

London Air Quality Network: Ratification Report for January to June 2001

A M Woolley, D M Butterfield, and B P Sweeney

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A M Woolley, D M Butterfield and B P Sweeney
Centre for Optical and Analytical Metrology

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National Physical Laboratory
Queens Road, Teddington, Middlesex, TW11 0LW

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Approved on behalf of Managing Director, NPL
by D H Nettleton, Head of Centre for Optical and Environmental Metrology

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1. INTRODUCTION

This report has been prepared for the Department of the Environment, Transport and the Regions by NPL under contract EPG 1/3/123. It covers the ratification of data in the London Air Quality Network relating to the period January to June 2001. The ratified data capture percentages and specific problems at sites are presented.

2. RATIFICATION PROCEDURE

The data received by NPL from the CMCU were processed and scaled according to calibrations carried out by the Local Site Operators every two weeks, and by NPL on a three monthly basis. The results of these NPL field calibrations are reported to the Department separately.

During an NPL intercomparison ozone analyser accuracy is quantified with a transfer standard photometer certified against the NPL primary photometer, while NO_x, CO and SO₂ analyser calibration responses are measured with gas mixtures certified against primary standard gases at NPL. Analyser linearities are determined by multi-point dilution of a high concentration mixture with zero air. Particulate analysers are calibrated with traceable pre-weighed masses, and sample and bypass flow rates are measured.

The data ratification process takes account of all relevant data from LSO, NPL and Equipment Service Unit calibrations. The optimum time-varying set of analyser response functions are determined and then applied to raw data to produce the ratified data set. The causes of gaps in the new data set are identified and periods for which analyser responses are seen to be unstable or changing rapidly are deleted.

3. DATA CAPTURE

The percentage data capture at each site for each pollutant is given in Table 1.

Table 1: Data capture for January to June 2001

Site Name	Percentage Data Capture by Pollutant					
	O ₃	NO _x	SO ₂	CO	PM ₁₀	Mean
Bromley		94		97		96
Camden		99			99	99
Eltham	99	95	99		97	98
Hackney	94	96		95		95
Haringey 1		97			99	98
Haringey 2	97					97
Hounslow		99		99		99
Kensington and Chelsea	95	93	96	86	96	93
Lewisham	0	0	0			0
Marylebone Road	98	98	80	99	95	94
Southwark 1	98	98	97	98		98
Southwark 2		95	95	95		95
Sutton 1		99	97	98	74	92
Sutton 3	99	87				93
Tower Hamlets		82		99		91
Wandsworth 2	99	99				99
Mean	87	89	81	96	93	
Mean (excluding Lewisham)	97	95	94	96	93	

Percentages below 90% are highlighted.

4. GENERIC REASONS FOR ABSENT RATIFIED DATA

Two general categories for ratified data loss are distinguished:

4.1 ABSENT UNRATIFIED DATA

During periods of power failure, telecommunications failure, instrument calibration and repair, or other similar circumstances, clearly there is no “raw” data to ratify, and this will be reflected directly in the data capture. Such instances are described below as periods for which the QA/QC Unit did not receive data. Typically the reasons are not investigated, as this is more of a matter for the CMCU.

4.2 UNRATIFIABLE DATA

From time to time most sites will produce data that cannot be ratified with sufficient confidence due to an analyser malfunction or a peripheral problem such as leaking pipe work. Most problems are apparent to the CMCU as they carry out regular remote checks, and they can initiate repairs promptly, preventing large amounts of data loss. The speed of repair will of course depend on the organisation responsible maintaining the instrument, which will not necessarily be the CMCU for affiliated sites.

The instances described in this Report are those where either the repair took a significant time, or the problem was not readily apparent remotely. In these cases the problem is usually noticed at a visit by the LSO or QA/QC Unit, then reported and remedied. As LSO visits on the London Network are fortnightly (and QA/QC Unit visits quarterly) this can lead to periods of data lasting several weeks being deleted. The crucial elements in minimising data loss are experience in recognising the problems, clear communication of the problem to the CMCU, and prompt remedial action. To a limited extent the experience of these problems can be used to modify LSO, CMCU, ESU or QA/QC Unit procedures, or extend the training of LSOs.

In some instances, the cause of ratified data loss is an underlying problem, which can be predicted to recur, and preventative action can therefore be recommended.

5. SPECIFIC PROBLEMS AT SITES

The sites with data capture of less than 90% for any pollutant are listed here and reasons are given for the absence of the data.

5.1 Kensington and Chelsea (CO 86% data capture)

Absent Unratified Data

1st-2nd January (35 hours of O₃ and CO data) were lost as a result of suspected power or air conditioning malfunction.

18th-19th January (29 hours of NO_x, CO and SO₂ data) were lost as a result of suspected power or air conditioning malfunction.

28th January – 1st February (99 hours of all data) were lost as work was carried out to upgrade the electrical services to the site.

6th-7th March (46 hours of all data) were lost as a result of a power cut.

Unratifiable Data

30th May – 5th June (139 hours of CO data) due to analyser pump malfunction. The analyser was switched off by the LSO on 30th May to prevent the malfunction affecting the rest of the analyser and the ESU attended to repair the fault on 1 June.

23rd-30th June (190 hours of CO data) were deleted owing to an analyser pump malfunction. The ESU attended the site on 28th June.

5.2 Lewisham (NO_x 0%, Ozone 0% SO₂ 0% data capture)

Unratifiable Data

1st January to 6th June (3756 hours). Data were deleted following a continuation of the manifold sampling problems experienced during the previous reporting period. The problem originally only became apparent to the CMCU upon examination of a reasonably large dataset following work that was carried out in 2000, and because of the length and inaccessibility of the sample manifold any remedial work that was carried out unfortunately had to be subject to a similar type of long term examination before it could be determined as having been successful. It is now judged that the site was measuring unrepresentative concentrations before the replacement of the manifold pump by the ESU on 6th June 2001.

6th June to 30th June (588 hours). The site was decommissioned on June 18th to allow major building work to be carried out. Following the manifold problems outlined previously the data were of acceptable quality for only twelve days and, due to insufficient calibration data, could not be ratified satisfactorily.

5.3 Marylebone Road (SO₂ 80% data capture)

Unratifiable Data

10th – 24th January and 8th February – 1st March (858 hours of SO₂ data in total) were deleted as the analyser response factor could not be determined from the calibration data, which showed excessively noisy variation.

5.4 Sutton 1 (PM₁₀ 74% data capture)

Unratifiable Data

3rd - 4th January and 16th May – 1st June (417 hours of PM₁₀ data in total) were deleted due to excess noise resulting from a badly seated filter.

10th April – 2nd May (532 hours of PM₁₀ data) were deleted resulting from a damaged sampling head which was discovered at a QA/QC visit on 24th April.

Absent Unratified Data

11th-17th January (147 hours of PM₁₀ data) were lost due to an analyser power malfunction. The ESU fixed the fault on 17th January.

5.5 Sutton 3 (NO_x 83% data capture)

Unratifiable Data

1st - 22nd January 2001 (565 hours of NO_x data) were lost as the analyser measurement range was lower than the concentration of the site calibration cylinder. Therefore the analyser response saturated during calibration and no response factor could be determined. The QA/QC unit reported this fault to the CMCU at two consecutive quarterly visits but despite an initial ESU visit on 7th December 2000, the analyser wasn't finally fixed until 22nd January 2001.

5.6 Tower Hamlets (NO_x 82% data capture)

Unratifiable Data

24th January – 9th February (386 hours of NO_x data) were deleted as no analyser response factor could be determined owing to inconsistent calibration results. The ESU was called out and repaired the analyser on 9th February.

22nd April – 8th May (387 hours of NO_x data) were deleted due to analyser malfunction. The ESU attended the site on 3rd May but the analyser remained broken until a second ESU visit on 8th May.

7. RECOMMENDATIONS TO IMPROVE DATA QUALITY / CAPTURE

7.1 Internal Sampling

Although no examples of this fault were found in this period, LSOs should be reminded by the CMCU to check that analyser sample lines have been correctly connected to the sample manifold and the sample inlet of the analyser. There is a check box on the LSO's calibration pro forma to remind them to check this.

Internal sampling is very difficult to detect by examining real-time data and it would be very difficult for a CMCU to detect this fault without devoting excessive time to examining the data.

7.2 Incorrect Repairs or Calibrations by the ESU

On a number of occasions the ESU has been unable to repair an analyser on site and has had to remove the faulty analyser for repair. There have been instances where the ESU installed a replacement analyser at the site, but failed to calibrate this analyser, or did not calibrate before it was subsequently removed. These events occur in between QA/QC visits and so in some cases no calibrations are performed on the analysers for the time that they are at the site. This is a particular problem in the case of ozone instruments, as there is no on-site standard for use by the LSO. In this situation the data must be deleted as no analyser response factor may be determined.

The ESU must perform a full calibration on an analyser when it is installed and removed from site. The ESU must also record the serial numbers of any artefacts used to calibrate analysers.

The CMCU should check that a replacement analyser has been calibrated at installation and removal.

7.3 Site Manifold Sampling Systems

NPL has recently carried out some tests on site sampling manifold systems to ensure that the measurements at sites are not compromised by the sampling methods used. Although no specific problems have been found as yet on the LAQN, there are two systems, namely those at Southwark 1 and 2, which due to both the inaccessibility of the sampling point and the system configuration are not possible to test satisfactorily. Consideration should therefore be given, where possible, to the modification of these systems to enable them to be fully tested

Where it becomes necessary to modify or replace any part of a site sampling manifold system it should be verified by the ESU that the new system is free of leaks. Also, any manifold delivery system should include a port through which it is possible to measure the flow along the manifold such that the measurement is representative of the manifold's length.

7.4 On Going Quality Control

When ESUs change the sample lines at the annual service, please could they leave the old sample lines on site, so that the QA/QC unit can collect them and test them for sample degradation.

8. INVENTORY

The DETR assets held by NPL for this work are shared with the Automatic Rural Network and are given in the corresponding report.