QA/QC Data Ratification Report for the Automatic Urban and Rural Network, April-June 2016

Report for the Environment Agency

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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 159 monitoring stations in the AURN operated during the three-month period April-June 2016.

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.

Ratified hourly average data capture for the network averaged 92.74% for all pollutants (O_3, NO_2, SO_2, CO, PM_{10} and $PM_{2.5}$) during the three-month reporting period April-June 2016. Average data capture for all pollutants were above 85%. There were 35 monitoring stations with data capture less than 90% for the period, of which 21 had data capture below 85%.

The main reasons for data loss were sampling faults, poor analyser performance and persistent temperature problems in the cabins resulting from air conditioning systems not working adequately.

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. Until 2016, 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 April to June 2016 dataset has been assessed and no baseline corrections were applied at this point. Most of the summer zero tests were carried out in early Q3, and the results of these may lead to a zero baseline correction being applied when the Q3 data are ratified.

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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 of (and under 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 159 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 have historically been used in validating the performance of the automatic analysers; several of the Partisols are now considered to have served their purpose and the Environment Agency took the decision to discontinue their operation, as of September 2016). 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 April-June 2016, or "Quarter 2" (Q2) of the year. This report covers the main QA/QC activities – data ratification and monitoring station QAQC intercalibration audits.

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. The Hub login page is at: https://aurnhub.defra.gov.uk/login.php
- 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 Quarter

Table 1.1 shows the new monitoring stations which were commissioned in April – June 2016, and those which began monitoring additional pollutants during this quarter. No monitoring stations closed in this quarter.

Table 1.1 Station changes in Q2 of 2016

New stations	Pollutants	Date started
Greenock A8 Roadside	NO_2	05/05/16
Additional analysers at existing sites	**Pollutants**	**Date**
Ballymena Ballykeel	NO_2	01/05/16
Reading London Road	PM_{10}	04/05/16

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

2.2.1 Purpose of Intercalibration

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?

2.2.2 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. Until 2016 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}.

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 (2016)

3.1 National Network Overview

During April 2016, Ricardo Energy & Environment undertook an intercalibration of 78 ozone monitoring stations in operation in the Defra and the Devolved Administrations Automatic Urban and Rural Monitoring Network. These calibrations constitute the ISO17025 traceable calibration required every three months by the DQO. 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 Station Operators, with a view to ensuring confidence in the accuracy, consistency and traceability of air pollution measurements made at all the monitoring stations.

3.2 Compliance of Analyser Types

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 during 2016. The PM_{10} analyser at Stockton-on-Tees Eaglescliffe is also non-compliant and was eventually replaced in October 2016.

4 Data Ratification Results (2nd 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 92.74% for all pollutants (O_3, NO_2, SO_2, CO, PM_{10} and $PM_{2.5}$) during the three-month reporting period April-June 2016. 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 the quarter is shown in Table 4.1.

Table 4.1: AURN Ratified Data Capture (%) for April-June 2016

Quarter	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2	Mean
Q2 2016	92.70	94.11	95.49	86.59	93.31	91.18	92.74

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 data quality issues have been identified in April to June 2016:

- Improperly configured sampling systems (as a result of human errors during installation or repairs) which compromise the sampled air, resulting in false readings. This has been a

problem in the past, and during 2016 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 June 2016, only Armagh Roadside was still reporting gaseous data as integers.

4.2 Data Capture and Station-Specific Issues April-June 2016- England (Excluding Greater London)

Table 4.2 shows percentage data capture for stations in England during Quarter 2 of 2016. The table is followed by details of individual station-specific issues.

Table 4.2 Data Capture – England – Quarter 2 (April-June) 2016

Name	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2	Quarter Average
Barnsley Gawber		99.59	99.63			99.77	99.66
Billingham		99.77					99.77
Birmingham Acocks Green		99.22	72.94		99.27		90.48
Birmingham Tyburn		99.95	99.86	99.86	94.69	99.95	98.86
Birmingham Tyburn Roadside		98.40	99.63	58.65	95.83		88.13
Blackburn Accrington Road		9.84					9.84
Blackpool Marton		97.85	97.99		99.40		98.41
Bottesford			99.45				99.45
Bradford Mayo Avenue		98.99					98.99
Brighton Preston Park		92.03	95.74		100.00		95.92
Bury Whitefield Roadside		99.68		99.22			99.45
Cambridge Roadside		91.44					91.44
Canterbury		99.73	99.40				99.57
Carlisle Roadside		86.49		71.79	77.11		78.46
Chatham Centre Roadside		99.82		91.35	94.18		95.12
Chesterfield Loundsley Green		100.00		99.13	98.31		99.15
Chesterfield Roadside		98.44		99.27	91.16		96.29
Chilbolton Observatory		86.26	99.22	86.95	99.86	29.76	80.41
Chilbolton Observatory (Partisol)				53.85	59.34		56.59
Coventry Allesley		98.63	98.44		98.76		98.61

Name	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2	Quarter Average
Doncaster A630 Cleveland Street		99.77					99.77
Eastbourne		98.81		97.57	99.13		98.50
Glazebury		99.63	99.91				99.77
Great Dun Fell			98.03				98.03
High Muffles		99.50	99.82				99.66
Horley		98.76					98.76
Hull Freetown		99.77	94.37		99.86	99.77	98.44
Hull Holderness Road		99.73		89.38			94.55
Ladybower		99.82	99.68			99.54	99.68
Leamington Spa		99.18	99.27	99.59	99.18		99.30
Leamington Spa Rugby Road		99.13		99.45	99.54		99.37
Leeds Centre	99.77	99.68	99.82	99.45	100.00	99.59	99.72
Leeds Headingley Kerbside		99.77		99.36	99.68		99.60
Leicester A594 Roadside		98.72		98.99			98.86
Leicester University		99.95	99.86		99.86		99.89
Leominster		89.97	86.22				88.10
Lincoln Canwick Road		99.68					99.68
Liverpool Queen's Drive Roadside		88.97					88.97
Liverpool Speke		97.21	96.75	100.00	99.95	99.68	98.72
Lullington Heath		98.40	98.49			86.45	94.44
Luton A505 Roadside		99.13					99.13
Manchester Piccadilly		96.29	97.39		76.05	48.72	79.61
Manchester Sharston		97.89	98.17				98.03
Market Harborough		93.68	97.76				95.72
Middlesbrough		99.54	99.91	99.59	95.38	99.54	98.79
Newcastle Centre		97.62	97.44	88.69	96.66		95.10
Newcastle Cradlewell Roadside		100.00					100.00
Northampton Kingsthorpe		69.09	99.91		100.00		89.67
Norwich Lakenfields		98.53	98.58	87.50	96.66		95.32
Nottingham Centre		99.82	99.86	99.18	99.91	99.68	99.69
Nottingham Western Boulevard		98.63		98.49			98.56
Oldbury Birmingham Road		98.81					98.81
Oxford Centre Roadside		96.52					96.52

Name	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2	Quarter Average
Oxford St Ebbes		0.00		0.00	0.00		0.00
Portsmouth		87.27	99.82	61.17	74.91		80.79
Preston		94.28	98.63		93.68		95.53
Reading London Road		97.94		62.41			80.17
Reading New Town		99.36	97.39	99.59	99.54		98.97
Rochester Stoke		91.07	85.21	81.87	81.96	99.08	87.84
Salford Eccles		95.51		94.00	92.86		94.12
Sandy Roadside		99.73		69.69	90.02		86.48
Scunthorpe Town		99.50		46.06		80.91	75.49
Shaw Crompton Way		98.67					98.67
Sheffield Devonshire Green		99.82	99.86	93.18	100.00		98.21
Sheffield Tinsley		98.12					98.12
Sibton			98.40				98.40
Southampton A33 Roadside		98.44		96.02			97.23
Southampton Centre		70.42	70.19	51.65	68.36	69.64	66.05
Southend-on-Sea		94.18	94.18		86.45		91.61
St Osyth		76.83	83.20				80.01
Stanford-le-Hope Roadside		98.17		92.67	95.47		95.44
Stockton-on-Tees A1305 Roadside		99.50			99.91		99.70
Stockton-on-Tees Eaglescliffe		98.81		68.64	99.77		89.07
Stoke on Trent A50 Roadside		99.68		91.03			95.35
Stoke-on-Trent Centre		99.82	99.91		99.13		99.62
Storrington Roadside		99.50		98.90	96.84		98.41
Sunderland Silksworth		95.70	98.72		98.49		97.63
Sunderland Wessington Way		99.95					99.95
Thurrock		99.68	99.86	99.27		99.63	99.61
Walsall Woodlands		98.72	99.95				99.34
Warrington		99.86		99.77	99.54		99.73
Weybourne			99.91				99.91
Wicken Fen		45.38	99.40			92.67	79.15
Wicken Fen						98.93	98.93
Widnes Milton Road		82.69					82.69
Wigan Centre		99.45	96.38		78.98		91.61
Wirral Tranmere		91.03	91.21		99.08		93.77
York Bootham				97.53	87.36		92.45
York Fishergate		99.22		97.76	97.85		98.28
Number of Sites	**1**	**82**	**46**	**41**	**47**	**17**	**89**

Name	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2	Quarter Average
Number of sites < 85 %	**0**	**7**	**3**	**11**	**8**	**4**	**13**
Number of sites < 90%	**0**	**12**	**5**	**15**	**10**	**5**	**20**
Average	**99.77**	**93.61**	**96.43**	**85.82**	**91.70**	**88.43**	**92.27**

Birmingham Tyburn Roadside

The PM_{10} analyser suffered a variety of problems during the quarter, including suspected valve fault, blocked filter, flow status faults, and required mass transducer and drier replacements.

Blackburn Accrington Roadside

The data for much of the quarter were erroneous early in April. Two separate hot-spare analysers were installed, initially due to a flow fault with the site analyser, then due to a pressure transducer failure. A second hot-spare installed produced very low data, which persisted until the audit on 17 July, when levels returned to normal. The auditor was unaware of any faults which may have been responsible.

Carlisle Roadside

Monitoring restarted at this site on 8 April following flood damage in 2015. However, the $PM_{2.5}$ and PM_{10} data were unstable for much of the quarter, with poor correlation in the data. A problem with the internal zero span (IZS) running on into ambient data resulted in the loss of further NOx data.

Chilbolton (including Partisols)

The SO_2 data were unstable from 10 March to 3 June, callouts for pump and IZS faults. The NOx data were also spurious and have been deleted from 23 April- 4 May, with other negative peaks removed throughout the quarter. The PM_{10} FDMS was out of service 27 March - 11 April due to a suspected mass transducer fault.

The Partisols both lost data due to safety issues concerning roof access in April/May, and then both instruments failed requiring removal for workshop repair. Some additional data were deleted due to poor agreement with the FDMS analysers.

Exeter Roadside

The ozone data for this and previous quarters in 2016 were observed to be low. An engineer attended on 5 July, and although the analyser appeared to be working OK at audit on 7 July, the data were found to be noisy and erratic during ratification. The analyser was removed for workshop repair in August-September 2016 when the lamp was replaced. All data for this quarter have been deleted.

Leominster

All data were lost 2-4 and 20-25 April due to the power tripping out and subsequent communications problems. Some further ozone data were lost 31 May-1 June due to a blocked valve.

Liverpool Queens Drive Roadside

Data were lost 19-26 May due to vandalism and subsequent flow faults.

Manchester Piccadilly

The SO_2 analyser was found to have suffered a detector failure on 5 May; data up to the repair have been deleted.

Northampton Kingsthorpe

A suspected sampling fault between LSO calibrations possibly due to operator error resulted in the loss of data from 1-29 June.

Oxford St Ebbes

It was noted during the summer that the trees had grown around the sample inlets such that sampling is likely to be adversely affected. All data for Q2 have been deleted, and this will continue into Q3 until the trees are cut back adequately.

Portsmouth

Several short periods of $PM_{2.5}$ and PM_{10} data were deleted during the quarter due to site temperature issues; no air conditioning faults have been reported. A logger fault resulted in the loss of NOx and PM_{10} data from 28 March-12 April,

Reading London Road.

The BAM tape broke on 3 June, and when attended to on 6 June, a fault was discovered and a hotspare analyser was installed. The data from this analyser have not been received from the CMCU.

Rochester Stoke

The air conditioning failed on 1 April and 12 May, resulting in several days data loss from most of the analysers on both occasions.

Sandy Roadside

The site suffered from prolonged overheating from the beginning of May due to problems with the air conditioning unit. The PM_{10} was worst affected, and these data have been deleted from 5 May to 2 June.

Scunthorpe Town

The SO_2 analyser had communications problems during June into July resulting in the loss of data from 13-27June. The PM_{10} volatiles were very noisy and have been deleted from 12 May- 29 June.

Southampton Centre

The site was switched off on 18 May due to a significant rainwater leak. A temporary repair allowed monitoring to restart on 6 June, but a recurrence on 23 June meant that a new enclosure is required. All instruments remain turned off as of October 2016 whilst replacement of the enclosure is undertaken.

St Osyth

Due to an air conditioning failure, the site was switched off from 16 June-1 July.

Stockton-on-Tees Eaglescliffe

The PM_{10} BAM was removed for workshop repair from 3 June- 5 July.

Wicken Fen

The NOx analyser produced spurious data from 13 May up to replacement by a hotspare on 1 July. These data have been deleted. The SO_2 data are still under investigation for possible analyser/sampling faults.

4.3 Data Capture and Station-Specific Issues April-June 2016- Greater London

Table 4.3 shows percentage data capture for stations in Greater London during Quarter 2 of 2016. The table is followed by details of individual station-specific issues.

Table 4.3 Data Capture – Greater London - Quarter 2 (April-June) 2016

Name	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2	Quarter Average
London Bexley		99.63			99.86		99.75
Camden Kerbside		99.68		95.15	99.77		98.20
London Bloomsbury		98.12	99.86	99.68	99.95	99.63	99.45
Ealing Horn Lane				89.61			89.61
Haringey Roadside		99.40					99.40
London Haringey Priory Park South		99.50	99.50				99.50
London Hillingdon		97.48	98.40				97.94
London Westminster		90.34			98.90		94.62
London Harrow Stanmore					99.63		99.63
London Harlington		98.67	98.58				98.63
London Harlington				99.91	99.91		99.91
London N. Kensington	95.10	99.22	98.72	74.82	90.57	64.79	87.20
London N. Kensington (Partisol)				91.21	100.00		95.60
London Eltham		99.45	99.54		93.18		97.39
London Marylebone Road	75.18	97.34	98.31	97.66	95.92	98.21	93.77
London Marylebone Road (Partisol)				100.00	100.00		100.00
Southwark A2 Old Kent Road		98.58		95.65			97.12
London Teddington		99.95	99.95				99.95
London Teddington Bushy Park					91.48		91.48
Tower Hamlets Roadside		90.57					90.57
No of sites	**2**	**14**	**8**	**9**	**12**	**3**	**20**
No <85%	**1**	**0**	**0**	**1**	**0**	**1**	**0**
No <90%	**1**	**0**	**0**	**2**	**0**	**1**	**2**
Average	**85.14**	**97.71**	**99.11**	**93.74**	**97.43**	**87.55**	**96.49**

Ealing Horn Lane

This site narrowly failed to make the 90% target; data were deleted between 5-13 June due to high noise and deviation from the regional average.

London North Kensington

The PM_{10} analyser lost its software on two occasions in May and June, and a period of noisy data in June was also deleted. The SO_2 analyser suffered a pump failure 20-27 June.

4.4 Data Capture and Station-Specific Issues April-June 2016– Wales

Table 4.4 shows percentage data capture for stations in Wales during Quarter 2 of 2016. The table is followed by details of individual station-specific issues.

Table 4.4 Data Capture - Wales - Quarter 2 (April-June) 2016

Name	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2	Quarter Average
Aston Hill		98.90	89.19				94.05
Hafod-yr-ynys Roadside		99.63					99.63
Cardiff Centre	100.00	99.82	99.91	0.05	99.73	100.00	83.25
Chepstow A48		98.67		94.96	98.21		97.28
Cwmbran		99.82	99.91				99.86
Newport		99.77		99.54	98.12		99.15
Narberth		99.40	99.73	95.42		99.59	98.53
Port Talbot Margam (Partisol)				92.31			92.31
Port Talbot Margam	99.73	95.28	99.82	72.66	83.24	99.73	91.74
Swansea Roadside		99.82		95.70	93.41		96.31
Wrexham		98.44		94.51	92.31	94.78	95.01
Number of Sites	**2**	**10**	**5**	**8**	**6**	**4**	**11**
Number of sites < 85 %	**0**	**0**	**0**	**2**	**1**	**0**	**1**
Number of sites < 90%	**0**	**0**	**1**	**2**	**1**	**0**	**1**
Average	**99.86**	**98.96**	**97.71**	**80.64**	**94.17**	**98.52**	**95.19**

Cardiff Centre

The PM_{10} data for the whole quarter were deemed to be unacceptably noisy, and the data for the entire quarter have been deleted; this follows on from deletion of data from 13 January to the end of Q1. The ESU have attended to try to resolve the issue.

4.5 Data Capture and Station-Specific Issues April-June 2016– Scotland

Table 4.5 shows percentage data capture for stations in Scotland during Quarter 2 of 2016. The table is followed by details of individual station-specific issues.

Table 4.5 Data Capture Scotland - Quarter 2 (April-June) 2016

Name	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2	Quarter Average
Aberdeen		91.21	99.45	98.58	91.76		95.25
Aberdeen Union Street Roadside		99.91					99.91
Aberdeen Wellington Road		99.91					99.91
Auchencorth Moss			90.61	96.70	97.80		95.04
Auchencorth Moss (Partisol)				94.92	91.39		93.15
Bush Estate		99.31	99.50				99.40
Dumbarton Roadside		98.58					98.58
Dumfries		92.35					92.35
Edinburgh St Leonards	79.44	59.89	96.20	88.23	95.42	96.11	85.88
Eskdalemuir		94.92	94.83				94.87
Fort William		88.55	95.10				91.83
Glasgow Great Western Road		99.50					99.50
Glasgow High Street		78.39		89.33	92.81		86.84
Greenock A8 Roadside		No data*					
Glasgow Kerbside		99.45					99.45
Glasgow Townhead		99.86	99.86	99.82	100.00		99.89
Grangemouth Moray		95.92					95.92
Grangemouth		96.66		97.62	97.53	97.62	97.36
Inverness		99.04		96.70	100.00		98.58
Lerwick			97.44				97.44
Peebles		99.63	99.86				99.75

Name	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2	Quarter Average
Strathvaich			73.81				73.81
Number of Sites	**1**	**18**	**10**	**8**	**8**	**2**	**22**
Number of sites < 85 %	**1**	**3**	**1**	**0**	**0**	**0**	**2**
Number of sites < 90%	**1**	**4**	**1**	**2**	**0**	**0**	**4**
Average	**79.44**	**91.70**	**94.67**	**95.24**	**95.84**	**96.86**	**93.28**

New site

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.

Glasgow High Street

The NOx analyser suffered an ozonator failure on 9 April which was not identified until 13 April due to communications problems. A further IZS fault resulted in the analyser being removed for workshop repair 23-30 June.

Greenock A8 Roadside

This was a new site at the end of the quarter. The data were not received in time for ratification this quarter and will be ratified with Q3 data.

Strathvaich

The site suffered from communications problems from 7 June. The missing data have been supplied but not in time for ratification this quarter.

4.6 Data Capture and Station-Specific Issues April-June 2016- 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 2 of 2016. The table is followed by details of individual station-specific issues.

Table 4.6 Data Capture Northern Ireland - Quarter 2 (April-June) 2016

Name	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2	Average
Armagh Roadside		95.65		80.17			87.91
Ballymena Ballykeel		66.80				96.47	81.64
Belfast Stockman's Lane		99.82		99.95			99.89
Belfast Centre	99.68	95.60	99.86	99.95	100.00	94.32	98.24
Derry Rosemount		99.13	94.09	53.48	91.16	99.68	87.51
Lough Navar			93.27	43.09			68.18

Name	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2	Average
Mace Head			99.95				99.95
Number of Sites	**1**	**5**	**4**	**5**	**2**	**3**	**7**
Number of sites < 85 %	**0**	**1**	**0**	**3**	**0**	**0**	**2**
Number of sites < 90%	**0**	**1**	**0**	**3**	**0**	**0**	**4**
Average	**99.68**	**91.40**	**96.79**	**75.33**	**95.58**	**96.83**	**89.05**

Armagh Roadside

The PM_{10} data have been deleted from 20 March-18 April due to being identified as a regional outlier.

Ballymena Ballykeel

The NOx analyser was commissioned on 1 May 2016.

Derry Rosemount

The PM_{10} analyser suffered from a number of faults during the quarter, including drier faults and loss of firmware. Much of the data were noisy and have been deleted during ratification.

Lough Navar

The PM_{10} analyser produced unstable data and negative volatile concentrations for much of the quarter. On 9 May an engineer found the air temperature set to 0℃ instead of 30℃; the reason for this is not known. Subsequent drier problems also resulted in further data loss.

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 2016 unless otherwise stated):

- Aston Hill NOx, rescaled March 2016 due to change to cylinder concentration
- Aston Hill O_3, rescaled March 2016 due to audit result
- Blackburn Accrington Road NOx, rescaled March 2016 in light of a late calibration
- Canterbury NOx, rescaled Feb-March 2016 due to low converter efficiency
- Canterbury O_3, March 2016 rescaled due to audit result
- Charlton Mackrell O_3, rescaled Jan-March 2016 due to audit results
- Eskdalemuir O_3, rescaled March 2016 due to audit result
- Ladybower, O_3 rescaled March 2016 due to audit result
- Leicester University O_3, rescaled Jan-March 2016 due to audit result
- Liverpool Speke SO_2, rescaled Jan-March 2016 due to drifting cylinder concentration
- Northampton Kingsthorpe NOx, baseline rescaled Jan-March 2016 due to calibration results
- Sibton O_3, rescaled Jan-March 2016 due to audit results
- Stoke-on-Trent A50, NOx rescaled Jan-March 2016 due to audit results
- Stoke-on-Trent Centre O_3, rescaled due to audit results
- Widnes Milton Road NOx, rescaled due to drifting cylinder concentration

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 between January and March 2016:

- Edinburgh St Leonards PM_{10}, baseline adjusted 11 Feb-31 March 2016

No baseline corrections have so far been applied to the April to June 2016 data. The summer zero tests were mostly undertaken in July and August (i.e. early Q3): the results of these tests may reveal some cases where zero baseline correction is likely to be necessary, possibly extending back into Q2 or Q1. If so, this will be undertaken when the Q3 dataset is ratified.

5 Health and Safety Report April-June 2016

The risk status of the following monitoring stations was raised to “High” on the Health & Safety Database during April to June 2016. 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 April-June 2016

Station	Issue/Problem	Date went to 'High'	Date resolved
London Teddington*	Presence of asbestos	07/04/2016	Closed long-term for refurbishment
Southampton Centre	Leaking roof, electricity turned off	09/06/2016	Not yet resolved
Oxford St Ebbes	Failed site electrical test	28/06/2016	04/07/2016
Reading London Road	Failed site electrical test	29/06/2016	08/07/2016

*The building was closed for further asbestos removal in April 2016. This was completed in July 2016 but the lift remained out of order, which meant that heavy apparatus would have to be carried up the stairs. A further closure of at least 12 months is planned, for major refurbishment, from early 2017. The decision was therefore made to mothball the site.

6 Equipment Upgrade Requirements

6.1 Equipment

Many of the ozone photometers used by the QA/QC Unit are of considerable age, and replacement with newer models is scheduled for the near future.

7 Improved Technology

7.1 Improvements Introduced

The FDMS analysers at London Harlington were supplemented by a FIDAS instrument on 1 January. This instrument works by optical light scattering, and is capable of measuring several size fractions simultaneously. The analyser was granted type approval at the end of 2015. However, the data reported for Q1 and Q2 2016 are the FDMS datasets, as data handling protocols needed to be developed for data ratification.

8 Conclusions

8.1 Data Capture April-June 2016

During Quarter 2 of 2016 there were a total of 159 AURN monitoring stations in operation.

Data ratification for this quarter was completed by the deadline of 30 September 2016.

Ratified hourly average data capture for the network averaged 92.74% for all pollutants (O_3, NO_2, SO_2, CO, PM_{10} and $PM_{2.5}$) during the three-month reporting period April-June 2016. Average data capture for all pollutants were above 85%. There were 35 monitoring stations with data capture less than 90% for the period, of which 21 had data capture below 85%.

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