Ricardo Energy & Environment

QAQC Report for the Automatic Urban and Rural Network, July-September 2015

Report for Defra and the Devolved Administrations
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Executive summary

Ricardo Energy & Environment carries out the quality assurance and quality 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), the Scottish Government, Welsh Government and Department of Environment (DoE) in Northern Ireland.

Ratified hourly average data capture for the network averaged 90.9% for all pollutants (O_3, NO_2, SO_2, CO, PM_{10} and $PM_{2.5}$) during the 3-month reporting period July-September 2015. Average data capture for all pollutants except PM_{10} were above 85%. There were 28 stations with data capture less than 85% for the period (43 below 90%). The data capture target of the Air Quality Directive is 90% excluding periods of planned maintenance (e.g. calibrations, audits and servicing). An allowance of 5% is made for this, hence the target of 85%.

A total of 152 monitoring stations in the AURN operated during this quarter, of which 75 were Local Authority owned stations affiliated to the national network. Some are co-located and separately named gravimetric particulate analysers at stations with automatic analysers. Many affiliated stations have additional Defra-funded analysers installed on site.

During this quarter, the summer 2015 intercalibration exercise was carried out, involving comprehensive performance tests on every ozone analyser in the network. This allows the accuracy of the measured results to be determined, and a measurement uncertainty for each analyser to be determined, as required by the Data Quality Objective.

The data from each analyser in the network have been ratified by the QA/QC Unit using documented and validated methods. This process takes into account input from Local Site Operator (LSO) calibrations, the QA/QC audits and records from Equipment Support Unit (ESU) activity. Principal reasons for data loss are given here for stations which fail to make the 85% data capture target for the quarter.

Table of contents

1 Introduction

1.1 Background

The UK Automatic Urban and Rural Network (AURN) has been established to provide information on air quality concentrations throughout the UK for a range of pollutants. The primary function of the AURN is to provide data in compliance with EU Directives on Air Quality. However, in addition, the data and information from the AURN is required by scientists, policy makers and planners to enable them to make informed decisions on managing and improving air quality for the benefit of health and the natural environment.

A number of organisations are involved in the day-to-day running of the network. Currently, the role of Central Management and Co-ordination Unit (CMCU) for the AURN is contracted to Bureau Veritas, whilst the Environmental Research Group (ERG) of King's College London has been appointed as Management Unit (MU) for the AURN monitoring stations that are also part of the London Air Quality Network (LAQN). Ricardo Energy & Environment undertakes the role of Quality Assurance and Control Unit (QA/QC Unit) for stations within the AURN. The responsibility for operating individual monitoring stations is assigned to local organisations with relevant experience in the field under the direct management (and contract to) CMCU. Calibration gases for the network are supplied by Air Liquide Ltd and are provided with an ISO17025 certificate of calibration by Ricardo Energy & Environment. The monitoring equipment is serviced and maintained by a number of Equipment Support Units, under contract to the CMCU or the station owner in the case of affiliated stations.

Dissemination of the data from the AURN via UK-AIR (the UK online Air Information Resource, http://uk-air.defra.gov.uk /) and other media such social media and freephone services is undertaken by the Data Dissemination Unit (DDU). A summary report of the data is also published annually in the "Air Pollution in the UK" series of reports.

A total of 152 monitoring stations in the AURN operated during this quarter. Some of these are co-located and separately-named gravimetric particulate analysers at stations with automatic analysers. Many affiliated stations have additional Defra-funded analysers installed on station.

1.2 What this report covers

This report covers the three-month period July-September 2015, or "Quarter 3" of the year. This report covers the main QA/QC activities; the relevant CMCU reports should be consulted for more detail on station operational issues.

The main reasons for any data loss at the stations have been provided. These were predominantly due to instrument or air conditioning faults, response instability or problems associated with the replacement of analysers and infrastructure.

1.3 Where to Find More Information

Further information on the AURN can be found in the following:

- The AURN Hub. This online resource for AURN stakeholders contains network-specific information relating to the AURN, including the LSO Manual, QA/QC audit and ESU service schedules, CMCU reports and supporting information.
- UK-AIR, www.uk-air.defra.gov which contains information on individual stations along with real-time hourly data, graphs and statistics.

1.4 Changes to the Network during this Quarter

Table 1-1 shows the changes that were made to the network during the period July - September 2015:

Table 1-1 Network Changes Jul - Sep 2015

Station	Pollutants	Date
London Bexley	SO_2	Removed 1 Jan 2015

No new sites were started up or shut down during this quarter. However, following failure of the SO_2 analyser at London Bexley earlier in the year, it was deemed uneconomic to repair. The decision was taken to remove from the network, as it is not required for compliance.

2 Methodology

The QA/QC activities consist of the following key parts:

- QA/QC audits of all analysers in the network every six months (three months for ozone).
- Ratification of the data on a three-monthly basis, and upload ratified data to the Data Dissemination Unit.
- Assessment of new station locations in conjunction with the CMCU, and assessment of compliance with the siting criteria in the Directive.

2.1 Summer Intercalibration, July-September 2015

2.1.1 Overview of Summer Intercalibration

During July to September 2015, Ricardo Energy & Environment undertook an intercalibration of 148 monitoring stations in operation in the Defra and the Devolved Administrations Automatic Urban and Rural Monitoring Network. The intercalibration exercise is a vital step in the process of data ratification. The audits are used to undertake a number of analyser and infrastructure performance checks that cannot be performed by Local Site Operators, with a view to ensuring confidence in the accuracy, consistency and traceability of air pollution measurements made at all the monitoring stations.

2.1.2 Methodology for FDMS Baseline Checks

As part of the QA/QC remit for continuous improvement, an ad hoc study of particulate matter (PM) analyser baseline response has been undertaken for the past two years. This study has been coordinated following investigations of issues identified both by CMCU during routine operation and by QA/QC unit during the ratification process.

The study initially concentrated on FDMS analysers, examining the baseline profile of the reference channels and the relationship with other neighbouring monitoring stations. It has become clear that, on a daily mean basis, regional reference PM concentrations regularly reach a minimum value that approaches 0 µg m^{-3}. A mean zero average concentration of 3 µg m^{-3} provides a trigger for further investigation, and possible drier replacement if deemed necessary. The test is equally valid for BAM instruments, and thus the tests are also carried out on these.

2.2 Overview of Data Ratification

Data for each station are supplied monthly by the CMCUs. Once initial monthly data files have been received, checked and loaded into MODUS, the process of data ratification begins. This process is required to refine data scaling based on all the calibration and audit data available, and to identify, withdraw or flag anomalous data due to instrument or sampling faults or where data fall outside the Uncertainties or Limits of Detection defined by the Data Quality Objectives (**DQOs**) of Directive 2008/50/EC (the Air Quality Directive) and the European Union's Implementing Provisions for Reporting.

3 Intercalibration Results

3.1 National Network Overview

The intercalibration requires the coordination and close cooperation of QA/QC unit, Management Units, ESU's and LSO's in making sure the entire operation runs smoothly and is the result of many months of planning. Leading up to the intercalibration, a draft schedule of visits is prepared and circulated to MU's and ESU's for approval. ESU ozone photometers are calibrated at Ricardo Energy & Environment and all QA/QC equipment and cylinders are tested, calibrated and verified before use.

QA/QC visits are always undertaken before any ESU visits, to allow the performance of the sites to be quantified for the six month period prior to the visit. During the QA/QC visit, the LSO usually attends to demonstrate their competence in performing routine calibrations. The audits are used to transport independent calibration standard gases and test apparatus to all of the sites, to quantify the performance of the entire measurement process at the monitoring stations. The results obtained from these tests are fed into the ratification process, where any correction of datasets can be applied to account for any performance anomalies.

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

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

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

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

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

1. Analyser accuracy and precision. These are basic checks to ensure analysers respond to known concentrations of gases in a reliable manner.
2. Instrument linearity. This test refines the response checks on analysers, by assessing whether doubling a concentration of gas to the analyser results in a doubling of the analyser signal response. If an analyser's response characteristics are not linear, data cannot be reliably scaled into concentrations.
3. Instrument signal noise. This test checks that an analyser responds to calibration gases in a stable manner with time. A "noisy" analyser may not provide high quality data which may be difficult to process at lower concentrations.
4. Analyser response time. This test checks that the analyser responds quickly to a change in gas concentrations. If analyser response is too slow, data may not accurately reflect ambient concentrations.
5. Leak and flow checks. These tests ensure that ambient air reaches the analysers, without

being compromised in any way. Leaks in the sampling system can affect the ability of the analyser to sample ambient air reliably.

6. NOx analyser converter efficiency. This test evaluates the ability of the analyser to measure NO_2. An inefficient converter severely compromises the data from the analyser.
7. FDMS k_0 evaluation. The analyser uses this factor to calculate mass concentrations, so the value is calculated to determine its accuracy compared to the stated value.
8. Particulate analyser flow rate checks. These tests ensure that the flow rates through critical parts of the analyser are within specified limits. There are specific analyser flow rates that are set to make sure particle size fractions and mass concentration calculations are performed correctly.
9. SO_2 analyser hydrocarbon interference. This test evaluates the analyser's ability to remove interfering hydrocarbon gases from the sample gas. A failed test could have significant implications for analyser data.
10. Evaluation of site cylinder concentrations. These tests use a set of Ricardo Energy & Environment certified cylinders that are taken to all the sites. The concentrations of the site cylinders are used to scale pollution datasets, so it is important to ensure that the concentrations of gases in the cylinders do not change.
11. Competence of Local Site Operators (LSO) in undertaking calibrations. As it is the calibrations by the LSO's that are used to scale pollution datasets, it is important to check that these are undertaken competently.
12. Zero "calibration" of all automatic PM analysers. This test allows the baseline performance of PM analysers to be evaluated, to determine whether any remedial action is required.

Once all data have been collected, a "Network Intercomparison" is conducted. This utilises the audit gas cylinders transported to each site in the Network. These cylinders are recently calibrated by the Calibration Laboratory at Ricardo Energy & Environment, and allow us to examine how different site analysers respond when they are supplied with the same gas used at other sites. For ozone analysers, the calibration is undertaken with recently calibrated ozone photometers.

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

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

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

- ±10% of the network average for NOx, CO and SO_2 analysers,
- ±5% of the reference standard photometer for ozone analysers,
- ±2.5 % of the stated ko value for FDMS analysers,
- ±10% for particulate analyser flow rates,
- Particulate analyser average zero response within ±3.0 µg/m^3.
- ±10% for the recalculation of site cylinder concentrations.

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

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

- Drift of an analyser between scheduled LSO calibrations. This is by far the most common cause of an outlier result, and one that is simply corrected for during ratification of data.

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

The results of the intercalibration are summarised in Table 3-1 below:

Table 3-1 Summary of audited analyser performance – 148 UK stations

Parameter	Number of outliers	Number in network	% outliers in total
NOx analyser	22	131	17%
CO analyser	1	6	17%
SO_2 analyser	4	29	14%
Ozone analyser	11	78	14%
FDMS and BAM analysers	1 k_0, 8 flow, (32 zero)	67 FDMS PM_{10} 3 BAM PM_{10} 66 FDMS $PM_{2.5}$ 2 BAM $PM_{2.5}$	7%
Gravimetric PM analysers	1 flow	10 PM_{10} 11 $PM_{2.5}$	5%
Total	48	403	11.9%

- There are currently no gravimetric measurements of PM_{10} or $PM_{2.5}$ at either of the Glasgow monitoring stations.
- Leicester A594 Roadside could not be audited due to health & safety concerns.
- Wirral Tranmere NOx analyser was not at site at the time of the audit.

The number of analyser outliers identified is better than the previous exercise. At the Winter 2015 intercalibration 14.0% of the analysers in use were identified as outliers.

The procedures used to determine network performance are documented in Ricardo Energy & Environment Working Instructions. These methods are regularly updated and improved and are evaluated by the United Kingdom Accreditation Service (UKAS). Ricardo Energy & Environment holds ISO17025 accreditation for the on-site calibration of all the analyser types (NOx, CO, SO_2, O_3) and for the determination of the FDMS k_0 factor and particulate analyser flow rates used in the network. An ISO17025 certificate of calibration (Calibration Laboratory number 0401) for the analysers in the AURN is appended to this report.

3.2 Network Intercomparisons

The concentration of the audit cylinders was calculated averaged across all monitoring sites using the zero and scaling factors provided by the CMCU on the day of audit. How close the result is to the stated cylinder concentration is a good indication of the accuracy of the provisional results across the entire network. The results are given in Table 3-2 below. Certified cylinder concentrations are normalised for this purpose as several cylinders are used.

Table 3-2 Audit Cylinder Results

Parameter	Network Mean	Audit reference concentration	Network Accuracy %	%Std Dev
NO	482 ppb	478 ppb	0.8	4.6
NO_2	472 ppb	481 ppb	-1.9	4.6
CO	21.3 ppm	20.9 ppm	1.9	2.4
SO_2	478 ppb	473 ppb	0.9	5.1

- **Oxides of Nitrogen**

  A total of 22 outliers (17%) were identified during this intercalibration. This is better than the previous (winter 2015) exercise in which 23% of the analysers were identified as outliers. Of these outliers, 8 can be attributed to analyser drift, 8 to changes in site cylinder concentration, and 6 to issues experienced during the audit which compromised the results. All of the above outliers can be corrected with no data loss or impact on data quality.

  There were no converters which fell outside the ±5% acceptance limits. There were seven converters identified where the initial result was outside the ±2% trigger for NO_2 rescaling. Additional analysis showed that a total of 4 of these outlier converters required rescaling to be undertaken.

- **Carbon Monoxide**

  There was a single outlier identified at this intercalibration. No outliers were identified at the previous exercise.

- **Sulphur Dioxide**

  A total of 4 outliers (14%) were identified at this intercalibration. This is the better than the winter 2015 exercise, when 20% of the analysers were identified as outliers. All m-xylene interference tests were less than 27ppb, compared to 24ppb in summer 2014.

- **Ozone**

  A total of 11 outliers (14%) were identified during the summer 2015 exercise. This is better than the previous intercalibration, where 13 analysers were found to be outside the ±5% acceptance criterion.

- **Particulate Analysers**

  There was a single calculated k_0 determination outside the required ±2.5% of the stated values. This is the same as the previous exercise.

  8 FDMS main flows were found to be outside the ±10% acceptance limits. No BAM total

flows were found to be outside this limit. This total is better than the previous (winter 2015) exercise, when a total of four analyser flow outliers were identified.

A single Partisol analyser total flow was outside the acceptance limits. This is the same as the previous exercise.

- **PM analyser zero tests**

  A total of 32 analysers gave average responses to particle-free air that were higher than ±3µg/m³. This is much worse than the previous exercise, where 12 responses were higher than 3µg/m³. These results will be fed into the ratification process to determine appropriate action.

- **Site Cylinder Concentrations**

  9 of the 166 site cylinders (5.4%) used to scale ambient pollution data were found to be outside the ±10% acceptance limit.

London Sites

The results of the intercomparison for the 15 London sites in operation at the time of the intercalibration are summarised in Table 3-3 below:

Table 3-3 Summary of audited analyser performance – London Sites

Parameter	Number of outliers	Number in region
NOx analyser	3	12
NOx converter	0	
CO analyser	0	3
SO_2 analyser	0	4
Ozone analyser	3	9
FDMS and BAM analysers	0 k_0, 1 flow (5 zero)	5 FDMS PM_{10} 10 FDMS $PM_{2.5}$
Gravimetric PM analysers	0	2 PM_{10} 3 $PM_{2.5}$
Cylinders	0	19

Scottish Sites

The results of the intercomparison for the 18 Scottish sites are summarised in

Table 3-4 below:

Table 3-4 Summary of audited analyser performance – Scottish Sites

Parameter	Number of outliers	Number in region
NOx analyser	3	14
NOx converter	1	
CO analyser	1	2
SO_2 analyser	1	3
Ozone analyser	0	10
FDMS and BAM analysers	0 k_0, 2 flow (5 zero)	6 FDMS PM_{10} 6 FDMS $PM_{2.5}$
Gravimetric PM analysers	0	4 PM_{10} 4 $PM_{2.5}$
Cylinders	2	19

Welsh Sites

The results of the intercomparison for the 10 Welsh sites are summarised in Table 3-5 below:

Table 3-5 Summary of audited analyser performance – Welsh Sites

Parameter	Number of outliers	Number in region
NOx analyser	0	10
NOx converter	0	
CO analyser	0	2
SO2 analyser	0	4
Ozone analyser	0	6
FDMS and BAM analysers	0 k0, 0 flow (2 zero)	5 FDMS PM_{10} 1 BAM PM_{10} 3 FDMS $PM_{2.5}$ 1 BAM $PM_{2.5}$
Cylinders	1	16

Northern Ireland Sites (incl. Mace Head)

The results of the intercomparison for the 5 Northern Irish sites and Mace Head are summarised below:

Table 3-6 Summary of audited analyser performance – Northern Irish Sites

Parameter	Number of outliers	Number in region
NOx analyser	3	4
NOx converter	0	
CO analyser	0	1
SO_2 analyser	0	3
Ozone analyser	0	4
FDMS and BAM analysers	0 k_0, 0 flow (2 zero)	4 FDMS PM_{10} 1 FDMS $PM_{2.5}$
Gravimetric PM analysers	0	0 PM_{10} 0 $PM_{2.5}$
Cylinders	0	8

English Sites

The results of the intercomparison for the 86 English sites are summarised below:

Table 3-7 Summary of audited analyser performance – English Sites

Parameter	Number of outliers	Number in region
NOx analyser	13	82
NOx converter	3	
CO analyser	0	1
SO_2 analyser	3	16
Ozone analyser	8	53
FDMS and BAM analysers	1 k_0, 6 flow (18 zero)	39 FDMS PM_{10} 1 BAM PM_{10} 47 FDMS $PM_{2.5}$ 1 BAM $PM_{2.5}$
Gravimetric PM analysers	1	1 PM_{10} 4 $PM_{2.5}$
Cylinders	6	99

As noted earlier, the results from the intercalibration exercises are used to inform the entire data ratification process. Any actions required as a result of the intercalibration findings are discussed in the ratification section of this report.

3.3 Certification

The Network Certificate of Calibration is available on the AURN Hub (login page at https://aurnhub.defra.gov.uk/login.php). This certificate presents the results of the individual analyser scaling factors on the day of the audit, as calculated by Ricardo Energy & Environment using the audit cylinder standards, in accordance with our ISO17025 accreditation.

3.4 Calculation of Measurement of Uncertainty

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 EN14211:2012 (NOx), BS EN14212:2012 (SO_2), BS EN14626:2012 (CO) and BS EN14625:2012 (O_3) set out a series of performance criteria for analysers which must be achieved, both in the field and under laboratory conditions. The test requirements have been extensively reported in previous intercalibration summaries and should be referenced for further information.

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

To comply with the Directive, the uncertainty for gaseous analyser measurements must be less than ±15%. For PM analysers, the required measurement uncertainty is less than ±25%. For sites that have CEN-compliant instrumentation, it is possible to calculate the overall uncertainty of measuring air quality. This information is site and analyser specific and presented in Table 3-8 below:

Table 3-8 Analyser measurement uncertainties

Date	Site	O_3	CO	SO_2	NO_2	PM_{10}	$PM_{2.5}$
14-Jul	Aberdeen Union Street Roadside				12.2		
13-Jul	Aberdeen	11.2			12.2	8.7	16.4
25-Aug	Armagh Roadside				11.1		
29-Jun	Aston Hill	11.2			14.5		
29-Jul	Auchencorth Moss	11.2				12.9	16.4
21-Aug	Ballymena Ballykeel			9.9			
22-Jul	Barnsley Gawber	8.3		11.7	9.8		
21-Aug	Barnstaple A39					8.7	16.4
18-Aug	Bath Roadside				12.3		
25-Aug	Belfast Centre	8.3	8.0	10.0	12.0		
24-Aug	Belfast Stockmans Lane				12.2	21.2	
04-Jul	Billingham				12.2		
27-Jul	Birmingham Acocks Green	11.2			12.6		16.4
28-Jul	Birmingham Tyburn	7.3			13.2	8.7	16.4
28-Jul	Birmingham Tyburn Roadside	11.2			12.2	8.7	16.4
09-Jul	Blackburn Accrington Road				11.5		
09-Jul	Blackpool Marton	8.3			9.8		16.4
11-Aug	Bottesford	8.3					
19-Aug	Bournemouth	11.2			12.2		11.0
29-Jun	Bradford Mayo Avenue				11.1		
01-Jul	Brighton Preston Park	11.2			12.8		22.5

Date	Site	O_3	CO	SO_2	NO_2	PM_{10}	$PM_{2.5}$
17-Aug	Bristol St Paul's	11.2			12.3	8.7	16.4
10-Jul	Bury Whitefield Roadside				12.3	8.7	16.4
29-Jul	Bush Estate	11.2			12.2		
07-Jul	Cambridge Roadside				11.1		
04-Aug	Camden Kerbside				16.0	22.5	16.4
06-Aug	Canterbury	11.2			12.4		
22-Jul	Cardiff Centre	12.6		10.0	12.3	8.7	16.4
08-Jul	Carlisle Roadside				11.2	8.7	16.4
30-Jun	Charlton Mackrell	10.5			12.3		
06-Aug	Chatham Centre Roadside				12.3	8.7	16.4
24-Jul	Chepstow A48				11.7		16.4
21-Jul	Chesterfield Loundsley Green				11.6	8.7	16.4
20-Jul	Chesterfield Roadside				11.6	8.7	16.4
12-Aug	Coventry Allesley	8.3			9.8		16.4
23-Jul	Cwmbran	8.3			13.0		
18-Aug	Derry	11.2		10.2	12.3	8.7	16.4
22-Jul	Doncaster A630 Cleveland Street				12.2		
14-Jul	Dumbarton Roadside				11.1		
07-Jul	Dumfries				12.2		
03-Aug	Ealing Horn Lane					8.7	
01-Jul	Eastbourne				12.3	8.7	16.4
30-Jul	Edinburgh St Leonards	11.2	7.5	10.5	13.0	8.7	16.4
07-Jul	Eskdalemuir	11.2			12.3		
20-Aug	Exeter Roadside	7.2			13.5		
08-Jul	Fort William				12.2		
14-Jul	Glasgow Great Western Road				12.2		
14-Jul	Glasgow High Street				12.2	8.7	16.4
15-Jul	Glasgow Kerbside				9.8		
15-Jul	Glasgow Townhead	8.3			12.2	8.7	16.4
15-Jul	Glazebury	11.2			13.2		
31-Jul	Grangemouth			10.0	11.3	8.7	16.4
31-Jul	Grangemouth Moray				11.1		
08-Jul	Great Dun Fell	11.2					
24-Jul	Hafod-yr-ynys Roadside	8.3			12.3		
06-Aug	Haringey Roadside				15.8		16.4
20-Jul	Harwell	11.2		10.0	12.2	8.7	16.4

Date	Site	O_3	CO	SO_2	NO_2	PM_{10}	$PM_{2.5}$
22-Jul	High Muffles	11.2			12.4		
20-Aug	Honiton				12.6		
30-Jun	Horley				14.5		
29-Jun	Hull Freetown	8.3		10.6	9.8		16.4
30-Jun	Hull Holderness Road				12.2	8.7	
16-Jul	Inverness				12.6	8.0	11.0
20-Jul	Ladybower	11.2		10.0	12.2		
12-Aug	Leamington Spa	10.4			11.1	8.7	16.4
12-Aug	Leamington Spa Rugby Road				12.4	8.7	16.4
01-Jul	Leeds Centre	8.3	7.5	12.8	9.8	8.7	16.4
01-Jul	Leeds Headingley Kerbside				11.2	8.7	16.4
13-Aug	Leicester University	8.3			9.8		16.4
29-Jun	Leominster	11.2			13.7		
15-Jul	Lerwick	11.2		10.0	12.2		
11-Aug	Lincoln Canwick Road				12.2		
07-Jul	Liverpool Queen's Drive Roadside				12.6		
07-Jul	Liverpool Speke	8.3		15.1	15.3	8.7	16.4
29-Jul	London Bexley				13.0		16.4
27-Jul	London Bloomsbury	11.2		10.0	12.4		16.4
21-Jul	London Eltham	10.4			11.4		16.4
06-Aug	London Haringey Priory Park South	10.4			15.8		
22-Jul	London Harlington	11.2			13.4	8.7	16.4
04-Aug	London Harrow Stanmore						16.4
22-Jul	London Hillingdon	9.3			12.4		
21-Jul	Southwark A2 Old Kent Road				12.8	8.7	
05-Aug	London Teddington Bushy Park						16.4
05-Aug	London Teddington	11.8			19.6		
20-Jul	London Westminster				12.6	8.0	
23-Jul	London Marylebone Road	11.2		11.8	12.2	8.7	16.4
23-Jul	London N. Kensington	11.2	8.1	10.0	14.4	8.7	16.4
19-Aug	Lough Navar	11.2				8.7	
02-Jul	Lullington Heath	11.2		10.0	13.0		
10-Jul	Luton A505 Roadside				12.2		
20-Aug	Mace Head	Not compliant					
14-Jul	Manchester Piccadilly	8.3		11.4	10.4	9.3	16.4

Date	Site	O_3	CO	SO_2	NO_2	PM_{10}	$PM_{2.5}$
14-Jul	Manchester South			11.4	12.2	8.0	11.0
14-Aug	Market Harborough	8.3			9.8		
04-Jul	Middlesbrough	11.2		10.0	12.3	8.7	16.4
20-Jul	Narberth			10.0	12.7	8.7	
06-Aug	Newcastle Centre	8.5			9.8	8.7	16.4
05-Jul	Newcastle Cradlewell Roadside				11.7		
23-Jul	Newport				14.2	8.7	16.4
11-Aug	Northampton Kingsthorpe	7.2			13.3		11.0
09-Jul	Norwich Lakenfields	8.3			9.8	9.8	16.4
10-Aug	Nottingham Centre	8.3		10.0	9.8	8.7	16.4
30-Jul	Oldbury Birmingham Road				13.0		
23-Jul	Oxford Centre Roadside				11.7		
23-Jul	Oxford St Ebbes				20.1	8.7	
30-Jul	Peebles	11.2			12.2		
19-Aug	Plymouth Centre	8.3			10.0	8.7	
21-Jul	Port Talbot Margam	8.4	11.5	11.6	9.8	8.7	16.4
02-Jul	Portsmouth	8.3			14.0	10.7	16.4
09-Jul	Preston	8.3			9.9		
17-Aug	Reading New Town	8.3			9.8	8.7	16.4
03-Aug	Rochester Stoke			30.6	13.4	8.7	19.3
09-Jul	Salford Eccles				12.9	8.7	16.4
19-Aug	Saltash Callington Road					8.7	16.4
06-Jul	Sandy Roadside				12.2	12.3	16.4
06-Jul	Scunthorpe Town			11.5	14.9	8.7	
10-Jul	Shaw Crompton Way				13.6	9.3	
21-Jul	Sheffield Devonshire Green	8.3			9.8	8.7	16.4
21-Jul	Sheffield Tinsley				12.5		
09-Jul	Sibton	11.2					
20-Aug	Southampton Centre	8.7		10.3	14.2	8.7	16.4
05-Aug	Southend-on-Sea	8.3			9.8		16.4
05-Aug	St Osyth	8.3			9.8		
04-Aug	Stanford-le-Hope Roadside				12.2	8.7	16.4
03-Jul	Stockton-on-Tees A1305				12.2		
03-Jul	Stockton-on-Tees Eaglescliffe				12.3	9.3	not compliant
29-Jul	Stoke-on-Trent A50 Roadside				12.3	8.7	

Date	Site	O_3	CO	SO_2	NO_2	PM_{10}	$PM_{2.5}$
29-Jul	Stoke-on-Trent Centre	8.8			10.2		16.4
30-Jun	Storrington Roadside				10.5	28.6	16.4
16-Jul	Strath Vaich	11.2					
05-Jul	Sunderland Silksworth	11.5			11.5		16.4
05-Jul	Sunderland Wessington Way				12.2		
21-Jul	Swansea Roadside				12.2	9.3	12.6
04-Aug	Thurrock	11.2		10.0	12.2	8.7	
28-Jul	Tower Hamlets Roadside				11.9		
30-Jul	Walsall Woodlands	11.2			12.2		
08-Jul	Warrington			11.7	15.9	8.7	16.4
10-Jul	Weybourne	8.3					
06-Jul	Wicken Fen	11.2		10.0	12.2		
09-Jul	Widnes Milton Road				13.7		
13-Jul	Wigan Centre				13.0		16.4
06-Jul	Wirral Tranmere	8.3			Not tested		16.4
06-Jul	Wrexham			11.6	13.2	8.0	11.0
01-Jul	Yarner Wood	11.2			13.1		
30-Jun	York Bootham					8.7	16.4
30-Jun	York Fishergate				11.7	8.7	16.4

This table is updated and extended after every intercalibration to include upgraded sites and replacement analysers.

The poor measurement uncertainty reported for the NOx analysers at Camden Kerbside, Haringey Roadside, London Haringey Priory Park South, London Teddington and Warrington, together with the SO_2 analyser at Rochester Stoke were all due to significant instrument noise recorded during the audit.

The poor measurement uncertainty reported for the NOx analysers at Liverpool Speke and Oxford St Ebbes, together with the SO_2 analyser at Liverpool Speke were due to poor response to the linearity tests.

The poor measurement uncertainty for Storrington Roadside PM_{10} arose as a result of the very high measured instrument flow rates at the audit. The significance of this will be examined fully during ratification.

The ozone analyser at Mace Head and the $PM_{2.5}$ BAM at Stockton-on-Tees Eaglescliffe are not CEN compliant models and therefore no performance data have been calculated.

A total of 10 analysers (one PM and nine gaseous) were outside the uncertainty limits defined in the Directive.

4 Data Ratification Results

4.1 Data Capture – Network Overview

4.1.1 Overall Data Capture

The overall data capture for the period July-September 2015 is given in Table 4-1. The data capture target of the Air Quality Directive is 90% excluding periods of planned maintenance (e.g. calibrations, audits and servicing). An allowance of 5% is made for this, hence the target of 85% also shown in the table.

Table 4-1 Data Capture Summary, July-September 2015

Name	CO	PM_{10}	$PM_{2.5}$	NO_2	O_3	SO_2	All
Number of stations	7	72	80	132	79	28	152
Number of stations < 85 %	0	21	19	14	6	3	28
Number of stations < 90%	0	29	28	18	10	3	43
Network mean	97.50	81.90	85.43	93.66	95.65	94.81	90.91

4.1.2 Generic Data Quality Issues

The QA/QC audits continued to identify high particle analyser baselines and some data were deleted as a result. These zero tests, along with regional volatile comparisons, continue to provide evidence for poor FDMS drier performance. Evidence is being collected by the QA/QC Unit and both CMCUs to develop a method for correcting data where high baselines have been identified.

4.2 Data Capture and Station-Specific Issues - England (Excluding Greater London)

A summary of data capture for England for July-September 2015 is given in Table 4-2:

Table 4-2 Data Capture for England, July-September 2015

Name	CO	PM_{10}	$PM_{2.5}$	NO_2	O_3	SO_2	All
Barnsley Gawber				98.14	98.14	96.38	97.55
Barnstaple A39		53.67	86.28				69.97
Bath Roadside				98.10			98.10
Billingham				98.41			98.41
Birmingham Acocks Green			32.07	97.42	98.60		76.03
Birmingham Tyburn		25.91	29.44	87.82	87.95	70.88	60.40
Birmingham Tyburn Roadside		96.11	95.97	98.10	97.96		97.03
Blackburn Accrington Road				81.57			81.57
Blackpool Marton			93.66	93.80	98.01		95.15

Name	CO	PM_{10}	$PM_{2.5}$	NO_2	O_3	SO_2	All
Bottesford					99.59		99.59
Bournemouth			97.83	97.83	97.55		97.74
Bradford Mayo Avenue				97.19			97.19
Brighton Preston Park			89.13	97.96	98.69		95.26
Bristol St Paul's		87.91	87.91	95.47	93.61		91.23
Bury Whitefield Roadside		89.40		94.29			91.85
Cambridge Roadside				94.16			94.16
Canterbury				98.46	90.67		94.57
Carlisle Roadside		85.82	85.05	78.13			83.00
Charlton Mackrell				98.78	99.82		99.30
Chatham Centre Roadside		87.41	86.91	93.57			89.30
Chesterfield Loundsley Green		96.92	97.01	47.33			80.42
Chesterfield Roadside		96.47	96.38	91.58			94.81
Coventry Allesley			90.17	98.32	97.55		95.35
Doncaster A630 Cleveland Street				98.32			98.32
Eastbourne		93.34	79.26	97.42			90.01
Exeter Roadside				98.46	85.55		92.01
Glazebury				83.70	81.75		82.72
Great Dun Fell					81.97		81.97
Harwell		87.86	94.07	96.33	96.47	84.56	91.86
Harwell		94.57	96.74				95.65
High Muffles				97.78	98.01		97.89
Honiton				98.10			98.10
Horley				96.83			96.83
Hull Freetown			86.19	97.33	97.55	97.15	94.55
Hull Holderness Road		65.90		97.64			81.77
Ladybower				98.55	98.23	98.01	98.26
Leamington Spa		97.19	60.24	98.78	99.37		88.89
Leamington Spa Rugby Road		92.12	91.62	97.96			93.90
Leeds Centre	97.28	83.15	91.89	97.19	90.94	97.19	92.94
Leeds Headingley Kerbside		93.25	93.93	99.28			95.49

Name	CO	PM_{10}	$PM_{2.5}$	NO_2	O_3	SO_2	All
Leicester A594 Roadside		24.55		98.19			61.37
Leicester University			93.70	98.28	98.41		96.80
Leominster				98.64	98.64		98.64
Lincoln Canwick Road				98.60			98.60
Liverpool Queen's Drive Roadside				95.79			95.79
Liverpool Speke		91.03	91.08	97.19	94.07	97.37	94.15
Lullington Heath				20.92	98.55	93.52	71.00
Luton A505 Roadside				97.74			97.74
Manchester Piccadilly			73.32	97.37	97.42	97.42	91.38
Manchester South				97.33	97.55		97.44
Market Harborough				92.84	96.83		94.84
Middlesbrough		96.65	93.57	98.73	99.86	98.10	97.38
Newcastle Centre		23.19	14.67	91.67	97.83		56.84
Newcastle Cradlewell Roadside				95.56			95.56
Northampton Kingsthorpe			97.83	97.37	97.37		97.52
Norwich Lakenfields		69.47	93.70	98.32	98.60		90.02
Nottingham Centre		84.06	66.49	74.05	91.17	94.66	82.08
Oldbury Birmingham Road				99.14			99.14
Oxford Centre Roadside				98.05			98.05
Oxford St Ebbes		94.16	99.28	97.64			97.03
Plymouth Centre		79.76	69.20	97.33	97.46		85.94
Portsmouth		95.11	97.10	95.06	99.73		96.75
Preston			99.50	98.46	98.64		98.87
Reading New Town		88.27	94.93	99.37	99.86		95.61
Rochester Stoke		93.48	92.30	98.05	97.24	97.60	95.73
Salford Eccles		88.68	95.24	98.23			94.05
Saltash Callington Road		80.53	88.90				84.71
Sandy Roadside		20.52	90.94	97.51			69.66
Scunthorpe Town		95.06		97.55		64.63	85.75
Shaw Crompton Way				81.70			81.70
Sheffield Devonshire Green		23.41	94.07	97.10	97.19		77.94

Name	CO	PM_{10}	$PM_{2.5}$	NO_2	O_3	SO_2	All
Sheffield Tinsley				48.96			48.96
Sibton					99.82		99.82
Southampton Centre		90.17	85.60	90.63	99.28	99.23	92.98
Southend-on-Sea			93.12	97.87	98.46		96.48
St Osyth				94.57	85.14		89.86
Stanford-le-Hope Roadside		70.15	97.01	98.46			88.54
Stockton on Tees A1035 Roadside				99.46			99.46
Stockton-on-Tees Eaglescliffe		93.52	94.11	98.41			95.35
Stoke on Trent A50 Roadside		93.52		82.29			87.91
Stoke-on-Trent Centre			92.75	98.32	81.75		90.94
Storrington Roadside		92.57	92.80	98.78			94.72
Sunderland Silksworth			92.48	66.53	99.55		86.19
Sunderland Wessington Way				97.83			97.83
Thurrock		96.42		98.37	96.65	98.28	97.43
Walsall Woodlands				99.59	99.59		99.59
Warrington		91.80	91.39	91.58			91.59
Weybourne					99.86		99.86
Wicken Fen				89.63	98.19	97.33	95.05
Widnes Milton Road				65.31			65.31
Wigan Centre			66.71	98.41	98.87		88.00
Wirral Tranmere			95.52	54.53	54.80		68.28
Yarner Wood				97.19	97.74		97.46
York Bootham		93.52	93.66	74.91			87.36
York Fishergate		93.57	74.77	97.60			88.65
Number of Sites	**1**	**42**	**51**	**88**	**52**	**16**	**95**
Number of sites < 85 %	**0**	**13**	**10**	**13**	**4**	**3**	**20**
Number of sites < 90%	**0**	**20**	**18**	**15**	**7**	**3**	**31**
Mean	**80.72**	**85.83**	**92.42**	**95.27**	**92.64**	**90.26**	**80.72**

The following site-specific issues were identified:

Barnstaple A39

A faulty dew point sensor on the PM_{10} FDMS caused a significant divergence of the volatile PM_{10} from the regional average; more than a month's data from 25 June to 25 July have been deleted.

Birmingham Acocks Green

The $PM_{2.5}$ FDMS failed the zero test in July. Data have been deleted from 26 April up to drier replacement on 1 September.

Birmingham Tyburn

Both the $PM_{2.5}$ and PM_{10} FDMS failed the zero test in July. Data from both have been deleted from 26 April up to drier replacement on 28 August.

Blackburn Accrington Road

A shift in measured concentrations was observed from 3 June up to the service on 17 July, possibly due to a sampling fault. These data (which amounted to more than one month's worth) have been deleted.

Carlisle Roadside

The NOx analyser suffered a series of faults, including flow faults, extended IZS sequence and an electronic fault during the quarter. Some small periods of data from both FDMS analysers were also deleted due to instability.

Chatham Centre Roadside

Some minor PM_{10} data losses occurred due to drier replacement and amplifier retuning. Some spurious flat $PM_{2.5}$ data were also deleted in August.

Chesterfield Loundsley Green

A shift in measured NOx concentrations was observed from 28 July to 14 September, possibly due to a sampling fault. These data (more than one month's worth) have been deleted.

Glazebury

The site suffered power cuts from 31 July to 10 August and 19 - 21 September. The NOx analyser also suffered a burnt out power supply and the ozone analyser had a loose sample filter, both resulting in some data loss.

Great Dun Fell

The analyser was found to be a significant outlier at the summer audit, not long after returned to site following workshop repair. Erratic data from 1 July to the service on 17 July have been deleted, continuing the data deletion from the previous quarter. (More than one month of data deleted).

Leeds Centre

PM_{10} data nulled between 18th Feb and next service on 14th Jul due to failed baseline test.

Leicester A594 Roadside

The PM_{10} FDMS analyser was faulty on installation in May, and was removed for workshop repair. Problems with the site electrical supply prevented reinstallation until 4 September.

Lullington Heath

The NOx sample system was found to be allowing sampling of internal air at an ESU callout on 11 September. The NOx data have been deleted from the commissioning of the new site on 20 May up to this visit. The SO2 and O3 are unaffected.

Newcastle Centre

The $PM_{2.5}$ and PM_{10} analysers were found to need drier replacement at the summer audit. Data have been deleted from 2 April ($PM_{2.5}$) and 26 March (PM_{10}) up to the callout on 9 September. Further problems with the valve seals in the $PM_{2.5}$ analyser resulted in further loss up to 17 September.

Nottingham Centre

The NOx analyser was replaced by a hotspare from 23 June-24 July; however the data from the replacement was low and of poor quality and have been deleted. Whilst on site replacing the site NOx analyser on 23 July, the engineer found the PM10 valve motor had failed and the ozone sample pump had broken; both faults required repeat visits to repair. Some $PM_{2.5}$ data were lost due to anomalous high volatile concentrations at the beginning of the quarter followed by high noise, finally cured on 29 July.

Saltash Callington Road

Poor quality PM_{10} data continued from the previous quarter up to the ESU callout on 13 July, when the transducer magnets required refixing. The PM_{10} analyser then failed the zero test at audit, and the drier was replaced at service 7-10 September. The $PM_{2.5}$ data were deleted 7-13 July due to a cooler failure.

Sandy Roadside

The PM_{10} analyser continued to perform poorly during this quarter, with drier and valve faults. The analyser was removed for workshop repair from 20 August to 30 September.

Shaw Crompton Way

The power tripped out on 30 August, and then again on 17 September. The cause was found to be the air conditioning unit. This was removed for repair, and the site turned off for the remainder of the quarter.

Sheffield Devonshire Green

The PM_{10} analyser failed the zero check at the summer audit. The deletion of data from Q2 has been continued to the drier change on 9 September.

Sheffield Tinsley

The ESU attended site on 7 July to investigate a communications problem. The analyser would not reset, so was removed and a hotspare installed. Unfortunately, telephone line faults prevented communications with the analyser, and once restored, it was found the ozone generator had failed and data were lost from 3 July-20 August.

Wicken Fen

Although no data have been deleted this quarter, the SO_2 levels at Wicken Fen appear to be higher than might be expected at such a rural site. The QA/QC Unit have carried out some initial investigations presented at the January 2016 Contractors' meeting; further investigations will be considered.

Widnes Milton Road

A fault was suspected on 24 August and the LSO, then the ESU were requested to attend. The ESU then returned the analyser to the supplier, where no fault was found. Subsequent delays in returning the analyser to site resulted in data being lost for the remainder of this quarter, and into Q4.

Wirral Tranmere

As reported in the previous report, the sample inlets were vandalised on 20 June; repairs were finally completed on 11 August.

York Fishergate

Some $PM_{2.5}$ data were lost due to drier replacement in July, leaking seals in August and high noise in September.

4.3 Data Capture and Station-Specific Issues - Greater London

A summary of data capture for England for July-September 2015 is given in Table 4-3:

Table 4-3 Data Capture for Greater London, July-September 2015

Name	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Average
Camden Kerbside		95.20	96.38	99.28			96.95
Ealing Horn Lane		97.15					97.15
Haringey Roadside			95.56	95.29			95.43
London Bexley			22.10	73.96		0.00	32.02
London Bloomsbury		60.01	60.19	97.19	97.42	96.65	82.29
London Eltham			87.45	95.11	99.50		94.02
London Haringey Priory Park South				99.37	99.64		99.50
London Harlington		78.76	53.13	95.61	87.50		78.75
London Harrow Stanmore			80.89				80.89
London Hillingdon				98.46	74.73		86.59
London Marylebone Road	98.19	96.92	95.06	97.92	97.15	98.14	97.23
London Marylebone Road		96.74	97.83				97.28
London N. Kensington	98.19	94.34	96.88	98.32	96.88	98.19	97.13
London N. Kensington		98.91	98.91				98.91
London Teddington				98.37	82.97		90.67
London Teddington Bushy Park			48.82				48.82
London Westminster			97.83	91.12			91.39
Southwark A2 Old Kent Road		94.84		98.51			96.67
Tower Hamlets Roadside				98.23			98.23
Number of Sites	**2**	**9**	**13**	**14**	**8**	**4**	**19**
Number of sites < 85 %	**0**	**2**	**5**	**1**	**2**	**1**	**5**
Number of sites < 90%	**0**	**2**	**6**	**1**	**3**	**1**	**6**
Network mean	**98.19**	**90.32**	**79.31**	**95.48**	**91.97**	**73.25**	**87.36**

Ealing Horn Lane

The QA/QC Unit identified periods of poor quality data at Ealing Horn Lane during 2015, and some had been deleted in previous quarters during the ratification process. However at Defra's request, these data were reinstated between 3 February and 13 May 2015 with provisional status to assist with rectification of analyser faults. These will be deleted in due course.

London Bexley

The $PM_{2.5}$ FDMS failed the zero test at the summer audit in July, and a new drier was recommended. For a number of reasons, this did not happen until December, and so $PM_{2.5}$ data were deleted from 13 July to the end of the quarter; this will continue for most of Q4.

In addition, the power supply in the NOx analyser failed on 3 September. A replacement analyser was installed on 16 September, which in turn was itself replaced with a compliant analyser on 23 September.

London Bloomsbury

The PM_{10} FDMS had been removed for workshop repair in June, and was replaced at the service on 4 August. The $PM_{2.5}$ FDMS failed the zero test at the summer audit and a replacement drier was requested. Data have been deleted from 27 March to 7 August.

London Harrow Stanmore

The $PM_{2.5}$ FDMS analyser failed the zero test at the summer audit and a replacement drier was ordered. Data from 4 to 13 August have been lost. In addition, a firmware and valve fault resulted in data loss from 9 to 17 September.

London Harlington

The LSO failed to remove the scrubbers from the FDMS analysers following the zero tests; data from 22 July to 10 August were lost from both instruments. Following removal, the $PM_{2.5}$ analyser displayed extreme instability, resulting in further data loss up to 3 September.

London Hillingdon

The O_3 analyser was found to have a flow fault at the audit in July. Data have been deleted from 1-22 July. Data from 5 April to 30 June were deleted in Q2.

London Teddington Bushy Park

A fault with the air conditioning resulted in poor quality $PM_{2.5}$ data, which were deleted from 7 July to 13 August.

4.4 Data Capture and Station-Specific Issues – Wales

A summary of data capture for Wales for July-September 2015 is given in Table 4-4.

Table 4-4 Data Capture for Wales, July-September 2015

Name	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Average
Aston Hill				98.14	96.01		97.08
Cardiff Centre	96.97	91.89	83.38	89.72	95.43	96.38	92.29
Chepstow A48		92.84	92.80	94.43			93.36
Cwmbran				98.64	99.77		99.21
Hafod-yr-ynys Roadside				98.10			98.10
Narberth		75.50		99.64	99.68	99.64	93.61
Newport		90.22	90.72	98.60			93.18
Port Talbot Margam		98.91					98.91
Port Talbot Margam	98.14	95.29	94.34	93.93	98.41	97.96	96.35

Name	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Average
Swansea Roadside		95.29	95.15	98.28			96.24
Wrexham		85.87	65.22	98.37		98.28	86.93
Number of Sites	**2**	**8**	**6**	**10**	**5**	**4**	**11**
Number of sites < 85 %	**0**	**1**	**2**	**0**	**0**	**0**	**0**
Number of sites < 90%	**0**	**2**	**2**	**1**	**0**	**0**	**1**
Network mean	**97.55**	**90.73**	**86.93**	**96.78**	**97.86**	**98.06**	**95.02**

4.5 Data Capture and Station-Specific Issues – Scotland

A summary of data capture for Scotland for July-September 2015 is given in Table 4-5:

Table 4-5 Data Capture for Scotland, July-September 2015

Name	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Average
Aberdeen		94.52	84.69	98.82	97.06		93.77
Aberdeen Union St Roadside				98.55			98.55
Auchencorth Moss (Partisol)		98.91	98.91		98.60		98.62
Auchencorth Moss (FDMS)		0.00	92.21				46.11
Bush Estate				98.41	98.60		98.51
Dumbarton Roadside				93.80			93.80
Dumfries				98.05			98.05
Edinburgh St Leonards	96.38	37.50	67.39	96.60	97.24	96.65	81.96
Eskdalemuir				94.25	98.41		96.33
Fort William				97.28	98.64		97.96
Glasgow Great Western Rd				98.37			98.37
Glasgow High Street		94.70	93.93	95.79			94.81
Glasgow Kerbside				98.41			98.41
Glasgow Townhead		60.42	94.84	93.30	97.51		86.51
Grangemouth		48.05	93.52	96.42		96.56	83.64
Grangemouth Moray				88.99			88.99
Inverness		95.65	90.22	92.57			92.60
Lerwick					99.14		99.14
Peebles				98.32	98.23		98.28
Strath Vaich					99.41		99.41

Name	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Average
Number of stations	1	9	8	17	10	2	21
Number of stations < 85 %	0	5	2	1	0	0	4
Number of stations < 90%	0	5	2	2	0	0	6
Network mean	96.38	58.86	89.46	90.47	98.28	96.60	87.80

Auchencorth Moss

The volatile PM_{10} concentration diverges from the $PM_{2.5}$ volatile from the end of June, and the agreement with the PM_{10} Partisol is poor for the period. The FDMS PM_{10} data (more than one month's worth) have been deleted from 27 June to 30 September.

Edinburgh St Leonards

The PM_{10} analyser failed the zero test at the summer audit, and closer inspection of the data showed a baseline drift from early in 2015. The PM_{10} data from 17 February to the drier change on 24 August.

Glasgow Townhead

The PM_{10} analyser failed the zero test at the summer audit. The PM_{10} data have been deleted from 25 March up to service on 4 August, when the drier was replaced.

Grangemouth

The PM_{10} analyser failed the zero test at the summer audit, and closer inspection of the data showed a baseline drift from early in 2015. The PM_{10} data from 1 May to the drier change on 17 August have been deleted.

4.6 Data Capture and Station-Specific Issues - Northern Ireland

A summary of data capture for Northern Ireland and Mace Head for July-September 2015 is given in Table 4-6:

Table 4-6 Data Capture for Northern Ireland (plus Mace Head), July-September 2015

Name	CO	PM_{10}	PM_{25}	NO_2	O_3	SO_2	Average
Mace Head					100		100
Armagh Roadside		92.89		99.82			96.35
Ballymena Ballykeel						98.55	98.55
Belfast Centre	97.37	62.77	92.53	97.15	96.83	97.33	90.66
Belfast Stockman's Lane		95.24		98.28			96.76
Derry		92.53	95.83	92.75	98.37	98.14	95.53
Lough Navar		95.02			98.96		96.99
Number of Sites	**1**	**5**	**2**	**4**	**4**	**3**	**7**
Number of sites < 85 %	**0**	**1**	**0**	**0**	**0**	**0**	**0**
Number of sites < 90%	**0**	**1**	**0**	**0**	**0**	**0**	**0**
Network mean	**97.37**	**87.69**	**94.18**	**97.00**	**98.05**	**98.01**	**95.81**

5 Changes to Previously Ratified Data

Occasionally there are circumstances where it is necessary to make changes to data which have previously been flagged as "Ratified". This may be for example where:

- A QAQC audit or other investigation 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.
- Further research comes to light which indicates that new or tighter QAQC criteria are required to meet the data quality objectives. This may require review and revision of historic calibration data by applying the new criteria.

Details of changes made during July to September 2015, to data previously ratified, are shown in Table 5-1.

Table 5-1 Changes to Data Previously Marked as Ratified, July - September 2015

Monitoring Station	Pollutant(s) and Reasons
Birmingham Acocks Green	NOx deleted 28 July-28 November 2014, suspected sampling fault resulting in spurious high data
Blackburn Accrington Road	NOx deleted 3-30 Jun, suspected sampling problem
Bottesford	O_3 rescaled 25 Feb-14 Apr 2015, as a result of summer 2015 audit findings.
Brighton Preston Park	O_3 rescaled 1 Jan-30 Jun 2015, as a result of summer 2015 audit findings.
Canterbury	O_3 deleted 19 Mar-23 Apr 2015, instrument fault.
Coventry Allesley	NOx rescaled 21 Oct 2014-30 Jun 2015, problem with calibration system, rescaled using audits. (Change to 2014 dataset previously notified to Defra.)
Derry	SO2 rescaled 1-30 Jun in light of additional calibrations received.
Edinburgh St Leonards:	PM_{10} deleted from 17 Feb-30 Jun 2015, due to high baseline up to drier change on 24 Aug.
Glasgow Townhead	PM_{10} deleted 25 Mar-30 Jun 2015; high baseline up to drier change on 4 Aug.
Leeds Centre	PM_{10} deleted 18 Feb -30 Jun 2015, high baseline up to service on 14 Jul.
London Bloomsbury	PM deleted 27 Feb-30 Jun 2015, high baseline up to drier change on 7 Aug.
Wicken Fen	SO_2 deleted 13 Dec 2014-30 Jun 2015. Investigation pending into anomalously high data. (Change to 2014 dataset previously notified to Defra.)

6 Health and Safety Report

A summary of instances when an AURN station went to 'HIGH' risk status during the quarter is given in Table 6-1:

Table 6-1 Summary of "High" Risk Station Safety Status Incidents, July – September 2015

Station	Risk	Date went to 'High'	Date resolved	Action taken
Leicester A594 Roadside	Failed site electrical test. Electrical supply installed was not adequate for later installation of FDMS.	13/07/2015	04/09/2015	Resolved.
Carlisle Roadside	Major overhaul of car park in which it is located, presence of dumper trucks etc.	11/08/2015	13/08/2015	Returned to moderate as advised by BV who established that the site could still be accessed safely with due care and attention.
London Teddington	Site closed to all visitors for removal of asbestos from surrounding building.	12/08/2015	04/09/2015	Informed relevant stakeholders including CMCU, LSO and Defra. Site remains closed.
Portsmouth	Set to 'high' in error by LSO. Not genuine.	03/09/2015	03/09/2015	CMCU edited risk assessment.

7 Equipment Upgrade Requirements

The ozone photometers used for the summer 2015 intercalibration are old (more than 10 years in some cases) and will need replacement shortly.

The ozone analyser at Mace Head and the $PM_{2.5}$ BAM instrument at Stockton-on-Tees Eaglescliffe have been identified as noncompliant models. A replacement compliant ozone analyser has been identified for installation at Mace Head; however negotiations over the BAM are currently ongoing.

8 Station Infrastructure Issues

No specific station infrastructure issues have been identified by the QA/QC Unit this quarter.

9 Conclusions and Recommendations

Conclusions

1. During Quarter 3 of 2015 there was a total of 152 AURN monitoring stations in operation.
2. Data ratification for this quarter was completed by the deadline of 30 September 2015.
3. Ratified hourly average data capture for the network averaged 90.9% for all pollutants (O_3, NO_2, SO_2, CO, PM_{10} and $PM_{2.5}$) during the 3-month reporting period July-September 2015. Average data capture for all pollutants except PM_{10} were above 85%. There were 28 stations with data capture less than 85% for the period (43 below 90%). The data capture target of the Air Quality Directive is 90% excluding periods of planned maintenance (e.g. calibrations, audits and servicing). An allowance of 5% is made for this, hence the target of 85%
4. During this quarter, the summer 2015 intercalibration exercise was carried out, involving comprehensive performance tests on every ozone analyser in the network. This allows the accuracy of the measured results to be determined, and a measurement uncertainty for each analyser to be determined, as required by the Data Quality Objective.
5. The uncertainty of measurement for each analyser has been determined to ensure compliance with the Data Quality Objective. Ten analysers were found to be outside the required uncertainty.

Recommendations:

1. The ozone photometers used for the summer 2015 intercalibration are old (more than 10 years in some cases) and will need replacement shortly.
2. Unusual ongoing high SO_2 data at Wicken Fen require further action. As agreed at the AURN Contractors meeting on 13th Jan 2016, the permeation device should be removed for a test period, and a duplicate analyser installed.
3. LSO and ESU support at Armagh Roadside must be put in place
4. The non-compliant instruments at Stockton-on-Tees Eaglescliffe and Mace Head should be removed or replaced with appropriate instruments
5. Elevated SO_2 levels at Wicken Fen should be investigated.

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