.00%	26-Aug-09	31-Jan-10	Instrument fault	ENG C/O Repaired leak on PM2.5	159	3813
Scotland							
Aberdeen Union Street Roadside							
NO2	0.00%	23-Sep-09	31-Jan-10	NO2 converter fault	Data deleted	131	3144
Auchencorth Moss							
PM10	0.00%	01-Oct-09	31-Dec-09		See Appendix 4	92	2208
		30-Oct-09	30-Oct-09			1	24
PM25	0.00%	01-Oct-09	31-Dec-09			92	2208
		12-Oct-09	12-Oct-09			1	24
		30-Oct-09	30-Oct-09			1	24
		28-Nov-09	28-Nov-09			1	24
		01-Dec-09	01-Dec-09			1	24
		04-Dec-09	04-Dec-09			1	24
		18-Dec-09	21-Dec-09			4	96
		23-Dec-09	24-Dec-09			2	48
		28-Dec-09	31-Dec-09			4	96
Auchencorth Moss PM10 PM25							
PM10	0.00%	03-Aug-09	31-Jan-10	Instrument fault	See Section 4.3.2	182	4368
Edinburgh St Leonards							
PM10	40.20%	24-Jul-09	20-Nov-09	Instrument fault	FDMS dryer upgrade from C to CB dryer	119	2859
		15-Dec-09	17-Dec-09	Instrument fault	ESU tests	2.5	61
		20-Dec-09	21-Dec-09	High noise	Deleted noisy data until 21st	2	48
Inverness							
NO2	89.40%	22-Dec-09	31-Dec-09	Instrument fault	ENG C/O Low data. Site remotely contacted hut very cold	9.4	226
Lerwick							
O3	66.30%	23-Oct-09	23-Nov-09	Operator error	Step change in analyser response.	31	745

Wales							
Cardiff Centre							
PM10	56.40%	06-Oct-09	12-Oct-09	Instrument fault	ENG C/O Install FDMS PM10 After repair	6.3	152
		24-Oct-09	27-Oct-09	Instrument fault	Incorrect valve position following LSO cal	3.2	77
		02-Nov-09	03-Nov-09	Unstable response	Call out: Response instability on FDMS PM10	0.9	22
		16-Nov-09	15-Dec-09	Instrument fault	Analyser removed for repair	29.1	699
		22-Dec-09	22-Dec-09	FDMS volatile recovery or noisy	Unstable data following ESU callout	0.3	6
Chepstow A48							
PM10	64.10%	20-Aug-09	31-Oct-09	Instrument fault	Data too low after service onwards	72.7	1744
		12-Dec-09	14-Dec-09	Power cut	Power cut followed by flat data	1.6	38
Cwmbran							
NO2	68.20%	19-Oct-09	17-Nov-09	No mV data collected	Analyser failed; hotspare installed	29.1	698
Newport							
PM10	52.60%	18-Nov-09	25-Jan-10	Sampling fault	Spurious data due to performance issue following ESU 16.00 to 14	68.1	1635
Swansea Roadside							
PM25	35.30%	01-Oct-09	01-Oct-09	High noise	Highly negative data	0.3	6
		12-Oct-09	01-Nov-09		ENG C/O Noisy PM2.5 Low flows found	20.2	485
		03-Nov-09	04-Nov-09	Instrument fault	ESU on site	0.8	19
		24-Nov-09	04-Jan-10	Instrument fault	Cooler fault instrument removed for repair	41	984

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: October-December 2009

Partisol data were ratified for the following sites and measurement periods.

Site	Start date	End date	Ratified Data Capture, %
Auchencorth Moss PM_{10}	1st Oct	31st Dec	99
Auchencorth Moss $PM_{2.5}$	1st Oct	31st Dec	85
Bournemouth $PM_{2.5}$	1st Oct	31st Dec	99
Brighton Preston Park $PM_{2.5}$	1st Oct	31st Dec	87
Harwell PM_{10}	1st Oct	31st Dec	100
Harwell $PM_{2.5}$	1st Oct	31st Dec	100
Inverness PM_{10}	1st Oct	31st Dec	100
Inverness $PM_{2.5}$	1st Oct	31st Dec	89
London Marylebone Road PM_{10}	1st Oct	31st Dec	91
London Marylebone Road $PM_{2.5}$	1st Oct	31st Dec	0
London N Kens PM10	1st Oct	31st Dec	100
London N Kens $PM_{2.5}$	1st Oct	31st Dec	93
London Westminster $PM_{2.5}$	1st Oct	31st Dec	95
Northampton $PM_{2.5}$	1st Oct	31st Dec	96
Port Talbot Margam $PM_{2.5}$	1st Oct	31st Dec	69
Wrexham PM_{10}	1st Oct	31st Dec	89
Wrexham $PM_{2.5}$	1st Oct	31st Dec	25 (100% of operational period: started up 9th Dec.)

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 rough comparison of ambient concentrations with those from co-located 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 m3.
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 6 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 – Summer 2009 and winter 2009-10 periods.

Site	Audit date	Flowrate m3/h	% out from 16.7 m^3/h
Auchencorth Moss PM_{10} (serial no. 21550)	1 Jul 2009 3 Feb 2010	17.2 16.7	3.42 0
Auchencorth Moss $PM_{2.5}$ (serial no. 21548)	1 Jul 2009 3 Feb 2010	16.6 16.7	-0.54 0
Bournemouth $PM_{2.5}$ (serial no. 21257)	10 Aug 2009 8 Feb 2010	17.20 17.48	3.18 4.70
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 28 Jan 2010	16.99 16.7	1.92 0
Harwell $PM_{2.5}$	23 Feb 2009 28 Jan 2010	16.86 16.7	1.14 0
Inverness PM_{10} (serial no. 21255)	12 Aug 2009 20 Jan 2010	16.58 16.7	-0.54 0
Inverness $PM_{2.5}$ (serial no. 21861)	12 Aug 2009 20 Jan 2010	16.62 16.7	-0.48 0
London Marylebone Road PM_{10} (serial no. 21306)	19 Aug 2009 11 Feb 2010	Not tested, no safe ladder access.	Not tested, no safe ladder access.
London Marylebone Road $PM_{2.5}$ (serial no. 21493)	19 Aug 2009 11 Feb 2010	Not tested, no safe ladder access.	Not tested, no safe ladder access.
London N Kens PM_{10} (serial no. 21722)	13 Jul 2009 12 Jan 2010	Not tested, no safe ladder access.	- -
London N Kens $PM_{2.5}$	13 Jul 2009 12 Jan 2010	Not tested, no safe ladder access.	- -
London Westminster $PM_{2.5}$	17 Aug 2009 8 Feb 2010	17.36 16.7	4.14 0
Northampton $PM_{2.5}$	19 Aug 2009 10 Feb 2010	Not tested, no safe ladder access.	- -
Port Talbot Margam $PM_{2.5}$	4 Aug 2009 2 Jan 2010	not tested 16.7	not tested 0
Wrexham (serial no. 212240)	12 Aug 2009 10 Feb 2010	16.06 16.7	-3.66 0

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_{10}: Data capture was 99% for this quarter. Only one day's data was lost:
30th Oct current time re-set, < 18 hours sampled.

$PM_{2.5}$: Data capture was 85% for this quarter. Data losses as follows:
30th Oct current time re-set, < 18 hours sampled.
1st Dec, < 18 h sampled
4th Dec, error in initial weighing
18th – 21st Dec, 23rd – 24th Dec, 28th – 31st Dec: flow errors.

A lot of problems with flow errors occurred during December.

Bournemouth

$PM_{2.5}$ only: Data capture was 99% for this quarter. Only one day was lost:
30th Dec - double filter exposure.
$PM_{2.5}$ levels at this site track those at Southampton FDMS reasonably well.

Brighton Preston Park

$PM_{2.5}$ only: Data capture was 87% for this quarter, as there were two periods of prolonged power failure:
21st - 27th Nov and 10th – 14th Dec: power failures .

The second of these breakdown periods was attributed to water getting into the instrument.

Harwell

PM_{10}: 100% data capture.
$PM_{2.5}$: 100% data capture.

Inverness

PM_{10}: 100% data capture.

$PM_{2.5}$: Data capture = 89%. Data losses:
22nd – 24th Nov: filter exchange failure
9th – 15th Dec – filter exchange failure caused initially by low pump pressure. The LSO was unable to resolve this and called in the ESU who repaired it.

London Marylebone Road

PM_{10}: Data capture = 91%. Data losses:
14th Oct – ran out of filters
28th Oct – filter exchange failure
1st -7th Dec: no communication from unit. Partisol removed from site and repaired.
The communications fault began on 27th Nov, but the LSO was checking the instrument twice daily and verified that the flow rate and sampled time were acceptable. *Therefore, data for 27th -30th Nov have not been rejected.*

$PM_{2.5}$: Data capture 0% due to internal sampling caused by a missing tube inside the analyser. All 2009 data deleted.

London North Kensington

PM_{10}: data capture 100%.
$PM_{2.5}$: Data capture was 93%. Data losses:
21st – 26th Oct: flow problem. Fixed by ESU.
Several instances of error 4 – "system reset" – but none fatal.

London Westminster
$PM_{2.5}$ only. Data capture = 95%. Data losses –
15th – 16th Nov and 19th – 21st Dec – filter exchange failures.

Northampton

$PM_{2.5}$ only: Data capture was 96%. Data losses:
17th Dec: error in initial weighing.
19th – 21st Dec – filter exchange failure.

Port Talbot Margam

$PM_{2.5}$ only: data capture = 68%. Lots of problems with this Partisol. Data losses-see below:
7th Oct: filter exchange failure.
14th – 15th Oct: filter exchange failure. LSO dealt with this but did not clear error code. BV did this remotely and left unit to re-start next day.
22nd – 29th Oct: filter exchange failure.
5th – 20th Nov – filter exchange failure, necessitating off-site repair.
26th Nov – unspecified failure.
28th Dec: double filter exposure.

The two incidents in October and November are related and concern the pump and mechanism involved in the changeover process. The unit failed on 22nd (Thursday) and a the LSO was asked to attend, removed the jammed filter and left the unit in WAIT mode. It failed again on 23rd (Friday) and a call out was issued. ESU attended on 27th (Tuesday) and rebuilt the pump. The unit failed again on 5th November (Thursday) and the LSO was not contactable so a call out was issued on 9th (Monday). ESU attended on 11th and removed the unit. It was not returned until 20th November. This instrument has been converted to PM_{10} with effect from 18 February 2010.

Wrexham
PM_{10}: Data capture was 89%. Data losses:
13th Oct: < 18h sampled, due to inlet cleaning.
27th Nov – 4th Dec: filter exchange failure and flow error.

$PM_{2.5}$: New this quarter, installed 9th Dec. 100% data capture from start date to 31st Dec.

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
Mold	NO_2 O_3	Wales					

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