School of
Biomedical &
Health Sciences

Environmental
Research Group

KING'S College LONDON
University of London

UK Automatic Urban Network
London Air Quality Network Affiliated Sites

Management Report
July to September 2009

Prepared for the Department for Environment, Food and Rural Affairs (DEFRA), Scottish Executive, Welsh Assembly Government and the DoE in Northern Ireland

October 2009

Title	UK Automatic Urban Network London Air Quality Network Affiliated Sites Management Report, July to September 2009

Customer	Department for Environment, Food and Rural Affairs (DEFRA), Scottish Executive, Welsh Assembly Government and the DoE in Northern Ireland

Customer Ref	EPG 1/3/168

File Reference	ERG\Airquali\London\DEFRA\Report\2009

Report Number	KCLERG\MT\DEFRA\CMCU\Q12009

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1 Introduction

This report details the equipment performance for the AURN affiliate sites where the King's College London Environmental Research Group (ERG) is contracted as the Central Management Unit and Control Unit (CMCU) by Defra under contract number EPG 1/3/168. The report highlights issues causing data capture to fall below 90% during the period July to September 2009.

2 Routine Data Handling

The routine handling of data from the air sampling through to the dissemination of verified data to the QA/QC Unit is a multi stage process. Data is stored on site in either an external logging system or in individual, in-built analyser logging systems. This is the first stage of quality control as many loggers and analysers are capable of diagnosing faults and identifying them as non-ambient data. Data is collected every hour from each air quality monitoring site using the MONNET data handling software and transferred to an MS-SQL database. After data collection, files are placed in an import queue to await processing, in practice the processing power of the King's air quality server is such that files are processed in a matter of seconds. During this transfer process raw data is checked against algorithms to ensure data quality and data is scaled according to the last known calibration response. Both scaled and raw measurements are stored in the MS-SQL database, this ensures that data can be rescaled from the raw values if necessary.

Data is disseminated to the DDU on an hourly basis by email. Data collection calls are scheduled to complete within the first 20 minutes of each hour. This enables an email to be automatically assembled and dispatched at 27 minutes past the hour, arriving sufficiently early to update the National Air Quality Archive at 45 minutes past the hour.

Manual verification occurs twice daily, this aims to confirm valid data, record site events, identify and diagnose analyser faults.

Fifteen-minute mean measurements, including those diagnosed as non-ambient, are transferred to the QA/QC Unit at the start of each month in the format required. Data from the automatic overnight calibrations and routine LSO visits are also supplied.

2.1 Data Dissemination Performance

Between July and September 2009, ERG estimate that 97% of hourly emails arrived at the DDU to meet their timetabled requirements. Accurate figures of punctual e-mails can be obtained from the DDU.

3 Quality Control / Quality Assurance (QA/QC)

Sites affiliated to the AURN are operated in accordance with the Network Operations Manual and any additional QA/QC procedures requested. Through close liaison with the local authorities and the LSOs, the QA/QC unit is provided with unrestricted access to the monitoring sites.

3.1 QA/QC Site Audits

The QA/QC Unit (AEA) carried out routine equipment audits at the AURN affiliated sites managed by King's during the third quarter of 2009 to assess the performance of the instruments. The dates of these audits are shown in **Error! Reference source not found.**. Southwark Roadside has not been audited as the site is currently closed for relocation. Storrington was not audited as there are some remaining issues from installation that needed to be addressed.

Name	Start Date
Camden Kerbside	18/08/2009
Eastbourne	10/09/2009
Haringey Roadside	04/08/2009
Horley	03/08/2009
London Bexley	12/08/2009
London Eltham	06/08/2009
London Haringey	04/08/2009
London Harrow Background	28/09/2009
London North Kensington	13/07/2009
Marylebone Road	19/08/2009
Sandy Roadside	28/07/2009
Southwark Roadside	Closed
Stanford-le-Hope	03/09/2009
Storrington	Not audited
Tower Hamlets Roadside	19/08/2009

Table 1: Quarter 3 audit dates

4 Changes to sites affiliated to the AURN

The AURN is in the process of reorganisation due to the requirements of the EU Directive on ambient air quality and cleaner air for Europe. This resulted in the de-affiliation of several sites from the LAQN at the end of September 2007 and the affiliation of several sites from networks managed by King's. The sites identified for affiliation to the AURN and the current status of each site is shown in Table 2.

Site	Current Status
Horley	Affiliated 21/11/07
Stewartby	Affiliated 26/11/07
London Haringey (NO_X)	Affiliated 29/11/07
Stanford-Le-Hope Roadside	Affiliated 22/01/08
London Bexley ($PM_{2.5}$ FDMS)	Affiliated 25/02/08
London Eltham ($PM_{2.5}$ FDMS)	Affiliated 15/05/08
Sandy Roadside	Affiliated 28/07/08
London Bexley ($PM_{2.5}$ FDMS)	Affiliated 20/10/08
London Harrow Background ($PM_{2.5}$ FDMS)	Affiliated 16/12/08
London North Kensington ($PM_{2.5}$ FDMS)	Affiliated 17/12/08
Sandy Roadside ($PM_{2.5}$ FDMS)	Affiliated 27/01/09
Sandy Roadside (PM_{10} FDMS)	Affiliated 28/01/09
Haringey Roadside (PM_{10} FDMS)	Affiliated 18/02/09
Haringey Roadside ($PM_{2.5}$ FDMS)	Affiliated 18/02/09
Camden Kerbside (PM_{10} FDMS)	Affiliated 19/02/09
Camden Kerbside ($PM_{2.5}$ FDMS)	Affiliated 19/02/09
Marylebone Road ($PM_{2.5}$ FDMS)	Affiliated 20/03/09
Marylebone Road (PM_{10} FDMS)	Affiliated 21/03/09
London North Kensington (PM_{10} FDMS)	Affiliated 31/03/09
Stanford-Le-Hope Roadside ($PM_{2.5}$ FDMS)	Affiliated 01/04/09
Stanford-Le-Hope Roadside (PM_{10} FDMS)	Affiliated 01/04/09
Eastbourne Background	Affiliated 19/05/09
Storrington Roadside	Installed 29/07/09

Table 2: Sites managed by King's which have been identified for affiliation to the AURN

5 Quarterly Data Capture Statistics

Data capture rates for July, August and September are detailed in

SiteCode	Data Capture for July 2009					
	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2
Camden Kerbside		*2.2*		*1.2*	*1.2*	
Eastbourne				100.0	91.9	
Haringey Roadside		99.7		91.0	99.2	
Horley		99.3				
London Bexley					*87.4*	
London Eltham		99.7	99.5		97.9	
London Haringey		98.8	98.1			
London Harrow Background					*37.2*	
Marylebone Road	99.6	99.7	96.6		99.2	96.5
North Kensington	98.1	98.5	98.0	*83.6*	98.4	98.1
Sandy Roadside		93.6		96.5	99.1	
Stanford-Le-Hope Roadside		99.2		*35.4*	*75.1*	*80.8*
Tower Hamlets Roadside	97.7	99.5				

Table 3, **Error! Reference source not found.** and **Error! Reference source not found.**. The data capture for each month was calculated from valid hourly averages, after excluding data lost due to calibration and the faults discussed. The overall data capture for the quarter July to September is detailed in the

SiteCode	Data Capture for September 2009					
	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2
Camden Kerbside		99.6		98.9	98.8	
Eastbourne				97.4	98.8	
Haringey Roadside		99.3		99.6	99.7	
Horley		99.7				
London Bexley					100.0	
London Eltham		*67.5*	99.9		99.9	
London Haringey		99.4	99.4			
London Harrow Background					97.9	
Marylebone Road	91.7	95.6	95.6	*29.6*	98.9	95.6
North Kensington	95.3	96.0	95.8	95.8	96.3	95.6
Sandy Roadside				98.2	99.4	
Stanford-Le-Hope Roadside		95.7		92.4	94.2	*77.5*
Storrington Roadside				99.6	91.3	
Tower Hamlets Roadside	99.3	99.4				

Table 5: Hourly data capture for September 2009

SiteCode	Data Capture for July to September 2009					
	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2
Camden Kerbside		*40.2*		*36.1*	*47.2*	
Eastbourne				91.4	93.0	
Haringey Roadside		99.2		*85.0*	98.7	

Horley		99.5				
London Bexley					92.5	
London Eltham		*84.3*	97.4		97.6	
London Haringey		98.1	98.9			
London Harrow Background					*56.8*	
Marylebone Road	96.9	98.2	94.4	*9.7*	99.2	97.2
North Kensington	96.6	95.4	96.9	*89.3*	97.2	96.8
Sandy Roadside		*50.6*		97.6	99.1	
Stanford-Le-Hope Roadside		98.2		*65.8*	*78.7*	*86.1*
Storrington Roadside		0		*63.5*	*43.2*	
Tower Hamlets Roadside	96.2	99.1				

Table 6.

Specific issues affecting data collection and quality at each site are discussed in 5.1 to **Error! Reference source not found.**. Details of faults are specified where data capture falls below 90% for the quarter. Instruments affiliated part way through the quarter also have data capture below 90% as this was calculated as a percentage of the whole quarter rather than since the affiliation date.

SiteCode	**Data Capture for July 2009**					
	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2
Camden Kerbside		*2.2*		*1.2*	*1.2*	
Eastbourne				100.0	91.9	
Haringey Roadside		99.7		91.0	99.2	
Horley		99.3				
London Bexley					*87.4*	
London Eltham		99.7	99.5		97.9	
London Haringey		98.8	98.1			
London Harrow Background					*37.2*	
Marylebone Road	99.6	99.7	96.6		99.2	96.5
North Kensington	98.1	98.5	98.0	*83.6*	98.4	98.1
Sandy Roadside		93.6		96.5	99.1	
Stanford-Le-Hope Roadside		99.2		*35.4*	*75.1*	*80.8*
Tower Hamlets Roadside	97.7	99.5				

Table 3: Hourly data capture for July 2009

SiteCode	**Data Capture for August 2009**					
	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2
Camden Kerbside		*20.8*		*10.1*	*43.4*	
Eastbourne				*77.2*	*88.4*	
Haringey Roadside		98.7		*64.9*	97.2	
Horley		99.3				
London Bexley					90.5	
London Eltham		*85.1*	93.0		95.2	
London Haringey		96.0	99.1			
London Harrow Background					*36.4*	
Marylebone Road	99.3	99.3	91.1		99.6	99.3
North Kensington	96.2	91.7	96.8	*88.7*	96.9	96.6

Sandy Roadside		*56.7*		98.3	98.9	
Stanford-Le-Hope Roadside		99.6		*70.6*	*67.2*	99.9
Storrington Roadside				91.9	*39.9*	
Tower Hamlets Roadside	91.5	98.5				

Table 4: Hourly data capture for August 2009

SiteCode	Data Capture for September 2009					
	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2
Camden Kerbside		99.6		98.9	98.8	
Eastbourne				97.4	98.8	
Haringey Roadside		99.3		99.6	99.7	
Horley		99.7				
London Bexley					100.0	
London Eltham		*67.5*	99.9		99.9	
London Haringey		99.4	99.4			
London Harrow Background					97.9	
Marylebone Road	91.7	95.6	95.6	*29.6*	98.9	95.6
North Kensington	95.3	96.0	95.8	95.8	96.3	95.6
Sandy Roadside				98.2	99.4	
Stanford-Le-Hope Roadside		95.7		92.4	94.2	*77.5*
Storrington Roadside				99.6	91.3	
Tower Hamlets Roadside	99.3	99.4				

Table 5: Hourly data capture for September 2009

SiteCode	Data Capture for July to September 2009					
	CO	NO_2	O_3	PM_{10}	$PM_{2.5}$	SO_2
Camden Kerbside		*40.2*		*36.1*	*47.2*	
Eastbourne				91.4	93.0	
Haringey Roadside		99.2		*85.0*	98.7	
Horley		99.5				
London Bexley					92.5	
London Eltham		*84.3*	97.4		97.6	
London Haringey		98.1	98.9			
London Harrow Background					*56.8*	
Marylebone Road	96.9	98.2	94.4	*9.7*	99.2	97.2
North Kensington	96.6	95.4	96.9	*89.3*	97.2	96.8
Sandy Roadside		*50.6*		97.6	99.1	
Stanford-Le-Hope Roadside		98.2		*65.8*	*78.7*	*86.1*
Storrington Roadside		0		*63.5*	*43.2*	
Tower Hamlets Roadside	96.2	99.1				

Table 6: Hourly data capture for July to September 2009

5.1 Camden Kerbside Nitrogen Dioxide — 40.2%

1st to 7th July 2009 — *137 Hours*

As reported in the Management Report for Quarter 2 of 2009, the air conditioning unit developed a fault on 24th May and eventually failed. The nitrogen dioxide analyser was showing a fault related to the elevated cabin temperatures.

7h July to 17th August 2009 *576 Hours*

The analyser was turned off due to the continuing high cabin temperatures.

The ESU attended for the air conditioning fault on 9th July. The unit was assessed to be beyond economic repair.

The ESU made arrangements with the Local Authority to purchase a replacement air conditioning unit. Due to the cost and time required to source a new unit this was installed on 17th August and the analysers were switched back on.

17th to 18th August *23 Hours*

After the analyser was switched back on, it was not possible to collect any data. This was due to the analyser having the wrong date and time which was corrected by the QAQC unit when they attended for audit on 18th August.

18th to 25th August *167 Hours*

Following the visit by the ESU for a fault on the PM_{10} FDMS on 19th August, the NOX analyser became unresponsive, first giving measurements around the value of the instrument baseline and the measurements then stopped completely. The ESU returned to investigate the issue and carry out the service on 24th August but this did not resolve the fault. On 25th August an LSO from King's ERG went to site and found the analyser had the wrong date which was then corrected and the measurements resumed.

Further measurements had to be excluded prior to start of the fault on 19th August due to the fact that no calibration had been carried out after the instrument was switched on so there were no scaling factors available for these measurements. There were no overnight calibrations at the time and particularly taking into account the very low scaling factor recorded pre service, it was not considered that there was enough information to reliably back-apply this scaling factor to the time when instrument was switched on.

5.2 Camden Kerbside PM_{10} 36.1%

1st July to 17th August *1137 Hours*

As described in section 5.2 there was a fault with the air conditioning unit which required a new unit to be purchased and installed. This resulted in temperature errors being flagged by the FDMS and for some time the instrument was switched off. The instrument was switched back on after the air conditioning replacement on 17th August.

17th to 18th August 2009 *25 Hours*

The measurements from the instrument came back very elevated after it was switched on. The QAQC unit attended for the audit on 18th August, following which the measurements were no longer so elevated. The audit also found a leak on the instrument.

18th to 28th August 2009 *248 Hours*

The ESU attended to repair the leak on the instrument on 19th August. However, the measurements remained noisy and unstable after the repair so another callout was issued on 24th August. The ESU attended for the callout and service on 24th August.

The readings remained noisy and unstable after the service. An LSO from King's ERG attended site on 25th August where the purge filter was found to be incorrectly installed. The purge filter was reinstalled which resolved the noisy and unstable readings. However, the volatile measurement was still not matching well with other sites so the ESU was asked to return to site which they did on 28th August, following which the measurements were much improved.

5.3 Camden Kerbside $PM_{2.5}$ 47.2%

1st July to 17th August *1134 Hours*

As described in section 5.2 there was a fault with the air conditioning unit which required a new unit to be purchased and installed. This resulted in the FDMS instrument flagging errors and for some time being turned off. After being switched back on the instrument took some time to settle.

18th August *19 Hours*

Following the service, the measurements from the instrument took some time to settle. Measurements were excluded until they matched with other sites.

5.4 Haringey Roadside PM_{10} 85%

29th July to 11th August *326 Hours*

The measurements from the instrument became noisy and erratic. The LSO attended on 30th July to change the filters but this did not resolve the fault. A callout was issued to the ESU on 3rd August. The QAQC unit attended for the audit on 4th August where they found a large leak. It is unclear whether this related to the existing fault which will be an issue for the QAQC unit to consider at ratification.

The ESU attended for a preliminary investigation on 6th August, following which there was a problem with data collection. The ESU were due to return on 7th August but were unable to gain access. The ESU attended again on 11th August to change the V seal and calibrate the flow. However, this did not resolve the data collection problem. When the LSO attended for a routine calibration visit on 13th August the instrument was found in the wrong communications mode. The missing data was collected when the mode was changed but the measurements prior to the ESU visit on 11th August had to be excluded.

5.5 London Eltham Nitrogen Dioxide 84.3%

28th August to 10th September *324 Hours*

It was noted on 8th September that the measurements from the analyser appeared to be repeating. The start of the fault was traced to 28th August. The instrument was not flagging any errors during this time. A callout was issued to the ESU on 8th September. The ESU attended on 10th September where it was found that there was a dirty bearing on the chopper motor. Following this the measurements returned to normal.

5.6 London Harrow Background 56.8%

4th to 7th July *64 Hours*

The instrument flagged an error due to elevated cabin temperatures. The LSO attended to check the air conditioning which temporarily resolved the fault.

11th to 18th July *166 Hours*

The cabin temperature again became elevated causing a temperature fault on the FDMS. The LSO was unable to adjust the air conditioning to improve matters so the instruments were turned off on 16th July and switched on when an engineer attended on 17th July. Some additional measurements were excluded until 18th July as the FDMS took some time to recover after being switched on.

23rd July to 18th August *611 Hours*

The fault with the air conditioning resumed on 23rd July. The FDMS again flagged temperature errors. The LSO arranged for an engineer to attend but the air conditioning unit required parts to be ordered. The parts arrived and the unit was repaired on 18th August.

18th to 19th August *24 Hours*

The volatile readings were not matching well with other sites after the air conditioning repair. Measurements were excluded until matching other sites

19th to 20th August *26 Hours*

There was an intermittent dryer fault flagged on the FDMS. The ESU replaced the pump on 21st August after which the fault did not reoccur.

5.7 Marylebone Road PM_{10} **9.7%**

1st July to 14th September *1814 Hours*

Following comparison with the VCM corrected TEOM data from this site, there were concerns that the PM_{10} measurements from the FDMS were under-reading. This was traced back to the middle of May. A callout was issued to the ESU on 3rd September. The ESU attended on 4th September but this did not appear to resolve the fault. A new callout was issued on 11th September. The ESU attended on 14th September after which the measurements compared better to the VCM corrected TEOM measurements. The measurements have been set for review, with the final decision to be made by the QAQC unit.

23rd September to 6th October *335 Hours*

After a filter change by the LSO the measurements again became low. The LSO attended to change the filters again on 7th October after which the measurements were improved.

5.8 North Kensington PM_{10} **89.3%**

1st to 3rd July *35 Hours*

Following the filter change on 1st July, the volatile measurements were not matching well with other sites. Measurements were excluded until the instrument settled.

14th to 15th July *19 Hours*

The volatile measurements became too negative after a filter change and the non-volatile measurements were also low. Measurements were excluded until matching other sites.

29th July to 1st August *73 Hours*

The measurements from the analyser did not settle well after a filter change on 29th July. The LSO returned to site to change the filters again on 31st July and the measurements settled by 1st August.

6th to 7th August *21 Hours*

The whole site was affected by a power cut. The power was restored by the LSO.

26th to 28th August *49 Hours*

The instrument was slow to recover after a filter change with volatile measurements not matching other sites. The LSO reseated the filter on 27th August and the measurements began to match other sites by 28th August.

2nd September *7 Hours*

The instruments were turned off for electrical testing.

5.9 Sandy Roadside Nitrogen Dioxide **50.6%**

19th August onwards *1015 Hours*

The measurements from the analyser started to over-read usually comparable sites. This appears to have started following a service by the previous site ESU. A callout was issued to the current ESU on 16th September. The ESU reset the baseline remotely on 16th September but this did not resolve the fault.

The ESU asked that the LSO carry out a calibration to check the scaling factors. This was done on 24th September but the measurements still remained elevated. The current ESU attended on 30th September but were unable to find a fault with the instrument. The ESU therefore requested that the fault be addressed by the previous ESU. This issue is still under investigation.

5.10 Stanford-Le-Hope Roadside PM_{10} **65.8%**

30th June to 10th July *230 Hours*

The instrument became stuck in the reference measurement mode. The LSO attended to reboot the analyser but this did not resolve the fault. A callout was issued to the ESU on 3rd July. The ESU

attended on 6th July to remove the analyser for repair. The instrument was returned to site on 10th July.

10th to 15th July *95 Hours*

After the instrument was returned to site, the measurements were noisy and unstable. The ESU discovered a leak which they returned to repair on 14th July. After the repair it took some time for the analyser to settle and for the measurements to match with other sites.

24th to 30th July *135 Hours*

The measurements became noisy and unstable after a filter change. A callout was issued to the ESU on 27th July. The ESU attended on 28th July. The measurements appeared to settle by 30th July

1st to 10th August *219 Hours*

The measurements became noisy and unstable again. A callout was issued on 6th August. The ESU attended on 10th August where they put in a spare TEOM sensor unit after which the measurements were much more stable.

3rd to 4th September *21 Hours*

The volatile measurements were too negative compared to other sites after a filter change. The measurements returned to normal without the need for intervention.

16th to 17th September *30 Hours*

There was a fault with the instrument after the service which the ESU returned to rectify the next day.

5.11 Stanford-Le-Hope Roadside $PM_{2.5}$ 78.7%

11th to 12th July *6 Hours*

The measurements from the analyser became noisy and erratic. This settled without any action being taken.

13th to 15th July *57 Hours*

The noisy erratic measurements returned so the ESU was called out. The instrument took some time to recover after the ESU visit but then the measurements looked better.

27th July to 10th August *332 Hours*

Both King's ERG and the LSO noted that there had been a lot of dips and spikes in the measurements and that the filter loading reading had been unstable. A callout was issued to the ESU on 27th July. The ESU attended for a service on 28th July but after this the volatile measurements were more negative than other sites and the dips and spikes continued.

Another callout was issued on 6th August which was attended on 10th August. After a few hours of the instrument settling, the measurements looked improved.

3rd to 4th September *20 Hours*

The analyser was slow to recover to a routine filter change, with the volatile measurement remaining too negative for several hours afterward. However, this returned to normal with any further intervention.

6th September *6 Hours*

There was a brief spell of noisy and erratic measurements but these returned to normal without any action being taken.

5.12 Stanford-Le-Hope Sulphur Dioxide 86.1%

30th June to 6th July *147 Hours*

There was a fault with the instrument when it was switched back on after a repair to the air conditioning unit. The ESU attended on 3rd July but found a fault with the PMT thermistor which could not be repaired. The ESU returned to site on 6th July with a replacement thermistor.

25th September onwards *132 Hours*

The analyser started flagging a PMT temperature fault on 25th September. A callout was issued on 26th September and the ESU attended on 1st October. However, it was not possible to repair the analyser at this time so it was removed to the workshop for further investigation.

5.13 Storrington Roadside Nitrogen Dioxide 0%

4th August onwards

The instrument was installed on 4th August. There were some initial problems with the data logging which were resolved on 19th August. However, no calibrations have been carried out due to a delay in the calibration gas being delivered and a problem with electrical cables at site which has been discovered since the installation.

5.14 Storrington Roadside PM_{10} 63.5%

Data collection began from the instrument on 29th July. Since this time data capture to the end of the quarter was 91.2%.

5.15 Storrington Roadside $PM_{2.5}$ 43.2%

Data collection began from the instrument on 30th July. Since this time data capture to the end of the quarter was 62.1%. Therefore faults which have led to data exclusion since installation are described as follows.

30th July to 19th August *481 Hours*

The volatile measurements were reading positive since the installation. The ESU were asked to investigate while on site for another issue on 10th August. The filters were changed but this did not resolve the fault.

A callout was issued to the ESU on 11th August. The ESU attended again on 14th August but were unable to resolve the fault. The ESU returned to site on 19th August to install a spare FDMS instrument. After this the measurements were much improved.

2nd to 4th September *39 Hours*

The measurements from the instrument became noisy and erratic. The instrument recovered without intervention

6th to 7th September *14 Hours*

The noisy erratic measurements resumed. A callout was issued to the ESU on 7th September. The instrument recovered briefly before the repair.

9th to10th September *10 Hours*

The ESU attended to investigate the intermittently noisy and erratic measurements. They tightened some loose fittings at the back of the analyser and after a period of recovery, the measurements matched well with other sites.

6 Contact Information

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Day-to-day operational issues can be directed to the ERG Duty Officer by telephone on 020 7848 4022 or by Email on airquality@erg.kcl.ac.uk