2015 Updating and Screening Assessment for

The London Borough of Richmond upon Thames

In fulfillment of Part IV of the
Environment Act 1995
Local Air Quality Management

June, 2015

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Executive Summary

The London Borough of Richmond upon Thames is committed to improving air quality in the Borough. As such the Council is demonstrating its political leadership; taking action; leading by example; monitoring air quality; using the planning system; integrating air quality into the public health system; and informing the public. This 2015 Updating and Screening Assessment fulfils one further aspect of this ongoing commitment.

This 2015 Updating and Screening Assessment for Richmond upon Thames reviews and assesses air quality against the objectives in the Air Quality Regulations 2000 and amendment regulations. The air quality objectives to be assessed by local authorities are for the following seven pollutants: carbon monoxide, benzene, 1,3-butadiene, lead, nitrogen dioxide, sulphur dioxide and particles (PM_{10}).

The role of the Review and Assessment process is to identify any relevant areas in the Borough where it is considered that the government's air quality objectives for the above air pollutants will be exceeded. The Council has previously undertaken the earlier rounds of Review and Assessment of local air quality management and identified areas where some of the objectives are exceeded and declared the whole borough an Air Quality Management Area (AQMA), for the pollutants nitrogen dioxide (NO_2) and PM_{10} particulates.

This report concerns the sixth round Updating and Screening Assessment of air quality. For this, pollution sources have been re-examined and recent air quality monitoring checked in the Borough in accordance with Defra LAQM guidance.

The report identifies that:

For carbon monoxide, benzene, 1,3-butadiene, lead and sulphur dioxide there is not a significant risk of the objectives being exceeded in the Council's area.

However for nitrogen dioxide and particles (specifically PM_{10}) the Council has previously designated an AQMA across the Borough. The findings from this report indicate that the AQMA should be maintained.

In view of the findings from the report the Council will undertake the following actions:

1. Undertake consultation with the statutory and other consultees as required.
2. Maintain the existing monitoring programme.
3. Continue with the implementation of its Air Quality Action Plan in pursuit of the AQS objectives.
4. Prepare for the submission of its next Air Quality report.

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1 Introduction

1.1 Description of Local Authority Area

Richmond upon Thames is situated in the southwest of Outer London. The Borough covers 57.41km^2 and approximately half is open space; including Richmond Park, Kew Gardens, Bushy Park and Old Deer Park. The other main land use is residential use and businesses, consisting mainly retail and professional services. The Borough is also home to a number of attractions: Kew Gardens, Hampton Court Palace, Twickenham Stadium and the WWT London Wetlands Centre. The estimated 2013 population was 191,365 (from the Office of National Statistics (ONS)).

The main sources of atmospheric pollutants are road transport. The principal roads through the Borough include the A316, A308, plus the A305, A306 and A307. Heathrow airport lies around 5km to the west of the western edge of the Borough.

1.2 Purpose of Report

This report fulfils the requirements of the Local Air Quality Management process as set out in Part IV of the Environment Act (1995), the Air Quality Strategy for England, Scotland, Wales and Northern Ireland 2007 and the relevant Policy and Technical Guidance documents. The LAQM process places an obligation on all local authorities to regularly review and assess air quality in their areas, and to determine whether or not the air quality objectives are likely to be achieved. Where exceedences are considered likely, the local authority must then declare an Air Quality Management Area (AQMA) and prepare an Air Quality Action Plan (AQAP) setting out the measures it intends to put in place in pursuit of the objectives.

The objective of this Updating and Screening Assessment is to identify any matters that have changed which may lead to risk of an air quality objective being exceeded. A checklist approach and screening tools are used to identify significant new sources or changes and whether there is a need for a Detailed Assessment. The USA report

should provide an update of any outstanding information requested previously in Review and Assessment reports.

1.3 Air Quality Objectives

The air quality objectives applicable to LAQM **in England** are set out in the Air Quality (England) Regulations 2000 (SI 928), The Air Quality (England) (Amendment) Regulations 2002 (SI 3043), and are shown in Table 1A. This table shows the objectives in units of micrograms per cubic metre µg m^{-3} (milligrammes per cubic metre, mg m^{-3} for carbon monoxide) with the number of exceedences in each year that are permitted (where applicable).

Table 1A Air Quality Objectives included in Regulations for the purpose of LAQM in England

Pollutant	Air Quality Objective		Date to be achieved by
	Concentration	Measured as	
Benzene	16.25 µg m^{-3}	Running annual mean	31.12.2003
	5.00 µg m^{-3}	Running annual mean	31.12.2010
1,3-Butadiene	2.25 µg m^{-3}	Running annual mean	31.12.2003
Carbon monoxide	10.0 mg m^{-3}	Running 8-hour mean	31.12.2003
Lead	0.5 µg m^{-3}	Annual mean	31.12.2004
	0.25 µg m^{-3}	Annual mean	31.12.2008
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	31.12.2005
Particles (PM_{10})	50 µg m^{-3}, not to be	24-hour mean	31.12.2004

(gravimetric)	exceeded more than 35 times a year		
	40 µg m^{-3}	Annual mean	31.12.2004
Sulphur dioxide	350 µg m^{-3}, not to be exceeded more than 24 times a year	1-hour mean	31.12.2004
	125 µg m^{-3}, not to be exceeded more than 3 times a year	24-hour mean	31.12.2004
	266 µg m^{-3}, not to be exceeded more than 35 times a year	15-minute mean	31.12.2005

Table 1B details other air quality objectives in England that are in addition to those set for the purpose of LAQM.

Table 1B Air Quality Objectives not included in Regulations for the purpose of LAQM in England

Pollutant	**Air Quality Objective**		**Date to be achieved by**
	Concentration	**Measured as**	
$PM_{2.5}$ (Not Scotland)	25 µg m^{-3}	Annual mean	2020
	Target of 15% reduction in concentrations at urban background locations	3-year mean	Between 2010 and 2020
Ozone	100 µg m^{-3} not to be exceeded more than 10 times a year	8 hour mean	31.12.2005

1.4 Summary of Previous Review and Assessments

The London Borough of Richmond upon Thames (LBRuT) has previously completed all earlier stages of air quality review and assessment as required under the LAQM regime. As part of its earlier duties the Council completed a Detailed Review and Assessment for nitrogen dioxide (NO_2) and particles (PM_{10}). The aim of this was to determine with reasonable certainty whether or not there is a likelihood of the AQ objectives being achieved. The assumptions used were therefore in depth and the data used were quality assured to a high standard.

Modelled predictions confirmed that the annual mean NO_2 and PM_{10} objectives were exceeded. These predictions highlighted that the objectives were exceeded in areas close to busy roads and junctions throughout the Borough. Relevant public exposure was identified in these areas and on the basis of the findings and following extensive public consultation the Council designated the whole Borough an Air Quality Management Area (AQMA) for the NO_2 and PM_{10} in 2000. The Council subsequently published its Air Quality Action Plan, again following public consultation in 2002.

The Council's subsequent Updating and Screening Assessments and Progress reports were also completed and the findings remain in accordance with those of the earlier Detailed Assessment; this is despite improvements in air quality.

The reports for the above stages are available on the Council's web site (http://www.richmond.gov.uk/home/environment/pollution/air_pollution/air_quality_reports.htm).

2 New Monitoring Data

2.1 Summary of Monitoring Undertaken

The monitoring data in this report comes from monitoring surveys undertaken across the LBRuT. Monitoring was carried out at 4 automatic monitoring sites (with data uploaded to the internet every hour) in 2014. The Council also undertakes a passive diffusion tube survey of NO_2 at 62 monitoring sites across the Borough.

The latest monitoring results for 2014 confirm that air pollution in the LBRuT still exceeds the Government Air Quality objectives, and therefore there is still a need for LBRuT to be designated as an AQMA and consequently there is still a need to pursue improvements in air quality.

The Council routinely monitors the pollutants below:

- NO_2
- PM_{10}
- Ozone (O_3)
- $PM_{2.5}$

The Council previously monitored SO_2 (ceased in April 2011), CO (ceased in April 2012), and Benzene (ceased in January 2012) are not included in this report. Please see previous Council reports for further information.

2.1.1 Automatic Monitoring Sites

The continuous monitors collect real time data, which are stored as 15-minute means and can be converted into the various averages. This type of equipment provides accurate readings of pollution levels but is expensive, so using them for a large coverage of LBRuT is not possible on cost grounds.

The sites (see Table 2) are also representative of relevant exposure either at the site or very close by. The three Richmond operated sites are part of the King's London Air Quality Network, as is the site at the National Physical Laboratory (NPL) which is also part of the government's UK Automatic Urban and Rural Network (AURN).

All data undergo quality assurance and quality control (QA/QC) procedures to ensure that the data obtained is of a high quality. The standards of QA/QC at the LAQN sites are similar to those of the government's AURN sites. For QA/QC purposes, all the continuous analysers are manually checked and calibrated every two weeks, serviced every six months and audited by an independent auditor (the National Physical Laboratory) every six months. Subsequent data ratification is undertaken by King's College London. Further details of the sites can be found at www.londonair.org.uk.

Table 2 Details of Automatic Monitoring Sites

Site Name	Site Type	X OS Grid Ref	Y OS Grid Ref	Pollutants Monitored	In AQMA?	Monitoring Technique	Relevant Exposure? *(Y/N with distance (m) to relevant exposure)*	Distance to kerb of nearest road *(N/A if not applicable)*	Does this location represent worst-case exposure?
Castelnau Library, Barnes (R1)	Roadside	522500	177165	NO_2 PM_{10}	Y	TEOM	N (8)	3m	Y
Wetlands Centre, Barnes (R2)	Suburban	522991	176495	NO_2, O_3 and PM_{10}	Y	TEOM	Y	N/A	N
Mobile Air Quality Unit	Mostly roadside locations	Changes	Changes	NO_2, O_3 and PM_{10}	Y	TEOM	Varies dependent on location	Varies dependent on location	Varies dependent on location
NPL - Teddington AURN (TD0)	Suburban	515542	170420	NO_2, $PM_{2.5}$ and O_3	Y	TEOM	Y	N/A	N

2.1.2 Non-Automatic Monitoring Sites

Table 3 lists the details of the NO_2 diffusion tube monitoring locations in the LBRuT. The tubes are a relatively cheap way of monitoring, which therefore allows samples to be taken across the whole LBRuT and gives a Borough-wide view. The results obtained give monthly averages and so provide an indication of NO_2 pollution levels. The accuracy of the diffusion tube readings can be increased when their results are compared, and the bias adjusted, with data from the more accurate continuous monitors. The Council had a network of 62 diffusion tube sites across the Borough. Six of these diffusion tubes sites are now closed (although the data from previous years is reported). Three of the diffusion tubes sites are triplicate and collocated with an automatic monitoring site.

The diffusion tubes were supplied and analysed by Gradko International Ltd, with a preparation method using 50% TEA in acetone. Gradko participates in the AIR NO_2 PT, which is an independent analytical proficiency-testing scheme, operated by LGC Standards and supported by the Health and Safety Laboratory (HSL). AIR PT is a new scheme, started in April 2014, which combines two long running PT schemes (LGC Standards STACKS PT scheme and the HSL WASP PT scheme). Gradko achieved a 100% “Satisfactory” in the laboratory performance testing rounds 121-124 for WASP and AIR NO_2 PT rounds AR001, 3, 4 and 6.

It is widely acknowledged that diffusion tubes have lower accuracy than continuous monitors. However, by comparing the diffusion tube data with that from the Borough’s continuous monitors, it is possible to calculate an adjustment factor for the diffusion tubes, and hence end up with a more accurate result. To obtain the adjustment factor for the diffusion tubes, three tubes per month are deployed alongside the continuous monitors. Each month the results from the three tubes are then averaged, and compiled into an annual average at the end of the year for comparison with the continuous data.

In 2014 the results were as follows;

- The annual average for the Castelnau diffusion tubes (Nº 23) was 39 μg m^{-3}; for the continuous site (R1) it was 37 μg m^3. Thus the bias adjustment factor is **0.95**
- The annual average for the Wetlands diffusion tubes (Nº 37) is 23 μg m^{-3}; for the continuous site (R2) it was 25 μg m^3. Thus the bias adjustment factor is **1.09**
- The annual average for the Mobile Air Unit diffusion tubes was 49 μg m^{-3}; for the continuous site it was 42 μg m^3. Thus the bias adjustment factor is **0.86**

The 2014 bias adjustment factor used in this report is the average of the three values mentioned above; **0.97**.

(Note the national bias default factor produced for 2014 (version 3/15) was the same value 0.97. This was derived from 9 studies; 8 of which (including those from LBRuT) had good precision).

Table 3 Details of Non-Automatic Monitoring Sites

Site Code	Location	Site type	Grid references	Relevant exposure (y/n with distance (m) from tube to roadside)	Distance from roadside (metres) to receptor	Pollutants Monitored	In AQMA?	Is monitoring collocated with a Continuous Analyser (Y/N)	Does this location represent worst-case exposure?
1	Hampton Court Road, Hampton	Roadside	515824, 168815	Y – 1.7m	1.9	NO_2	Y	N	Y
2	Percy Road, Hampton (Nr. Oldfield Road)	Roadside	513229, 169712	Y – 1.3m	3	NO_2	Y	N	Y
3	Uxbridge Road, Hampton (Nr. Arundel Close)	Roadside	513850, 171040	N 0.5m	10.7	NO_2	Y	N	Y
4	Hampton Road, Teddington (Nr. Bushy Park Gardens)	Kerbside	514882, 171155	N 0.6m	9.8	NO_2	Y	N	Y

Site Code	Location	Site type	Grid references	Relevant exposure (y/n with distance (m) from tube to roadside)	Distance from roadside (metres) to receptor	Pollutants Monitored	In AQMA?	Is monitoring collocated with a Continuous Analyser (Y/N)	Does this location represent worst-case exposure?
5	Sandy Lane, Teddington (Shaef Way)	Kerbside	516391, 170322	N 0.6m	9.0	NO_2	Y	N	Y
6	Kingston Road, Teddington (Nr. Woffington Close)	Kerbside	517266, 170031	N 0.7m	6.5	NO_2	Y	N	Y
7	Broad Street, Teddington (Tesco)	Kerbside	515624, 170975	Y - for 1 hour mean objective and N - for residential 0.8m	2.5	NO_2	Y	N	Y
8	Strawberry Vale, Teddington (Clive Road)	Kerbside	516165, 172043	N 0.4m	8.7	NO_2	Y	N	Y
9	Hampton Road, Twickenham	Kerbside	514842, 172346	N 0.6m	2.0	NO_2	Y	N	Y

Site Code	Location	Site type	Grid references	Relevant exposure (y/n with distance (m) from tube to roadside)	Distance from roadside (metres) to receptor	Pollutants Monitored	In AQMA?	Is monitoring collocated with a Continuous Analyser (Y/N)	Does this location represent worst-case exposure?
10	Twickenham Road, Twickenham (opp. Fulwell golf course)	Kerbside	513278, 172199	N 0.6m	2.0	NO_2	Y	N	Y
11	Percy Road, Whitton (Nr. Percy Way)	Kerbside	514050, 173189	N 0.6m	7.2	NO_2	Y	N	Y
12	Hanworth Road, Whitton	Kerbside	512600, 173404	N 0.6m	9.1	NO_2	Y	N	Y
13	Whitton Road, Whitton, (opp. Rugby ground)	Kerbside	515387, 174146	N 0.8m	6.3	NO_2	Y	N	Y
14	Cross Deep, Twickenham (Poulett Gardens)	Kerbside	516133, 173051	N 0.3m	2.7	NO_2	Y	N	Y

Site Code	Location	Site type	Grid references	Relevant exposure (y/n with distance (m) from tube to roadside)	Distance from roadside (metres) to receptor	Pollutants Monitored	In AQMA?	Is monitoring collocated with a Continuous Analyser (Y/N)	Does this location represent worst-case exposure?
15	Richmond Road, Twickenham (opp. Marble Hill Park)	Kerbside	517197, 173939	N 0.6m	1.8	NO_2	Y	N	Y
16	St Margaret's Road, St Margaret's (Nr. Bridge Road)	Kerbside	516742, 174373	N 0.6m	3.1	NO_2	Y	N	Y
17[c]	Red Lion St, Richmond (Formerly Parkshot Magistrates Courtyard, Richmond)	kerbside	517916, 175257	Y - for 1 hour mean objective and N - for residential 0.5m	2.0	NO_2	Y	N	Y
18	Lower Mortlake Road, Richmond (nr.Trinity Road)	Kerbside	518822, 175590	N 0.9m	9.3	NO_2	Y	N	Y

Site Code	Location	Site type	Grid references	Relevant exposure (y/n with distance (m) from tube to roadside)	Distance from roadside (metres) to receptor	Pollutants Monitored	In AQMA?	Is monitoring collocated with a Continuous Analyser (Y/N)	Does this location represent worst-case exposure?
19	Kew Road, Kew (Nr. Walpole Avenue)	Kerbside	518637, 176161	N 0.7m	16	NO_2	Y	N	Y
20	Mortlake Road, Kew (Nr. Kent Road)	Kerbside	519205, 177221	N 0.6m	2.8	NO_2	Y	N	Y
21	Lower Richmond Road, Mortlake (Nr. Kingsway)	Roadside	520053, 175826	Y 2m	7.0	NO_2	Y	N	Y
22	Castelnau, Barnes (Nr. Hammersmith Bridge)	Kerbside	522845, 177904	N 0.5m	4.2	NO_2	Y	N	Y
23[b]	Castelnau Library, Barnes (static site)	Roadside	522502, 177166	Y 3.3m	9.0	NO_2	Y	Collocated, Triplicate	Y

Site Code	Location	Site type	Grid references	Relevant exposure (y/n with distance (m) from tube to roadside)	Distance from roadside (metres) to receptor	Pollutants Monitored	In AQMA?	Is monitoring collocated with a Continuous Analyser (Y/N)	Does this location represent worst-case exposure?
24	Lonsdale Road, Barnes (Nr Suffolk Road)	Kerbside	521750, 177056	N 0.30m	6.3	NO_2	Y	N	
25	URRW (Nr. Sheen School)	Roadside	521130, 175450	Y 2.3m	2.5	NO_2	Y	N	Y
26	URRW, Sheen (Nr. Courtland Estate)	Roadside	519031, 175021	N 0.6m	11.8	NO_2	Y	N	Y
27	Queens Road, Richmond (Nr. Russell Walk)	Roadside	518745, 174346	Y 2.3m	5.2	NO_2	Y	N	Y
28	Holly Lodge, Richmond Park	Urban background	519467, 173993	Y - for 1 hour mean objective 250m	250	NO_2	Y	N	Y
29	Petersham Road, Ham. (Nr. Sandy Lane)	Kerbside	517967, 172543	Y 3.6m	3.6	NO_2	Y	N	Y

Site Code	Location	Site type	Grid references	Relevant exposure (y/n with distance (m) from tube to roadside)	Distance from roadside (metres) to receptor	Pollutants Monitored	In AQMA?	Is monitoring collocated with a Continuous Analyser (Y/N)	Does this location represent worst-case exposure?
30	German School Petersham Road	Roadside	518003, 173233	Y 1.9m	1.3	NO_2	Y	N	Y
31	A316 (near Chuddleigh Rd)	Roadside	515438, 174048	N 1.0m	6.4	NO_2	Y	N	Y
32	Kings Street, Twickenham	Kerbside	516226, 173195	Y - for 1 hour mean objective and N - for residential 1.7m	3.8	NO_2	Y	N	Y
33	Heath Road, Twickenham	Kerbside	515927, 173129	Y for 1 hour mean objective and N - for residential 0.9m	4.6	NO_2	Y	N	Y
34	Thames Street, Hampton	Roadside	515927, 173129	Y 1.4m	1.3	NO_2	Y	N	Y
35	High Street, Hampton Wick	Kerbside	517524, 169583	Y – for 1 hour mean objective	1.4	NO_2	Y	N	Y

Site Code	Location	Site type	Grid references	Relevant exposure (y/n with distance (m) from tube to roadside)	Distance from roadside (metres) to receptor	Pollutants Monitored	In AQMA?	Is monitoring collocated with a Continuous Analyser (Y/N)	Does this location represent worst-case exposure?
				and N - for residential 1.3m					
36	Upper Richmond Road West (URRW), Sheen Lane	Kerbside	520510, 175393	Y for 1 hour mean objective and N - for residential 0.9m	2.2	NO_2	Y	N	Y
37[b]	Wetlands Centre, Barnes (static site)	Urban Background	522989, 176727	Y 1 hour mean objective - children in play area/people attending Wetlands Centre	N/A	NO_2	Y	Collocated, Triplicate	Y
38[f]	Queen's Road, Teddington (Park Road end)	Kerbside	515777, 170519	N 0.5m	5.0	NO_2	Y	N	Y

Site Code	Location	Site type	Grid references	Relevant exposure (y/n with distance (m) from tube to roadside)	Distance from roadside (metres) to receptor	Pollutants Monitored	In AQMA?	Is monitoring collocated with a Continuous Analyser (Y/N)	Does this location represent worst-case exposure?
39	Richmond Road, Richmond Bridge, East Twickenham	Kerbside	515777, 170519	Y – for 1 hour mean objective and N - for residential 1.2m	2.7	NO_2	Y	N	Y
40[g]	Staines Road, Twickenham	Kerbside	514278, 172521	N 0.4m	11.9	NO_2	Y	N	Y
41	Paradise Road, Richmond	Kerbside	518102, 174854	N 0.9m	5.6	NO_2	Y	N	Y
42	The Quadrant, Richmond	Kerbside	517991, 175075	Y – for 1 hour mean objective and N -for residential (above shops) 2.5m	1.8	NO_2	Y	N	Y
43[d]	Hill Street, Richmond	Kerbside	517771, 174701	Y - for 1 hour mean objective and N -for	1.6	NO_2	Y	N	Y

Site Code	Location	Site type	Grid references	Relevant exposure (y/n with distance (m) from tube to roadside)	Distance from roadside (metres) to receptor	Pollutants Monitored	In AQMA?	Is monitoring collocated with a Continuous Analyser (Y/N)	Does this location represent worst-case exposure?
				residential above shops 0.7m					
44	Sheen Road, Richmond (Shops)	Kerbside	518458, 175042	Y – for 1 hour mean objective and N - for residential 0.5m	0.5	NO_2	Y	N	Y
45	High Street, Teddington (post office)	Kerbside	516260, 171140	Y - for 1 hour mean objective and N - for residential 0.5m	3.3	NO_2	Y	N	Y
46	15 Queen's Road, Teddington	Kerbside	515522, 170927	N 0.4m	3.3	NO_2	Y	N	Y
47	Causeway, Teddington	Kerbside	515829, 170967	Y - for 1 hour mean objective	2.7	NO_2	Y	N	Y

Site Code	Location	Site type	Grid references	Relevant exposure (y/n with distance (m) from tube to roadside)	Distance from roadside (metres) to receptor	Pollutants Monitored	In AQMA?	Is monitoring collocated with a Continuous Analyser (Y/N)	Does this location represent worst-case exposure?
				and N - for residential 1.8m					
48	Stanley Road, Teddington (junc Strathmore Road)	Kerbside	515059, 171805	N 2.4m	7.1	NO_2	Y	N	Y
49	URRW War Memorial, Sheen Lane, Sheen	Kerbside	520505, 175390	Y - for 1 hour mean objective and N - for residential 0.9m	2.9	NO_2	Y	N	Y
50	URRW (Nr. Clifford Avenue, Sheen)	Kerbside	519962, 175321	Y - for 1 hour mean objective and N - for residential 0.7m	2.7	NO_2	Y	N	Y
51	Sheen Lane	Kerbside	520497,	N 0.4m	1.3	NO_2	Y	N	Y

Site Code	Location	Site type	Grid references	Relevant exposure (y/n with distance (m) from tube to roadside)	Distance from roadside (metres) to receptor	Pollutants Monitored	In AQMA?	Is monitoring collocated with a Continuous Analyser (Y/N)	Does this location represent worst-case exposure?
	(railway crossing), Sheen		175790						
52	Clifford Avenue, Chalkers Corner	Kerbside	519776, 175746	N 0.5m	2.2	NO_2	Y	N	Y
53[b]	Mobile Air Quality Site	Roadside	512401, 173103	N 0.2m	1.6	NO_2	Y	Collocated, Triplicate	Y
54	Mortlake Rd (adj. to West Hill Rd) Kew	Kerbside	519589 176489	Y – 0.6m for residential	1.4	NO_2	Y	N	Y
55	Mortlake Rd (adj. to cemetery gates), Kew	Kerbside	519800 176142	N 0.6m	4.1	NO_2	Y	N	Y
56[e]	A316 (St Margaret's Roundabout)	Roadside	516791 174521	Y – 7.3m	9.6	NO_2	Y	N	Y
57[e]	A316 (Lincoln	Kerbside	513953 172915	Y - 16.3	12.3	NO_2	Y	N	Y

Site Code	Location	Site type	Grid references	Relevant exposure (y/n with distance (m) from tube to roadside)	Distance from roadside (metres) to receptor	Pollutants Monitored	In AQMA?	Is monitoring collocated with a Continuous Analyser (Y/N)	Does this location represent worst-case exposure?
	Ave)								
58[h]	London Road, Twickenham	Kerbside	519793 176139	N 0.7m	2.2	NO_2	Y	N	Y
RUT 01	Civic Centre, York Street, Twickenham	Roadside	516356, 173365	Y - for 1 hour mean objective 2.9m	3.0	NO_2	Y	N	Y
RUT 02	George Street, Richmond	Kerbside	517917, 174928	Y - for 1 hour mean objective and N - for residential (above shops) 0.7m.	2.2	NO_2	Y	N	Y
RUT 03[i]	Alexandra Hall, Cromwell Place, Mortlake	Urban background	520348, 175849	Y – 54.3m	1.9	NO_2	Y	N	Y
RUT	Side of Elmfield	Urban	515916,	Y - 18.9	2.2	NO_2	Y	N	Y

Site Code	Location	Site type	Grid references	Relevant exposure (y/n with distance (m) from tube to roadside)	Distance from roadside (metres) to receptor	Pollutants Monitored	In AQMA?	Is monitoring collocated with a Continuous Analyser (Y/N)	Does this location represent worst-case exposure?
04[j]	House, Waldegrave Road, Teddington	background	171118						
59[k]	Whitton Road, Twickenham	kerbside	515980, 173758	0.6m	1.4	NO_2	Y	N	Y
60[l]	Front of Elmfield House, Waldegrave Road, Teddington	kerbside	515894, 171148	0.5m	2.2	NO_2	Y	N	Y
61[m]	London Road Twickenham (Nr. Waitrose)	Roadside	516224, 173444	1.8m	4.3	NO_2	Y	N	Y
62[n]	High Street, Barnes	kerbside	521651, 176430	0.4m	2.3	NO_2	Y	N	Y
63[o]	High Street,	kerbside	514181,	0.8m	3.2	NO_2	Y	N	Y

Site Code	Location	Site type	Grid references	Relevant exposure (y/n with distance (m) from tube to roadside)	Distance from roadside (metres) to receptor	Pollutants Monitored	In AQMA?	Is monitoring collocated with a Continuous Analyser (Y/N)	Does this location represent worst-case exposure?
	Whitton		173875						
64[p]	High Street, Hampton Hill	kerbside	514484, 171251	0.5m	1.6	NO_2	Y	N	Y

[b] Location of triplicate diffusion tubes .

[c] The Parkshot diffusion tube, Number 17, was moved on 01/12/09 to Red Lion Street, Richmond.

[e] Sites 56 & 57 were established on 02/03/2010; the results for 2010 are based on 10 months data.

[f] Site 38, Queens Road, closed 03/01/2012.

[g] Site 40 was moved to the opposite side of Staines Road on 29/09/2010

[h] Site 58 was established on 29/03/2011; the results for 2011 are based on 9 months data.

[i] RuT 03 Alexandra Hall, Mortlake closed on 03/01/2012

[J] RuT 04 moved from the side to the front of 4 Waldegrave Road, Teddington on 03/01/2012, re-named site 60

[k] Site 59 Whitton Road, Twickenham (opposite Heatham House) opened 03/01/12,

[l] Site 60 pavement near 4 Waldegrave Rd, Teddington opened on 03/01/2012

[m] Site 61 London Road Twickenham (near Waitrose) opened 03/01/2012

[n] Site 62 High Street, Barnes opened 02/01/2013

[o] Site 63 High Street, Whitton opened 02/01/2013

[p] Site 64 High Street, Hampton Hill opened 02/01/2013

2.2 Comparison of Monitoring Results with Air Quality Objectives

2.2.1 Nitrogen Dioxide

The NO_2 monitoring results for the four LBRuT automatic sites are compared directly to the annual mean and hourly mean objectives. The data for 2014 included provisional data; all years prior to this have been fully ratified. The Mobile Air Quality Unit was located along Hanworth Road during all of the 2014 at a roadside location.

The 2014 data capture for each site was good, representing more than 90%. Data capture for the R1 (Castelnau) and R2 (Wetlands) sites was 91%. For the TD0 (National Physic Laboratory) and the Mobile Air Quality Unit (Hanworth Road) sites it was 98%.

Automatic Monitoring Data

Table 4 provides the 2014 results of the NO_2 automatic monitoring and a comparison with annual mean objective.

The 2014 results show that three of the sites met the objective of 40 $\mu g\ m^{-3}$. The 2014 annual means for the R2 (Wetlands) and TD0 (Teddington) sites were 25 and 27 $\mu g\ m^{-3}$ respectively. These sites are both backgrounds sites and therefore representative of low pollution in the Borough. The annual mean at the R2 Wetlands site was similar to previous years, whereas the 2014 annual mean was higher than all previous years (other than 2013).

The annual mean at the R1 (Castelnau) roadside site was 37 $\mu g\ m^{-3}$, which is borderline to the objective of 40 $\mu g\ m^{-3}$. This concentration was similar to previous years reported.

The Mobile Air Quality Unit exceeded the objective in 2014, with an annual mean concentration of 42 $\mu g\ m^{-3}$. It was located in Hanworth Road which is a roadside site. In previous years it has also been located at roadsides in the Borough and annual

mean concentrations have always exceeded the objective. Both of these sites are typical of concentrations closer to roads across the Borough.

Table 5 provides the results of automatic monitoring for NO_2 for the 1-hour mean objective. This objective is less stringent than the annual mean and it was met at all sites and for every year reported. Moreover, the hourly mean standard of 200 $\mu g\ m^{-3}$ was not exceeded. In 2013 this standard was exceeded two times at both the R1 Castelnau site and at the Mobile Air Quality Unit site.

Table 4 Automatic Monitoring of Nitrogen Dioxide: Comparison with Annual Mean Objective

Site ID	Site Type	Within AQMA?	Valid Data Capture for period of monitoring %	Valid Data Capture for 2014 %[a]	Annual Mean Concentration μg m^{-3}				
					2010	2011	2012	2013	2014
Castelnau Library, Barnes (R1)	Roadside	Y	N/a	91	**43**	39	37	39	37
Wetlands Centre, Barnes (R2)	Suburban	Y	N/a	91	30	26	25	24	25
Mobile Air Quality Unit	Mostly roadside locations	Y	N/a	98	**45**	**48**	**44**	**43**	**42**
NPL - Teddington AURN (TD0)	Suburban	Y	N/a	98	24	21	36	21	27

[a] Data capture for the full calendar year (e.g. if monitoring was carried out for six months the maximum data capture for the full calendar year would be 50%).

Table 5 Automatic Monitoring for Nitrogen Dioxide: Comparison with 1-hour mean Objective

Site ID	Site Type	Within AQMA?	Valid Data Capture for period of monitoring %	Valid Data Capture for 2014 %[a]	Number of Exceedences of Hourly Mean (200 μg m^{-3})				
					2010	2011	2012	2013	2014
Castelnau Library, Barnes (R1)	Roadside	Y	N/a	91	0	0	0	2	0
Wetlands Centre, Barnes (R2)	Suburban	Y	N/a	91	0	0	0	0	0
Mobile Air Quality Unit	Mostly roadside locations	Y	N/a	98	0	0	0	2	0
NPL - Teddington AURN (TD0)	Suburban	Y	N/a	98	0	0	0	0	0

[a] Data capture for the full calendar year (e.g. if monitoring was carried out for six months the maximum data capture for the full calendar year would be 50%).

Diffusion Tube Monitoring Data

Tables 6 and 7 show the NO_2 diffusion tube monitoring results, with bias corrected values for each year from 2010 to 2014. (Note – see Appendix B for the unbiased monthly data for 2014). The results in bold indicate an exceedence of the annual mean objective of 40 μg m^{-3}.

Most of the NO_2 diffusion tubes are located on lamp posts close to the kerbside of the road, so that the nearest relevant exposure arises at residential properties that are set back often around 5 metres or more from the kerb. The monitoring site at Holly Lodge in Richmond Park (Nº 28) and the collocated site at Wetlands Centre, Barnes (Nº 37) are background sites, set well away from roads.

The results in brackets are the exposure estimate for the nearest residential façades i.e. these are bias adjusted results that have been corrected for distance (using the Defra distance calculator, with the NPL Teddington AURN site as background). (Note – this was only undertaken when the bias adjusted result exceeded the objective of 40 μg m^{-3}).

The data capture for the sites was very good, with an overall data capture of almost 98%. Only the Queens Road site (Nº 27) in Richmond had a reduced data capture of less than 75%, with 66%. This site was therefore adjusted using an annualising factor from nearby continuous background sites (in accordance with TG09). The adjustment factor used was 1.07993.

The overall monitoring results for the Borough show that NO_2 concentrations exceeded the UK annual mean objective (as it has done for each year since 2005). This is also in line with the modelling prediction of the Borough (reported in the previous 2014 Progress Report).

The results from the 2014 monitoring show that the objective of 40 μg m^{-3} was exceeded at 49 sites. Nine of these sites also exceeded an annual mean of 60 μg m^{-3}

which indicates that the 1 hour-mean objective may also have been exceeded at these locations.

After the distance correction, the annual mean objective is exceeded at 30 sites, with 4 of them exceeding the annual mean concentration of 60 μg m^{-3}.

In previous years the majority of monitored concentrations from the diffusion tube survey sites also exceeded the annual mean objective. The annual mean results for the sites operating for the five years from 2010 are shown in Table 7 and these are summarised below (based on the results without distance correction).

The total number of sites where monitoring was undertaken was 62. There was only a small variation between the locations for the different years; this was due to some of the sites being closed or moved. For all years other than 2011 the number of sites exceeding the objective was more than 46. The mean concentration of these sites was slightly more than 50 μg m^{-3}, with little variation in the most recent three years. This corresponds to findings in London and elsewhere in urban locations where concentrations of NO_2 are not falling over time.

	2010	2011	2012	2013	2014
Number > 40 μg m^{-3}	50	37	46	51	49
Total number of sites	62	62	62	62	62
Mean of those > 40 μg m^{-3}	56.1	51.5	52.1	53.4	53.3

Table 6 Results of Nitrogen Dioxide Diffusion Tubes in 2014

Site ID	Location	Site Type	Within AQMA (Y/N)	Triplicate or Collocated Tube	Data with less than 9 months has been annualised (Y/N)	Data Capture 2014 (Number of Months)	Annual mean concentration [a] (Bias Adjustment factor = 0.97) 2014 (μg m^{-3})	Annual mean concentrations distance corrected 2014 (μg m^{-3})
1	Hampton Court Road, Hampton	Roadside	Y	N	N/a	12	**49**	**48.4**
2	Percy Road, Hampton (Nr. Oldfield Road)	Roadside	Y	N	N/a	12	33	N/a
3	Uxbridge Road, Hampton (Nr. Arundel Close)	Roadside	Y	N	N/a	12	**44**	36.7
4	Hampton Road, Teddington (Nr. Bushy Park Gardens)	Kerbside	Y	N	N/a	12	**44**	35.3

Site ID	Location	Site Type	Within AQMA (Y/N)	Triplicate or Collocated Tube	Data with less than 9 months has been annualised (Y/N)	Data Capture 2014 (Number of Months)	Annual mean concentration [a] (Bias Adjustment factor = 0.97) 2014 (μg m^{-3})	Annual mean concentrations distance corrected 2014 (μg m^{-3})
5 (closed)	Sandy Lane, Teddington (Shaef Way)	Kerbside	Y	N	N/a	-	-	N/a
6	Kingston Road, Teddington (Nr. Woffington Close)	Kerbside	Y	N	N/a	12	**41**	35.1
7	Broad Street, Teddington (Tesco)	Kerbside	Y	N	N/a	12	**54**	**48.1**
8 (closed)	Strawberry Vale, Teddington (Clive Road)	Kerbside	Y	N	N/a	-	-	
9	Hampton Road, Twickenham	Kerbside	Y	N	N/a	12	**48**	**43.4**

Site ID	Location	Site Type	Within AQMA (Y/N)	Triplicate or Collocated Tube	Data with less than 9 months has been annualised (Y/N)	Data Capture 2014 (Number of Months)	Annual mean concentration [a] (Bias Adjustment factor = 0.97) 2014 (μg m^{-3})	Annual mean concentrations distance corrected 2014 (μg m^{-3})
10	Twickenham Road, Twickenham (opp. Fulwell golf course)	Kerbside	Y	N	N/a	12	**47**	37.9
11	Percy Road, Whitton (Nr. Percy Way)	Kerbside	Y	N	N/a	12	**48**	37.6
12	Hanworth Road, Whitton	Kerbside	Y	N	N/a	12	**46**	37.3
13	Whitton Road, Whitton, (opp. Rugby ground)	Kerbside	Y	N	N/a	12	**47**	39
14	Cross Deep, Twickenham (Poulett Gardens)	Kerbside	Y	N	N/a	12	**45**	38.6

London Borough of Richmond upon Thames

Site ID	Location	Site Type	Within AQMA (Y/N)	Triplicate or Collocated Tube	Data with less than 9 months has been annualised (Y/N)	Data Capture 2014 (Number of Months)	Annual mean concentration [a] (Bias Adjustment factor = 0.97) 2014 (μg m^{-3})	Annual mean concentrations distance corrected 2014 (μg m^{-3})
15	Richmond Road, Twickenham (opp. Marble Hill Park)	Kerbside	Y	N	N/a	12	40	37.4
16	St Margaret's Road, St Margaret's (Nr. Bridge Road)	Kerbside	Y	N	N/a	12	**43**	39.8
17[c]	Red Lion St, Richmond (Formerly Parkshot Magistrates Courtyard, Richmond)	kerbside	Y	N	N/a	12	**68**	**57.9**

London Borough of Richmond upon Thames

Site ID	Location	Site Type	Within AQMA (Y/N)	Triplicate or Collocated Tube	Data with less than 9 months has been annualised (Y/N)	Data Capture 2014 (Number of Months)	Annual mean concentration [a] (Bias Adjustment factor = 0.97) 2014 (μg m^{-3})	Annual mean concentrations distance corrected 2014 (μg m^{-3})
18	Lower Mortlake Road, Richmond (Nr. Trinity Road)	Kerbside	Y	N	N/a	12	**66**	**48**
19	Kew Road, Kew (Nr. Walpole Avenue)	Kerbside	Y	N	N/a	11	**55**	38.5
20	Mortlake Road, Kew (Nr. Kent Road)	Kerbside	Y	N	N/a	11	**55**	**47.1**
21	Lower Richmond Road, Mortlake (Nr. Kingsway)	Roadside	Y	N	N/a	12	**41**	36.9

Site ID	Location	Site Type	Within AQMA (Y/N)	Triplicate or Collocated Tube	Data with less than 9 months has been annualised (Y/N)	Data Capture 2014 (Number of Months)	Annual mean concentration [a] (Bias Adjustment factor = 0.97) 2014 (μg m^{-3})	Annual mean concentrations distance corrected 2014 (μg m^{-3})
22	Castelnau, Barnes (Nr. Hammersmith Bridge)	Kerbside	Y	N	N/a	12	**59**	**47**
23[b]	Castelnau Library, Barnes (static site)	Roadside	Y	Collocated, Triplicate	N/a	12	38	N/a
24	Lonsdale Road, Barnes (Nr Suffolk Road)	Kerbside	Y	N	N/a	12	**40**	33.6
25	URRW (Nr. Sheen School)	Roadside	Y	N	N/a	12	**51**	**50.5**
26	URRW, Sheen (Nr. Courtland Estate)	Roadside	Y	N	N/a	11	**42**	33.8

Site ID	Location	Site Type	Within AQMA (Y/N)	Triplicate or Collocated Tube	Data with less than 9 months has been annualised (Y/N)	Data Capture 2014 (Number of Months)	Annual mean concentration [a] (Bias Adjustment factor = 0.97) 2014 (μg m^{-3})	Annual mean concentrations distance corrected 2014 (μg m^{-3})
27	Queens Road, Richmond (Nr. Russell Walk)	Roadside	Y	N	Y	8	38	N/a
28	Holly Lodge, Richmond Park	Urban background	Y	N	N/a	12	18	N/a
29	Petersham Road, Ham. (Nr. Sandy Lane)	Kerbside	Y	N	N/a	12	36	N/a
30	German School Petersham Road	Roadside	Y	N	N/a	12	34	N/a
31	A316 (near Chuddleigh Rd)	Roadside	Y	N	N/a	12	**62**	48.9
32	Kings Street, Twickenham	Kerbside	Y	N	N/a	12	**73**	67.8

Site ID	Location	Site Type	Within AQMA (Y/N)	Triplicate or Collocated Tube	Data with less than 9 months has been annualised (Y/N)	Data Capture 2014 (Number of Months)	Annual mean concentration [a] (Bias Adjustment factor = 0.97) 2014 (μg m^{-3})	Annual mean concentrations distance corrected 2014 (μg m^{-3})
33	Heath Road, Twickenham	Kerbside	Y	N	N/a	12	**69**	**55.5**
34	Thames Street, Hampton	Roadside	Y	N	N/a	12	40	**40**
35	High Street, Hampton Wick	Kerbside	Y	N	N/a	12	**48**	**47.7**
36	Upper Richmond Road West (URRW), Sheen Lane	Kerbside	Y	N	N/a	12	**56**	**50.9**
37[b]	Wetlands Centre, Barnes (static site)	Urban Background	Y	Collocated, Triplicate	N/a	12	22	N/a
38[f] (closed)	Queen's Road, Teddington (Park Road end)	Kerbside	Y	N	N/a	-	-	-

Site ID	Location	Site Type	Within AQMA (Y/N)	Triplicate or Collocated Tube	Data with less than 9 months has been annualised (Y/N)	Data Capture 2014 (Number of Months)	Annual mean concentration [a] (Bias Adjustment factor = 0.97) 2014 (μg m^{-3})	Annual mean concentrations distance corrected 2014 (μg m^{-3})
39	Richmond Road, Richmond Bridge, East Twickenham	Kerbside	Y	N	N/a	12	**56**	**51.1**
40[g]	Staines Road, Twickenham	Kerbside	Y	N	N/a	12	**40**	32.5
41	Paradise Road, Richmond	Kerbside	Y	N	N/a	12	**41**	35.9
42	The Quadrant, Richmond	Kerbside	Y	N	N/a	12	**54**	**56.2**
43[d]	Hill Street, Richmond	Kerbside	Y	N	N/a	12	**80**	**71.8**
44	Sheen Road, Richmond (Shops)	Kerbside	Y	N	N/a	12	**45**	**45**

Site ID	Location	Site Type	Within AQMA (Y/N)	Triplicate or Collocated Tube	Data with less than 9 months has been annualised (Y/N)	Data Capture 2014 (Number of Months)	Annual mean concentration [a] (Bias Adjustment factor = 0.97) 2014 (μg m^{-3})	Annual mean concentrations distance corrected 2014 (μg m^{-3})
45	High Street, Teddington (post office)	Kerbside	Y	N	N/a	11	**45**	39
46 (closed)	15 Queen's Road, Teddington	Kerbside	Y	N	N/a	-	-	-
47	Causeway, Teddington	Kerbside	Y	N	N/a	12	37	N/a
48	Stanley Road, Teddington (junc Strathmore Road)	Kerbside	Y	N	N/a	12	**45**	**40.2**
49	URRW War Memorial, Sheen Lane, Sheen	Kerbside	Y	N	N/a	12	**45**	**40.8**

Site ID	Location	Site Type	Within AQMA (Y/N)	Triplicate or Collocated Tube	Data with less than 9 months has been annualised (Y/N)	Data Capture 2014 (Number of Months)	Annual mean concentration [a] (Bias Adjustment factor = 0.97) 2014 (μg m^{-3})	Annual mean concentrations distance corrected 2014 (μg m^{-3})
50	URRW (nr. Clifford Avenue, Sheen)	Kerbside	Y	N	N/a	12	**60**	**51.6**
51	Sheen Lane (railway crossing), Sheen	Kerbside	Y	N	N/a	12	34	
52	Clifford Avenue, Chalkers Corner	Kerbside	Y	N	N/a	12	**62**	**52.8**
53[b]	Mobile Air Quality Site	Roadside	Y	Collocated, Triplicate	N/a	12	**48**	37.3
54	Mortlake Rd (adj to West Hill Rd) Kew	Kerbside	Y	N	N/a	12	**56**	**51.5**

Site ID	Location	Site Type	Within AQMA (Y/N)	Triplicate or Collocated Tube	Data with less than 9 months has been annualised (Y/N)	Data Capture 2014 (Number of Months)	Annual mean concentration [a] (Bias Adjustment factor = 0.97) 2014 (μg m^{-3})	Annual mean concentrations distance corrected 2014 (μg m^{-3})
55	Mortlake Rd (adj. to cemetery gates), Kew	Kerbside	Y	N	N/a	12	**55**	**45.2**
56[e]	A316 (St Margaret's Roundabout)	Roadside	Y	N	N/a	12	38	N/a
57[e]	A316 (Lincoln Ave)	Kerbside	Y	N	N/a	12	36	N/a
58[h]	London Road, Twickenham	Kerbside	Y	N	N/a	12	**50**	**40.4**
RUT 01	Civic Centre, York Street, Twickenham	Roadside	Y	N	N/a	11	**62**	**61.7**
RUT 02	George Street, Richmond	Kerbside	Y	N	N/a	11	**96**	**81.1**

Site ID	Location	Site Type	Within AQMA (Y/N)	Triplicate or Collocated Tube	Data with less than 9 months has been annualised (Y/N)	Data Capture 2014 (Number of Months)	Annual mean concentration [a] (Bias Adjustment factor = 0.97) 2014 (μg m^{-3})	Annual mean concentrations distance corrected 2014 (μg m^{-3})
RUT 03[i] (closed)	Alexandra Hall, Cromwell Place, Mortlake	Urban background	Y	N	N/a	12	-	N/a
RUT 04[j] (closed)	Side of Elmfield House, Waldegrave Road, Teddington	Urban background	Y	N	N/a	12	-	N/a
59[k]	Whitton Road, Twickenham,	kerbside	Y	N	N/a	11	**42**	39.7
60[l]	Front of Elmfield House, Waldegrave Road, Teddington	kerbside	Y	N	N/a	9	32	
61[m]	London Road Twickenham (near Waitrose)	Roadside	Y	N	N/a	12	**54**	**48.6**

Site ID	Location	Site Type	Within AQMA (Y/N)	Triplicate or Collocated Tube	Data with less than 9 months has been annualised (Y/N)	Data Capture 2014 (Number of Months)	Annual mean concentration [a] (Bias Adjustment factor = 0.97) 2014 (μg m^{-3})	Annual mean concentrations distance corrected 2014 (μg m^{-3})
62[n]	High Street, Barnes	kerbside	Y	N	N/a	11	**52**	**44.6**
63[o]	High Street, Whitton	kerbside	Y	N	N/a	12	**42**	38
64[p]	High Street, Hampton Hill	kerbside	Y	N	N/a	12	**<u>60</u>**	**53.2**

[a] Exceedences of the 40 μg m^{-3} objective in **bold** and exceedences of 60 μg m^{-3} <u>underlined</u>.

[b] Location of triplicate diffusion tubes .

[c] The Parkshot diffusion tube, Number 17, was moved on 01/12/09 to Red Lion Street, Richmond.

[e] Sites 56 & 57 were established on 02/03/2010; the results for 2010 are based on 10 months data.

[f] Site 38, Queens Road, closed 03/01/2012.

[g] Site 40 was moved to the opposite side of Staines Road on 29/09/2010

[h] Site 58 was established on 29/03/2011; the results for 2011 are based on 9 months data.

[I] RuT 03 Alexandra Hall, Mortlake closed on 03/01/2012

[J] RuT 04 moved from the side to the front of 4 Waldegrave Road, Teddington on 03/01/2012, re-named site 60

[k] Site 59 Whitton Road, Twickenham (opposite Heatham House) opened 03/01/12,

[l] Site 60 pavement near 4 Waldegrave Rd, Teddington opened on 03/01/2012

[m] Site 61 London Road Twickenham (near Waitrose) opened 03/01/2012

[n] Site 62 High Street, Barnes opened 02/01/2013

[o] Site 63 High Street, Whitton opened 02/01/2013

[p] Site 64 High Street, Hampton Hill opened 02/01/2013

Table 7 Results of Nitrogen Dioxide Diffusion Tubes (2010 to 2014) NB the results in brackets indicate the exposure estimate, calculated for the nearest residential façade

Site ID	Site Type	Within AQMA?	Annual mean concentration (adjusted for bias) μg m^{-3}				
			2010* (Bias Adjustment Factor = 1.06)	**2011* (Bias Adjustment Factor = 0.92)**	**2012* (Bias Adjustment Factor = 1.06)**	**2013* (Bias Adjustment Factor = 0.96)**	**2014* (Bias Adjustment Factor = 0.97)**
1	Roadside	Y	**51 (50)**	**44 (43)**	**45 (46)**	**47 (46)**	**49 (48.4)**
2	Roadside	Y	39 (36)	31 (29)	34 (34)	32 (31)	33
3	Roadside	Y	**44** (33)	35 (28)	**44 (40**)	**44** (33)	**44** (36.7)
4	Kerbside	Y	39 (31)	38 (30)	**44 (40)**	**44** (34)	**44** (35.3)
5	Kerbside	Y	38 (31)	32 (27)	33 (33)	Closed	Closed
6	Kerbside	Y	**48** (38)	34 (29)	43 (40)	**43** (35)	**41** (35.1)
7	Kerbside	Y	**69 (59)**	**49 (43)**	**59 (54)**	**61 (53)**	**54 (48.1)**
8	Kerbside	Y	39 (31)	30 (26)	34 (34)	Closed	Closed
9	Kerbside	Y	**55 (48)**	**47 (42)**	**50 (47)**	**49 (44)**	**48 (43.4)**
10	Kerbside	Y	**47** (37)	36 (33)	**44 (42)**	**46 (42)**	**47** (37.9)
11	Kerbside	Y	**52** (38)	**46** (35)	**54 (46)**	**49** (38)	**48** (37.6)
12	Kerbside	Y	**52** (39)	**41** (32)	**45 (41)**	**49** (37)	**46** (37.3)
13	Kerbside	Y	**53 (42)**	**42** (34)	**48 (43)**	**48** (38)	**47** (39)
14	Kerbside	Y	**52 (42)**	38 (32)	**48 (44)**	**46** (38)	**45** (38.6)
15	Kerbside	Y	**53 (47)**	**41 (40)**	**44 (42)**	**40** (37)	**40** (37.4)
16	Kerbside	Y	**48 (43)**	38 (35)	**45 (42)**	**44** (38)	**43** (39.8)

Site ID	Site Type	Within AQMA?	Annual mean concentration (adjusted for bias) μg m^{-3}				
			2010* (Bias Adjustment Factor = 1.06)	**2011* (Bias Adjustment Factor = 0.92)**	**2012* (Bias Adjustment Factor = 1.06)**	**2013* (Bias Adjustment Factor = 0.96)**	**2014* (Bias Adjustment Factor = 0.97)**
17c	Kerbside	Y	**79 (67)**	**65 (55)**	**70 (59)**	**68 (57)**	**68 (57.9)**
18	Kerbside	Y	**70 (52)**	**66 (47)**	**68 (48)**	**71 (49)**	**66 (48)**
19	Kerbside	Y	**46** (37)	**50** (35)	**56** (38)	**53** (36)	**55** (38.5)
20	Kerbside	Y	**54 (42)**	**40** (36)	**53 (45)**	**51 (43)**	**55 (47.1)**
21	Roadside	Y	**47 (42)**	39 (35)	**43** (38)	44 (38)	**41** (36.9)
22	Kerbside	Y	**55 (46)**	**46** (38)	**51 (41)**	**57 (45)**	**59 (47)**
23b	Roadside	Y	**43 (40)**	35 (32)	38 (35)	39 (35)	38
24	Kerbside	Y	**42** (36)	36 (30)	**40** (33)	**40** (32)	**40** (33.6)
25	Roadside	Y	**42 (42)**	32 (32)	**47 (47)**	**51 (51)**	**51 (50.5)**
26	Roadside	Y	**46** (37)	**40** (31)	**42** (33)	**43** (33)	**42** (33.8)
27	Roadside	Y	**44 (41)**	38 (35)	**41** (38)	**40** (37)	37
28	Background	Y	24 (24)	20 (20)	22 (22)	21 (21)	18
29	Kerbside	Y	39 (39)	37 (37)	**43 (43)**	39 (39)	36
30	Roadside	Y	**41 (42)**	33 (34)	36 (36)	38 (39)	34
31	Roadside	Y	**53 (42)**	**50 (40)**	**59 (50)**	**61 (47)**	**62 (48.9)**
32	Kerbside	Y	102 (88)	**75 (66)**	**77 (70)**	**74 (65)**	**73 (67.8)**
33	Kerbside	Y	66 (53)	**47** (39)	**58 (51)**	**62 (50)**	**69 (55.5)**
34	Roadside	Y	42 (42)	36 (36)	39(39)	38 (38)	**40 (40)**
35	Kerbside	Y	**54 (54)**	**46 (46)**	**50 (50)**	**52 (52)**	**48 (47.7)**
36	Kerbside	Y	**60 (55)**	**46 (42)**	**54 (49)**	**56 (50)**	**56 (50.9)**

Site ID	Site Type	Within AQMA?	Annual mean concentration (adjusted for bias) μg m^{-3}				
			2010* (Bias Adjustment Factor = 1.06)	**2011* (Bias Adjustment Factor = 0.92)**	**2012* (Bias Adjustment Factor = 1.06)**	**2013* (Bias Adjustment Factor = 0.96)**	**2014* (Bias Adjustment Factor = 0.97)**
37b	Background	Y	28	26	25	25	22
38f	Kerbside	Y	40 (34)	35 (30)	closed	closed	closed
39	Kerbside	Y	**70 (62)**	**58 (52)**	**62 (58)**	**56 (51)**	**56 (51.1)**
40g	Kerbside	Y	31 (27)	37 (28)	**43** (39)	**41** (31)	**40** (32.5)
41	Kerbside	Y	**49 (42)**	38 (33)	**45** (38)	**42** (36)	**41** (35.9)
42	Kerbside	Y	**69 (73)**	**53 (55)**	**56 (59)**	**58 (61)**	**54 (56.2)**
43d	Kerbside	Y	**82 (73)**	**74 (66)**	**78 (70)**	**87 (77)**	**80 (71.8)**
44	Kerbside	Y	**49 (49)**	**42 (42)**	**46 (46)**	**45 (45)**	**45 (45)**
45	Kerbside	Y	**48 (40)**	**44 (37)**	**43 (41)**	**48 (40)**	**45** (39)
46	Kerbside	Y	**48** (39)	36 (31)	**41** (39)	closed	closed
47	Kerbside	Y	**49 (44)**	33 (32)	**40 (40)**	**40** (39)	37
48	Kerbside	Y	**54 (46)**	**43 (37)**	**42 (40)**	**45 (39)**	**45 (40.2)**
49	Kerbside	Y	**50 (45)**	39 (36)	**47 (42)**	**45 (40)**	**45 (40.8)**
50	Kerbside	Y	**64 (55)**	**49 (42)**	**63 (53)**	**61 (52)**	**60 (51.6)**
51	Kerbside	Y	39 (37	32 (30)	36 (34)	34 (32)	34
52	Kerbside	Y	**71 (60)**	**52 (45)**	**59 (50)**	**59 (50)**	**62 (52.8)**
53b	Roadside	Y	**55 (45)**	**51 (43)**	**46(43)**	**48 (40)**	**48** (37.7)
54	Kerbside	Y	**62 (57)**	**44 (41)**	**55 (50)**	**54 (49)**	**56 (51.5)**
55	Kerbside	Y	**59 (49)**	**41** (35)	**48 (40)**	**52 (42)**	**55 (45.2)**
56e	Roadside	Y	**41** (39)	35 (30)	**41 (41)**	**46 (44)**	38

Site ID	Site Type	Within AQMA?	Annual mean concentration (adjusted for bias) μg m^{-3}				
			2010* (Bias Adjustment Factor = 1.06)	**2011* (Bias Adjustment Factor = 0.92)**	**2012* (Bias Adjustment Factor = 1.06)**	**2013* (Bias Adjustment Factor = 0.96)**	**2014* (Bias Adjustment Factor = 0.97)**
57e	Kerbside	Y	24 (23)	38 (38)	39 (38)		36
58h	Kerbside	Y	**43** (39)	**52 (49)**	**58 (51)**		**50 (40.4)**
RUT 01	Roadside	Y	**70 (70)**	**48 (48)**	**53 (53)**	**60 (60)**	**62 (61.7)**
RUT 02	Kerbside	Y	**106 (90)**	**93 (78)**	**95 (80)**	**94 (79)**	**96 (81.1)**
RUT 03i	Background	Y	32	26	closed	closed	closed
RUT 04j	Background	Y	29	29 (36)	closed	closed	closed
59k	Kerbside	Y	Not open	Not open	**44 (41)**	**46 (43)**	**42** (39.7)
60l	Kerbside	Y	Not open	Not open	**40** (39)	32 (30)	32
61m	Roadside	Y	Not open	Not open	**55 (47)**	**58 (51)**	**54 (48.6)**
62n	Kerbside	Y	Not open	Not open	Not open	**54 (45)**	**52 (44.6)**
63o	Kerbside	Y	Not open	Not open	Not open	**43** (38)	**42** (38)
64p	Kerbside	Y	Not open	Not open	Not open	**54 (48)**	**60 (53.2)**

[a] Exceedences of the 40 μg m^{-3} objective in **bold** and exceedences of 60 μg m^{-3} underlined.

2.2.2 PM_{10}

The LBRuT uses a Tapered Element Oscillating Microbalance (TEOM) to continuously monitor PM_{10}. All TEOM results are converted to reference equivalence using the Volatile Correction Method (VCM), which is administered by King's College London, when they process our monitoring data. As mentioned in section 1.4, PM_{10} is a specified pollutant for the whole Borough AQMA.

The PM_{10} monitoring results for the LBRuT automatic sites are compared directly to the annual mean and 24 hour mean objectives. The following tables (Tables 8 and 9) provide results for the period from 2010 to 2014 inclusive. All year data except for 2014 are fully ratified.

PM_{10} measurement was undertaken at three sites including the Mobile Air Unit, which was placed in Hanworth Road during all the 2014 monitoring period. The data capture was good, representing more than 90% at each site. The R1 Castelnau site achieved 91%, the R2 Wetlands site 96% and the Mobile Air Unit in Hanworth Road 98%.

Table 8 provides results of automatic monitoring of PM_{10} and a comparison with annual mean objective. The objective of 40 $\mu g\ m^{-3}$ was met at each site for every year reported.

The 2014 annual mean for the Mobile Air Quality Unit, located at a roadside site was highest, with the other road side site at Castelnau slightly lower. The lowest concentration monitored in the Borough was that of the background site at the Wetlands Centre in Barnes. The annual means from 2012 to 2014 at all three sites were similar for each year, albeit with 2014 recording the lowest concentrations.

Table 9 provides the comparison with 24-hour mean objective. The objective of no more than 35 days exceeding 50 $\mu g\ m^{-3}$ was met at each site for all years reported. All sites however exceeded this daily standard at least once for all years reported.

The number of days exceeding the daily standard at each site was the lowest recorded since 2010.

For 2011 the sites had an increased number of days that exceeded compared to previous years. This was mainly as a result of the episodes that arose in the early part of the year and also during November. These peaks in PM_{10} concentrations occur during periods of stable conditions, specifically during winter when London sources can dominate concentrations, at other times high pressure systems can lead to imported transboundary PM_{10} from elsewhere in the UK and Europe.

The concentrations measured in Richmond are considered typical of those measured elsewhere across London (KCL, 2012).

Table 8 Results of Automatic Monitoring of PM_{10}: Comparison with Annual Mean Objective

Site ID	Site Type	Within AQMA?	Valid Data Capture for monitoring Period %	Valid Data Capture 2014 %[a]	Confirm Gravimetric Equivalent (Y or NA)	Annual Mean Concentration μg m^{-3}				
						2010	2011	2012	2013	2014
Castelnau Library, Barnes (R1)	Roadside	Y	N/a	91	Y	21	23	21	22	20
Wetlands Centre, Barnes (R2)	Suburban	Y	N/a	96	Y	19	22	18	20	18
Mobile Air Quality Unit	Mostly roadside locations	Y	N/a	98	Y	22	27	24	25	23

[a] Data capture for the full calendar year (e.g. if monitoring was carried out for six months the maximum data capture for the full calendar year would be 50%).

Table 9 Results of Automatic Monitoring for PM_{10}: Comparison with 24-hour mean Objective

Site ID	Site Type	Within AQMA?	Valid Data Capture for monitoring Period %	Valid Data Capture 2014 %[a]	Confirm Gravimetric Equivalent	Number of Exceedences of 24-Hour Mean (50 μg m^{-3})				
						2010	2011	2012	2013	2014
Castelnau Library, Barnes (R1)	Roadside	Y	N/a	91	Y	2	15	14	10	4
Wetlands Centre, Barnes (R2)	Suburban	Y	N/a	96	Y	1	17	13	6	3
Mobile Air Quality Unit	Mostly roadside locations	Y	N/a	98	Y	1	12	10	8	6

[a] Data capture for the full calendar year (e.g. if monitoring was carried out for six months the maximum data capture for the full calendar year would be 50%).

2.2.3 Other pollutants monitored

Ozone

Ozone is continuously monitored at three sites in the Borough, including the Mobile Air Quality Unit which was located in Hanworth Road during all the 2014 monitoring period. The results from 2010 to 2014 are shown in Table 10 below.

These ozone data are useful for studies of urban background pollution levels within London. As expected, the data below demonstrates that higher exceedence levels arise away from busy roads.

Table 10 shows ozone levels at the Wetlands, Mobile and NPL from 2010 to 2014. The UK's air quality objective limit is no more than 10 exceedences of 100 µg m^{-3} as the daily maximum of the running 8-hour mean. (NB this objective is not part of the LAQM as advised earlier in Section 1.3). All exceedences of the 8 hour mean limit are highlighted in bold.

Table 10 Ozone levels in LBRuT (2010 to 2014)

	2010	2011	2012	2013	2014
Wetlands					
Number of exceedences of the running 8-hour mean	6	**12**	**15**	**15**	**16**
Data capture (%)	97%	97%	95%	90%	99%
Mobile Unit					
Number of exceedences of the running 8-hour mean	0	1	2	0	1
Data Capture (%)	98%	91%	75%	80%	98%
NPL – Teddington AURN					
Number of exceedences of the running 8-hour mean	**16**	**28**	6	**25**	5
Data capture (%)	83%	97%	92%	68%	83%

$PM_{2.5}$

$PM_{2.5}$ monitoring was undertaken at the National Physical Laboratory (NPL) background site using the Filter Dynamics Measurement System (FDMS). The monitoring started in 2009 and ended in mid-2013.

Table 11 $PM_{2.5}$ levels at NPL

NPL – Teddington AURN	2010	2011	2012	2013
Annual mean [a]	14	17.5	11.5	*16.7*
Data capture (%)	77%	80%	98%	52%

The objective, which is not part of LAQM, is (i) an annual average target value of 25 µg m^{-3} by 2010; (ii) limit value of 25 µg m^{-3} by 2015; (iii) exposure reduction target of up to 20% reduction of urban background particulate matter levels from a reference year of 2010, to be achieved by 2020.

The results show that the $PM_{2.5}$ levels for 2010, 2011 and 2012 were below the target value. The results for the $PM_{2.5}$ levels for 2013 were also below, although they do not represent the full year.

2.2.4 Summary of Compliance with AQS Objectives

The London Borough of Richmond upon Thames has examined the results from monitoring in the Borough. The results show that concentrations of PM_{10} were below the relevant objective values. NO_2 concentrations exceeded the objectives at a number of locations across the Borough. In addition, the latest modelling for 2015 confirms that there is still a need for the LBRuT to be designated as a borough-wide AQMA for NO_2.

The position with PM_{10} designation is more border-line, with exceedences still possible at some vulnerable receptor locations (as indicated by modelling). It therefore seems sensible to retain the Borough wide AQMA PM_{10} designation for the present, to accommodate a poor meteorological year, rather than revoke the designation just yet.

3 Road Traffic Sources

3.1 Narrow Congested Streets with Residential Properties Close to the Kerb

The London Borough of Richmond upon Thames confirms that there are no new/newly identified congested streets with a flow above 5,000 vehicles per day and residential properties close to the kerb, that have not been adequately considered in previous rounds of Review and Assessment.

3.2 Busy Streets Where People May Spend 1-hour or More Close to Traffic

The London Borough of Richmond upon Thames confirms that there are no new/newly identified busy streets where people may spend 1 hour or more close to traffic.

3.3 Roads with a High Flow of Buses and/or HGVs.

The London Borough of Richmond upon Thames confirms that there are no new/newly identified roads with high flows of buses/HDVs.

3.4 Junctions

The London Borough of Richmond upon Thames confirms that there are no new/newly identified busy junctions/busy roads.

3.5 New Roads Constructed or Proposed Since the Last Round of Review and Assessment

The London Borough of Richmond upon Thames confirms that there are no new/proposed roads.

3.6 Roads with Significantly Changed Traffic Flows

The London Borough of Richmond upon Thames confirms that there are no new/newly identified roads with significantly changed traffic flows.

3.7 Bus and Coach Stations

The London Borough of Richmond upon Thames confirms that there are no relevant bus stations in the Local Authority area.

4 Other Transport Sources

4.1 Airports

The London Borough of Richmond upon Thames confirms that there are no new airports within its boundary. Heathrow is approximately 5 km away. Aircraft fly over the Borough, on both take offs and landings. Although there are significant pollutant emissions over the Borough, the height of the aircraft (over 1500 feet) is sufficiently high to ensure that the concentrated pollution does not reach the ground.

The other noteworthy source of airport related pollution in the Borough comes from the road traffic which is related to airport operations. At the Terminal 5 Inquiry, the road traffic was modelled for when T5 would be fully operational (2016), and it was estimated that the T5 traffic would constitute 5% of traffic on major roads and 3% on minor roads, for the parts of the Borough nearest to Heathrow.

4.2 Railways (Diesel and Steam Trains)

4.2.1 Stationary Trains

The London Borough of Richmond upon Thames confirms that there are no locations where diesel or steam trains are regularly stationary for periods of 15 minutes or more, with potential for relevant exposure within 15m.

4.2.2 Moving Trains

The London Borough of Richmond upon Thames confirms that there are no locations with a large number of movements of diesel locomotives, and potential long-term relevant exposure within 30m.

4.3 Ports (Shipping)

The London Borough of Richmond upon Thames confirms that there are no ports or shipping that meet the specified criteria within its area.

5 Industrial Sources

5.1 Industrial Installations

5.1.1 New or Proposed Installations for which an Air Quality Assessment has been Carried Out

The London Borough of Richmond upon Thames confirms that there are no new or proposed industrial installations for which planning approval has been granted within its area, or nearby in a neighbouring authority.

5.1.2 Existing Installations where Emissions have Increased Substantially or New Relevant Exposure has been introduced

The London Borough of Richmond upon Thames confirms that there are no industrial installations with substantially increased emissions or new relevant exposure in their vicinity within its area or nearby in a neighbouring authority.

5.1.3 New or Significantly Changed Installations with No Previous Air Quality Assessment

The London Borough of Richmond upon Thames confirms that there are no new or proposed industrial installations for which planning approval has been granted within its area or nearby in a neighbouring authority.

5.2 Major Fuel (Petrol) Storage Depots

There are no major fuel (petrol) storage depots within the Local Authority area.

5.3 Petrol Stations

The London Borough of Richmond upon Thames confirms that there are no petrol stations meeting the specified criteria**.**

5.4 Poultry Farms

The London Borough of Richmond upon Thames confirms that there are no poultry farms meeting the specified criteria.

6 Commercial and Domestic Sources

6.1 Biomass Combustion – Individual Installations

The London Borough of Richmond upon Thames confirms that there are no known new individual biomass combustion installations in the Local Authority area, since the 2013 Progress Report

6.2 Biomass Combustion – Combined Impacts

The London Borough of Richmond upon Thames confirms that there are no known areas of combined biomass combustion in the Local Authority area which are likely to be significant

6.3 Domestic Solid-Fuel Burning

The London Borough of Richmond upon Thames confirms that there are no areas of significant domestic fuel use in the Local Authority area.

7 Fugitive or Uncontrolled Sources

The London Borough of Richmond upon Thames confirms that there are no potential sources of fugitive particulate matter emissions in the Local Authority area.

8 Conclusions and Proposed Actions

8.1 Conclusions from New Monitoring Data

In 2014 NO_2 concentrations were found to exceed the objective of 40ug m^{-3} at many of the locations monitored. This conclusion remains true even when façade level corrections are made, indicating that there are still exceedences with relevant public exposure. This indicates the continuing need for the Borough to remain designated as a Borough-wide AQMA, for NO_2. The results further indicate that the hourly objective is potentially exceeded however at some sites.

The PM_{10} monitoring results show that the annual mean PM_{10} and daily mean PM_{10} limits were not exceeded at any site in the Borough during the last four years. However, modelling undertaken for 2015 (from the 2014 Progress Report) indicates that we should expect the objectives to be exceeded at a few vulnerable receptor sites. On that basis the AQMA designation for PM_{10} is retained.

8.2 Conclusions from Assessment of Sources

The Updating Screening and Assessment report has not identified any new or significantly altered road traffic, industrial, commercial or domestic sources that need to be subjected to a Detailed Assessment.

8.3 Proposed Actions

This report follows the technical guidance (TG09) and fulfils this part of the continuing LAQM process.

The findings from following this methodology are that the Council has not identified a need to amend air quality boundaries and thus need not proceed to a Detailed Assessment. The findings also indicate that the AQMA should be maintained.

The Council will therefore undertake the following actions:

1. Undertake consultation on the findings arising from this report with the statutory and other consultees as required.

2. Maintain the existing monitoring programme so far as reasonably practicable.

3. Continue with its Air Quality Action Plan in pursuit of the AQS objectives.

4. Prepare for the submission of its next Air Quality report.

9 References

Department for the Environment, Food and Rural Affairs (DEFRA), 2003. Technical Guidance for Local Air Quality Management LAQM. TG (09) HMSO, London.
The report can be found at: http://www.defra.gov.uk/publications/files/pb13081-tech-guidance-laqm-tg-09-090218.pdf

Department for the Environment, Food and Rural Affairs (DEFRA), 2007. The Air Quality Strategy for England, Scotland, Wales and Northern Ireland. HMSO, London.
The report can be found at:
http://archive.defra.gov.uk/environment/quality/air/airquality/strategy/documents/air-qualitystrategy-vol1.pdf

Office of Public Sector Information (OPSI), 2007. Statutory Instruments 2007 No. 64 environmental protection. The Air Quality Standards Regulations 2007.
The regulations can be found at: www.opsi.gov.uk/si/si2007/uksi_20070064_en_1

Local Air Quality Management – Policy Guidance (PG09)
http://www.defra.gov.uk/publications/2011/06/17/pb13566-laqm-policy-guidance-pg09/

Useful Tools and Technical Guidance
http://www.defra.gov.uk/environment/quality/air/air-quality/laqm/guidance/policy/

London Air Quality Network
http://www.londonair.org.uk/LondonAir/Default.aspx

London Borough of Richmond upon Thames – 2014 Air Quality Progress Report for The London Borough of Richmond upon Thames
http://www.richmond.gov.uk/home/services/environment/pollution/air_pollution/air_quality_reports/progress_reports_and_air_quality_action_plans.htm

Appendices

Appendix A: QA/QC Data

Appendix B: 2014 NO_2 diffusion tubes Data

Appendix A: QA/QC Data

All data undergoes quality assurance and quality control (QA/QC) procedures to ensure that the data obtained are of a high quality.

Diffusion Tube Bias Adjustment Factors from Local Co-location Studies

The Borough undertakes co-location studies at three continuous NO_2 monitoring sites, together with 3x NO_2 diffusion tubes at each of the following the locations:
Richmond 1 Castelnau (site 23): a roadside site.
Richmond 2 Barnes Wetlands (site 37): a suburban site.
Richmond Mobile: a roadside site, located at Hanworth Road from 15/3/12.

In 2014 the results were as following;

- The annual average for the Castelnau diffusion tubes (Nº 23) is 39 μg m^{-3}; for the continuous site (R1) it is 37 μg m^3. Thus the bias adjustment factor is **0.95**
- The annual average for the Wetlands diffusion tubes (Nº 37) is 23 μg m^{-3}; for the continuous site (R2) it is 25 μg m^3. Thus the bias adjustment factor is **1.09**
- The annual average for the Mobile Air Unit diffusion tubes is 49 μg m^{-3}; for the continuous site it is 42 μg m^3. Thus the bias adjustment factor is **0.86**

The 2014 bias adjustment factor used in this report is the average of the three values mentioned above; **0.97**.

PM_{10} Monitoring Adjustment

PM_{10} particulates are measured using Tapered Element Oscillating Microbalance (TEOM) analysers, with the data presented as the gravimetric equivalent.

No automatic or fortnightly calibrations are carried out on TEOMs. Calibrations are only carried as part of the routine servicing and regular independent audits. The on-going performance of the monitor is checked on-line, by the King's College London Duty Officer. The role of the LSO at the fortnightly visits is to make more detailed performance checks. The LSO is also on standby at other times, to change the TEOM's monitoring filter as required, depending on the filter loading.

Since 2009, TEOM data have been improved by routine adjustments, using the volatile correction method (VCM). This corrects for the loss of any volatile mass, which has been driven off by the heat applied in the TEOM's inlet column. The VCM adjustments are carried out by King's College London, prior to dissemination of the data.

The TEOM equipment is serviced every six months and also audited by NPL every six months as part of the King's LAQN QA/QC procedure, to ensure optimum data quality. All three sites are part of the LAQN and King's are responsible for the daily data collection, storage, validation and dissemination via the LAQN website (www.londonair.org.uk). King's ratifies the data periodically, viewing data over longer time periods and using the results from fortnightly checks, equipment services and equipment audits.

QA/QC of NO_2 Automatic Monitoring

Each NO_2 continuous analyser is automatically calibrated every night and also manually checked and calibrated every two weeks. There is a need for frequent calibration adjustments as the gradual build-up of dirt within the analyser reduces the response rate. This fall off in response needs appropriate correction, to ensure the recording of the true concentrations. The calibration process involves checking the monitoring accuracy against a known concentration of span gas. The span gas used is nitric oxide and is certified to an accuracy of 5%. Both the automatic and manual calibrations use this same certified span gas (i.e. the automatic overnight one does not use the less accurate permeation tube method).

Teddington (AURN) monitoring station at NPL is part of the AURN and the QA/QC for this station is managed by AEA Technology. For more information go to www.airquality.co.uk/archive/index.php (Defra, 2009d).

QA/QC of Diffusion Tube Monitoring

Directive 2008/50/EC of the European Parliament and of the Council on ambient air quality and cleaner air for Europe (EC, 2008) sets data quality objectives for NO_2 along with other pollutants. Under the Directive, annual mean NO_2 concentration data

derived from diffusion tube measurements must demonstrate an accuracy of ±25 % to enable comparison with the NO_2 air quality objectives of the Directive.

In order to ensure that NO_2 concentrations reported are of a high quality, strict performance criteria need to be met through the execution of QA and QC procedures. A number of factors have been identified as influencing the performance of NO_2 diffusion tubes including the laboratory preparing and analysing the tubes, and the tube preparation method (AEA, 2008). QA and QC procedures are therefore an integral feature of any monitoring programme, ensuring that uncertainties in the data are minimised and allowing the best estimate of true concentrations to be determined.

Our NO_2 diffusion tubes are analysed for us by Gradko. Gradko take an active role in developing rigorous QA and QC procedures in order to maintain the highest degree of confidence in their laboratory measurements. Gradko were involved in the production of the Harmonisation Practical Guidance for NO_2 diffusion tubes (AEA, 2008) and have been following the procedures set out in the guidance since January 2009.

For example, Gradko perform their own laboratory blank exposures that serve as a quality control check on the tube preparation procedure, as well as providing the Borough with a travel blank. In accordance with the latest guidance, blanks have not been routinely subtracted from results since the beginning of 2009 (AEA, 2008).

Appendix B: 2014 NO_2 diffusion tubes Data

Table 12 NO_2 diffusion tubes Data for 2014, non-bias adjusted (µg m^{-3})

Site Code	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual mean
1	55.65	45.80	52.91	48.41	47.50	43.04	54.66	44.30	52.87	49.15	56.65	52.37	50
2	40.28	29.57	37.36	30.99	25.27	35.61	33.48	23.69	39.19	31.21	42.73	33.13	34
3	44.57	39.69	42.66	42.28	47.46	40.31	45.20	38.91	51.36	46.61	53.17	52.86	45
4	47.23	39.46	46.31	49.23	43.47	46.96	44.55	33.24	56.91	39.09	54.00	42.35	45
5	closed	closed	closed	closed	closed	closed	closed	closed	closed	closed	closed	closed	-
6	44.72	30.29	49.62	44.33	34.64	43.27	40.32	35.95	54.17	36.37	53.92	38.79	42
7	47.65	30.62	58.09	64.80	39.95	67.14	67.61	43.26	72.90	44.60	83.59	48.54	56
8	closed	closed	closed	closed	closed	closed	closed	closed	closed	closed	closed	closed	-
9	58.55	46.02	52.26	55.09	44.02	45.83	46.97	33.18	60.64	45.29	63.14	43.58	50
10	47.25	40.70	58.24	48.16	47.77	40.91	32.10	42.41	49.72	47.16	77.64	50.93	49
11	61.64	46.81	47.41	48.54	36.96	52.54	44.97	39.47	52.10	49.44	60.21	55.15	50
12	47.27	38.11	50.96	50.52	40.88	46.57	49.21	40.77	54.18	44.90	58.44	42.00	

													47
13	60.81	41.07	53.94	51.83	49.06	39.70	40.31	34.83	56.60	43.09	57.82	47.35	48
14	48.94	43.08	52.25	45.70	39.99	42.01	48.43	38.08	51.26	46.00	55.75	48.21	47
15	43.85	36.11	42.59	39.72	39.81	39.44	42.32	38.36	46.09	39.95	47.18	40.26	41
16	54.06	39.16	46.19	42.65	45.64	41.44	39.77	36.97	46.76	33.37	55.50	47.48	44
17	78.91	68.57	75.09	68.00	68.74	71.59	68.48	58.50	82.26	66.94	70.68	64.20	70
18	63.11	68.05	72.61	65.17	72.32	78.81	69.69	66.60	82.86	96.29	52.57	23.29	68
19		56.41	62.36	60.93	49.88	53.56	52.84	51.26	57.40	56.28	60.50	56.91	56
20	59.05	49.45	55.90	49.58		51.98	53.67	58.82	59.98	57.51	69.62	56.11	57
21	38.01	31.14	44.78	46.14	37.72	45.74	40.38	34.81	53.97	35.03	55.26	44.08	42
22	72.68	50.01	57.37	65.24	56.26	52.15	60.97	50.97	74.98	58.76	72.88	62.11	61
23													39
24	46.21	34.31	45.37	38.97	37.38	39.44	38.43	32.76	52.76	36.58	51.02	46.85	42
25	46.16	41.98	54.29	53.23	51.30	58.73	53.93	47.65	71.45	44.26	57.65	48.29	52
26	46.74	36.01	48.75	40.21	40.09	36.10		35.51	49.38	44.34	50.06	50.46	43
27	38.14		50.70	39.28	27.53	38.39	34.47	30.14		42.62			38
28	21.28	13.27	22.03	21.42	14.17	17.35	15.27	12.18	23.00	15.49	29.18	23.41	19
29	43.39	34.13	38.45	34.19	32.97	35.04	28.77	25.47	47.42	38.17	48.58	32.72	37
30	39.94	27.78	39.41	37.53	30.99	35.75	30.41	23.65	46.99	31.40	44.96	33.09	35

31	80.94	54.33	71.65	58.37	65.35	46.12	60.87	53.81	69.45	63.11	77.28	60.04	63
32	93.25	73.67	85.89	79.50	85.49	52.65	70.30	57.68	87.14	74.38	81.01	58.71	75
33	61.16	43.52	74.07	66.58	89.43	80.83	92.61	59.32	87.59	56.83	73.67	65.24	71
34	40.58	33.92	45.36	45.56	36.16	38.82	38.67	31.40	48.30	41.25	48.81	41.22	41
35	56.97	52.07	54.31	51.44	49.08	46.66	46.65	43.49	45.74	48.01	52.98	51.74	50
36	60.84	40.30	63.65	62.55	53.77	70.81	65.44	41.96	75.13	45.93	65.38	53.04	58
37													23
38	closed	closed	closed	closed	closed	closed	closed	closed	closed	closed	closed	closed	-
39	58.23	47.27	68.51	55.63	53.21	59.98	56.38	57.67	72.40	55.12	55.26	58.43	58
40	45.51	34.99	43.43	41.59	41.15	34.55	39.15	32.84	47.81	33.53	56.59	46.06	41
41	40.71	35.98	49.28	42.28	36.65	39.38	41.85	34.91	50.74	41.12	49.79	45.82	42
42	54.81	44.43	57.49	63.43	67.89	54.98	59.58	34.06	71.30	45.90	60.86	48.96	55
43	22.32	97.03	88.62	89.58	86.98	88.24	94.69	82.52	89.77	80.77	86.25	87.78	83
44	44.70	40.26	49.49	47.27	38.15	40.40	38.90	38.50	55.10	42.88	68.80	51.98	46
45	56.76	47.53	51.60	44.60	42.34	42.23	43.30	39.50	50.67	49.19		42.18	46
46	closed	closed	closed	closed	closed	closed	closed	closed	closed	closed	closed	closed	-
47	38.19	28.01	46.44	39.93	34.77	35.52	41.52	31.62	47.03	27.21	46.51	38.90	38
48	52.35	49.50	51.85	45.74	44.99	44.64	45.46	39.02	51.43	40.91	50.28	41.29	46
49	42.66	36.43	46.95	48.29	46.49	48.08	57.02	32.24	59.06	36.19	60.16	41.60	46

50	60.48	48.11	65.09	58.27	62.03	66.83	67.84	54.37	76.16	59.94	72.35	53.52	62
51	39.14	31.94	36.88	34.82	28.19	31.15	28.52	25.78	40.80	33.07	49.89	37.38	35
52	67.95	50.62	69.01	65.85	60.53	72.43	75.01	52.26		55.04	67.18	65.30	64
53													49
54	61.01	55.88	54.67	55.10	62.76	53.86	54.63	53.92	67.88	55.80	60.76	53.88	58
55	59.55	47.85	59.08	54.28	54.72	55.64	66.29	49.82	65.21	51.58	60.20	51.64	56
56	42.72	30.22	42.12	40.70	31.09	43.04	37.89	31.51	45.29	41.98	41.47	42.13	39
57	42.36	28.06	42.68	38.64	30.91	34.61	35.63	35.50	42.12	31.59	44.76	41.96	37
58	56.15	40.67	54.53	54.51	54.44	55.90	50.75	36.25	59.55	45.92	57.71	49.73	51
59	45.02	37.75	48.24	49.14	49.91	53.64	52.89	35.79	58.70	11.41		39.04	44
60	40.34	29.48	38.01	35.30		29.01	30.34	22.79		28.57	39.73		33
61	63.31	47.44	63.94	67.72	56.27	59.98	62.78	31.62	48.89	41.72	73.60	51.73	56
62	48.56	43.46	53.51	56.88		57.35	56.98	50.51	62.09	46.42	60.80	58.44	54
63	46.57	43.29	44.21	38.67	40.79	35.39	35.47	31.53	46.69	47.43	61.71	43.58	43
64	59.95	51.95	62.34	59.20	52.81	68.23	74.38	55.30	68.29	63.51	67.62	55.74	62
Rut 01	64.42	46.98	55.34	49.96		50.59	51.31	47.91	60.32	57.06	172.61	48.45	64
Rut 02	93.67	88.57	110.80	90.32	93.41	109.74	122.03	101.80	109.43	90.97		83.27	99
Rut 03	closed	closed	closed	closed	closed	closed	closed	closed	closed	closed	closed	closed	-
Rut 04	closed	closed	closed	closed	closed	closed	closed	closed	closed	closed	closed	closed	-

Site Code	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual mean
23	42.80	35.95	42.98	39.48	35.07	36.63	37.04	27.65	47.91	42.86	52.92	37.87	39.93
23/2	40.12	31.45	41.80	43.30	34.71	39.07	39.59	29.15	46.03	39.35		38.35	38.45
23/3	40.92	30.26	44.24	42.56	36.98	36.48	39.02	25.05	42.98	36.92	48.47	38.13	38.50
Average													38.96
37	25.53	16.60	26.69	25.54	16.70	18.28	18.39	17.93	28.94	20.67	32.42	21.60	22.44
37/2	25.24	17.31	32.72	26.12	19.55	22.02	19.68	16.03	26.96	19.82	33.85	28.35	23.97
37/3	25.00	16.97	33.36	25.99	17.60	22.10	19.94	17.28	27.35	19.75	34.10	24.65	23.68
Average													23.36
53	49.27	40.58	45.57	48.40	42.67	47.25	52.07	41.52	52.47	44.52	56.26	43.03	46.97
53/2	51.95		50.90	51.61	44.23	50.99	50.65	44.40	56.03	47.94	53.50	45.95	49.83
53/3	54.58	43.37	51.71	47.70	47.40	46.83	49.18	42.37	56.28	49.56	55.97	47.85	49.40
Average													48.73