

Nitrogen Dioxide Diffusion Tube Survey Annual Report 2011

London Borough of Ealing





Kathryn Mellor Graduate Environmental Scientist Checked by:

Govell Clips

Dr Gareth Collins Technical Director

Approved by:

Prepared by:

Michele Hackman

Technical Director

Nitrogen Dioxide Diffusion Tube Survey Annual Report 2011

London Borough of Ealing

Rev	Comments	Checked	Approved	Date
No		by	by	
1	Draft Report	GMC	MPH	Apr 2012
2	Draft Final Report	GMC	MPH	July 2012

9th & 10th Floors, Sunley House, 4 Bedford Park, CR0 2AP Telephone: 020 8639 3500 Website: http://www.aecom.com

Job No 60145337 Reference v.04.12 Date Created July 2012

This document has been prepared by AECOM Limited for the sole use of our client (the "Client") and in accordance with generally accepted consultancy principles, the budget for fees and the terms of reference agreed between AECOM Limited and the Client. Any information provided by third parties and referred to herein has not been checked or verified by AECOM Limited, unless otherwise expressly stated in the document. No third party may rely upon this document without the prior and express written agreement of AECOM Limited.

Table of Contents

Executive Summary1				
1	Introd	uction	2	
	1.1	Overview	2	
	1.2	Legislation and Policy Background	2	
0	Matha	de le mu		
2		Dreadures and Site Changes	4	
	2.1	Tube Dreparation Apply and OA/OC	4	
	2.2	Factors Affecting Diffusion Tube Derformance	4	
	2.3	Data Validation	5 5	
	2.4	Site Details	5	
	2.5		0	
3	Resul	ts	7	
	3.1	Data Capture	7	
	3.2	Bias Adjustment	7	
	3.3	Annual Mean NO ₂ Concentrations	8	
	3.4	Comparison with Objectives	8	
	3.5	Variation with Height	9	
	3.6	Seasonal Variation	. 10	
	3.7	Historical Trends in NO ₂	. 10	
4	Concl	usions and Recommendations	. 12	
Appen	dix A:	Diffusion Tube Sites Details	.13	
Appen	dix B:	Bias Adjustment Calculations	.27	
• •				
Table	1:	UK and EU Air Quality Objectives for NO ₂ and NO _x	3	
Table 2	2:	Laboratory Summary Performance for WASP Rounds R112-115	4	
Table :	3:	Site Type Designation Criteria, based on AEAT Practical Guidance	6	
Table 4	4:	Data Capture Rates, Ealing Diffusion Tube Network, 2006 – 2011	7	
Table	5:	Summary of Continuous Monitoring Data and Local Bias Adjustment Factors, 2011	7	
Table	6:	Summary of National Bias Adjustment Factors, 2011	8	
Table	7:	Annual Mean NO ₂ Concentrations in Ealing, 2011	8	
Table	8:	Sites Exceeding Annual Mean NO ₂ Objective, 2011	9	
Table	9:	Sites With Bias Adjusted Annual Mean NO ₂ Greater Than 60 µg/m ³ , 2011	9	
Table	10:	Annual Mean NO ₂ Concentrations in Ealing, 2011	.10	
Table	11:	Monthly Mean Raw NO ₂ Concentrations in Ealing, 2011	.10	
lable	12:	Raw Winter and Summer Period Mean Concentrations in Ealing, 2011	.10	
Table	13:	Ealing Diffusion Tube Network Monitoring Site Details, 2010	.14	
I able	14:	National Blas Adjustment Factor Calculation, Roadside and Kerbside Sites	.31	
Table	15:	National Blas Adjustment Factor Calculation, Near-Road Sites	.32	
I able	16:	National Blas Adjustment Factor Calculation, Urban Background Sites	.32	
Figure	1:	Historic NO ₂ Diffusion Tube Concentrations (Annual Mean, Uncorrected) in the London Borough of Ealing	. 11	

Figure 2:	Monitoring Sites in Ealing – Northolt and Greenford	
Figure 3:	Monitoring Sites in Ealing – Southall and Hanwell	
Figure 4:	Monitoring Sites in Ealing – Ealing Town and Haven Green	23
Figure 5:	Monitoring Sites in Ealing – South Ealing	24
Figure 6:	Monitoring Sites in Ealing - Acton Town and Surrounding Area	25
Figure 7:	Monitoring Sites in Ealing – North Acton and Park Royal	26
Figure 8:	Local Bias Adjustment Factor Calculation, Ealing Town Hall	
Figure 9:	Local Bias Adjustment Factor Calculation, Acton Town Hall	29
Figure 10:	Local Bias Adjustment Factor Calculation, Southall (Blair Peach School)	

Executive Summary

The London Borough of Ealing Diffusion Tube Network was established several years ago to provide insight into the spatial and temporal variation of nitrogen dioxide (NO_2) concentrations throughout the Borough. The network in 2011 was comprised of 126 tubes across 99, including several long-term monitoring sites, and supplements continuous monitoring activities undertaken at several locations within the Borough.

This report provides an analysis of the data collected during the 2011 monitoring period, running from the week commencing 4^{th} January 2011 to the week commencing 3^{rd} January 2012. The bias adjusted annual mean NO₂ concentrations are presented along with the raw monthly results and details of the bias adjustment calculation. The final results have been compared with the annual mean NO₂ objective to indicate areas of exceedence. A comparison is drawn with historical NO₂ concentration data from the network to look for evidence of long-term trends and significant changes in pollutant levels at specific locations.

A number of monitoring sites in 2011 were relocated to provide a better representation of receptors at these locations. For more details see Appendix A. Good data capture was achieved across the network with 116 tubes having greater than 90% data capture and a further 9 tube sites having greater than 75%. All sites are classified according to the Practical Guidance for Diffusion Tube Monitoring. All sites are categorised as either "kerbside", "roadside", "near-road", or "urban background".

The highest recorded annual mean NO₂ concentration was measured at by the single tube site at Fernlea House, Hangar Lane (93.6 μ g/m³). In total 68 tube sites in the survey were found to exceed the annual mean NO₂ objective and 20 tube sites were determined to be likely to exceed the hourly objective.

1 Introduction

1.1 Overview

AECOM was commissioned in December 2009 to manage and maintain the operation of the London Borough of Ealing nitrogen dioxide diffusion tube monitoring network. The network covers 99 sites throughout the Borough, providing information on the spatial and temporal variation in NO₂ concentrations in the area. The diffusion tube network supplements data collected at six continuous monitoring stations within the Borough providing high-resolution real-time measurements of NO₂ concentrations. These sites are located at Horn Lane, Hangar Lane Gyratory, Acton Town Hall, Ealing Town Hall, Blair Peach School (Southall) and Western Avenue.

This report covers the 2011 diffusion tube monitoring period from January to December 2011. It describes details of bias adjustment of the raw diffusion tube results, reports upon the annual mean concentrations and analyses the spatial and temporal variations at locations in the Borough.

1.2 Legislation and Policy Background

Limit values and air quality objectives for nitrogen dioxide and oxides of nitrogen (NO_x) were set out in the First Daughter Directive (1999/30/EC) and subsequent revisions. An annual mean NO₂ objective was set at 40 μ g/m³ to be achieved by 1st January 2010. A 200 μ g/m³ hourly mean standard not to be exceeded more than 18 hours per year was also outlined, to be achieved by the same compliance date. These objectives were reiterated in the 2008 Directive on ambient air quality and cleaner air for Europe (2008/50/EC).

The UK published its own Air Quality Strategy, which detailed the UK's position on nitrogen dioxide. The UK air quality objectives differ from the European objectives only in their compliance dates; the UK objectives were to be achieved by the end of 2005. European and UK air quality objectives have also been set for oxides of nitrogen for the protection of vegetation and ecosystems. A summary of the principal air quality objectives for NO_2 and NO_x is given in Table 1.

Table 1: UK and EU Air Quality Objectives for NO2 and NO3

	l	JK Air Quality Objectives				
Pollutant	Standard / Concentration	Measured as	Date to be achieved by and maintained thereafter			
Nitrogen Dioxide	200 μg/m ³ not to be exceeded more than 18 times a year	1 Hour Mean	31.12.2005			
	40 μg/m ³	Annual Mean				
Nitrogen Oxides (for the protection of vegetation)	30 μg/m ³	Annual Mean	31.12.2000			
	E	U Air Quality Objectives	ality Objectives			
	Standard / Concentration	Measured as	Date to be achieved by and maintained thereafter			
Nitrogen Dioxide	200 μg/m ³ not to be exceeded more than 18 times per year	1 Hour Mean	1 January 2010			
	40 μg/m³	Annual Mean				
Nitrogen Oxides (assuming as nitrogen	30 μg/m³	Annual Mean	19 July 2001			

2 Methodology

2.1 Procedures and Site Changes

At the beginning of 2011 the Ealing Diffusion Tube Network covered a total of 99 sites distributed throughout the Borough. In January, February, March and April 2011, some monitoring sites were relocated to better represent receptors around the monitoring location (more details about which monitoring sites were relocated are provided in Appendix A). The total number of tubes deployed is 126.

Triplicate tubes are deployed at 13 sites with single tubes being deployed at the remaining sites. Of the triplicate sites, six are co-located with continuous analysers. At Wendover Court, Western Avenue, four tubes are installed, one on each floor of the building, to monitor the variation in NO_2 with height.

Tubes were collected and replaced every four to five weeks in accordance with the UK Diffusion Tube Calendar¹. All tubes were stored in a refrigerator prior to deployment and after. Any tubes exposed outside of the time frame dictated by the calendar have been removed from the dataset. Tubes subject to contamination (e.g. spider webs, foreign bodies, etc.) or vandalised have also been excluded from the final dataset.

2.2 Tube Preparation, Analysis and QA/QC

The diffusion tubes were supplied and analysed by Gradko International Ltd. To maintain consistency with previous monitoring the preparation method used was 20% v/v triethanolamine in water. Gradko International Ltd. participate in the Health and Safety Laboratory's Workplace Analysis Scheme for Proficiency (WASP) scheme, which provides a Quality Assurance / Quality Control framework for local authorities carrying out diffusion tube monitoring as a part of their local air quality management process. This scheme is based on a z-score system where if 95% of the laboratory results occur within the $z_{score} < \pm 2$ for each WASP round, then this is deemed a satisfactory laboratory result. If this percentage is substantially lower than 95% then one can conclude that the laboratory in question may have significant systematic sources of bias in their assay and the results are questionable or unsatisfactory. Table 2 shows Gradko International Ltd. summary performance for WASP NO₂ PT rounds R112 – R115 which cover the 2011 monitoring period. The performance summary shows that Gradko International Ltd. has earned 100% ratings from January to September 2011 which corresponds with a 'Good' rating via the old WASP scheme. However, results obtained in October to December 2011 should be dealt with caution as the laboratory performance is 'questionable'².

WASP Round	WASP R112	WASP R113	WASP R1114	WASP R115
Round conducted in the period	Jan-March 2011	April-June 2011	July – Sept 2011	Oct – Dec 2011
Gradko International	100%	100%	100%	37.5%

Table 2: Laboratory Summary Performance for WASP Rounds R112-115

2.3 Factors Affecting Diffusion Tube Performance

 NO_2 diffusion tubes are an indicative monitoring technique, as they do not offer the same accuracy as the reference method for NO_2 , the automatic chemiluminescence analyser. NO_2 diffusion tubes are affected by several factors, which may cause them to exhibit bias relative to the reference technique.

² WASP – Annual Performance Criteria for NO₂ Diffusion Tubes used in Local Air Quality Management (LAQM), 2007 onwards, and Summary of Laboratory Performance in Rounds 108-115. April 2012. Available from http://lagm.defra.gov.uk/diffusion-tubes/ga-gc-framework.html

¹ UK Diffusion Tube Calendar 2011. Details of exposure dates and tube changeover dates available from <u>http://www.airquality.co.uk</u> .

Over-estimation may be attributed to one of the three interfering factors:

- The shortening of the diffusive path length caused by the wind
- The blocking of UV light resulting in reduced NO₂ photolysis in the tube
- The interference effects of peroxyacetyl nitrate (PAN).

Under-estimation can be caused by the following factors:

- Increasing exposure period. This is thought to be due to degradation of the absorbed nitrate with time
- Insufficient extraction of nitrite from the meshes.
- The photochemical degradation of the triethanolamine-nitrite complex by light. This has been minimised by the use of opaque end-caps.
- The solution used. For example, 50% v/v solution of TEA in water has been reported to lead to comparatively reduced NO₂ uptake.

There are a number of additional factors that may also affect diffusion tube performance including time of the year, the exposure setting (i.e. sheltered or open sites), the proximity to roads, the preparation method and analytical laboratory used, the exposure concentration and the ratio of NO_2 to NO_x .

2.4 Data Validation

Validation of diffusion tube readings is vital to ensure public confidence in the measurements produced. Validation is achieved through comparison of diffusion tube readings co-located alongside a continuous monitor. The comparison of the NO₂ concentration as measured by the diffusion tube with the continuous monitor measurement is used to derive a bias adjustment factor. Bias adjustment factors can also be obtained using the Nitrogen Dioxide Diffusion Tube Bias Adjustment spreadsheet ³, which is updated periodically and collates the bias-adjustment factors obtained in co-location studies conducted nationally.

There are six operational continuous NO_2 monitoring sites within the Borough which are affiliated to the London Air Quality Network (LAQN). Co-location studies were conducted at five of the six sites for the whole of 2011. Co-location at Ealing Horn Lane commenced in February 2011 due to lack of data in January 2011. The results of the co-location studies have been used to derive a local bias adjustment factor to correct the raw diffusion tube measurements.

2.5 Site Details

2.5.1 Locations

Single and triplicate tubes are positioned at 99 locations throughout the Borough at locations representing kerbside, roadside, near road (intermediate) and urban background sites and, where possible, to be in locations of relevant exposure. See section 2.5.2 for details of site designations. The tube locations, along with a full list of period mean raw and bias adjusted NO₂ concentrations are listed in Appendix A.

2.5.2 Site Designations

The designation of site types was used to compare different locations statistically. Sites were categorised as kerbside, roadside, near road (intermediate) and urban background sites according to the definitions given in the "Practical Guidance for Diffusion Tube Monitoring" ⁴ report. These definitions are reproduced in Table 3 below. Site type designations are included in the site details in Appendix A.

³ Spreadsheet of Combined Bias Adjustment Factors. Available for download from <u>http://laqm1.defra.gov.uk/review/tools/no2/baf-national.php</u>.

⁴ AEAT (2008). Diffusion Tubes for Ambient NO₂ Monitoring: Practical Guidance. Report to Defra & the Devolved Administrations. Report Ref: AEAT/ENV/R/2504

Site Type	Definition
Kerbside	Within 1 m of the kerb.
Roadside	Between 1 m and 5 m from the kerb.
Near Road	More than 5 m from kerb of a nearby busy road but air quality is likely to be affected by the busy road.
Urban Background	 >50 m from any major NO₂ source, e.g. multi-storey car parks; >30 m from any very busy road (>30,000 vehicles per day); >20 m from any busy road (10,000 - 30,000 vehicles per day) >10 m from any main road (quiet roads in residential estates are acceptable); >5m from any area where vehicles are likely to be idling.

Table 3: Site Type Designation Criteria, based on AEAT Practical Guidance 4

3 Results

3.1 Data Capture

Data capture for the whole network in 2011 was very good (97.4%) and is summarised in Table 4. Good data capture (greater than 90%) was achieved at 116 of the 126 tube sites (90 out of 99 locations). Tubes located at the 3rd floor and ground floor of Wendover Court suffered from few thefts, resulting in 75% and 66.7% data capture, respectively. The average data capture for this site was 81.3%.

Tubes located at Bond Street, Kirn Road, Castle Road and Beech Haven Residential Care Home achieved 75% data capture. Moreover, two months of data were lost at sites located in High Street, Little Elms Meadow, Brent Road and middle of Haven Green leading to less than 90% data capture.

Cite Turne	Data Capture (%)					
Site Type	2006	2007	2008	2009	2010	2011
All Sites	96.1	93.4	91.4	93.7	95.7	97.4
Roadside / Kerbside	96.5	96.4	94.7	96.0	94.3	97.8
Near Roadside	98.8	95.9	90.9	94.3	96.8	96.0
Urban Background	90.1	87.5	86.1	89.6	97.2	99.1

Table 4: Data Capture Rates, Ealing Diffusion Tube Network, 2006 – 2011

3.2 Bias Adjustment

The results of the three co-location studies were used to calculate a local bias adjustment factor (Ealing Town Hall, Acton Town Hall and Blair Peach School, Southall). Data from Western Avenue and Horn Lane were excluded due to insufficient data capture. The triplicate tubes at Hangar Lane are not strictly co-located with the continuous monitor and so this comparison was also excluded.

The AEA Diffusion Tube Precision Accuracy Bias Spreadsheet ⁵ tool was used to calculate bias adjustment factors for each co-location site. Continuous monitoring data was sourced from the London Air Quality Network (LAQN) website ⁶. It should be noted that the continuous monitoring data used in the bias adjustment calculations has not been ratified for the entirety of 2011 and may therefore be subject to change (see Table 3 and associated footnotes). Further details can be found in Appendix B.

Table 5: Summary of Continuous Monitoring Data and Local Bias Adjustment Factors, 2011

Site Name	Site Type	Annual Mean NO ₂ Concentration (μg/m ³)	Data Capture (%)	Bias Adjustment Factor
Ealing Town Hall	Near Roadside	42.1	100.0	1.23
Acton Town Hall	Roadside / Kerbside	50.9	100.0	1.05
Southall (Blair Peach School)	Urban Background	29.3	100.0	0.96

Notes: Data from Ealing Town Hall and Acton Town Hall ratified to 01/02/2011; Data from Southall ratified to 02/02/2011

⁵ AEA Diffusion Tube Precision Accuracy Bias Spreadsheet. Downloaded from <u>http://laqm.defra.gov.uk/diffusion-tubes/diffusion-tubes.html</u> 23/04/2012.

⁶ London Air Quality Network Website: <u>http://www.londonair.org.uk</u> accessed 23/04/2012.

Bias adjustment factors were also sourced from the national Spreadsheet of Combined Bias Adjustment Factors ⁷ for comparison purposes. However, due to the acceptable data capture in the local co-location studies, the local bias adjustment factors in Table 5 have been applied to all of the raw diffusion tube data according to the site type designation.

Table 6: Summary of National Bias Adjustment Factors, 2011

Site Type Designation	Number of Studies	Bias Adjustment Factor
Roadside & Kerbside	21	0.89
Near Road (Urban Centre)	1	1.12
Urban Background	3	0.87

Note: Figures taken from Spreadsheet of Combined Bias Adjustment Factors (Version 03.2012). Inputs used: Analysed by Gradko International Ltd; Method – 20% TEA in Water; Year – 2012.

3.3 Annual Mean NO₂ Concentrations

Bias adjusted annual mean NO₂ concentrations during 2011 were highest at the roadside sites (57.0 μ g/m³). Mean near road site concentrations were lower (52.6 μ g/m³). There are no sites classified as kerbside sites. The lowest concentrations, as expected, were recorded at the Urban Background sites (32.1 μ g/m³). The bias adjusted annual mean NO₂ concentration across the entire network was 49.9 μ g/m³. A summary of the bias adjusted results is presented in Table 7.

The 2011 results indicate that the annual mean NO₂ objective of 40 μ g/m³ continues to be exceeded throughout the Borough of Ealing, particularly at roadside locations. In keeping with historical trends, the highest annual mean concentration was recorded at Fernlea House, Hangar Lane (93.6 μ g/m³; Site 81, Appendix A). The mean NO₂ concentration across the entire network in 2011 was 0.4 μ g/m³ lower than in 2010.

Table 7: Annual Mean NO2 Concentrations in Ealing, 2011

Site Type	Bias Adjusted Annual Mean NO ₂ Concentration (μg/m ³)	Data Capture (%)
Roadside	57.0	97.8
Near Road	52.6	96.0
Urban Background	32.1	99.1
All Sites	49.9	97.4

3.4 Comparison with Objectives

As reported in Section 3.3, the annual mean NO_2 concentration for the whole of the Ealing diffusion tube network exceeded the annual mean NO_2 objective during 2011. Table 8 shows the number of sites exceeding the annual mean NO_2 objective. Sites with data capture rates of 75% and below have been excluded.

⁷ Spreadsheet of Diffusion Tube Bias Adjustment Factors Version 03.12. Downloaded from <u>http://laqm.defra.gov.uk/bias-adjustment-factors/national-bias.html</u> on 23/04/2012.

Table 8: Sites Exceeding Annual Mean NO2 Objective, 2011

Site Type Designation	Total Number of Sites	Number of Sites Exceeding Objective
Kerbside	0	N/A
Roadside	52	35
Near Road	46	32
Urban Background	28	1
All Sites	126	68

It has been suggested in LAQM.TG(09) that sites where annual mean NO₂ concentrations are higher than 60 μ g/m³ it is likely that the hourly exceedences NO₂ objective (hourly mean NO₂ concentration of 200 μ g/m³ not to be exceeded on more than 18 occasions per year) may also be exceeded. A total of 20 sites in Ealing measured bias adjusted annual mean NO₂ concentrations greater than 60 μ g/m³ and therefore have the potential to breach the short-term objective. These are listed in Table 9.

Table 9: Sites With Bias Adjusted Annual Mean NO₂ Greater Than 60 µg/m³, 2011

Site Name / Location	Bias Adjusted Annual Mean NO₂ Concentration (μg/m³)
Wendover Court, Western Avenue, W3, 4th Floor*	70.2
Wendover Court, Western Avenue, W3, 2 nd Floor	72.0
Wendover Court, Western Avenue, W3, 1 st Floor	69.5
Wendover Court, Western Avenue, W3, Ground Floor*	67.2
25 Waverley Gardens, North Circular Road, Park Royal	66.6
205 Old Oak Common Lane, W3	65.0
Dexters, 182 High Street, Acton, W3	69.8
Opposite 8 Broadway Buildings, Ealing, W5	71.8
55 King Street, Southall, UB2 4DQ	65.6
143 Church Road, Northolt, UB5	67.8
11 Uxbridge Road, Southall, UB1	67.0
53 Old Oak Common Lane	63.7
2 Horsenden Lane South, Greenford, UB6	64.2
6 Western Avenue	72.9
98 Western Avenue	62.4
Fernlea House, Hanger Lane (tri) - Façade	81.6
Fernlea House, Hanger Lane - Lampost	93.6
Ealing Western Avenue AQMS, W3 OPL (Tri)	77.4
326 Western Avenue, Acton	75.8
Middle of Haven Green*	65.4
Sinton Andrews Estate Agent, 8 Spring Bridge Road	74.4
Montague Lambert Solicitors, 41-42 Haven Green	63.0

* Data capture less than 90%

3.5 Variation with Height

At Wendover Court, Western Avenue diffusion tubes are exposed on each floor of the four-storey building allowing the change in NO_2 concentration with height to be investigated. The bias adjusted results are presented in Table 10. It should be noted that there are no valid results for the top floor site for January, February and April, due to theft of the tubes, resulting in data capture of 75%, and for the tube located on the ground floor from September to December inclusive due to theft of the tubes,

resulting in data capture of 66.7%. Therefore the data must be viewed with caution. However, these results indicate that there is no obvious decrease in NO_2 concentrations with height.

Site Type	Bias Adjusted Annual Mean NO ₂ Concentration (μg/m ³)	Data Capture (%)
Mean – All Floors	69.7	81.3
Top Floor	70.2	75.0
2 nd Floor	72.0	91.7
1 st Floor	69.5	91.7
Ground Floor	67.2	66.7

Table 10:	Annual Mean	NO ₂ Concenti	rations in	Ealing.	2011
				,	

3.6 Seasonal Variation

The seasonal variation in NO_2 concentrations during 2011 are shown in Table 11. Due to seasonal variations in the bias adjustment that can occur at diffusion tube sites the results that have been presented are the raw concentrations with no bias adjustment applied.

Table 11: Monthly Mean Raw NO2 Concentrations in Ealing, 2011

Site Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Roadside	54.2	43.2	49.0	50.9	37.7	42.3	37.0	44.9	43.7	51.7	52.7	43.9
Near-Road	46.4	42.3	46.0	46.7	34.4	39.1	33.4	42.2	40.2	47.1	51.7	42.2
Urban Background	38.2	32.1	40.8	36.4	24.5	28.3	25.0	31.0	31.8	39.4	40.4	33.8
All	47.8	43.2	49.0	50.9	37.7	42.3	37.0	44.9	43.7	51.7	52.7	43.9

Table 12:	Raw Winter and Summer Period Mean Conc	entrations in Ealing, 2011
-----------	--	----------------------------

Site Type	Winter Mean Concentration (Jan – Mar, Oct – Dec) (μg/m³)	Summer Mean Concentration (Apr – Sep) (μg/m³)	Ratio Winter : Summer
Roadside	49.1	42.7	1.05
Near-Road	45.9	39.3	1.17
Urban Background	37.4	29.5	1.27
All	48.0	42.7	1.12

Considering all site types in the network, the highest monthly mean NO₂ concentrations were measured in November followed by October. July and May displayed the lowest monthly mean NO₂ concentrations. In all cases the winter mean NO₂ concentrations (Jan – Mar and Oct – Dec) were higher than summer mean concentrations (Apr – Sep). The ratio of winter to summer mean concentrations ranged from 1.05 for roadside site types to 1.27 for urban background sites. For all sites collectively the ratio of winter to summer mean NO₂ concentration was 1.12.

3.7 Historical Trends in NO₂

The annual mean NO₂ concentrations since 2005 at 11 long-term monitoring locations in Ealing are shown in Figure 1. The results displayed are uncorrected for bias due to the change in the monitoring

period in 2008 from April – March to January – December. Despite the results showing year to year variations there are few discernible upward or downward trends over time in uncorrected annual mean concentrations at any of the long-term sites.

At sites 54 - 56, Ealing Town Hall annual mean NO₂ concentrations increased from 2007 to 2009 before falling again in 2010 to approximately the 2007 level. The NO₂ results for 2011 looks stable compared to the 2010 concentration. At site 49, 143 Church Road Northolt NO₂ concentrations show some evidence of a reduction since 2007. The annual mean NO₂ concentration at site 58, Bond Street peaked in 2007 and has since fallen to concentrations similar to those observed in 2006, with a slightly increase in 2011 compared to the previous year.



Figure 1: Historic NO₂ Diffusion Tube Concentrations (Annual Mean, Uncorrected) in the London Borough of Ealing

4 Conclusions and Recommendations

The main conclusions of the 2011 Ealing Diffusion Tube Survey are as follows:

- The annual mean NO₂ concentration for all sites in the network was 49.9 μ g/m³. This represents a slight decrease of 0.4 μ g/m³ relative to 2010.
- Roadside sites showed the highest annual mean NO₂ concentration (57.0 μ g/m³) followed by near road sites (52.6 μ g/m³). This is consistent with 2010. However, annual mean concentrations in 2011 were higher than 2010 (Roadside 56.8 μ g/m³ and near road sites 49.2 μ g/m³). The annual men concentration at urban background sites have decreased in 2011 relative to 2010;
- The annual mean NO₂ objective of 40 μg/m³ was exceeded at 70 sites;
- The maximum annual mean NO₂ concentration was 93.6 μg/m³, recorded at Fernlea House, Hangar Lane (Site 98);
- 20 sites recorded annual mean NO₂ concentrations of greater than 60 μ g/m³ making it likely that the hourly objective for NO₂ may have been exceeded at these locations;
- Good data capture (greater than 90%) was achieved at 90 out of 99 locations;
- Winter mean concentrations were higher than summer mean concentrations at all sites in the network. The ratio of winter to summer concentrations was 1.12 for all sites.

On the basis of the findings of the 2011 survey the following recommendations are suggested:

- Continue the present level of monitoring within the Borough, in particular the long-term monitoring sites in order to preserve and continue historical trends

During the 2011 survey the following actions were taken as a result of theft.

- Relocation of the tubes at the top floor and ground floor of Wendover Court, Western Avenue to reduce the incidence of tube theft.

Appendix A: Diffusion Tube Sites Details

Table 13: Ealing Diffusion Tube Network Monitoring Site Details, 2010

				Annual M	ean NO ₂ Cond	entration	
Site Number	Site Name	Site Designation	Grid Reference (X,Y)	Raw (μg/m³)	Local Bias Adjusted (µg/m³)	National Bias Adjusted (μg/m ³)	Data Capture (%)
1	39 Old Oak Lane, NW10 6EJ	R	521587,182684	53.4	56.1	47.7	100.0
2 ^(a)	99 Wells House Road, NW10 6EA	UB	521224,181913	38.3	36.8	33.5	100.0
3 ^(a)	36 Wales Farm Road, W3 6UE	R	520724,181552	47.9	50.3	42.8	100.0
4	5 Leamington Park, Acton, W3 6TJ	R	520532,181517	47.9	50.3	42.8	100.0
5 ^(a)	92 Long Drive, Acton W3 7PH	UB	521139,181436	37.9	36.4	33.1	100.0
6	Wendover Court, Western Avenue, W3 - 3rd Floor	N	519997,182178	57.1	70.2	64.0	75.0
7	Wendover Court, Western Avenue, W3 - 2nd Floor	N	519997,182178	58.5	72.0	65.6	91.7
8	Wendover Court, Western Avenue, W3 - 1st Floor	N	519997,182178	56.5	69.5	63.3	91.7
9	Wendover Court, Western Avenue, W3 - Ground Floor	N	519997,182178	54.6	67.2	61.2	66.7
10 ^(a)	25 Waverley Gardens, North Circular Road, Park Royal, NW10 7EE	N	518600,182979	54.2	66.6	60.7	100.0
11 ^(b)	6 Brentmead Gardens, NW10 7DS	UB	518976,182963	35.9	34.4	31.3	100.0
12 ^(a)	3 Iveagh Terrace, NW10 7SY	Ν	519142,183399	43.9	54.0	49.2	100.0
13	57-75 Old Oak Common Lane (PO)	R	521557,180996	52.5	55.2	47.0	100.0
14 ^(b)	4 St Andrews Road, W3	R	512138,180953	42.9	45.0	38.3	100.0
15 ^(b)	205 Old Oak Common Lane, W3	R	521614,180852	58.9	61.8	52.6	100.0
16 ^(b)	205 Old Oak Common Lane, W3	R	521614,180852	62.0	65.1	55.4	100.0
17 ^(b)	205 Old Oak Common Lane, W3	R	521614,180852	64.8	68.1	58.0	91.7

				Annual M	lean NO ₂ Cond	centration	
Site Number	Site Name	Site Designation	Grid Reference (X,Y)	Raw (μg/m³)	Local Bias Adjusted (µg/m³)	National Bias Adjusted (μg/m ³)	Data Capture (%)
18 ^(a)	East Acton Primary School, East Acton Lane, W3 7HA	N	521093,180613	39.8	49.0	44.6	100.0
19 ^(b)	17, The Vale	R	521720,180084	49.4	51.9	44.2	100.0
20 ^(a)	177A The Vale, W3 7RD	R	521088,180046	49.5	52.0	44.3	100.0
21	Maples Nursery, East Churchfield Road, W3	UB	520754,180316	35.6	34.2	31.1	100.0
22 ^(a)	16 Lantry Court, Lexden Road, Acton, W3 9PE	UB	519849,180485	30.1	28.9	26.3	100.0
23 ^(a)	Dexters, 182 High Street, Acton, W3	R	520026,180141	66.5	69.8	59.5	83.3
24	Acton Health Centre, Church Road, Acton, W3	N	520128,180016	32.5	39.9	36.4	100.0
25 ^(a)	Acton Care Centre, 48 Gunnersbury Lane, W3 8EG	N	519562,179977	36.5	44.9	41.0	100.0
26	Horn Lane Surgery, 156 Horn Lane, W3	R	520180,180896	45.9	48.2	41.1	91.7
27	1-4 Peal Gardens, W13 OBA	R	516089,182400	38.3	40.2	34.2	100.0
28 (^{a)}	19 Runnymede Gardens, UB6 8SX	R	515240,183102	42.7	44.9	38.2	100.0
29	14 Blenheim Close (off Western Avenue)	Ν	514866,183116	39.4	48.5	44.2	100.0
30	205 Windmill Lane, Greenford	Ν	514259,182234	40.4	49.7	45.3	100.0
31 ^(a)	Greenford High School, Lady Margaret Road, Southall, UB1 2GU	Ν	513158,182600	34.6	42.5	38.7	100.0
32 ^(b)	2 Shadwell Drive, Northolt, UB5	UB	512603,182837	32.5	31.2	28.4	100.0
33 ^(a)	Northolt Library, Church Road, UB5	R	512089,183545	41.3	43.3	36.9	100.0
34 ^(a)	213 Church Road, Northolt, UB5 5BE	UB	512442,183769	44.7	42.9	39.0	100.0
35 ^(a)	West London Academy, Compton Crescent, UB5	UB	512168,183907	34.6	33.2	30.2	100.0
36	Opposite 8 Broadway Buildings, Ealing, W5	R	517887,180914	68.4	71.8	61.1	100.0

		Annual Mean NO ₂ Concentration					
Site Number	Site Name	Site Designation	Grid Reference (X,Y)	Raw (μg/m³)	Local Bias Adjusted (µg/m³)	National Bias Adjusted (μg/m ³)	Data Capture (%)
37 ^(a)	124 Gunnersbury Lane, W3 9BA	N	519404,179620	37.6	46.3	42.2	100.0
38	Hanwell Nursery, 25A Laurel Gardens, W7	N	515242,180158	47.3	58.2	53.0	100.0
39 ^(b)	Ealing Hospital, Uxbridge Road	UB	514740,179876	28.2	27.1	24.6	100.0
40	Hobbayne First School, Greenford Avenue, W7	UB	515477,181081	32.9	31.6	28.7	100.0
41 ^(a)	1 Shaftesbury Gardens, Park Royal, NW10 6LJ	R	512206,180522	41.5	43.6	37.1	100.0
42	Hambrough Primary and Nursery School, South Road	N	512673,180069	46.6	57.3	52.2	100.0
43	Hambrough Primary and Nursery School, South Road	N	512673,180069	47.2	58.1	52.9	100.0
44	Hambrough Primary and Nursery School, South Road	N	512673,180069	47.8	58.7	53.5	100.0
45	2-4 Merrick Road, Southall, UB2	N	512657,179712	42.5	52.3	47.6	100.0
46 ^(a)	Perivale Wood, r/o 36-38 Sunley Gardens	UB	516160,183582	27.8	26.7	24.3	100.0
47 ^(a)	Perivale Wood, Little Elms Meadow	UB	515855,183597	26.5	25.4	23.1	83.3
48 ^(a)	55 King Street, Southall, UB2 4DQ	R	512341,179186	62.5	65.6	55.8	100.0
49	143 Church Road, Northolt, UB5	R	512690,183983	64.6	67.8	57.7	100.0
50 ^(a)	Jubilee Gardens Library, Jubilee Gardens, UB1	UB	513263,181526	35.6	34.1	31.0	100.0
51	Brent Lodge, Church Road, W7	UB	514740,180643	26.9	25.8	23.5	100.0
52	Health Centre, Netheravon Road, W7	N	515680,180360	35.5	43.7	39.8	100.0
53	11 Uxbridge Road, Southall, UB1	R	512768,180400	63.8	67.0	57.1	100.0
54	Ealing Town Hall, New Broadway, W5	N	517534,180737	42.0	51.6	47.1	100.0
55	Ealing Town Hall, New Broadway, W5	N	517534,180737	42.0	51.7	47.1	100.0

				Annual M			
Site Number	Site Name	Site Designation	Grid Reference (X,Y)	Raw (μg/m³)	Local Bias Adjusted (µg/m³)	National Bias Adjusted (μg/m ³)	Data Capture (%)
56	Ealing Town Hall, New Broadway, W5	N	517534,180737	42.2	51.9	47.3	100.0
57	Perceval House, 14/16 Uxbridge Road, W5	N	517440,180677	40.3	49.5	45.1	91.7
58	14/16 Bond Street, Ealing, W5	R	517644,180613	56.3	59.1	50.3	75.0
59	South Ealing Cemetery	UB	517750,178860	29.8	28.6	26.0	100.0
60	Acton Town Hall, High Street, Acton, W3 6NE	R	520306,180055	52.6	55.2	47.0	100.0
61	Acton Town Hall, High Street, Acton, W3 6NE	R	520306,180055	50.5	53.1	45.2	100.0
62	Acton Town Hall, High Street, Acton, W3 6NE	R	520306,180055	49.6	52.1	44.3	100.0
63 ^(b)	85 St Pauls Close, W5 3JX	UB	518594,179848	28.7	27.6	25.1	91.7
64 ^(a)	44 Acton Lane, W4 5ED	R	520480,178854	41.2	43.3	36.8	100.0
65	Clayponds Hospital and Day Treatment Centre, Sterling Place	UB	518153,178709	31.1	29.8	27.1	100.0
66	53 Old Oak Common Lane	R	521573,180932	60.7	63.7	54.3	100.0
67 ^(a)	16 Balfour Road, W13	UB	516703,179728	28.9	27.8	25.3	100.0
68 ^(d)	1 Kirn Road, Ealing W13 0UB	R	516699,180509	51.4	54.0	46.0	75.0
69	St David's Home, 12 Castlebar Hill, W5	UB	516992,181698	32.6	31.3	28.4	100.0
70 ^(d)	4 Thirlmere Avenue, Perivale, UB6 8EF	UB	517072,182912	38.0	36.5	33.1622	100.0
71	2 Horsenden Lane South, Greenford, UB6	R	516368,182978	61.1	64.2	54.6	100.0
72 ^(b)	64 Hanger Lane,Ealing,W2 2JH	N	518635,181288	44.5	54.7	49.8	91.7
73 ^(a)	Oldfield Primary School, Oldfield Lane North, Greenford	UB	514722,183345	39.2	37.6	34.2	100.0
74 ^(a)	Oldfield Primary School, Oldfield Lane North, Greenford	UB	514722,183345	39.3	37.7	34.3	100.0

				Annual M	ean NO ₂ Cond	centration	
Site Number	Site Name	Site Designation	Grid Reference (X,Y)	Raw (μg/m³)	Local Bias Adjusted (µg/m³)	National Bias Adjusted (μg/m ³)	Data Capture (%)
75 ^(a)	Oldfield Primary School, Oldfield Lane North, Greenford	UB	514722,183345	40.5	38.8	35.3	100.0
76 ^(d)	1504 Greenford Road, Greenford, UB6 0HR	Ν	515402,185313	42.3	52.1	47.4	91.7
77 ^(a)	79 Whitton Avenue East, Greenford, UB6 0QD	R	516867,184689	29.9	31.4	26.8	100.0
78	126 Petts Hill, Northolt,	Ν	513794,185348	39.5	48.6	44.3	100.0
79 ^(b)	169 Castle Road, Northolt, UB5 4SG	N	514125,184562	31.4	38.6	35.2	75.0
80 ^(b)	4 Minterne Avenue, Southall,UB2 4LL	N	513606,178917	29.8	36.6	33.4	100.0
81 ^(a)	Featherstone Primary School, Western Road, Southall, UB2 5JT	N	511475,178899	44.6	54.9	50.0	100.0
82 ^(a)	Featherstone Primary School, Western Road, Southall, UB2 5JT	N	511475,178899	45.0	55.3	50.4	100.0
83 ^(a)	Featherstone Primary School, Western Road, Southall, UB2 5JT	N	511475,178899	44.4	54.6	49.8	100.0
84 ^(b)	150 Brent Road, Southall, UB2	R	511170,179251	42.3	44.4	37.8	83.3
85	6 Boston Gardens Hanwell, W7	Ν	516277,178882	36.6	45.0	41.0	100.0
86 ^(b)	255 Boston Road, W7 2AT	N	516080,179318	33.2	40.9	37.2	91.7
87	7 Greenford Avenue, Southall	N	512753,180478	38.3	47.1	42.9	91.7
88 ^(b)	Oakley House, Oakley Avenue, W5 3SB	N	519167,180915	33.1	40.7	37.1	100.0
89 ^(a)	Belmont Health Centre, 18 Western Road, Southall, UB2 5DU	R	512181,179219	38.1	40.0	34.1	100.0
90	6 Western Avenue	R	521549,180923	69.5	72.9	62.1	100.0
91 ^(c)	Martin's Court, Southbridge Way, Southall	Ν	512560,179739	41.7	51.3	46.8	100.0
92	98 Western Avenue,	N	521173,180981	50.7	62.4	56.9	100.0
93	171 Old Oak Road	R	521646,180800	45.9	48.2	41.0	100.0

				Annual M	lean NO ₂ Cond	centration	
Site Number	Site Name	Site Designation	Grid Reference (X,Y)	Raw (μg/m³)	Local Bias Adjusted (µg/m³)	National Bias Adjusted (μg/m ³)	Data Capture (%)
94	Southfields First and Middle School	UB	521200,179500	33.5	32.1	29.2	100.0
95	Fernlea House, Hanger Lane (tri)	R	518541,182707	76.1	79.9	68.0	100.0
96	Fernlea House, Hanger Lane (tri)	R	518541,182707	79.5	83.5	71.1	100.0
97	Fernlea House, Hanger Lane (tri)	R	518541,182707	77.5	81.3	69.3	100.0
98	Fernlea House, Hanger Lane	R	518540,182700	89.2	93.6	79.7	100.0
99	27 Wells House Road	UB	521305,181966	39.3	37.8	34.3	100.0
100	94 North Acton Road	N	520780,182775	39.3	48.4	44.1	100.0
101	914 Greenford Road (Bennetts Avenue)	R	514985,183770	41.3	43.3	36.9	100.0
102	Blair Peach School, Beaconsfield Road	UB	511680,180071	30.4	29.2	26.5	100.0
103	Blair Peach School, Beaconsfield Road	UB	511680,180071	28.4	27.2	24.8	100.0
104	Blair Peach School, Beaconsfield Road	UB	511680,180071	29.0	27.8	25.3	100.0
105	The Straight, Southall, UB1	N	512514,179795	41.4	50.9	46.4	100.0
106	The Straight, Southall, UB1	N	512514,179795	42.0	51.6	47.0	100.0
107	The Straight, Southall, UB1	N	512514,179795	41.5	51.1	46.6	100.0
108 ^(a)	41 Manor Road, W13 OJA	R	516387,180738	35.2	37.0	31.5	100.0
109 ^(a)	41 Manor Road, W13 OJA	R	516387,180738	35.4	37.2	31.6	100.0
110 ^(a)	41 Manor Road, W13 OJA	R	516387,180738	33.4	35.1	29.9	100.0
111	Ealing Horn Lane AQMS (Tri)	R	520432,181428	53.3	56.0	47.6	100.0
112	Ealing Horn Lane AQMS (Tri)	R	520432,181428	58.8	61.7	52.6	100.0

	Site Name	Site Designation	Grid Reference (X,Y)	Annual M			
Site Number				Raw (μg/m³)	Local Bias Adjusted (µg/m³)	National Bias Adjusted (μg/m ³)	Data Capture (%)
113	Ealing Horn Lane AQMS (Tri)	R	520432,181428	56.1	58.9	50.1	100.0
114	Ealing Western Avenue AQMS, W3 OPL (Tri)	R	520430,181950	76.8	80.6	68.7	100.0
115	Ealing Western Avenue AQMS, W3 OPL (Tri)	R	520430,181950	72.6	76.2	64.9	100.0
116	Ealing Western Avenue AQMS, W3 OPL (Tri)	R	520430,181950	71.9	75.5	64.3	100.0
117	326 Western Avenue, Acton, W3 0PL	N	520426,181958	61.7	75.8	69.1	100.0
118	21 Haven Lane, W5 2HZ	R	518022,181114	40.9	42.9	36.6	100.0
119 ^(a)	Gordon Road / Spring Bridge Rd.	R	517718,180944	45.1	47.3	40.3	91.7
120 ^(b)	Middle of Haven Green	N	517834,181000	53.2	65.4	59.6	83.3
121 ^(b)	27 Haven Green, W5 2NZ	N	517940,181092	39.1	48.1	43.8	100.0
122 ^(b)	31 Castlebar Road, W5 2DJ	R	517472,181088	37.6	39.4	33.6	100.0
123 ^(a)	Beech Haven Residential Care Home	N	517578,180917	35.7	43.9	40.0	75.0
124	Haven Green Court, Haven Green, Ealing, W5 2UZ	N	517803,181082	39.0	48.0	43.7	100.0
125	Sinton Andrews Estate Agent, 8 Spring Bridge Road, London W5 2AA	R	517745,180827	70.8	74.4	63.3	91.7
126 ^(a)	Montague Lambert Solicitors, 41-42 Haven Green, London, W5 2NX	R	517909,180971	60.0	63.0	53.6	100.0

Notes:

^(a) New for January 2011; ^(b) New for February 2011; ^(c) New for March 2011; ^(d) New for April 2011. Cells highlighted in green: triplicate diffusion tubes co-located with AQMS. Cells highlighted in blue: sites located at Wendover Court, Western Avenue as part of the NO₂ study with height.

Cells highlighted in yellow: other triplicate diffusion tube sites.

Figure 2: Monitoring Sites in Ealing – Northolt and Greenford



Figure 3: Monitoring Sites in Ealing – Southall and Hanwell



Figure 4: Monitoring Sites in Ealing – Ealing Town and Haven Green



Figure 5: Monitoring Sites in Ealing – South Ealing



Figure 6: Monitoring Sites in Ealing – Acton Town and Surrounding Area



Figure 7: Monitoring Sites in Ealing – North Acton and Park Royal



Appendix B: Bias Adjustment Calculations

Figure 8: Local Bias Adjustment Factor Calculation, Ealing Town Hall

Ch	Checking Precision and Accuracy of Triplicate Tubes													
			Diff	usion Tu	bes Mea	surements	3				Automat	tic Method	Data Quali	ty Check
Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 μgm ⁻³	Tube 2 μgm ⁻³	Tube 3 µgm ^{•3}	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean		Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
1	07/01/2011	01/02/2011	43.3	37.2	39.4	40	3.1	8	7.7		54.3	99.5	Good	Good
2	01/02/2011	01/03/2011	47.6	45.6	40.1	44	3.9	9	9.7		53.8	98.8	Good	Good
3	01/03/2011	29/03/2011	39.1	56.8	53.3	50	9.4	19	23.3		69.6	59.5	Good	or Data Captur
4	29/03/2011	27/04/2011	49.1	47.1	48.9	48	1.1	2	2.7		62.6	79.3	Good	Good
5	27/04/2011	02/06/2011	34.0	31.6	34.8	33	1.6	5	4.1		41.6	95.3	Good	Good
6	02/06/2011	29/06/2011	40.2	41.0	39.5	40	0.7	2	1.8		38.9	97.4	Good	Good
7	29/06/2011	03/08/2011	35.8	36.3	36.5	36	0.3	1	0.8		45.0	98.5	Good	Good
8	03/08/2011	02/09/2011	38.6	36.2	34.3	36	2.1	6	5.3		41.4	98.9	Good	Good
9	02/09/2011	29/09/2011	40.7	39.2	42.4	41	1.6	4	4.0		43.8	99.5	Good	Good
10	29/09/2011	01/11/2011	43.3	46.2	43.5	44	1.6	4	4.0		64.3	99.6	Good	Good
11	01/11/2011	28/11/2011	48.9	46.9	51.3	49	2.2	5	5.5		69.2	99.4	Good	Good
12	28/11/2011	05/01/2012	43.4	39.9	42.3	42	1.8	4	4.4		44.3	99.8	Good	Good
13														
lt is n	ecessary to hav	e results for at l	east two tu	ibes in orde	er to calcul	ate the precisi	on of the meas	surements			Overal	l survey>	Good precision	Good Overall DC
Site	Name/ ID:	Ea	aling Tov	vn Hall			Precision	12 out of 1	2 periods h	ave a C	V smaller t	han 20%	(Check average	CV & DC from
	Accuracy	(with 9	5% con	fidence	interval)		Accuracy	(with 9	5% confi	idence	interval)		Accuracy ca	lculations)
	without pe	riods with C	V larger	than 20	%		WITH ALL	DATA			í.	50%	1	
	Bias calcula	ated using 1	1 period	s of data			Bias calcu	lated using 1	1 periods	s of dat	ta	8		
	В	ias factor A	1.23	(1.13 - 1	.35)			Bias factor A	1.23	(1.13 -	1.35)	se 25%		
		Bias B	-19%	(-26% -	-11%)			Bias B	-19%	(-26%	11%)	a 0%		
	Diffusion T	uboo Moon:	44				Diffusion	Tuboo Moon:	44	uam-3		E .	Without-CV>20%	With all data
	Dimusion Tubes Mean: 41 µgm						Moon C	(Dresision)	41	µgm		-25%	-	
	viean Cv	(Frecision).	4				wear ov	(Frecision).	4			E con		
Automatic Mean: 51 μgm ⁻³ Data Capture for periods used: 97%							Automatic Mean: 51 µgm ⁻³					□ -50%		
	Adjusted T	ubes Mean:	51 (4	7 - 56)	µgm ⁻³	3	Adjusted Tubes Mean: 51 (47 - 56) µgm ⁻³ Jaume Targa, fo						ga, for AEA	
												Ver	sion 04 - Feb	ruary 2011

Figure 9: Local Bias Adjustment Factor Calculation, Acton Town Hall

Checking Precision and Accuracy of Triplicate Tubes

Checking Precision and Accuracy of Triplicate Tubes														
			Diffu	usion Tu	bes Mea	surements	5				Automa	tic Method	Data Quali	ity Che
Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 μgm ⁻³	Tube 2 μgm ⁻³	Tube 3 μgm ⁻³	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean		Period Mean	Data Capture (% DC)	Tubes Precision Check	Auton Mon Da
1	07/01/2011	01/02/2011	54.3	44.2	55.3	51	6.1	12	15.3		54.3	99.8	Good	Go
2	01/02/2011	01/03/2011	61.9	52.8	48.1	54	7.0	13	17.5		53.8	99.0	Good	Goo
3	01/03/2011	29/03/2011	52.9	60.0	41.6	51	9.3	18	23.0		69.6	99.6	Good	Goo
4	29/03/2011	27/04/2011	51.5	50.6	52.6	52	1.0	2	2.4		62.6	99.1	Good	Goo
5	27/04/2011	02/06/2011	41.2	43.5	41.2	42	1.3	3	3.3		41.6	99.7	Good	Goo
6	02/06/2011	29/06/2011	44.2	45.7	43.8	45	1.0	2	2.6		38.9	82.7	Good	Goo
7	29/06/2011	03/08/2011	43.2	40.6	44.4	43	1.9	5	4.8		45.0	99.8	Good	Goo
8	03/08/2011	02/09/2011	49.5	49.4	53.1	51	2.1	4	5.2		41.4	72.2	Good	or Data
9	02/09/2011	29/09/2011	44.7	46.5	51.2	47	3.4	7	8.4		43.8	99.4	Good	Goo
10	29/09/2011	01/11/2011	81.5	67.1	60.2	70	10.9	16	27.1		64.3	99.1	Good	Goo
11	01/11/2011	28/11/2011	68.7	64.5	62.1	65	3.4	5	8.4		69.2	99.7	Good	Goo
12	28/11/2011	05/01/2012	37.7	41.4	41.7	40	2.2	5	5.5		44.3	85.9	Good	Goo
13	3													
It is	necessary to have	to reculte for at	loast two ti	thes in orde	ar to calcul	ato the procisi	ion of the measure	uromonte					Cood	Cov

Precision

Accuracy WITH ALL DA

18	23.0		69.6	99.6	Good	Good
2	2.4		62.6	99.1	Good	Good
3	3.3		41.6	99.7	Good	Good
2	2.6		38.9	82.7	Good	Good
5	4.8		45.0	99.8	Good	Good
4	5.2		41.4	72.2	Good	or Data Capture
7	8.4		43.8	99.4	Good	Good
16	27.1		64.3	99.1	Good	Good
5	8.4		69.2	99.7	Good	Good
5	5.5		44.3	85.9	Good	Good
ents			Overa	ll survey>	Good precision	Good Overall DC
2 out of 1	2 periods h	nave a C ¹	V smaller t	han 20%	(Check average Accuracy ca	CV & DC from alculations)
A			,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	50%	1	
d using '	11 period	s of dat	a	m • 25%		
factor A	1.05	(0.97 -	1.14)	Bia		
Bias B	-5%	(-13%	- 3%)	- a 0%	I I I I I I I I I I I I I I I I I I I	T
s Mean:	51	µgm ⁻³		Lug -25%	Without CV>20%	With all data
ecision):	8		والمتعادية وسيناد	Lis I		
c Mean:	53	µgm ⁻³		a -50%		
e for peri	ods used:	97%				

Data Quality Check

Jaume Targa, for AEA

Version 04 - February 2011

Automatic

Monitor

Data

Good

Good

It is necessary to have results for at least two tubes in order to calculate the precision of the measurem

Sit	e Name/ ID:	Ac	Acton Town Hall							
	Accuracy	(with 98	5% conf	idence i	interval)					
	without pe	riods with C	/ larger	than 20	%					
	Bias calcula	s of data	a							
	В	ias factor A	1.05	(0.97 - 1	1.14)					
		Bias B	-5%	(-13% -	- 3%)					
	Diffusion To	ubes Mean:	51	µgm ⁻³						
	Mean CV	(Precision)	8							
	Autor	natic Mean:	53	µgm ⁻³						
	Data Capi	ture for period	ls used:	97%						
	Adjusted To	ubes Mean:	53 (49	9 - 58)	µgm ⁻³					

Bias calculated using 11	period	s of da	ta
Bias factor A	1.05	(0.97 -	1.14)
Bias B	-5%	(-13%	- 3%)
Diffusion Tubes Mean:	51	µgm ⁻³	3
Mean CV (Precision):	8		
Automatic Mean:	53	µgm ⁻³	}
Data Capture for perior	ds used:	97%	
Adjusted Tubes Mean:	53 (49	- 58)	µgm ⁻³

29

Figure 10: Local Bias Adjustment Factor Calculation, Southall (Blair Peach School)

Ch	Checking Precision and Accuracy of Triplicate Tubes														
			Diffu	usion Tu	bes Mea	surements	;				Automat	ic Method	Data Quali	ty Check	
Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 μgm ⁻³	Tube 2 μgm ⁻³	Tube 3 µgm ⁻³	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean		Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data	
1	07/01/2011	01/02/2011	35.9	35.2	33.4	35	1.3	4	3.3		36.7	100.0	Good	Good	
2	01/02/2011	01/03/2011	35.3	35.8	34.0	35	0.9	3	2.2		34.5	99.4	Good	Good	
3	01/03/2011	29/03/2011	39.3	38.9	33.4	37	3.3	9	8.2		45.8	99.7	Good	Good	
4	29/03/2011	27/04/2011	36.9	27.4	35.0	33	5.0	15	12.4		35.4	100.0	Good	Good	
5	27/04/2011	02/06/2011	22.2	17.4	19.5	20	2.4	12	6.0		16.2	94.1	Good	Good	
6	02/06/2011	29/06/2011	25.5	22.0	24.9	24	1.9	8	4.7		16.3	99.8	Good	Good	
7	29/06/2011	03/08/2011	19.0	18.6	18.6	19	0.2	1	0.6		16.1	99.8	Good	Good	
8	03/08/2011	02/09/2011	26.4	27.1	25.5	26	0.8	3	2.0		19.7	99.0	Good	Good	
9	02/09/2011	29/09/2011	27.9	27.4	27.6	28	0.2	1	0.5		23.0	100.0	Good	Good	
10	29/09/2011	01/11/2011	31.9	30.4	31.3	31	0.7	2	1.8		25.6	99.9	Good	Good	
11	01/11/2011	28/11/2011	32.1	30.0	36.1	33	3.1	9	7.7		36.8	99.1	Good	Good	
12	28/11/2011	05/01/2012	32.4	30.1	28.8	30	1.8	6	4.5		30.1	99.9	Good	Good	
13															
lt is n	ecessary to hav	e results for at l	least two tu	ibes in ord	er to calcul	ate the precisi	on of the meas	surements		6.	Overal	survey>	Good precision	Good Overall DC	
Site	Name/ ID:		South	all			Precision 12 out of 12 periods have a CV smaller					than 20% (Check average CV & DC from			
Accuracy (with 95% confidence interval) without periods with CV larger than 20% Bias calculated using 12 periods of data Bias factor A 0.96 (0.85 - 1.09) Bias B 4% (-8% - 17%) Diffusion Tubes Mean: 29 µgm ⁻³ Mean CV (Precision): 6 Automatic Mean: 28 µgm ⁻³ Data Capture for periods used: 99%							Accuracy WITH ALL Bias calcu Diffusion Mean CV Auto Data Ca	(with 9 DATA Ilated using 1 Bias factor A Bias B Tubes Mean: ((Precision): matic Mean: pture for perio	2 periods 0.96 (4% (29 6 28 0ds used:	dence c of dat: (0.85 - 1 (-8% - 1 μgm ⁻³ 99%	interval) a 1.09) 7%)	50% B 25% office Bias office B	Accuracy ca	With all data	
	Adjusted Tu	ubes Mean:	28 (2	5 - 32)	µgm⁻°		Adjusted	Tubes Mean:	28 (25	- 32)	µgm [™]	Ver	Jaume Tar sion 04 - Feb	ga, for AEA ruary 2011	

Table 14: National Bias Adjustment Factor Calculation, Roadside and Kerbside Sites

Analysed By ¹	Method	Site Type	Local Authority	Length of Study (months)	Diffusion Tube Mean Conc. (Dm) (μg/m ³)	Automatic Monitor Mean Conc. (Cm) (μg/m ³)	Bias (B)	Tube Precision ⁶	Bias Adj Factor (A) (Cm/Dm)
Gradko	20% TEA in Water	R	Scarborough Borough Council	12	35	37	-4.7%	G	1.05
Gradko	20% TEA in Water	R	Dudley MBC	12	35	28	23.3%	G	0.81
Gradko	20% TEA in Water	R	Dudley MBC	11	45	40	11.8%	G	0.89
Gradko	20% TEA in Water	K	South Lakeland District Council	10	41	38	8.3%	G	0.92
Gradko	20% TEA in Water	R	Gedling Borough Council	11	43	35	24.5%	G	0.80
Gradko	20% TEA in Water	R	Gateshead	12	39	37	4.9%	Р	0.95
Gradko	20% TEA in Water	R	Gateshead	12	37	36	1.8%	G	0.98
Gradko	20% TEA in Water	R	Gateshead	10	33	31	5.1%	G	0.95
Gradko	20% TEA in Water	R	Gosport Borough Council	10	28	25	11.1%	G	0.90
Gradko	20% TEA in Water	R	Dudley MBC	9	50	51	-1.5%	G	1.02
Gradko	20% TEA in Water	К	Marylebone Road Intercomparison	12	111	100	11.4%	G	0.90
Gradko	20% TEA in Water	R	Boston Borough Council	11	57	36	59.6%	Р	0.63
Gradko	20% TEA in Water	R	Exeter City Council	11	37	33	15.1%	S	0.87
Gradko	20% TEA in Water	R	Bromsgrove District Council (Worcester Regulatory Services)	10	56	53	6.0%	G	0.94
Gradko	20% TEA in Water	R	Monmouthshire County Council	11	47	40	17.9%	S	0.85
Gradko	20% TEA in Water	К	New Forest District Council	10	49	42	16.7%	G	0.86
Gradko	20% TEA in Water	R	New Forest District Council	12	34	26	29.9%	G	0.77
Gradko	20% TEA in Water	R	Fareham Borough Council	12	39	33	17.4%	G	0.85
Gradko	20% TEA in Water	R	Rushcliffe BC	11	35	39	-9.5%	G	1.10
Gradko	20% TEA in Water	R	Carlisle City Council	12	35	28	24.8%	G	0.80
Gradko	20% TEA in Water	0	North Warwickshire Borough Council	12	48	39	23.0%	G	0.81
Gradko	20% TEA in Water	R	Wokingham Borough Council	11	41	38	8.6%	G	0.92
								Average	0.89

Table 15: National Bias Adjustment Factor Calculation, Near-Road Sites

Analysed By ¹	Method	Site Type	Local Authority	Length of Study (months)	Diffusion Tube Mean Conc. (Dm) (μg/m ³)	Automatic Monitor Mean Conc. (Cm) (μg/m ³)	Bias (B)	Tube Precision	Bias Adjustment Factor (A) (Cm/Dm)
Gradko	20% TEA in Water	UC	Southampton City Council	12	31	35	-10.8%	G	1.12
								Average	1.12

Table 16: National Bias Adjustment Factor Calculation, Urban Background Sites

Analysed By ¹	Method	Site Type	Local Authority	Length of Study (months)	Diffusion Tube Mean Conc. (Dm) (μg/m ³)	Automatic Monitor Mean Conc. (Cm) (μg/m³)	Bias (B)	Tube Precision ⁶	Bias Adjustment Factor (A) (Cm/Dm)
Gradko	20% TEA in Water	UB	Dudley MBC	12	28	25	10.0%	G	0.91
Gradko	20% TEA in Water	UB	Luton Borough Council	11	39	35	11.1%	G	0.90
Gradko	20% TEA in Water	UB	Belfast City Council	12	36	29	23.5%	G	0.81
								Average	0.87