

AEAT/ENV/R/0597
Issue 1

QA/QC Data Ratification Report for the Automatic Urban Network, July – December 2000

Jane Vallance-Plews

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1. Introduction

This report covers the Quality Assurance and Control (QA/QC) activities undertaken by NETCEN to ratify automatic urban monitoring network data for the 6-month period July to December 2000. It summarises significant QA/QC issues related to the network, identifying the major site problems where data capture falls below the required 90% level. Included in this report is an up-to-date inventory of Department-owned equipment used by QA/QC Unit (Appendix A) and a recommended list of equipment that may need replacing or up-grading in the network (Appendix B).

Two new DETR-funded sites were affiliated into the network during this period, bringing the total number of operational AUN monitoring sites to 70. The new site at Southend on Sea was commissioned on 24th July and the Blackpool site was commissioned on 7th August 2000.

In order to satisfy the requirements of the new European Air Quality Directives for SO₂, NO_x and PM₁₀, the DETR carried out a questionnaire exercise on Local Authority monitoring with respect to integrating further affiliated sites into the national networks. QA/QC Unit then undertook a programme of pre-affiliation assessment visits to a number of Local Authority sites and as a result of this a further three new direct-funded sites at Wrexham, Dumfries and Inverness and eight Local Authority affiliate sites were selected to be commissioned into the network. In addition, three of the existing network sites were selected to be up-graded with additional analysers. Progress on the affiliation of these new sites is discussed in Section 2.6.

During this reporting period two AUN sites were temporarily closed down for several months. At Sunderland the site was closed for refurbishment from 20th June until 14th November 2000 and Belfast Centre was closed from 30th October until 29th January 2001 to enable the site to be up-graded to accommodate additional particulate monitors.

Ratified hourly average data capture for the network averaged 95% for all pollutants (O₃, NO₂, SO₂, CO and PM₁₀) during this 6-month reporting period (see Table 1.1).

Table 1.1 AUN Ratified Data Capture (%) July - December 2000

| Pollutant | O ₃ | NO ₂ | CO | SO ₂ | PM ₁₀ | Average |
|------------------|----------------|-----------------|----|-----------------|------------------|---------|
| Data Capture (%) | 96 | 94 | 95 | 93 | 96 | 95 |

Generic data quality issues affecting the network are discussed in Section 2. For general information which is relevant to this reporting period, brief reviews of the effect of the September 2000 fuel shortage on ambient air quality and bonfire night PM₁₀ episode data are also included in Sections 2.1 and 2.2 respectively.

Specific data quality issues affecting individual sites are given in Section 3. The main site operational and QA/QC issues giving rise to data capture below the required 90% level are summarised in Section 4.

A more detailed breakdown of the hourly data capture statistics for each site is presented in Section 5, Table 5.1. In total, only 7 out of the 70 sites (10%) had an average data capture rate

below the required 90% level for the July to December 2000 period. Ratified data capture statistics for the complete year January-December 2000 are given in Table 5.2. The annual average data capture for the network was 94% which is consistent with the overall high levels of network performance seen over the last few years. (See Figure 1.1 below).

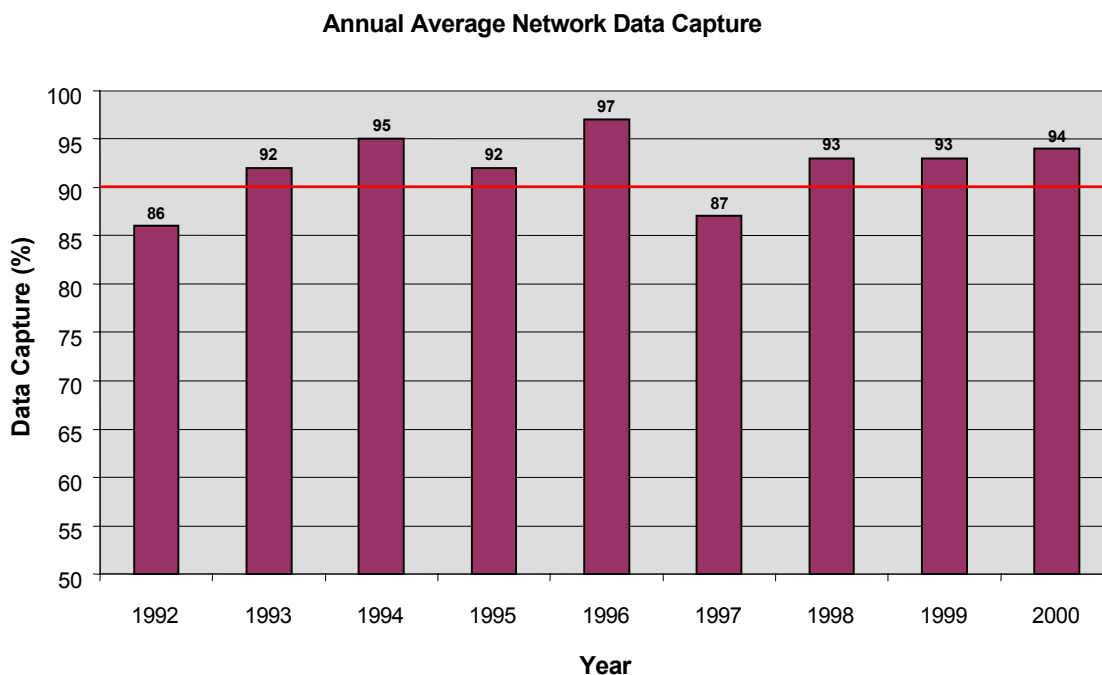


Figure 1.1 AUN Data Capture 1992 - 2000

QA/QC Unit carried out the winter network intercalibration and site audits during January to March 2001 and the results have been used to assess the accuracy and consistency of the data for this reporting period. Details of this intercalibration and audit exercise will be reported separately.

The Local Site Operator's manual was revised and up-dated in November 2000. Useful information has been included for local authorities appointing and managing their own equipment support and maintenance contract and this can now be found in the "ESU contract specifications" section of the manual. A new "trouble-shooting" section was also added which provides examples of common problems and faults that may arise during the routine operation or calibration of the automatic analysers. The new sections can be found on the UK National Air Quality Information Archive web site (www.aeat.co.uk/netcen/airqual/home.html). Select Main Archive Sections then Research Reports and under the heading Local Authority Guidance, select UK Automatic Network Site Operator's Manual and locate the ESU Contract Specification or Trouble-shooting sections.

2. Generic Data Quality Issues

2.1 EFFECT OF FUEL SHORTAGE ON AMBIENT AIR QUALITY

During September 2000 the supply of petrol and diesel to filling stations was interrupted by protest blockades at fuel depots. Over the period 10th - 15th September there was very little petrol or diesel available to the general public, and road traffic was visibly reduced. Air quality monitoring data from the Automatic Urban Network (AUN) was analysed by NETCEN to investigate whether the traffic reduction during this period had any detectable effect on air quality. The study concluded that, at most sites, ambient concentrations of NO_x, PM₁₀ and roadside CO did show a reduction during the fuel shortage period, relative to typical average September values. However, in most cases the reductions observed were greater than predicted by the measured traffic reductions alone. This was consistent with ambient concentrations being reduced by a combination of reduced traffic emissions and meteorological conditions. The weather conditions during this period were unsettled, with increasing rain and wind as the week progressed. Given that the prevailing winds were south-westerly, relatively good air quality would have been expected irrespective of the fuel shortage.

In general, it appeared that the modest reductions in ambient pollutant concentrations brought about by the fuel shortage traffic reductions were in most cases too small to be clearly detectable above the much larger variations due to meteorology. It was only in the case of NO_x at near-motorway sites (e.g. Walsall Alumwell, close to the M6 motorway), that the actual measured reductions were close to those predicted, based on the observed reductions in traffic.

2.2 BONFIRE NIGHT PM₁₀ EPISODES

Elevated levels of PM₁₀ were recorded at many sites over the bonfire night weekend of Saturday 4th to Sunday 5th November (see Figure 2.1). Thirteen sites reported “Moderate” levels of PM₁₀ pollution over the weekend, most on the Saturday night. Daily mean TEOM data (corrected to gravimetric equivalent) also exceeded 50 µg/m³ at 16 monitoring locations. Marylebone Road recorded exceedences of the 50µg/m³ daily mean gravimetric equivalent standard on both Friday and Saturday. At London Bexley, PM₁₀ concentrations were reported as “High” overnight from Saturday to Sunday. The highest level recorded at any site over the weekend was at Preston where “Very High” PM₁₀ air pollution was reported on Sunday night and into Monday morning. The Local Authority site operators reported that a bonfire had been burning only 5 metres away from the monitoring site.

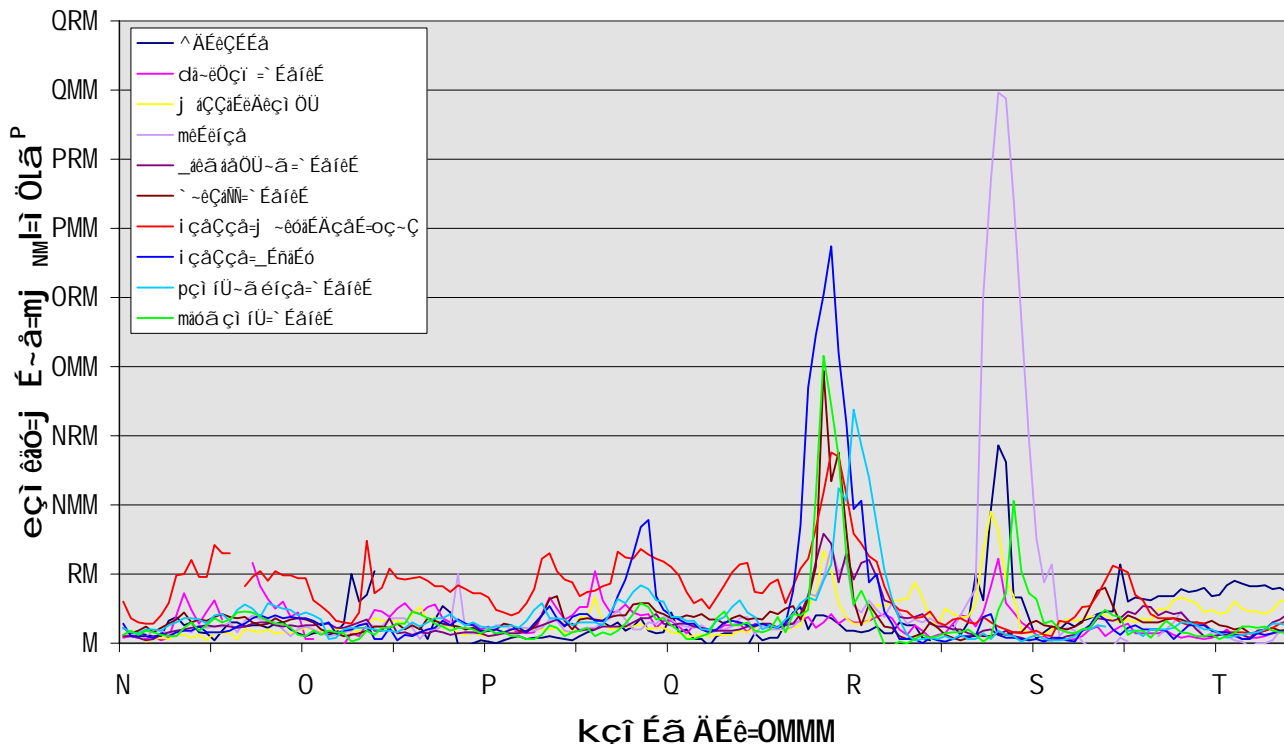


Figure 2.1 Bonfire night 2000 hourly mean PM₁₀ (TEOM) data

2.3 NO_x CONVERTERS

The winter 2001 intercalibration exercise identified two sites that failed the NO_x converter test and 5 “borderline” cases where the converters were found to be operating just marginally below the 95% level. (See Table 2.1 below).

Table 2.1 Sites with low NO_x converter efficiency (winter 2001 audit)

| Site | Analyser | Converter Efficiency | Comment |
|-------------------------|----------|----------------------|--|
| Coventry | Signal | 93.2% | Repeat fail (80/82% at last audit) The analyser was up-graded and relocated in January 2001. |
| Nottingham Centre | Signal | 92.7% | Repeat fail (93/94% at last audit) |
| BORDERLINE CASES | | | |
| Manchester South | Signal | 94.2% | Borderline at last audit (94.5%). 3-month test by Signal on Dec 4 th 2000 was 96%. Moly temperature increased. |
| West London | API | 94.5% | Borderline |
| Brighton Roadside | ML | 94.7% | Borderline |
| Rotherham Centre | Signal | 94.9% | 3-month test by Signal on Dec 1 st 2000 was 97.2%. |
| Blackpool | Signal | 94.9% | Borderline |

Following the recommendations given in the last ratification report, the Equipment Support Unit carried out additional converter tests three months after the service, at sites where the converters had shown a history of poor performance. Results of the 3-month converter tests carried out by the ESU are given in Table 2.2. In general, the early detection of poor converter performance by the ESU during these 3-month tests has helped to expedite the repair/replacement of faulty converters and minimise data loss during this 6-month ratification period.

Table 2.2 Equipment Support Unit's 3-monthly converter test results

| Site | Converter Efficiency | Comment |
|-------------------|----------------------|--|
| Coventry | 98.2% | Analyser up-graded and relocated |
| Rotherham | 97.2% | New converter fitted at service in February 2001 |
| Manchester South | 96% | Temperature increased |
| Plymouth | Not given | Replacement TECO analyser fitted |
| Glasgow Centre | 99.5% | |
| London Hillingdon | 94% | New converter fitted (99.5%) |

Effect on Data Quality

QA/QC Unit identified a low converter efficiency result (93%) at Coventry during the winter audit in February 2001. This audit was carried out at the new site location at Coventry Memorial Park shortly before the site was officially due to come on-line again. The ESU visited the site the next day to correct the converter problem. Because the audit was carried out at the new site location, it is not appropriate to use these results to assess the analyser's performance prior to the site being moved. Instead, the ESU's 3-month converter test, which was carried out in September, has been used. As this showed satisfactory converter performance (98%), all data from the service on August 11th until December 31st are considered acceptable.

At Nottingham Centre the chart records were used to examine the effect of the converter performance on the data quality. In cases where the converter efficiency is low, a noticeable decline in the response of the NO₂ span may be seen during the calibrations. The chart records indicated that the converter performance was generally satisfactory until January 2000, when the calibration response became unstable. Consequently the data quality for this ratification period (July-December) is considered acceptable, however data will be rejected from early January until repair of the converter at the service on 15th March 2001.

Examination of the data at the remaining five sites where the converter efficiency was borderline, did not reveal any significant effect on the overall data quality and no action has therefore been taken to reject data.

RECOMMENDATIONS

- | | |
|----|--|
| i) | The ESUs should continue to carry out 3-monthly converter tests at sites where the analyser shows a history of poor converter performance (e.g. by failing at least 2 audits in a row). In particular we recommend 3-month converter tests at Coventry, Manchester South, Nottingham and Rotherham (poor performance history) . |
|----|--|

- ii) LSOs should continue to pay careful attention to the stability of the NO₂ calibration response and notify CMCU if a declining NO₂ span response is recorded. Full details of this check can be found in the “Trouble-shooting” section of the Site Operator’s Manual.

2.4 CO AND SO₂ ZERO TRUNCATION

Data show that at some sites the analysers may still not be configured correctly to allow normal fluctuations in baseline response. As a result, the analyser’s response to zero air or low ambient concentrations appear “truncated” and a constant output of zero ppb may be recorded for several days in a row. Table 2.3 (presented in Appendix C) shows the number of days that the analyser response was 0ppb/ppm for all the sites in the network, during the 6-month period April-September 2000. As seen, there were a few sites that stand out as having an unusually high number of days where the concentration was zero. The most significant effect appears to be seen at the following sites:

| <u>Site</u> | <u>Pollutant</u> | <u>No of days concentration is at zero ppb/ppm</u> | <u>ESU</u> |
|-----------------|------------------|--|------------|
| Oxford Centre | SO ₂ | 26 | ETi |
| Exeter Roadside | SO ₂ | 18 | Siemens |
| Bolton | SO ₂ | 8 | Siemens |
| Bolton | CO | 12 | Siemens |
| Salford Eccles | CO | 11 | Siemens |

Oxford Centre SO₂ appears to be a clear anomaly and further investigation of the truncated zero response is required at this site.

QA/QC Unit installed a parallel analyser at Exeter Roadside for a few weeks in August to investigate the extended periods of low response. Unfortunately however, this comparison test proved inconclusive, as there were no unusual periods of zero response truncation on the site analyser during this time.

At Bolton, the analyser’s baseline offset was adjusted from 40mV to 0mV after an ESU call-out in early July. Shortly after this spurious adjustment, the analyser’s response profile changed to give extended periods of truncated baseline response. One month of data from 30th June until 27th July 2000 has been deleted during ratification due to this problem.

RECOMMENDATIONS

We recommend that the Equipment Support Units ensure that the analysers at Oxford Centre, Exeter Roadside, Bolton and Salford Eccles are correctly configured and check that:

- i) the analyser can output negative voltages
- ii) the logging system can record and store negative voltages
- iii) a suitable baseline offset of say 20mV is applied
- iv) any function which automatically resets the zero baseline is disabled

2.5 ANALYSERS FAULTS AND REPAIR TIMES

At a few sites there were some significant delays in repairing analyser faults giving rise to data gaps of a number of weeks rather than days. Given that the target data capture rate for each site is 90% (328 days), then the allowed data loss is 37 days per year. From this there needs to be deducted approximately 12 days for routine site calibrations ($\frac{1}{2}$ day every 2 weeks), 2 days for audits and 4 days for service. This leaves approximately 19 days data loss for other problems. As seen in Table 2.4 below, there are cases where just one fault has resulted in data loss well over this 19-day limit.

Table 2.4 Examples of extended periods of data loss (July-December 2000)

| Site | Status | Pollutant | Data loss | Reason |
|--------------------|-----------|-----------------|-------------------|--|
| Brighton Roadside | Affiliate | NO ₂ | 37 days (5 weeks) | Leak inside analyser giving rise to internal sampling |
| Bristol Old Market | Affiliate | NO ₂ | 34 days | Fan motor fault. Analyser removed from site for repair |
| Redcar | Affiliate | SO ₂ | 27 days | UV lamp fault and ESU/LSO contractual complications |
| Blackpool | DETR | SO ₂ | 13 days | Analyser cooling fan fault |
| Norwich Centre | DETR | SO ₂ | 19 days | PC "locked up" and new EPROM card installed |
| Hull | DETR | CO | 18 days | Air conditioning fault – analyser switched out of service to avoid over-heating |
| Southampton | DETR | CO | 15 days | Air conditioning fault |
| Coventry Centre | Affiliate | O ₃ | 14 days | Erratic response/optical bench problems |
| Salford Eccles | Affiliate | O ₃ | 26 days | Operator error – sample line not connected after calibration and leak in sample inlet filter |
| London Cromwell Rd | DETR | NO _x | 14 days | Operator error – sample line not connected to manifold after calibration |
| Wolverhampton | Affiliate | O ₃ | 8 days | Operator error – backing paper left in sample inlet filter |

The important factors that help to minimise data loss include:

- rapid fault identification (on-site inspections and remote data checking)
- fast and effective response from the ESUs
- LSOs following the correct site operational procedures
- good site management and communications between organisations.

In particular, the effective management of the equipment service and maintenance contract is essential if data capture targets are to be met. QA/QC Unit has included an example of the ESU contract specifications in the LSO manual, which should help the affiliate site operators to ensure that consistent procedures are adopted when appointing their ESUs.

RECOMMENDATIONS

| | |
|-----|---|
| i) | ESUs and LSOs should be aware that if the sites are out of service for more than 19 days (say 3 weeks) in a year, then the data capture will not reach the required 90% target level. |
| ii) | LSOs are reminded to pay careful attention to replacement of sample inlet filters and reconnection of sample lines after calibration. |

2.6 PROGRESS ON NEW SITE AFFILIATION

During this reporting period, QA/QC Unit has undertaken a number of pre-affiliation site audits with the aim of integrating 11 new sites into the network and incorporating additional monitors at a further 3 existing sites. Progress on the integration of the new sites is summarised in Table 2.5

Table 2.5 Progress on new site affiliation as of 20/4/2001

| Site | Pollutants | Status | Data available from * |
|--|---|---------------------------------|---|
| Aberdeen (existing site) | SO ₂ | On-line | 1 st January 2001 |
| Hove (existing site) | SO ₂ | On-line | 1 st January 2001 |
| Stockton-on-Tee (Yarm) | NO _x SO ₂ | On-line | 1 st January 2001 |
| Portsmouth | NO _x SO ₂ PM ₁₀ | On-line | 1 st January 2001 |
| Coventry Memorial Park (existing site) | PM ₁₀ | On-line | 26 th February 2001 |
| Grangemouth (Falkirk) | NO _x SO ₂ PM ₁₀ | On-line | 1 st February 2001 |
| Canterbury | NO _x PM ₁₀ | On-line | 25 th January 2001 (PM ₁₀) 14 th March 2001 (NO _x) |
| Wigan Leigh | NO _x SO ₂ PM ₁₀ | On-line | 1 st January 2001 |
| Northampton | NO _x PM ₁₀ | On-line | 1 st January 2001 |
| Bournemouth | NO _x SO ₂ | On-line | 15 th February 2001 |
| Dumfries | NO _x | Audited – waiting to go on-line | |
| London Westminster (Horseferry Road) | O ₃ NO _x CO SO ₂ | To be audited | |
| Wrexham | NO _x SO ₂ | To be installed | |
| Inverness | NO _x | To be installed | |
| Cwmbran | NO _x | To be relocated | |

* to be confirmed following ratification

A gravimetric PM₁₀ Partisol analyser has already been installed at Northampton and additional Partisol analysers will be installed at Bournemouth, Dumfries, Hove, Inverness and Wrexham in the near future.

3. Site Specific Issues

3.1 PLYMOUTH CENTRE SO₂

The performance of the SO₂ analyser at Plymouth was generally unsatisfactory and a considerable amount of time and effort was spent trying to ratify data from this data set. As seen in Figure 3.1 there were many negative response spikes and baseline shifts during the 6-month reporting period. In total over 11 weeks data were rejected due to the high noise and erratic response problems.

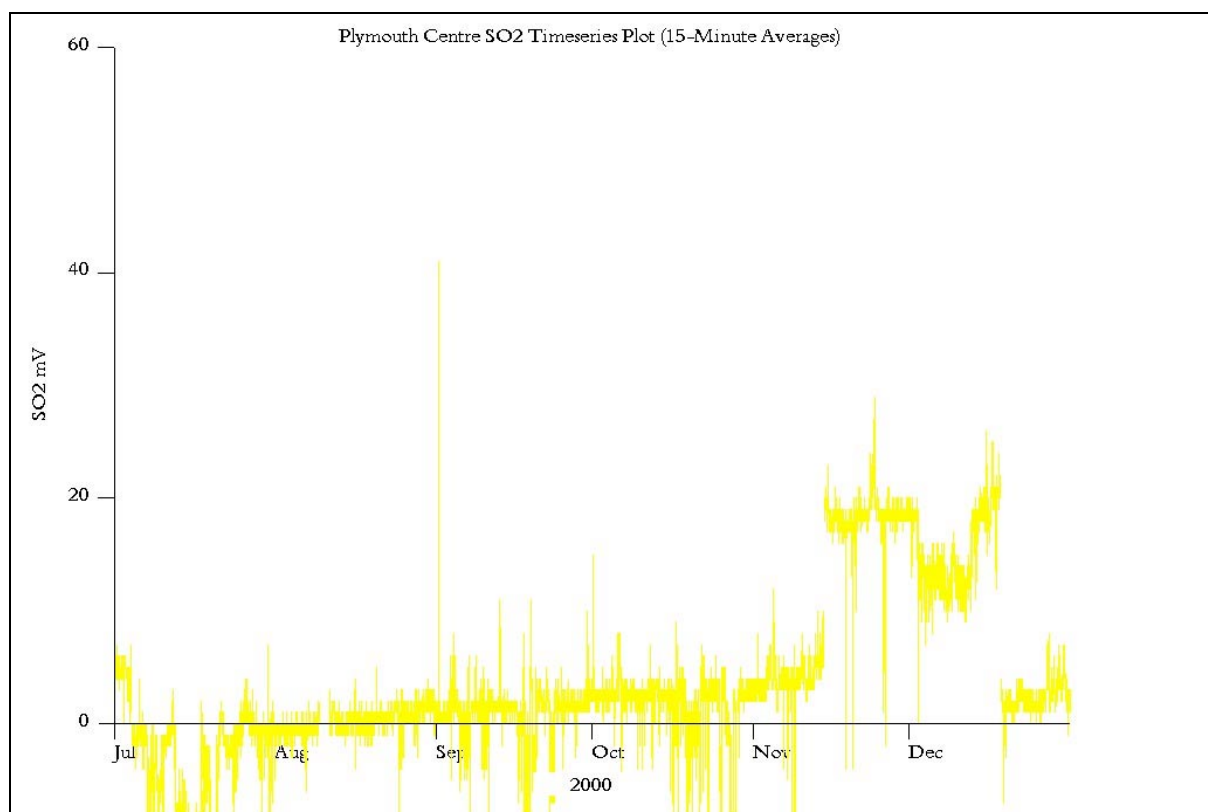


Figure 3.1 Erratic SO₂ response (raw mV data), Plymouth Centre

RECCOMENDATION

ESU to repair the SO₂ response fault at Plymouth Centre, if not already fixed at the winter service

4. Sites with Data Capture Below 90%

The following section provides a summary of the main site operational problems which have resulted in data capture below the required 90% level during the reporting period July to December 2000. The number of days of data lost during this reporting period is also given. In some cases the data gap extends beyond the 6-month reporting period, in which case the total data loss due to the fault is given below in italics.

Aberdeen

| Data Capture | Reason for Data Loss | Data Loss |
|--------------|--|-----------|
| CO = 87% | A problem with the data logger occurred and it was removed from site for repair giving rise to data loss from 2-11 th July. | 9 days |
| | Malfunction of the air conditioning unit and elevated rack temperatures resulted in data loss from 4-7 th August. | 3 days |
| | Data were lost from 18-28 th December due to a pump and sample flow fault. | 10 days |

Bath Roadside

| | | |
|-----------------------|--|---------|
| General | The data logger became corrupted on three occasions resulting in periods of CO and NO _x data loss from, 1-3 rd , 9-20 th November and 14-18 th December. | 17 days |
| NO ₂ = 82% | Data were lost from 4-7 th July and 20-23 rd August due to fault with the analyser's high voltage power supply. | 6 days |
| | A problem with the NO _x analyser's central processing unit card was identified on 3 rd November and the analyser was removed from site for repair during the period 1-20 th November. | 19 days |

Belfast Centre

| | | |
|------------------------|--|--|
| General | Routine monitoring was suspended from 30 th October 2000 until 29 th January 2001 to enable the site to be up-graded to accommodate additional particulate monitors. | 2 months <i>(3 months in total)</i> |
| SO ₂ = 61% | A photomultiplier tube temperature fault resulted in data loss from 1-7 th September. | 6 days |
| | Routine monitoring suspended as detailed above | 2 months |
| O ₃ = 65% | Routine monitoring suspended | 2 months |
| NO ₂ = 65% | Routine monitoring suspended | 2 months |
| CO = 65% | Routine monitoring suspended | 2 months |
| PM ₁₀ = 65% | Routine monitoring suspended | 2 months |

Bolton

| | | |
|----------|--|---------|
| CO = 81% | Data were deleted from 30 th June to 27 th July and from 16-21 st August due to truncated baseline response resulting in prolonged periods of 0mV response. (see Section 2.4) | 32 days |
|----------|--|---------|

Brighton Roadside

| | | |
|-----------------------|--|---------|
| NO ₂ = 79% | A sampling leak from inside the analyser resulted in data loss from 23 rd August to 29 th September. | 37 days |
|-----------------------|--|---------|

Bristol Old Market

| | | |
|-----------------------|---|--------------------------------------|
| NO ₂ = 73% | Spurious data from 6 th June until 10 th July were deleted due to a cracked lens in the reaction cell. The analyser was removed from site for repair | 10 days <i>(3 weeks in total)</i> |
| | A problem with the photomultiplier tube fan motor resulted in the analyser being removed from site again for repair from 31 st August until 4 th October. | 5 weeks |
| | Data from 20-24 th November were deleted due to severe baseline drift and a replacement analyser was installed. | 3 days |

Cambridge Roadside

| | | |
|-----------------------|---|---------|
| NO ₂ = 89% | A fault with the photomultiplier tube cooler resulted in data loss from 31 st August to 20 th September | 3 weeks |
|-----------------------|---|---------|

Coventry Centre

| | | |
|-----------------------|--|---|
| General | Data for all pollutants were lost during an unusually long service period from 31 st July – 11 th August | |
| O ₃ = 86% | Site service | 11 days |
| | Instrument response instability gave rise to erratic data being deleted from 1-14 th September. The optical bench cooling fan was modified to repair the fault. | 13 days |
| NO ₂ = 76% | The NO _x converter efficiency was found to be low (80%) at the Summer audit in July 2000. The 1-minute NO ₂ calibration response was examined to determine when the converter fault started. Data were deleted from the first unstable NO ₂ calibration on 28 th March until the converter was replaced at the service on 11 th August. | 6 weeks <i>(4.5 months in total)</i> |
| CO = 87% | Site service | 11 days |
| | ESU site investigation and software up-grade resulted in data loss from 6-14 th September. | 9 days |

Glasgow Centre

| | | |
|-----------------------|--|-----------------------------|
| NO ₂ = 78% | Data were deleted from 18 th April (first unstable NO ₂ calibration) until the service on 10 th August due to a low NO _x converter efficiency. | 6 weeks (4 months total) |
| SO ₂ = 84% | Poor quality data were deleted from 26 th June until 27 th July due to a lamp voltage fault. | 1 month |

Hull Centre

| | | |
|-----------------------|---|---------|
| General | Malfunction of the air conditioning unit in July gave rise to elevated temperatures inside the hut resulting in data loss | |
| CO = 88% | The CO analyser was switched out of service from 7-25 th July as a remedial action to reduce the rack temperature. | 18 days |
| SO ₂ = 89% | Overheating resulted in response instability and poor quality data were deleted from 11-27 th July. | 16 days |

Leeds Centre

| | | |
|----------|---|---------|
| CO = 88% | A chopper motor fault resulted in data loss from 1-20 th September | 19 days |
|----------|---|---------|

Liverpool Centre

| | | |
|------------------------|---|---------|
| PM ₁₀ = 89% | Poor quality data were deleted due to instrument response cycling and high noise during the periods 19 th August to 1 st September and 4-6 th September. | 15 days |
|------------------------|---|---------|

London Cromwell Road

| | | |
|-----------------------|---|--------------------------|
| NO ₂ = 89% | Data were deleted from 11-25 th July due to internal sampling when the sample line was accidentally left disconnect from the manifold after the LSO calibration. | 2 weeks |
| | Further data were lost from 28 th December to 2 nd January 2001 due to internal sampling after the LSO calibration. | 3 days (5 days total) |

Middlesbrough

| | | |
|-----------------------|--|---------|
| NO ₂ = 76% | An intermittent problem seen during September and October resulted in 2 days data loss from 2-4 th October. The ESU removed the analyser from site on 17 th October to investigate the fault and reinstated it on 24 th November. | 5 weeks |
|-----------------------|--|---------|

Norwich Centre

| | | |
|-----------------------|--|---------|
| SO ₂ = 84% | Data could not be accurately scaled and were deleted due to rapid zero drift and unstable response from 16 th August until 4 th September when a new EPROM card. | 19 days |
|-----------------------|--|---------|

| | | |
|--|--|--------|
| | An undocumented fault and ESU call-out resulted in data loss from 15-19 th September. | 5 days |
| | Further data were lost due to severe baseline response drift from 20-23 rd December | 3 days |

Plymouth Centre

| | | |
|-----------------------|--|------------------------------------|
| SO ₂ = 65% | Problems with erratic baseline response and high noise seen in the previous reporting period continued, resulting in poor quality data being deleted from 10 th June to 31 July, 5-7 th September, 18-29 th October and 12-18 th December. (See Section 3.1). The ESU was on site in December but details of the repair are not yet available. | 8 weeks <i>(11 weeks total)</i> |
|-----------------------|--|------------------------------------|

Preston

| | | |
|----------|--|---------------------------------|
| CO = 78% | Data were lost from 13 th September to 16 th October due to a sample pump fault. | 33 days |
| | A chopper motor fault resulted in further data loss from 27 th December to 3 rd January 2001 | 4 days <i>(1 week total)</i> |

Redcar

| | | |
|-----------------------|---|---------|
| SO ₂ = 84% | One month of data were lost from 28 th July to 25 th August due to a UV lamp fault and delays in repair arising from ESU/Local Authority contractual complications. | 27 days |
|-----------------------|---|---------|

Salford Eccles

| | | |
|----------------------|--|-----------------------------------|
| O ₃ = 88% | Spurious low data were deleted from 22 nd June until 18 th July when then sample line was left disconnected from the manifold after a routine calibration. A leak in the sample inlet filter was also found. | 18 days <i>(4 weeks total)</i> |
|----------------------|--|-----------------------------------|

Scunthorpe

| | | |
|------------------------|--|---------|
| PM ₁₀ = 87% | Malfunction of the TEOM due to moisture penetration resulted in data loss from 19 th September to 11 th October. | 3 weeks |
|------------------------|--|---------|

Southampton Centre

| | | |
|----------|---|---------|
| General | Several periods of data were lost throughout July and August due to power failures caused by the air conditioning problems. | |
| CO = 86% | The CO analyser was switched out of service from 6-21 st August due to the air conditioning fault giving rise to elevated temperatures inside the hut. | 15 days |

| | | |
|--|--|--------|
| | A replacement air conditioning unit was purchased and installed but further data were lost due to elevated hut temperatures on 17–20 th November. | 3 days |
|--|--|--------|

Southend-on-Sea

| | | |
|-----------------------|--|--------|
| NO ₂ = 89% | This new site was commissioned on 24 th July 2000. Data from 28 th July to 3 rd August could not be accurately processed due to an incorrect channel offset configuration. | 6 days |
| | Data from 1-9 th November were rejected due to internal sampling when the sample line was not securely connected to the sample inlet filter after calibration. | 8 days |

Sunderland

| | | |
|-----------------------|---|-------------------------------------|
| SO ₂ = 21% | Routine monitoring was suspended from 30 th March until 2 nd May and again from 30 th June until 14 th November due to building refurbishment | 5 months <i>(6 months total)</i> |
| | Data were lost when the analyser was removed from site to be serviced during the period 30 th November to 7 th December. | 1 week |

5. Ratified Data Capture Statistics

Table 5.1 provides the ratified data capture figures for each site for the 6-month period July to December 2000. Data capture values below 90% are shown in the shaded boxes. Table 5.2 gives the ratified data capture rates for the complete year January-December 2000.

Table 5.1 AUN ratified data capture (%) for July - December 2000.

| Site Name | O ₃ | NO ₂ | CO | SO ₂ | PM ₁₀ | Site Average |
|------------------------|----------------|-----------------|----|-----------------|------------------|--------------|
| ENGLAND | | | | | | |
| Barnsley 12 | - | - | - | 99 | - | 99 |
| Barnsley Gawber | 98 | 98 | - | 98 | - | 98 |
| Bath Roadside | - | 82 | 90 | - | - | 86 |
| Billingham | - | 99 | - | - | - | 99 |
| Birmingham Centre | 98 | 95 | 97 | 95 | 98 | 97 |
| Birmingham East | 98 | 97 | 98 | 98 | 98 | 98 |
| Blackpool* | 96 | 98 | 99 | 90 | 99 | 96 |
| Bolton | 98 | 98 | 81 | 98 | 96 | 94 |
| Bradford Centre | 98 | 98 | 98 | 98 | 98 | 98 |
| Brighton Roadside | - | 79 | 98 | - | - | 89 |
| Bristol Centre | 98 | 98 | 98 | 92 | 92 | 96 |
| Bristol Old Market | - | 73 | 99 | - | - | 86 |
| Bury Roadside | 98 | 97 | 98 | 98 | 95 | 97 |
| Cambridge Roadside | - | 89 | - | - | - | 89 |
| Coventry Centre | 86 | 76 | 87 | 92 | - | 85 |
| Exeter Roadside | 98 | 99 | 95 | 99 | - | 97 |
| Hove Roadside | - | 95 | 92 | - | - | 93 |
| Hull Centre | 98 | 93 | 88 | 89 | 96 | 93 |
| Leamington Spa | 99 | 99 | 99 | 99 | 99 | 99 |
| Leeds Centre | 98 | 96 | 88 | 97 | 98 | 96 |
| Leicester Centre | 98 | 96 | 96 | 98 | 96 | 97 |
| Liverpool Centre | 98 | 98 | 98 | 98 | 89 | 96 |
| London A3 Roadside | - | 98 | 97 | - | 99 | 98 |
| London Bexley | 98 | 98 | 92 | 98 | 97 | 97 |
| London Bloomsbury | 96 | 94 | 96 | 96 | 96 | 96 |
| London Brent | 99 | 97 | 99 | 99 | 99 | 99 |
| London Cromwell Road 2 | - | 89 | 98 | 97 | - | 95 |
| London Hillingdon | 98 | 98 | 98 | 98 | 98 | 98 |
| Manchester Piccadilly | 99 | 96 | 98 | 98 | 97 | 98 |
| Manchester South | 98 | 99 | - | 99 | - | 98 |
| Manchester Town Hall | - | 99 | 99 | - | - | 99 |
| Middlesbrough | 98 | 76 | 98 | 98 | 98 | 94 |
| Newcastle Centre | 98 | 98 | 95 | 98 | 98 | 98 |
| Norwich Centre | 98 | 98 | 98 | 84 | 98 | 95 |

| Site Name | O ₃ | NO ₂ | CO | SO ₂ | PM ₁₀ | Site Average |
|-------------------------|----------------|-----------------|-----------|-----------------|------------------|--------------|
| Norwich Roadside | - | 99 | - | - | - | 99 |
| Nottingham Centre | 98 | 98 | 98 | 94 | 98 | 97 |
| Oxford Centre | - | 99.5 | 99.6 | 99.6 | - | 99.6 |
| Plymouth Centre | 95 | 96 | 98 | 65 | 96 | 90 |
| Preston | 96 | 97 | 78 | 98 | 98 | 94 |
| Reading | 96 | 92 | 97 | 97 | 97 | 96 |
| Redcar | 99 | 99 | 97 | 84 | 94 | 94 |
| Rotherham Centre | 99 | 97 | - | 96 | - | 97 |
| Salford Eccles | 88 | 98 | 98 | 98 | 99 | 96 |
| Sandwell West Bromwich | 98 | 98 | 92 | 98 | - | 97 |
| Scunthorpe | - | - | - | 96 | 87 | 91 |
| Sheffield Centre | 99 | 99 | 99 | 97 | 99 | 98 |
| Sheffield Tinsley | - | 98 | 99 | - | - | 98 |
| Southampton Centre | 95 | 94 | 86 | 90 | 95 | 92 |
| Southend-on-Sea* | 95 | 89 | 98 | 99 | 98 | 96 |
| Stockport | - | 98 | 99 | 99 | 96 | 98 |
| Stoke-on-Trent Centre | 98 | 97 | 98 | 97 | 97 | 97 |
| Sunderland | - | - | - | 21 | - | 21 |
| Thurrock | 98 | 94 | 98 | 98 | 96 | 97 |
| Walsall Alumwell | - | 90 | - | - | - | 90 |
| Walsall Willenhall | - | 99 | - | - | - | 99 |
| West London | - | 97 | 96 | - | - | 97 |
| Wirral Tranmere | 96 | 95 | 95 | 95 | 96 | 95 |
| Wolverhampton Centre | 91 | 94 | 98 | 90 | 97 | 94 |
| NORTHERN IRELAND | | | | | | |
| Belfast Centre | 65 | 65 | 65 | 61 | 65 | 64 |
| Belfast Clara St | - | - | - | - | 90 [#] | 90 |
| Belfast East | - | - | - | 99 | - | 99 |
| Derry | 97 | 97 | 97 | 97 | 98 | 97 |
| SCOTLAND | | | | | | |
| Aberdeen | - | 91 | 87 | - | 93 | 90 |
| Edinburgh Centre | 98 | 95 | 98 | 98 | 98 | 98 |
| Glasgow Centre | 98 | 78 | 98 | 84 | 98 | 91 |
| Glasgow City Chambers | - | 99 | 97 | - | - | 98 |
| Glasgow Kerbside | - | 98 | 98 | - | 98 | 98 |
| WALES | | | | | | |
| Cardiff Centre | 95 | 98 | 98 | 98 | 98 | 97 |
| Port Talbot | 96 | 98 | - | 98 | 98 | 97 |
| Swansea | 98 | 97 | 98 | 97 | 97 | 97 |
| Network Mean (%) | 96 | 94 | 95 | 93 | 96 | 95 |

[#]Provisional PM₁₀ BAM data

*data capture adjusted to site start date for new sites.

| | |
|-----------------|------------|
| New sites | Start date |
| Blackpool | 08/08/00 |
| Southend on Sea | 24/07/00 |

Table 5.2 AUN ratified data capture (%) for January – December 2000.

| Site Name | O ₃ | NO ₂ | CO | SO ₂ | PM ₁₀ | Site Average |
|------------------------|----------------|-----------------|------|-----------------|------------------|--------------|
| ENGLAND | | | | | | |
| Barnsley 12 | - | - | - | 99 | - | 99 |
| Barnsley Gawber | 97 | 94 | - | 93 | - | 95 |
| Bath Roadside | - | 76 | 94 | - | - | 85 |
| Billingham | - | 99 | - | - | - | 99 |
| Birmingham Centre | 98 | 97 | 97 | 90 | 98 | 96 |
| Birmingham East | 98 | 97 | 98 | 98 | 97 | 98 |
| Bolton | 98 | 97 | 90 | 96 | 97 | 95 |
| Bradford Centre | 92 | 96 | 97 | 96 | 97 | 96 |
| Brighton Roadside | - | 55 | 65 | - | - | 60 |
| Bristol Centre | 98 | 96 | 94 | 91 | 93 | 94 |
| Bristol Old Market | - | 78 | 92 | - | - | 85 |
| Bury Roadside | 97 | 97 | 97 | 95 | 92 | 96 |
| Cambridge Roadside | - | 93 | - | - | - | 93 |
| Coventry Centre | 81 | 45 | 83 | 85 | - | 73 |
| Exeter Roadside | 60 | 98 | 96 | 98 | - | 88 |
| Hove Roadside | - | 89 | 88 | - | - | 88 |
| Hull Centre | 98 | 96 | 93 | 92 | 95 | 95 |
| Leamington Spa | 99 | 99 | 98 | 97 | 98 | 98 |
| Leeds Centre | 98 | 97 | 90 | 97 | 97 | 96 |
| Leicester Centre | 96 | 96 | 95 | 98 | 97 | 96 |
| Liverpool Centre | 97 | 96 | 97 | 97 | 91 | 96 |
| London A3 Roadside | - | 97 | 97 | - | 98 | 97 |
| London Bexley | 98 | 97 | 87 | 98 | 97 | 95 |
| London Bloomsbury | 97 | 96 | 95 | 97 | 97 | 97 |
| London Brent | 99 | 98 | 99 | 99 | 98 | 99 |
| London Cromwell Road 2 | - | 94 | 98 | 97 | - | 96 |
| London Hillingdon | 98 | 98 | 91 | 98 | 98 | 97 |
| Manchester Piccadilly | 98 | 97 | 98 | 98 | 98 | 98 |
| Manchester South | 97 | 81 | - | 85 | - | 88 |
| Manchester Town Hall | - | 96 | 99 | - | - | 97 |
| Middlesbrough | 98 | 85 | 98 | 97 | 96 | 95 |
| Newcastle Centre | 98 | 98 | 97 | 98 | 98 | 98 |
| Norwich Centre | 97 | 97 | 97 | 89 | 97 | 96 |
| Norwich Roadside | - | 99 | - | - | - | 99 |
| Nottingham Centre | 98 | 98 | 98 | 96 | 99 | 98 |
| Oxford Centre | - | 99 | 99.5 | 99.5 | - | 99 |
| Plymouth Centre | 97 | 85 | 97 | 72 | 95 | 89 |
| Reading | 97 | 95 | 98 | 98 | 95 | 96 |
| Redcar | 96 | 98 | 97 | 91 | 96 | 96 |
| Rotherham Centre | 99 | 97 | - | 95 | - | 97 |
| Salford Eccles | 85 | 97 | 98 | 98 | 98 | 95 |
| Sandwell West Bromwich | 96 | 89 | 93 | 96 | - | 93 |
| Scunthorpe | - | - | - | 97 | 90 | 93 |
| Sheffield Centre | 97 | 97 | 97 | 96 | 97 | 97 |
| Sheffield Tinsley | - | 97 | 99 | - | - | 98 |
| Southampton Centre | 95 | 95 | 92 | 94 | 97 | 94 |

| Site Name | O ₃ | NO ₂ | CO | SO ₂ | PM ₁₀ | Site Average |
|-------------------------|----------------|-----------------|-----------|-----------------|------------------|--------------|
| Stockport | - | 98 | 98 | 99 | 97 | 98 |
| Stoke-on-Trent Centre | 96 | 97 | 97 | 98 | 98 | 97 |
| Sunderland | - | - | - | 50 | - | 50 |
| Thurrock | 97 | 93 | 97 | 97 | 94 | 95 |
| Walsall Alumwell | - | 94 | - | - | - | 94 |
| Walsall Willenhall | - | 84 | - | - | - | 84 |
| West London | - | 98 | 97 | - | - | 98 |
| Wolverhampton Centre | 95 | 96 | 98 | 89 | 98 | 95 |
| NORTHERN IRELAND | | | | | | |
| Belfast Centre | 81 | 81 | 81 | 80 | 81 | 81 |
| Belfast Clara St | - | - | - | - | 93 [#] | 93 |
| Belfast East | - | - | - | 99 | - | 99 |
| Derry | 97 | 96 | 97 | 96 | 96 | 96 |
| SCOTLAND | | | | | | |
| Aberdeen | - | 94 | 86 | - | 94 | 91 |
| Edinburgh Centre | 97 | 95 | 98 | 98 | 96 | 97 |
| Glasgow Centre | 98 | 68 | 98 | 90 | 97 | 90 |
| Glasgow City Chambers | - | 99 | 98 | - | - | 98 |
| Glasgow Kerbside | - | 98 | 98 | - | 98 | 98 |
| WALES | | | | | | |
| Cardiff Centre | 96 | 97 | 95 | 94 | 98 | 96 |
| Port Talbot | 95 | 87 | - | 89 | 96 | 92 |
| Swansea | 98 | 98 | 96 | 98 | 97 | 97 |
| Network Mean (%) | | | | | | |
| | 95 | 92 | 95 | 94 | 96 | 94 |

PM₁₀ BAM data provisional

*data capture adjusted to new site start date

| New sites | Start date |
|-----------------|------------|
| Wirral Tranmere | 14/05/00 |
| Preston | 06/06/00 |
| Southend on Sea | 24/07/00 |
| Blackpool | 08/08/00 |

Appendix A

An up-to-date inventory of Department-owned equipment used by the QA/QC Unit is provided below:

QA/QC Unit's inventory of Department-owned equipment, April 2001

| | |
|-------------------------|--|
| Computer software | A HIS (Heuristic Information System) software suite used for all data management. A few specific capabilities of HIS were developed in order to meet specific Department deliverables or requirements (examples include software for annual report analysis/compilation, for formatting/transmitting network data to archive or DDU and for reporting Directive compliance data to the EC) |
| Field support equipment | 1 intercalibration equipment set (includes mass flow controllers and read-out unit) A second intercalibration kit (commissioned January 2001) 3 UV photometers : <i>API model M401- purchased April 99</i> <i>ML model 9812 – purchased April 99</i> <i>API model 401 - purchased October 2000</i> |
| Zero air pumps | 6 spare zero air pumps for routine maintenance/repair of zero air generators in the AUN |

Appendix B

As requested by the Department, QA/QC Unit has provided a list of suggestions for equipment that may need replacing or up-grading in the network. The following provides a summary of the list and the actions taken to date. From October 2000, the recommendations have been prioritised as follows:

| Priority | Definition | Time-scale |
|----------|---|----------------|
| High* | Immediate action necessary to avoid compromising data capture/quality or safety | Within 2 weeks |
| Medium | Essential but not immediate | 3-6 months |
| Low | Desirable but not essential | As appropriate |

*Note – QA/QC Unit’s practice is to notify CMCU immediately of any high priority issues at the time of the event.

| | Recommendations: October 1998 | Action | |
|------------------------------|---|--|---|
| 1 | Replace old teflon-coated sample manifolds at former SUN sites | Completed | |
| 2 | Replace long sample line at Manchester Town Hall | Completed | |
| 3 | Use of 1 micron sample filters on API ozone analysers | In-hand at DETR sites | |
| 4 | Fitting all AUN sites with ladder securing clips | In hand | |
| 5 | Improving access to PM ₁₀ head at Scunthorpe | No action (affiliated site) | |
| 6 | Safer access to Walsall Alumwell | No action | |
| 7 | Installing temperature probes at site without air-conditioning | Access to temp data from Ambirack site now possible | |
| Recommendations: April 2000 | | | |
| 8 | Consideration could be given to up-grading the “older generation” Ambirack system at Coventry in view of the problems identified at the audit. | Site relocated and analysers up-graded (February 2001) | |
| Recommendations October 2000 | | Priority | Action |
| 9 | The site at Walsall Alumwell should be moved from school roof to ground level in order to improve site access and safety. | Medium | Outstanding |
| 10 | Safer access to PM ₁₀ head at Scunthorpe | Medium | Outstanding |
| 11 | Safer access to PM ₁₀ head at Stockport. Check that the recent fire damage to the next door building has not reduced the structural integrity of the shared flat roof. | Medium | Smoke damage only |
| 12 | The CO analyser at Birmingham is very noisy (outside the ±0.5ppm acceptance level) and should be considered for replacement/up-grade | Medium | Outstanding - analyser performance remains poor |
| Recommendations April 2001 | | Priority | Action |
| 13 | Up-grade or repair noisy CO analyser at Birmingham Centre | Medium | |

Appendix C

Table 2.3 Truncated Zero Response

Sites with an unusually high number of days where the concentration is 0ppb/ppm have been highlighted. These data indicate there may be a zero response truncation problem at these sites.

| Number of day where SO ₂ concentration is zero ppb 01/04/2000 to 30/09/2000 | | | Number of day where CO concentration is zero ppm 01/04/2000 to 30/09/2000 | | |
|---|-----------------------|----------------|--|-----------------------|----------------|
| Channel | Site | Number of days | Channel | Site | Number of days |
| SO ₂ | Barnsley 12 | 1 | CO | Aberdeen | 0 |
| SO ₂ | Barnsley Gawber | 0 | CO | Bath Roadside | 0 |
| SO ₂ | Belfast Centre | 0 | CO | Belfast Centre | 0 |
| SO ₂ | Belfast East | 0 | CO | Birmingham Centre | 0 |
| SO ₂ | Birmingham Centre | 0 | CO | Birmingham East | 0 |
| SO ₂ | Birmingham East | 0 | CO | Blackpool | 0 |
| SO ₂ | Blackpool | 0 | CO | Bolton | 12 |
| SO ₂ | Bolton | 8 | CO | Bradford Centre | 0 |
| SO ₂ | Bradford Centre | 0 | CO | Brighton Roadside | 0 |
| SO ₂ | Bristol Centre | 0 | CO | Bristol Centre | 0 |
| SO ₂ | Bury Roadside | 0 | CO | Bristol Old Market | 0 |
| SO ₂ | Cardiff Centre | 0 | CO | Bury Roadside | 0 |
| SO ₂ | Coventry Centre | 0 | CO | Cardiff Centre | 0 |
| SO ₂ | Derry | 0 | CO | Coventry Centre | 0 |
| SO ₂ | Edinburgh Centre | 0 | CO | Derry | 0 |
| SO ₂ | Exeter Roadside | 18 | CO | Edinburgh Centre | 0 |
| SO ₂ | Glasgow Centre | 0 | CO | Exeter Roadside | 0 |
| SO ₂ | Hull Centre | 0 | CO | Glasgow Centre | 0 |
| SO ₂ | Leamington Spa | 0 | CO | Glasgow City Chambers | 0 |
| SO ₂ | Leeds Centre | 2 | CO | Glasgow Kerbside | 0 |
| SO ₂ | Leicester Centre | 0 | CO | Hove Roadside | 0 |
| SO ₂ | Liverpool Centre | 0 | CO | Hull Centre | 0 |
| SO ₂ | London Bexley | 0 | CO | Leamington Spa | 3 |
| SO ₂ | London Bloomsbury | 0 | CO | Leeds Centre | 0 |
| SO ₂ | London Brent | 3 | CO | Leicester Centre | 0 |
| SO ₂ | London Cromwell Road | 0 | CO | Liverpool Centre | 0 |
| SO ₂ | London Hillingdon | 0 | CO | London A3 Roadside | 0 |
| SO ₂ | Manchester Piccadilly | 0 | CO | London Bexley | 0 |
| SO ₂ | Manchester South | 0 | CO | London Bloomsbury | 0 |
| SO ₂ | Middlesbrough | 0 | CO | London Brent | 0 |
| SO ₂ | Newcastle Centre | 0 | CO | London Cromwell Rd | 0 |
| SO ₂ | Norwich Centre | 0 | CO | London Hillingdon | 0 |
| SO ₂ | Nottingham Centre | 0 | CO | Manchester Piccadilly | 0 |

| Number of day where SO ₂ concentration is zero ppb 01/04/2000 to 30/09/2000 | | | Number of day where CO concentration is zero ppm 01/04/2000 to 30/09/2000 | | |
|---|------------------------|----|--|------------------------|----|
| SO ₂ | Oxford Centre | 26 | CO | Manchester Town Hall | 0 |
| SO ₂ | Plymouth Centre | 0 | CO | Middlesbrough | 0 |
| SO ₂ | Port Talbot | 2 | CO | Newcastle Centre | 0 |
| SO ₂ | Preston | 0 | CO | Norwich Centre | 0 |
| SO ₂ | Reading | 0 | CO | Nottingham Centre | 0 |
| SO ₂ | Redcar | 2 | CO | Oxford Centre | 4 |
| SO ₂ | Rotherham Centre | 0 | CO | Plymouth Centre | 0 |
| SO ₂ | Salford Eccles | 1 | CO | Preston | 0 |
| SO ₂ | Sandwell West Bromwich | 2 | CO | Reading | 0 |
| SO ₂ | Scunthorpe | 0 | CO | Redcar | 0 |
| SO ₂ | Sheffield Centre | 0 | CO | Salford Eccles | 11 |
| SO ₂ | Southampton Centre | 0 | CO | Sandwell West Bromwich | 0 |
| SO ₂ | Southend-on-Sea | 0 | CO | Sheffield Centre | 0 |
| SO ₂ | Stockport | 3 | CO | Sheffield Tinsley | 0 |
| SO ₂ | Stoke-on-Trent Centre | 0 | CO | Southampton Centre | 0 |
| SO ₂ | Sunderland | 5 | CO | Southend-on-Sea | 0 |
| SO ₂ | Swansea | 0 | CO | Stockport | 0 |
| SO ₂ | Thurrock | 0 | CO | Stoke-on-Trent Centre | 0 |
| SO ₂ | Wirral Tranmere | 0 | CO | Swansea | 0 |
| SO ₂ | Wolverhampton Centre | 0 | CO | Thurrock | 5 |
| | | | CO | West London | 1 |
| | | | CO | Wirral Tranmere | 0 |
| | | | CO | Wolverhampton Centre | 0 |