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UK Automatic Rural Network: Ratification Report for January to June 2002

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by

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1. INTRODUCTION

This report has been prepared for the Department for the Environment, Food and Rural Affairs by NPL under contract EPG 1/3/123. It covers the ratification of data in the Rural Network relating to the period January to June 2002. A new site was added to this network during this period, located at St Osyth in Essex. The site reports measurements of NO, NO_2 and - for the first time on the Automatic Rural Network – low level CO. Data for this new site were ratified from 1 May 2002 and therefore have been excluded from the data capture statistics consideration.

The ratified data capture percentages and specific problems at sites are presented. An inventory of Department equipment held by NPL, and a list of recommendations for items to be purchased are also given.

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 SO_2 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. For the period covered by this report the overall Network Mean data capture (excluding the new site at St Osyth) is 92%.

Table 1. Data capture for January to June 2002

	Percentage Data Capture by Pollutant					
Site Name	**O_3**	**NO_x**	**SO_2**	**CO**	**PM_{10}**	**Mean**
Aston Hill	**80**					80
Bottesford	99					99
Bush	96					96
Eskdalemuir	100					100
Glazebury	99					99
Great Dun Fell	**89**					84
Harwell	98	97	98			98
High Muffles	**89**					89
Ladybower	95	95	95			95
Lough Navar	**82**				92	87
Lullington Heath	98	92	98			96
Narberth	**88**	92	**0**		**88**	67
Rochester	98	98	98		98	98
St Osyth*		99		**84**		92
Sibton	99					99
Somerton	97					97
Strath Vaich	92					92
Teddington	98	98	98			98
Weybourne	98					98
Wicken Fen	98	91	98			96
Yarner Wood	**84**					84
Mean	94	95	84	84	93	

*St Osyth data capture reported are based on a start date of 1/5/02, and thus reflect only two months' data collected.

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 are no "raw" data to ratify, and this will be reflected directly in the data capture. Such instances are described below as periods for which data were not received by the QA/QC Unit. 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 for 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 Rural Network are fortnightly (monthly for ozone-only sites), and QA/QC Unit visits are 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 that 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 Aston Hill (O_3 80% data capture)

Absent Unratified Data

1st – 18th January (409 hours). These data were lost as a result of a malfunction on the site data logger. The logger was replaced on 8th February 2002 by the ESU.

24th – 26th June (59 hours). These data were either deleted or not received by the CMCU, most likely due to a power or communications problem.

Unratifiable Data

26th March – 8th April (310 hours). These data were invalid as a result of the site manifold fan becoming detached from the manifold itself. The data were therefore not representative of external ambient concentrations.

5.2 Great Dun Fell (Ozone 89% data capture)

Unratifiable Data

12th – 30th June (447 hours). These data were invalidated as a result of an analyser malfunction that coincided with an ESU visit.

5.3 High Muffles (89% data capture)

Unratifiable Data

3rd – 21st January (425 hours). These data were removed on account of a malfunction that was suffered by the site manifold fan. These data were therefore unrepresentative of external ambient conditions.

5.4 Lough Navar (82% data capture)

Unratifiable Data

18th February – 15th March (591 hours). Data were deleted as a result of an analyser malfunction. After attempting to repair this instrument on-site it was eventually replaced with a spare on 15th March.

24th – 30th May (148 hours). These data were deleted as a result of analyser malfunction. The analyser in question was in fact the replacement for the previously outlined malfunctioning instrument that, having been repaired by the ESU, was returned to the site on 30th May.

5.5 Narberth (Ozone 88%, SO_2 0% PM_{10} 88% data capture)

Absent Unratified Data

23rd – 25th January, 24th – 26th March, 11th – 14th June (185 hours of PM10 and 192 hours of ozone data in total). Data were not received from the CMCU, probably owing to a power or communications problem.

Unratifiable Data

1st January – 30th June (4344 hours of SO2 data). These data were unusable owing to the excessive drift between calibrations, which meant that neither the analyser zero nor the calibration factors could be determined. The raw data could thus not be scaled with any degree of certainty.

12th – 17th April (129 hours of ozone data). These data exhibited excessive noise and were therefore deleted.

8th – 12th May, 25th – 28th May (188 hours of PM10 data in total). These data showed excessive short-term noise and were therefore removed.

5.6 Yarner Wood (Ozone 46% data capture)

Unratifiable Data

18th – 20th May (37 hours). These data were clearly unrepresentative of the external ambient conditions, as was apparent upon examination.

3rd – 27th June (579 hours). The analyser was found to be leaking at a QA/QC visit. This problem was traced back to the previous LSO calibration where the analyser sample filter had been badly seated.

6. RECOMMENDATIONS TO IMPROVE DATA QUALITY / CAPTURE

6.1 Site Sampling Manifolds

NPL continue to recommend that all types of manifold should be routinely cleaned at the six-monthly service.

6.2 Failure to calibrate replacement analysers

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 it before its subsequent removal. These events occur in between QA/QC visits, and so often no calibrations are performed on the analysers. This is a particular problem in the case of ozone instruments, as there is no on-site standard for use by the LSO and therefore no response factors may be calculated.

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. These calibrations should always be forwarded to the CMCU and QA/QC units to enable data checking and ratification procedures to be satisfactorily carried out.

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

It has also been found on more than one occasion that internal analyser calibration factors have been changed at ESU visits. This action will change the calibration history for the instrument, and possibly not be picked up by the CMCU leading to erroneous data being reported, in addition this may serve to mask analyser faults that should otherwise be noted. We would ask that instrument calibration factors are, as far as possible, left unchanged.

7. INVENTORY

The DETR owned assets used for this work are as follows:

1 PC (486-66)
NPL-developed ratification software
Cylinders, regulators and measurement instruments with individual values of less than £1000

8. RECOMMENDATIONS FOR EQUIPMENT PURCHASES

NPL would recommend that the following items be installed:

1. A chart recorder at Dunslair Heights.
2. Consideration should be given to the installation of new analysers at Narberth (SO2), and Wicken Fen (NOx).