QA/QC Data Ratification Report for the Automatic Urban and Rural Network, October-December 2015 and Annual Report, 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 Agriculture, Environment and Rural Affairs (DAERA) in Northern Ireland.

A total of 152 monitoring stations in the AURN operated during the three-month period October – December 2015.

Ricardo Energy & Environment carried out two Network Intercalibration exercises during calendar year 2015, in winter (January - March) and summer (August - September). The data were ratified quarterly in arrears and made available via Defra's online UK Air Information Resource (UK-AIR). In addition, calibration of all ozone analysers was carried out in April and October.

Ratified hourly average data capture for the network averaged 92.64% for all pollutants (O_3, NO_2, SO_2, CO, PM_{10} and $PM_{2.5}$) during the three-month reporting period October-December 2015. Average data capture for all pollutants were above 85%. There were 26 monitoring stations with data capture less than 90% for the period, of which 19 had data capture below 85%.

For the whole calendar year 2015, ratified hourly average data capture for the network averaged 91.53% for all pollutants (O_3, NO_2, SO_2, CO, PM_{10} and $PM_{2.5}$). The target for annual data capture is 85%, which is based upon the 90% data capture target of the Air Quality Directive, with an allowance of 5% for planned maintenance. There were 38 monitoring stations with data capture less than 90% for the period, of which 23 had data capture below 85%.

The main reasons for data loss were sampling faults, poor analyser performance and persistent temperature problems.

The routine QA/QC procedures have included checking of particulate analyser baselines for some time now. The CEN standard method for ambient particulate matter EN16450 states that action must be taken when baseline response is higher than 3 µg m^{-3} but does not state what the action should be. Up to now the only agreed action was to delete the data. However, as part of ongoing improvement activities a protocol has been agreed to enable baselines to be corrected where baseline responses exceed 3 µg m^{-3}. The 2015 dataset has been assessed and baselines adjusted where there is evidence to suggest this is appropriate, for example, a high zero response. This has resulted in some previously rejected data being reinstated. This protocol will continue from now onwards.

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1 Introduction

1.1 Background

The UK Automatic Urban and Rural Network (AURN) was established to provide information on air quality 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 are 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 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 Quality 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 (UK) Ltd and are provided with an ISO17025 certificate of calibration by Ricardo. The monitoring equipment is serviced and maintained by a number of Equipment Support Units, under contract to the CMCU.

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 as 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, available on UK-AIR.

A total of 152 monitoring stations in the AURN operated during this quarter. This includes five sites where Partisol gravimetric particulate samplers are co-located with automatic particulate analysers. (The gravimetric data are used in validating the performance of the automatic analysers). For data processing purposes the gravimetric sampler is treated as a separate station; and they are shown, and counted, separately in the data capture tables in section 4.

The main reasons for data loss at the stations are discussed in section 4. These were predominantly due to instrument or air conditioning faults, response instability or problems associated with the replacement of analysers and infrastructure.

1.2 What this Report Covers

This report covers the three-month period October to December 2015, or "Quarter 4" of the year. As it is the final quarterly report of the year, it also includes a summary of significant events and statistics for the full calendar year, a summary of health and safety activities, an inventory of Defra-owned equipment held by the QA/QC Unit in connection with this work, and a section relating to issues of improved technologies. This report covers the main QA/QC activities; the relevant CMCU reports should be consulted for more detail on station operational issues.

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, which contains information on individual stations along with real-time hourly data, graphs and statistics.

1.4 Changes to the Network during this Year

Table 1.1 shows the new monitoring stations which were commissioned in 2015, and those that closed in 2015.

Table 1.1 Station changes in 2015

New stations	Pollutants	Date started
Hull Holderness Road	NO_2 PM_{10}	1 Jan 2015
Sunderland Wessington Way	PM_{10}	15 Jan 2015
Glasgow High Street	NO_2	27 Jan 2015
Luton A505 Roadside	NO_2	11 Mar 2015
Chesterfield Loundsley Green	NO_2 $PM_{2.5}$ PM_{10}	1 Mar 2015
Widnes Milton Road	NO_2	9 Mar 2015
Bury Whitefield Roadside	NO_2 PM_{10}	1 Mar 2015
Bradford Mayo Avenue	NO_2	24 April 2015
Doncaster A630 Cleveland Street	NO_2	7 May 2015
Leicester A594 Roadside	NO_2	1 June 2015
Stoke on Trent A50 Roadside	NO_2 PM_{10}	1 May 2015
Station Closures	**Pollutants**	**Date closed**
Harwell	O_3 SO_2 NO_2 $PM_{2.5}$ PM_{10}	31 Dec 2015

(Harwell was replaced by a new station, Chilbolton Observatory, as of 11 Jan 2016).

2 Methodology

2.1 Overview of QA/QC Activities

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 of 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
- Investigation of instances of suspected poor quality data.

2.2 QA/QC Audits

The QA/QC intercalibration audits 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 station 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 station 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 station cylinder concentrations. These tests use a set of Ricardo Energy & Environment certified cylinders that are taken to all the stations. The concentrations of the station 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 Station Operators (LSOs) in undertaking calibrations. As it is the calibrations by the LSOs that are used to scale pollution datasets, it is important to check that these are undertaken competently.
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 to the analyser or baseline to be corrected during ratification.

Once all data have been collected, a "Network Intercomparison" is conducted. This utilises the audit gas cylinders transported to each station in the Network. These cylinders are recently calibrated by the Calibration Laboratory at Ricardo Energy & Environment, and allow us to examine how different station analysers respond when they are supplied with the same gas used at other stations. 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 services.
- These individual results are tabulated, and statistical analyses undertaken (e.g. network average result, network standard deviation, deviation of individual stations from the network mean etc.).

These results are then used to pick out problem stations, 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 k_0 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 station 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 stations 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 station cylinder concentrations between intercalibrations. Station cylinders can sometimes become unstable, especially at low pressures. All station 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.

Full audits of all analysers are carried out at six-monthly intervals in the winter (January-February) and summer (July-August). In addition, audits of ozone analysers are also carried out in spring (April) and autumn (October).

2.2.1 Methodology for FDMS & BAM 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}. The test is equally valid for BAM instruments, and thus the tests are also carried out on these.

The routine QA/QC procedures have included checking of particulate analyser baselines for some time now. The CEN standard method for ambient particulate matter EN16450 states that action must be taken when baseline response is higher than 3 µg m^{-3} but does not state what the action should be. Up to now the only agreed action was to delete the data. However, as part of ongoing improvement activities a protocol has been agreed to enable baselines to be corrected where baseline responses exceed 3 µg m^{-3}. The 2015 dataset have been assessed and baselines adjusted where there is evidence to suggest this is appropriate, for example a high zero response. This has resulted in some previously rejected data being reinstated. This protocol will continue from now onwards.

2.3 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 Objective) and the European Union's Implementing Provisions for Reporting.

3 Intercalibration Results Summary (2015)

3.1 National Network Overview

A summary of the findings of the 2015 intercalibrations is given in Table 3.1.

Table 3.1 Summary of Network Intercalibrations, 2015

	Winter 2015			Summer 2015		
Parameter	Number of outliers	Number in network	% outliers in total	Number of outliers	Number in network	% outliers in total
NOx analyser	29	126	23%	22	131	17%
CO analyser	0	7	0%	1	6	17%
SO_2 analyser	6	30	20%	4	29	14%
Ozone analyser	13	83	16%	11	78	14%
FDMS and BAM analysers	1 k_0 6 flow 12 zero	62 FDMS PM_{10} 3 BAM PM_{10} 69 FDMS $PM_{2.5}$ 2 BAM $PM_{2.5}$	5%	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	8 PM_{10} 9 $PM_{2.5}$	6%	1 flow	10 PM_{10} 11 $PM_{2.5}$	5%
Total	68	399	17.0%	80	403	19.8%

In the spring 2015 ozone intercalibration, there were 16 analysers out by more than 5%. The figure for the autumn exercise was 15.

3.2 Calculations of Measurement Uncertainty

The uncertainty of measurement of each analyser is calculated at each intercalibration. These are presented in the January-March and July-September QA/QC reports.

The ozone analyser at Mace Head was not a CEN compliant model and therefore no generic performance data have been calculated. It has been replaced with a compliant model in February 2016 The PM_{10} analyser at Stockton-on-Tees Eaglescliffe is also non-compliant and is due for replacement in due course.

3.3 Certification

Certificates of calibration for each intercalibration exercise are provided on the AURN Hub (at http://aurnhub.defra.gov.uk/login.php)

4 Data Ratification Results (4th Quarter)

4.1 Data Capture – Network Overview

4.1.1 Overall Data Capture

Ratified hourly average (daily average for Partisols) data capture for the network averaged 92.64% for all pollutants (O_3, NO_2, SO_2, CO, PM_{10} and $PM_{2.5}$) during the three-month reporting period October-December 2015. Data capture statistics 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. It is permissible to discount routine service and calibration from achievable data capture targets, but this is not calculated. For stations starting or closing during the period, the data capture is based on the actual date starting or closing. All pollutants achieved 85% or higher data capture on average. The data capture target for the purposes of monitoring compliance with the EU Air Quality Directive (Directive 2008/50/EC) is 90% excluding planned servicing and maintenance. For practical purposes in the AURN, planned maintenance is assumed to be 5% so a target of 85% data capture is used.

Data capture for each quarter is shown in Table 4.1.

Table 4.1: AURN Ratified Data Capture (%) by Quarter, 2015

Quarter	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2	Mean
Q1 2015	91.27	90.43	93.67	85.77	87.71	84.01	89.66
Q2 2015	96.68	91.23	92.22	90.71	95.10	89.86	92.08
Q3 2015	97.50	91.41	93.32	86.75	87.97	92.51	90.54
Q4 2015	98.71	93.02	96.18	89.28	92.97	93.21	92.64
2015	96.06	92.02	93.85	88.35	91.11	89.93	91.53

The data captures from previous quarters have been recalculated to reflect data changed in subsequent quarters.

Note that the overall data capture value is the average calculated from the data captures at individual sites, these themselves being the average of all pollutants at that site.

4.1.2 Generic Data Quality Issues

The following generic data quality issues have been identified in 2015:

- The use of obsolete mass transducer filters on FDMS analysers, resulting in high analyser noise
- Improperly configured sampling systems which compromise the sampled air, resulting in false readings. This has been a problem in the past, and during 2015 continued to cause significant data loss, for example at Edinburgh St Leonards.

4.1.3 Data Precision

As part of the requirements of the INSPIRE Directive 2007/2/EC and 2011/850/EU Implementing Decision, data is required to be reported to one decimal place (two for CO). As of January 2016, only Armagh Roadside was still reporting gaseous data as integers.

4.2 Data Capture and Station-Specific Issues October-December 2015- England (Excluding Greater London)

Table 4.2 shows percentage data capture for stations in England during Quarter 4 of 2015. The table is followed by details of individual station-specific issues.

Table 4.2 Data Capture – England – Quarter 4 (Oct-Dec) 2015

Name	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2	Quarter Average
Barnsley Gawber		99.64	99.73			97.87	99.08
Barnstaple A39				93.75	90.67		92.21
Bath Roadside		99.14					99.14
Billingham		99.55					99.55
Birmingham Acocks Green		99.91	99.59		99.82		99.77
Birmingham Tyburn		98.19	98.32	94.79	99.77	97.55	97.73
Birmingham Tyburn Roadside		96.29	98.01	92.35	97.19		95.96
Blackburn Accrington Road		99.59					99.59
Blackpool Marton		93.03	100.00		99.86		97.63
Bottesford			99.14				99.14
Bournemouth		99.86	99.95		100.00		99.94
Bradford Mayo Avenue		98.60					98.60
Brighton Preston Park		99.18	99.50		75.00		91.23
Bristol St Paul's		99.59	99.59	87.82	98.69		96.42
Bury Whitefield Roadside		91.12		87.91			89.52
Cambridge Roadside		95.38					95.38
Canterbury		96.38	100.00				98.19
Carlisle Roadside		68.30		70.02	70.11		69.47
Charlton Mackrell		99.91	99.91				99.91
Chatham Centre Roadside		99.77		99.91	81.84		93.84
Chesterfield Loundsley Green		94.57		99.18	99.73		97.83
Chesterfield Roadside		92.48		98.28	98.23		96.33
Coventry Allesley		99.82	99.77		88.86		96.15
Doncaster A630 Cleveland Street		99.68					99.68
Eastbourne		99.95		88.00	100.00		95.98
Exeter Roadside		99.18	0.00				49.59
Glazebury		99.37	99.55				99.46
Great Dun Fell			99.28				99.28
Harwell		99.55	99.86	86.45	99.95	95.70	96.30

Name	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2	Quarter Average
Harwell (Partisol)				100.00	100.00		100.00
High Muffles		80.25	80.39				80.32
Honiton		99.68					99.68
Horley		99.68					99.68
Hull Freetown		99.64	95.61		100.00	99.77	98.75
Hull Holderness Road		99.86		88.50			94.18
Ladybower		17.39	17.35			17.35	17.36
Leamington Spa		99.77	99.68	98.82	99.91		99.55
Leamington Spa Rugby Road		99.73		95.88	96.11		97.24
Leeds Centre	99.00	99.77	99.77	98.10	98.46	99.28	99.06
Leeds Headingley Kerbside		99.73		93.25	97.28		96.75
Leicester A594 Roadside		99.55		99.55			99.55
Leicester University		99.82	99.91		98.78		99.50
Leominster		99.77	100.00				99.89
Lincoln Canwick Road		99.64					99.64
Liverpool Queen's Drive Roadside		94.93					94.93
Liverpool Speke		99.37	99.95	99.77	99.91	99.55	99.71
Lullington Heath		99.37	99.41			92.80	97.19
Luton A505 Roadside		99.68					99.68
Manchester Piccadilly		99.82	99.37		99.32	99.77	99.57
Manchester South		99.18	99.32				99.25
Market Harborough		95.43	99.50				97.46
Middlesbrough		90.67	97.64	92.30	28.26	97.15	81.20
Newcastle Centre		92.84	88.72	91.53	83.06		89.04
Newcastle Cradlewell Roadside		95.83					95.83
Northampton Kingsthorpe		82.74	94.02		100.00		92.26
Norwich Lakenfields		99.86	99.91	87.27	93.07		95.03
Nottingham Centre		97.37	97.46	96.47	97.46	84.65	94.68
Oldbury Birmingham Road		82.02					82.02
Oxford Centre Roadside		99.41					99.41
Oxford St Ebbes		99.73		64.36	62.82		75.63
Plymouth Centre		99.82	99.95	99.95	53.22		88.24
Portsmouth		99.86	99.91	54.08	95.43		87.32
Preston		99.82	94.07		64.58		86.16

Name	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2	Quarter Average
Reading New Town		98.60	98.01	98.60	91.80		96.75
Rochester Stoke		99.82	99.77	52.58	97.64	95.56	89.08
Salford Eccles		98.41		98.87	99.50		98.93
Saltash Callington Road				46.38	75.63		61.01
Sandy Roadside		95.56		80.84	98.46		91.62
Scunthorpe Town		99.59		96.56		99.59	98.58
Shaw Crompton Way		41.80					41.80
Sheffield Devonshire Green		99.82	99.73	99.14	74.05		93.18
Sheffield Tinsley		92.84					92.84
Sibton			99.77				99.77
Southampton Centre		88.32	98.41	98.51	98.10	98.32	96.33
Southend-on-Sea		99.59	99.73		97.83		99.05
St Osyth		94.02	98.19				96.11
Stanford-le-Hope Roadside		99.68		0.00	99.28		66.32
Stockton-on-Tees A1305 Roadside		99.58					99.58
Stockton-on-Tees Eaglescliffe		99.86		98.32	99.05		99.08
Stoke on Trent A50 Roadside		98.87		98.96			98.91
Stoke-on-Trent Centre		99.55	99.55		90.76		96.62
Storrington Roadside		98.23		95.43	95.24		96.30
Sunderland Silksworth		82.47	99.86		99.32		93.89
Sunderland Wessington Way		99.73					99.73
Thurrock		95.11	99.73	99.68		99.18	98.43
Walsall Woodlands		99.86	99.86				99.86
Warrington		99.77		99.91	99.68		99.79
Weybourne			99.91				99.91
Wicken Fen		99.59	99.59			99.05	99.41
Widnes Milton Road		0.00					0.00
Wigan Centre		95.52	94.38		62.32		84.07
Wirral Tranmere		99.86	100.00		99.73		99.86
Yarner Wood		99.55	99.46				99.50
York Bootham				99.59	99.23		99.41
York Fishergate		99.64		99.77	98.37		99.26
Number of Stations	**1**	**87**	**52**	**42**	**51**	**16**	**95**
Number of stations < 85 %	**0**	**8**	**3**	**7**	**11**	**2**	**12**
Number of stations < 90%	**0**	**9**	**4**	**13**	**12**	**2**	**18**

Name	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2	Quarter Average
Average	**99.00**	**94.43**	**95.00**	**88.61**	**91.05**	**92.07**	**92.25**

Bury Whitefield Roadside

The NOx analyser developed faults and spare parts could not be sourced. A hotspare was installed in January pending purchase of a new analyser. The PM_{10} data were deleted from 14-21 December due to very poor agreement of regional volatile concentration.

Carlisle Roadside

The station was flooded on 6 December, and repairs resulted in the loss of data for the rest of the quarter.

Exeter Roadside

The ozone data for 2015 were observed to be low, up to a step change in 2016. All data for 2015 have been deleted

High Muffles

At the winter 2016 audit on 29 January, the sample manifold pump was found to have become disconnected from the manifold tube, allowing the analysers to sample internally. All data were deleted from 14 December to 29 January.

Ladybower

A step change in NOx and ozone data was observed on 16 December. Subsequent investigation suggested that the sampling system may have been compromised for some time, though no specific activity was noted on the day. All data from 1 January to 16 December have been deleted.

Oldbury Birmingham Road

Intermittent data losses from a faulty logger were observed in December.

Oxford St Ebbes

The poor quality data from both FDMS analysers have been a cause for concern in previous quarters, and ultimately both analysers were removed for workshop repair from 4 December to 5 January.

Plymouth Centre

A leak in the $PM_{2.5}$ FDMS valve block was found at the ESU callout on 23 December. Data from 13 November-24 December have been deleted.

Rochester Stoke

The PM_{10} sample head became blocked at the end of September to 23 October. The PM_{10} was then seen to be a regional outlier, and failed the zero test at the winter 2016 audit, where the pump vacuum was found to be low. Data from 15-31 December have been deleted.

Saltash Callington Road

Although there was no single period of more than a month for either analyser for which data was rejected, several shorter periods of data were rejected as a result of problems caused by water ingress, so overall data capture for Q4 of 2015 was poor.

Shaw Crompton Way

The station suffered from several communications faults during the quarter and data could not be retrieved.

Stanford-le-Hope Roadside

The PM_{10} FDMS has suffered from very poor performance for some time. The interface board was changed in January, which appears to have improved the data. All data from 6 September to 31 December have been deleted.

Widnes Milton Road

The analyser suffered several failures in 2015, including from 28 September when a hotspare analyser was installed. Unfortunately, this was not a CEN compliant model, and so these data have been deleted.

Wigan Centre

The station was switched off from 7-11 November for roof repairs. The $PM_{2.5}$ control unit was then removed for workshop repair; this was reinstalled on 20 November. From mid-December, the data drift from the regional average, and with some problems identified in Q1 of 2016, data were deleted 10-31 December.

4.3 Data Capture and Station-Specific Issues October-December 2015- Greater London

Table 4.3 shows percentage data capture for stations in Greater London during Quarter 4 of 2015. The table is followed by details of individual station-specific issues.

Table 4.3 Data Capture – Greater London - Quarter 4 (Oct-Dec) 2015

Name	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2	Quarter Average
London Bexley		99.86			99.77		99.82
Camden Kerbside		98.91		93.43	93.43		95.26
London Bloomsbury		99.68	99.82	94.75	99.00	99.73	98.60
Ealing Horn Lane				92.30			92.30
Haringey Roadside		95.56			99.50		97.53
London Haringey Priory Park South		99.73	99.73				99.73
London Hillingdon		99.91	99.82				99.86
London Westminster		95.43			88.04		91.73
London Harrow Stanmore					100.00		100.00
London Harlington		99.23	99.37	99.77	99.95		99.58
London N. Kensington	99.82	99.77	98.41	99.77	99.09	99.86	99.46
London N. Kensington (Partisol)				100.00	100.00		100.00
London Eltham		93.84	99.59		99.86		97.77
London Marylebone Road	99.50	99.46	99.05	96.83	98.87	99.41	98.85
London Marylebone Road (Partisol)				100.00	100.00		100.00
Southwark A2 Old Kent Road		99.82		14.13			56.97

Name	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2	Quarter Average
London Teddington		99.86	99.86				99.86
London Teddington Bushy Park					95.34		95.34
Tower Hamlets Roadside		52.85					52.85
Number of Stations	**2**	**14**	**8**	**9**	**13**	**3**	**19**
Number of stations < 85 %	**0**	**1**	**0**	**1**	**0**	**0**	**2**
Number of stations < 90%	**0**	**1**	**0**	**1**	**1**	**0**	**2**
Average	**99.66**	**95.28**	**99.46**	**87.89**	**97.91**	**99.67**	**93.45**

Southwark A2 Roadside

The PM_{10} has been attended for noisy data, however the ESU reported the installation differs significantly from the conditions in which it was equivalence tested in (flow splitter length reduced, distance between sensor and drier unit significantly increased) as it has been installed into a cabinet which is too small for it. Remedial work took place on 21 December 2015.

Tower Hamlets Roadside

The LSO reported a blank screen on the NOx analyser at the calibration on 22 November. Several visits were undertaken by the ESU, but the part needed was obsolete. A replacement analyser was installed on 2 February.

4.4 Data Capture and Station-Specific Issues October-December 2015– Wales

Table 4.4 shows percentage data capture for stations in Wales during Quarter 4 of 2015. The table is followed by details of individual station-specific issues.

Table 4.4 Data Capture Wales - Quarter 4 (Oct-Dec) 2015

Name	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2	Quarter Average
Aston Hill		99.77	98.64				99.21
Hafod-yr-Ynys Roadside		99.64					99.64
Cardiff Centre	99.91	74.91	99.91	90.99	99.91	99.73	94.23
Chepstow A48		99.73		99.91	99.37		99.67
Cwmbran		99.86	99.86				99.86
Newport		59.06		26.00	98.73		61.26
Narberth		98.51	98.60	97.92		90.22	96.31

Name	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2	Quarter Average
Port Talbot Margam (Partisol)				100.00			100.00
Port Talbot Margam	99.64	87.68	92.35	99.50	79.98	91.85	91.83
Swansea Roadside		99.73		98.46	98.69		98.96
Wrexham		99.09		100.00	94.57	99.91	98.39
Number of Stations	**2**	**10**	**5**	**8**	**6**	**4**	**11**
Number of stations < 85 %	**0**	**2**	**0**	**1**	**1**	**0**	**1**
Number of stations < 90%	**0**	**3**	**0**	**1**	**1**	**0**	**1**
Average	**99.77**	**91.80**	**97.87**	**89.10**	**95.21**	**95.43**	**94.49**

Newport

The data logger was found to have failed on 29 October, resulting in the loss of NO_2 data. The PM_{10} was a regional outlier, and data have been deleted from 2 December to 4 January.

4.5 Data Capture and Station-Specific Issues October-December 2015– Scotland

Table 4.5 shows percentage data capture for stations in Scotland during Quarter 4 of 2015. The table is followed by details of individual station-specific issues.

Table 4.5 Data Capture Scotland - Quarter 4 (Oct-Dec) 2015

Name	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2	Quarter Average
Aberdeen		97.51	90.90	99.64	77.49		91.38
Aberdeen Union Street Roadside		99.59					99.59
Auchencorth Moss (Partisol)			99.86	96.74	100.00		98.87
Auchencorth Moss				98.82	96.11		97.46
Bush Estate		99.95	99.95				99.95
Dumbarton Roadside		99.50					99.50
Dumfries		99.68					99.68

Name	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2	Quarter Average
Edinburgh St Leonards	93.34	0.00	95.79	95.20	93.07	93.30	78.45
Eskdalemuir		99.91	99.82				99.86
Fort William		99.82	99.91				99.86
Glasgow Great Western Road		99.77					99.77
Glasgow High Street		36.91		99.91	99.73		78.85
Glasgow Kerbside		99.55					99.55
Glasgow Townhead		99.86	99.91	99.00	99.37		99.54
Grangemouth Moray		89.86					89.86
Grangemouth		95.20		91.94	91.49	93.66	93.07
Inverness		99.73		97.83	93.48		97.01
Lerwick			99.41				99.41
Peebles		99.14	93.34				96.24
Strath Vaich			99.73				99.73
Number of Stations	**1**	**16**	**10**	**8**	**8**	**2**	**20**
Number of stations < 85 %	**0**	**2**	**0**	**0**	**1**	**0**	**2**
Number of stations < 90%	**0**	**3**	**0**	**0**	**1**	**0**	**3**
Average	**93.34**	**88.50**	**97.86**	**97.38**	**93.84**	**93.48**	**95.88**

Edinburgh St Leonards

Concerns were raised by the QA/QC Unit regarding the sampling system integrity for both NOx and SO_2 following cabin replacement in 2014. A further visit to investigate and rectify took place in May 2016, following which a step change in measured NOx concentrations could be seen. The other pollutants did not share the same sampling system and so were unaffected.

Grangemouth Moray

The NOx analyser was removed for repair from 24 September to 6 October following a software fault.

4.6 Data Capture and Station-Specific Issues October-December 2015- Northern Ireland

Table 4.6 shows percentage data capture for stations in Northern Ireland (also the Mace Head station in the Republic of Ireland) during Quarter 4 of 2015. The table is followed by details of individual station-specific issues.

Table 4.6 Data Capture Northern Ireland - Quarter 4 (Oct-Dec) 2015

Name	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2	Average
Armagh Roadside		6.79		31.48			19.13
Ballymena Ballykeel						69.38	69.38
Belfast Stockman's Lane		99.82		99.95			99.89
Belfast Centre	99.77	95.52	95.56	99.82	99.77	99.77	98.37
Derry		99.86	99.91	93.48	99.86	99.95	98.61
Lough Navar			99.14	98.82			98.98
Mace Head			100.00				100.00
Number of Stations	**1**	**4**	**4**	**5**	**2**	**3**	**7**
Number of stations < 85 %	**0**	**1**	**0**	**1**	**0**	**1**	**2**
Number of stations < 90%	**0**	**1**	**0**	**1**	**0**	**1**	**2**
Average	**99.77**	**75.50**	**98.65**	**84.71**	**99.82**	**89.70**	**83.48**

Armagh Roadside

The station has had no LSO or ESU support throughout the year, and as a result of insufficient calibrations, the NOx data have been deleted. The FDMS analyser failed the baseline check carried out by the QA/QC Unit and data have been deleted.

Ballymena Ballykeel

Data was of poor quality from 16 October to 13 November, when a new lamp was fitted by the ESU. These data were deleted during ratification.

4.7 Changes to Previously Ratified Data

The following data from previous quarters have been changed as a result of the ratification process for this quarter (all 2015 unless otherwise stated):

- Bush NO_2, rescaled September, ratified using incorrect cylinder concentration.
- Blackpool Marton $PM_{2.5}$, 13-14 July, isolated period of data deleted following review of annual dataset.
- Carlisle NO_2, 1 July-30 September, data reprocessed.
- Ealing Horn Lane PM_{10}, 3 February-13 May and 21 July-4 August, regional outlier, data deleted following review of annual dataset.
- Edinburgh St Leonards NO_2, deleted 9 December 2014-31 December 2015, sampling fault.
- Exeter Roadside ozone, 1 January-31 December, data deleted, suspected analyser fault.

- Ladybower, NO_2, SO_2 and ozone-deleted 1 January-30 September, sampling fault.
- Leominster NO_2, 1 July-30 September, data reprocessed.
- London Westminster NO_2, 16-30 September, data reprocessed.
- St Osyth, NO_2, 1 January-30 September, data reprocessed.
- Stoke-on-Trent A50 Roadside, NO_2, 1 July-30 September, ratified using incorrect cylinder concentration.
- Wicken Fen SO_2, 1 July-30 September, data reprocessed.
- Thurrock, ozone and NO_2, 1 July-30 September, data reprocessed.
- York Fishergate $PM_{2.5}$ 30-31 August, noisy data deleted, loose filter.

A list of changes to ratified data is given at http://uk-air.defra.gov.uk/data/changes-to-ratified-data .

4.8 Zero Baseline Correction

Until 2016, the only agreed action that could be taken in the event of a zero baseline response outside the range ±3 µg m^{-3} was to reject data. However, as of 2016, as part of ongoing improvement activities a protocol has been agreed to enable PM baselines to be corrected where baseline responses exceed 3 µg m^{-3}. Baseline correction has been incorporated into the data ratification protocols as of 2016 and the 2015 dataset has also been retrospectively reviewed, and baseline corrections applied where appropriate.

The following particulate data were rescaled:

- Belfast Centre PM_{10}: data reinstated from 12th June-28th July and baseline corrected from 10th June to 4th October 2015.
- Belfast Centre $PM_{2.5}$: baseline corrected 26th June-22nd September 2015.
- Birmingham Acocks Green $PM_{2.5}$: data reinstated from 26th April-1st September and baseline corrected from 2nd January – 1st September 2015.
- Birmingham Tyburn PM_{10}: data reinstated 26th April – 29th August and baseline corrected from 2nd January – 28th August 2015.
- Birmingham Tyburn $PM_{2.5}$: data reinstated 26th April – 29th August and baseline corrected 2nd January – 28th August 2015.
- Bristol St Pauls $PM_{2.5}$:data reinstated 3rd - 5th October and baseline corrected 11 August-29 September 2015.
- Chepstow A48: $PM_{2.5}$ baseline corrected 1st January-23rd July 2015.
- Edinburgh St Leonards PM_{10}: data deleted from 29th January – 3rd August and baseline corrected 29th January-24th August 2015
- Glasgow Townhead PM_{10}: data reinstated 24th March – 4th August 2015 and baseline corrected 24th March – 4th August 2015.
- Grangemouth PM_{10}: data reinstated 1st May – 17th August and baseline corrected 29th January – 17th August 2015.
- Leamington Spa Rugby Road: $PM_{2.5}$ baseline corrected 18th August – 31st December 2015
- Leeds Centre PM_{10}: data reinstated 14th February – 14th July and baseline corrected 14th February -14th July 2015.
- London Bexley $PM_{2.5}$: data reinstated 1st May – 30th June and 13th August – 31st December and baseline corrected 1st January – 31st December 2015.
- London Bloomsbury PM_{10}: baseline corrected 6th August – 31st December 2015.
- London Bloomsbury $PM_{2.5}$: data reinstated 27th March – 30th June and baseline corrected 2nd April – 5th August 2015.
- London Harlington PM_{10}: baseline corrected 6th February – 22nd July 2015.
- London Harlington $PM_{2.5}$: baseline adjusted 6th June – 31st December 2015.

- London Teddington Bushy Park $PM_{2.5}$: data reinstated 13th August – 15th September.
- Middlesbrough PM_{10}: baseline corrected 1st June – 31st December 2015.
- Newcastle Centre PM_{10}: data reinstated 26th March – 9th September and baseline corrected 1st January – 31st December 2015.
- Newcastle Centre: $PM_{2.5}$ data reinstated 1st May – 30th June and data deleted from 9th – 17th September due to valve seal fault.
- Norwich Lakenfields PM_{10}: data reinstated 2nd February – 1st March and baseline corrected 1st February – 1st March 2015.
- Plymouth PM_{10}: data reinstated 9th – 30th September.
- Saltash Callington Road PM_{10}: data reinstated 12th – 15th April and 9th -16th May 2015.
- Sheffield Devonshire Green $PM_{2.5}$: baseline corrected 24th July – 31st December 2015.

(Note: in the above cases, where the period of baseline correction is listed as being to 31st December 2015, it would usually be the case that the correction extends into 2016).

5 Health and Safety Report 2015

The risk status of the following monitoring stations was raised to “High” on the Health & Safety Database during 2015. This list includes all Defra monitoring networks, not just the AURN, as the QAQC contractor acts as health and safety co-ordinator for all monitoring networks. All the problems were satisfactorily resolved. Issues which were erroneously raised as “High” have been discounted.

Table 5.1 Summary of High Risk Occurrences 2015

Station	Issue/Problem	Date went to 'High'	Date resolved
Sheffield Tinsley	Failed Electrical Safety Test	13/04/2015	30/04/2015
Reading New Town	Unsecured NO cylinder nearly fell on an LSO due to missing strap.	18/05/2015	28/05/2015
Northampton Kingsthorpe	Station has failed the 5 yearly Periodic Inspection Review (PIR) electrical inspection.	21/05/2015	28/05/2015
Leicester A594 Roadside	Failed station electrical test. Electrical supply installed was not adequate for later installation of FDMS.	13/07/2015	04/09/2015
Carlisle Roadside	Major overhaul of car park in which it is located, presence of dumper trucks etc.	11/08/2015	13/08/2015
London Teddington	Station closed to all visitors for removal of asbestos from surrounding building.	12/08/2015	04/09/2015*
Southampton Centre	13/10/2015: Station failed 5 yearly PIR due to inadequate main earth connection.	13/10/2015	26/10/2015
St Osyth	Station failed 5 yearly PIR.	14/10/2015	22/10/2015

Station	Issue/Problem	Date went to 'High'	Date resolved
Sheffield Devonshire Green	Perceived risk of being threatened or attacked.	28/10/2015	28/10/2015
Newport	Water ingress from leaking roof causing fire or electrical hazard.	29/10/2015	23/11/2015
Camden Kerbside	Broken light switch with exposed contacts.	06/11/2015	15/12/2015
Wigan Centre	Water ingress from leaking roof causing fire or electrical hazard.	10/11/2015	12/11/2015
Hull Freetown	Water ingress from leaking roof causing fire or electrical hazard.	19/11/2015	30/11/2015
Lough Navar	Failed Electrical Safety Test	02/12/2015	21/12/2015
Ladybower	Small leak in roof causing water ingress.	11/12/2015	14/12/2015
Birmingham Tyburn Roadside	Site had to be kept locked due to broken door hinge.	08/12/2015	19/02/2016
Carlisle Roadside	Flooding	10/12/2015	18/04/2016
Brighton Preston Park	Electrical fault with the supply for the Partisol. Water ingress into the socket.	22/12/2015	07/03/2016

*The building was closed for further asbestos removal in 2016. A further closure of at least 12 months is planned, for major refurbishment. The decision was made to mothball the site.

6 AURN Hub

A summary of the usage statistics of the AURN Hub is given in Figure 6.1.

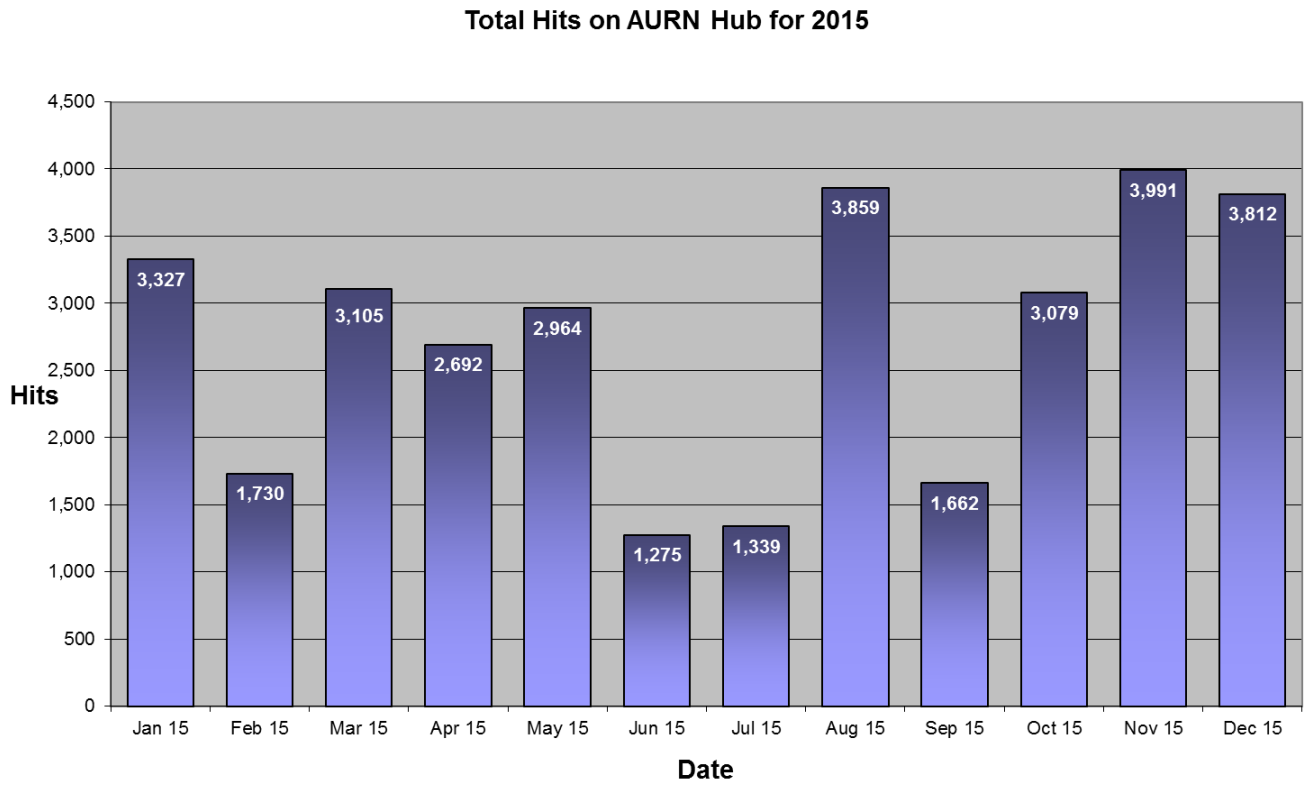

Figure 6.1 Usage Statistics for the AURN Hub

7 Equipment Upgrade Requirements

7.1 Equipment

As can be seen from the asset list in Section 8, many of the ozone photometers used by the QA/QC Unit are of considerable age, and consideration should be given to replacing the oldest ones in the near future. All of the Sabio™ instruments listed are no longer in a serviceable condition.

8 Inventory of Defra-Owned Equipment

This section provides an updated list of all Defra-owned equipment used by the QAQC unit. Not all equipment listed is in operational condition.

Table 8.1 Current Asset List as held by Ricardo Energy & Environment

Contract	Location	Asset	Serial number	Date in service	Operational
AURN QA/QC	Harwell - Ludbridge Mill	API model M401	123	01/04/1999	N
AURN QA/QC	Glasgow	API model M401	151	01/10/2000	Y
AURN QA/QC	Harwell - Ludbridge Mill	API model M401	176	01/12/2002	Y
AURN QA/QC	Glasgow	API model M401	291	01/05/2004	Y
AURN QA/QC	Harwell - Ludbridge Mill	API model M402	245	unknown	Y
AURN QA/QC	Harwell - Ludbridge Mill	API model M401	292	01/05/2004	Y
AURN QA/QC	Harwell - Ludbridge Mill	API model M401	293	01/05/2004	Y
AURN QA/QC	Glasgow	API model M703	255	01/01/2010	Y
AURN QA/QC	Glasgow	Sabio 2010 dilution calibrator	03740708	01/02/2005	N
AURN QA/QC	Harwell - Ludbridge Mill	Sabio 2020 dilution calibrator	02720306B	01/06/2006	N
AURN QA/QC	Harwell - Ludbridge Mill	Sabio 2020 zero air generator	02710306B	01/06/2006	N
AURN QA/QC	Harwell - Ludbridge Mill	Sabio 2020 zero air generator	03731208C	01/03/2006	N
AURN QA/QC	Harwell - Ludbridge Mill	Sabio 2030 ozone photometer	7820708	01/03/2008	N
AURN QA/QC	Harwell - Ludbridge Mill	Sabio 2010 dilution calibrator	02940306A	01/03/2008	Y
AURN QA/QC	Glasgow	Drycal flow meter	110085	unknown	N
AURN	Harwell - Ludbridge	Drycal flow	107881	2006	Y

Contract	Location	Asset	Serial number	Date in service	Operational
QA/QC	Mill	meter			
AURN QA/QC	Glasgow	Drycal low flow meter	6699	2002	N
AURN QA/QC	Glasgow	Sabio 2020 zero air source	03620708b	2006	N
AURN QA/QC	Glasgow	Sabio 2020 zero air source	03711208c	2006	N
AURN QA/QC	Harwell - Ludbridge Mill	Sabio 2020 zero air source	03701208c	2006	N
AURN QA/QC	Harwell - Ludbridge Mill	AC31 dual chamber NOx analyser	1672	01/03/2003	Y
AURN QA/QC	Harwell - Ludbridge Mill	TEI 43C SO_2 analyser	386	01/03/2003	Y
AURN QA/QC	Harwell - Ludbridge Mill	TEI 48C CO analyser	48C-77631-386	01/03/2003	Y
AURN QA/QC	Harwell - Ludbridge Mill	M265 chemilumines-cent ozone analyser	066, ET number 16373	01/03/2003	Y
AURN QA/QC	Glasgow	API fluorescent S02 Analyser Model 100A	1572	unknown	Y
AURN QA/QC	Glasgow	Thermo NO-NO2-NOx Analyser Model 42c	42c-56236-307	unknown	Y
AURN QA/QC	Harwell - Ludbridge Mill	API model M703	278	30/06/2010	Y
AURN QA/QC	Harwell - Ludbridge Mill	API model M703	279	30/06/2010	Y
AURN QA/QC	Mace Head	Ozone analyser Thermo 49i	713021785	unknown	Y
AURN QA/QC	Harwell - Ludbridge Mill	Ozone analyser Thermo 49i	713021784	unknown	Y
AURN QA/QC	Harwell - Ludbridge Mill	API model M703	254	06/01/2010	Y
AURN QA/QC	Harwell - Ludbridge Mill	API model M703	18942	06/01/2010	Y
AURN	Harwell - Ludbridge	Casella	0411771	01/04/2016	Y

Contract	Location	Asset	Serial number	Date in service	Operational
QA/QC	Mill	ML2010			
AURN QA/QC	Harwell - Ludbridge Mill	BIOS flowmeter	132883	27/8/2013	Y
AURN QA/QC	Harwell - Ludbridge Mill	BIOS flowmeter	134028	13/12/2013	Y
AURN QA/QC	Harwell - Ludbridge Mill	BIOS flowmeter	133530	13/12/2013	Y

9 Improved Technology

9.1 Improvements Introduced

No new technologies have been introduced into the network during 2015.

10 Conclusions

10.1 Annual Data Capture 2015

The data capture across the whole network for 2015 is given in Table 10.1.

Table 10.1 Annual Data Capture, 2015

Name	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2	Annual Average
2015	**96.06**	**92.02**	**93.85**	**88.35**	**91.11**	**89.93**	**91.53**

The network average data capture was 91.53%, with 23 (compared to 31 in 2014) stations failing to meet the target of 85% and 38 being below 90%. Principal reasons for data loss include station infrastructure upgrades, sampling faults, poor analyser performance and persistent temperature problems.

Figure 10.1 shows average data capture from the AURN from 1992-2015.

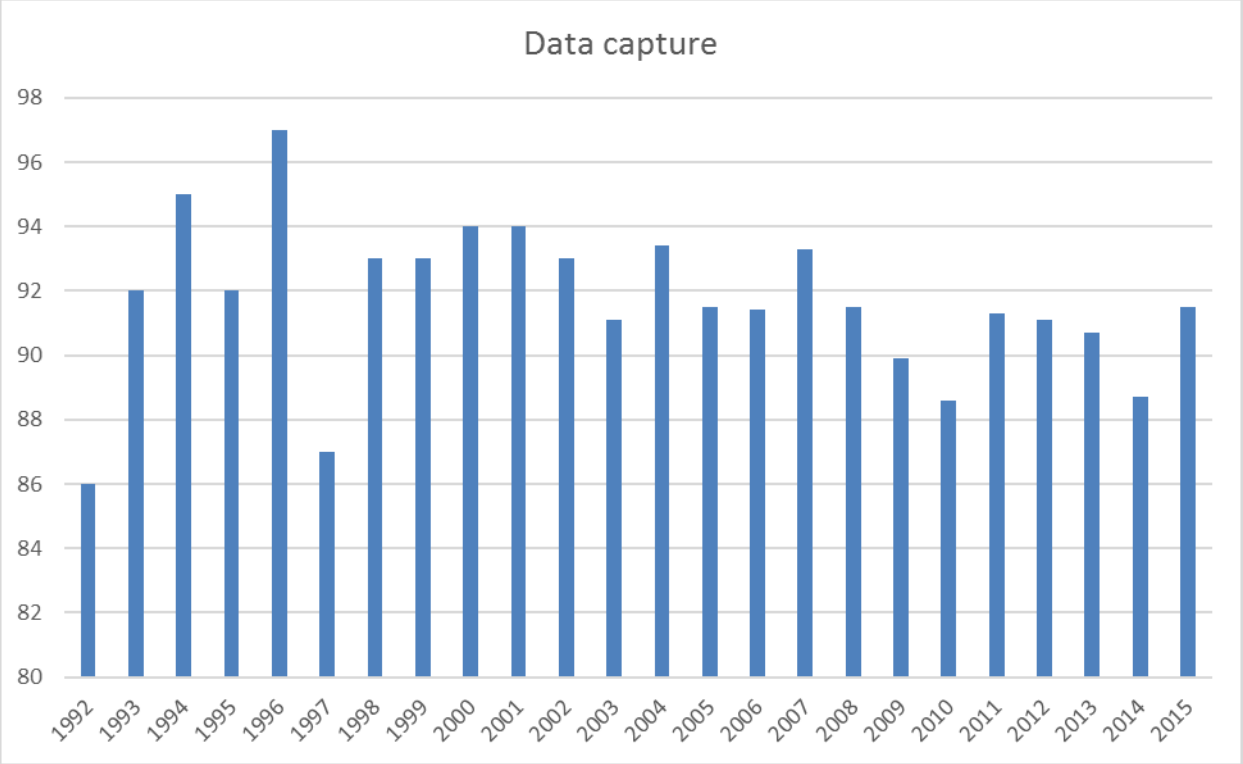

Figure 10.1 Data capture (%) 1992-2015

10.2 Stations where Data Capture was Below 85%

Table 10.2 shows the stations that failed to meet the requirement for 85% data capture across all the pollutants in 2015.

Table 10.2 Stations below 85%, 2015

Station	Annual Data capture 2015 (%)
Sheffield Tinsley	84.81
Sandy Roadside	84.66
London Hillingdon	84.26
Storrington Roadside	83.96
Auchencorth Moss	83.76
Carlisle Roadside	83.67
Saltash Callington Road	83.22
Newport	82.83
London Teddington Bushy Park	82.21
Chesterfield Loundsley Green	81.67
Wicken Fen	81.63
Eastbourne	81.07
Shaw Crompton Way	79.71
Great Dun Fell	79.25
Edinburgh St Leonards	78.14
Newcastle Cradlewell Roadside	74.39
Ealing Horn Lane	66.10
Sheffield Devonshire Green	63.63
Southwark A2 Old Kent Road	58.09
Widnes Milton Road	57.79
Exeter Roadside	49.67
Armagh Roadside	48.00
Ladybower	4.38

Details of data loss and the causes are given in the previous quarterly reports, or in the appropriate CMCU reports. Reports are available at http://uk-air.defra.gov.uk/library/reports?section_id=13 .

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