London Borough of Richmond upon Thames Air Quality Annual Status Report for 2018
Date of publication: 1st July 2019

This report provides a detailed overview of air quality in the London Borough of Richmond Upon Thames during 2018. It has been produced to meet the requirements of the London Local Air Quality Management statutory process[1].

[1] LLAQM Policy and Technical Guidance 2016 (LLAQM.TG(16)). https://www.london.gov.uk/what-we-do/environment/pollution-and-air-quality/working-boroughs

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Executive Summary

The London Borough of Richmond upon Thames is committed to improving air quality in the Borough. 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 2019 Annual Status Report reviews recent air quality monitoring in the Borough in accordance with Defra LAQM guidance. In doing so, it fulfils one further aspect of this ongoing commitment.

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.

In December 2000 the Council designated an AQMA across the whole Borough for nitrogen dioxide and particles (specifically PM_{10}). 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. Update and implement 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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Abbreviations

AQAP	Air Quality Action Plan
AQMA	Air Quality Management Area
AQO	Air Quality Objective
BEB	Buildings Emission Benchmark
CAB	Cleaner Air Borough
CAZ	Central Activity Zone
EV	Electric Vehicle
GLA	Greater London Authority
LAEI	London Atmospheric Emissions Inventory
LAQM	Local Air Quality Management
LLAQM	London Local Air Quality Management
NRMM	Non-Road Mobile Machinery
PM_{10}	Particulate matter less than 10 micron in diameter
$PM_{2.5}$	Particulate matter less than 2.5 micron in diameter
TEB	Transport Emissions Benchmark
TfL	Transport for London

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 A. 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 A. Summary of National Air Quality Standards and Objectives

Pollutant	Objective (UK)	Averaging Period	Date[1]
Nitrogen dioxide - NO_2	200 μg m^{-3} not to be exceeded more than 18 times a year	1-hour mean	31 Dec 2005
	40 μg m^{-3}	Annual mean	31 Dec 2005
Particles - PM_{10}	50 μg m^{-3} not to be exceeded more than 35 times a year	24-hour mean	31 Dec 2004
	40 μg m^{-3}	Annual mean	31 Dec 2004
Particles - $PM_{2.5}$	25 μg m^{-3}	Annual mean	2020
	Target of 15% reduction in concentration at urban background locations	3 year mean	Between 2010 and 2020
Sulphur Dioxide (SO_2)	266 μg m^{-3} not to be exceeded more than 35 times a year	15 minute mean	31 Dec 2005
	350 μg m^{-3} not to be exceeded more than 24 times a year	1 hour mean	31 Dec 2004
	125 μg m^{-3} mot to be exceeded more than 3 times a year	24 hour mean	31 Dec 2004

Note: [1]by which to be achieved by and maintained thereafter

1. Air Quality Monitoring

The latest monitoring results for 2018 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 to pursue improvements in air quality.

The Council (and NPL for $PM_{2.5}$) routinely monitor 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) which are not included in this report. Please see previous Council reports for further information. All complied with EU limit values for a minimum of 3 years pre cessation.

1.1 Locations

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 cost prohibitive.

The sites (see Table B) 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). Richmond also has a mobile Air Quality monitoring unit, which was stationed at Chertsey Road throughout 2018. Results are included in this report.

All data undergoes 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 B. Details of Automatic Monitoring Sites for 2018

Site ID	Site Name	X (m)	Y (m)	Site Type	In AQMA?	Distance from monitoring site to relevant exposure	Distance to kerb of nearest road (N/A if not applicable)	Inlet height	Pollutants monitored	Monitoring technique
RI1	**Castelnau Library**, Barnes	522500	177165	Roadside	Y	8m	3m	2.35m	NO2, PM10	Chemiluminescent; TEOM
RI2	**Wetlands Centre**, Barnes	522991	176495	Suburban	Y	Children in ajacent play area/people attending Wetlands Centre	N/A	3.2m	NO2, PM10,O3	Chemiluminescent; TEOM
RHG	**Mobile** Air Quality Unit, Chertsey Rd,TW2	515354	173994	Roadside	Y	2.3m	1.6m	2.9m	NO2, PM10	Chemiluminescent; TEOM
TD0	**NPL -** Teddington AURN	515542	170420	Suburban	Y	N/A	N/A		NO2,PM2.5 and O3	Chemiluminescent; FDMS

Non-Automatic Monitoring Sites

Table C lists the details of the NO2 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 provide monthly averages and so provide an indication of NO2 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 64 diffusion tube sites across the Borough in 2018. Three of the diffusion tubes sites are triplicate and collocated with all 3 Council automatic monitoring sites. All sites are kept under constant review and a few will be amended or moved, often in response to requests for more relevant monitoring, at the beginning of each year.

Table C. Details of Non-Automatic Monitoring Sites for 2018

Site ID	Site Name	X (m)	Y (m)	Site Type	In AQMA?	Distance of tube to kerbside	Distance of receptor to kerbside	Inlet height (approx.)	Pollutants monitored	Tube co-located with an automatic monitor?
						(m)	(m)	(m)		(Y/N)
1	Hampton Court Rd, Hampton	515824	168815	roadside	Y	1.7m	1.9m	2.2m	NO2	N
2	Percy Rd, Hampton (nr. Oldfield Rd)	513229	169712	roadside	Y	1.3m	3.0m	2.2m	NO2	N
4	Hampton Rd, Teddington (nr. Bushy Pk Gardens)	514882	171155	kerbside	Y	0.6m	9.8m	2.2m	NO2	N

6	Kingston Rd, Teddington (nr. Woffington Close)	517266	170031	kerbside	Y	0.7m	6.5m	2.2m	NO2	N
7	Broad St, Teddington (Boots)	515624	170975	kerbside	Y	0.8m	2.5m	2.2m	NO2	N
9	Hampton Rd, Twickenham	514842	172346	kerbside	Y	0.6m	2.0m	2.2m	NO2	N
10	Twickenham Rd, Twickenham (opp. Fulwell golf course)	513278	172199	kerbside	Y	0.6m	7.2m	2.2m	NO2	N
11	Percy Rd, Whitton (nr. Percy Way)	514050	173189	kerbside	Y	0.6m	9.1m	2.2m	NO2	N
12	Hanworth Rd, Whitton	512600	173404	kerbside	Y	0.6m	7.4m	2.2m	NO2	N
13	Whitton Rd, Whitton, (opp. rugby ground)	515228	174082	kerbside	Y	0.8m	6.3m	2.2m	NO2	N
14	Cross Deep, Twickenham (nr Poulett Gardens)	516133	173051	kerbside	Y	0.3m	2.7m	2.2m	NO2	N
15	Richmond Rd, Twickenham (opp. Marble Hill Pk)	517197	173939	kerbside	Y	0.6m	1.8m	2.2m	NO2	N

16	St Margarets Rd, St Margarets (nr. Bridge Rd)	517558	174369	roadside	Y	1.2m	3.1m	2.2m	NO2	N
17	Red Lion Street, Richmond	517822	174755	roadside	Y	1.2m	2.0m	2.2m	NO2	N
18	Lower Mortlake Rd, Richmond (nr. Trinity Rd)	518822	175590	kerbside	Y	0.9m	9.3m	2.2m	NO2	N
19	Kew Rd, Kew (nr. Walpole Av)	518637	176161	kerbside	Y	0.7m	16m	2.2m	NO2	N
20	Mortlake Rd, Kew (nr. Kent Rd)	519205	177221	kerbside	Y	0.6m	2.8	2.2m	NO2	N
21	Lower Richmond Rd, Mortlake, nr Chalkers Cnr	520053	175826	roadside	Y	2.0m	7.0m	2.2m	NO2	N
22	Castelnau, Barnes (nr. Hammersmith Bridge)	522845	177904	kerbside	Y	0.5m	4.2m	2.2m	NO2	N
23	Castelnau Library, Barnes (static site)	522502	177166	roadside	Y	3.3m	9m	2.2m	NO2	N
24	Lonsdale Road, Barnes (nr. Suffolk Rd)	521750	177056	kerbside	Y	0.3m	6.3m	2.2m	NO2	Y

25	URRW, (nr. Sheen School)	521211	175457	roadside	Y	2.3m	2.5m	2.2m	NO2	N
26	URRW, Sheen (nr. Courtland Estate)	519031	175021	roadside	Y	3.2m	11.8	2.2m	NO2	N
27	Queens Rd, Richmond (nr. Russell Walk)	518663	174208	kerbside	Y	0.7m	6.8m	2.2m	NO2	N
28	Holly Lodge, Richmond Pk	519467	173993	urban backgro und	Y	2175m	N/A	2.2m	NO2	N
29	Petersham Rd, Ham (nr. Sandy Lane)	517967	172543	kerbside	Y	0.6m	3.6m	2.2m	NO2	N
31	A316 (nr. Chudleigh Rd)	515438	174048	roadside	Y	1.0m	6.4m	2.2m	NO2	N
32	Kings St, Twickenham	516226	173195	roadside	Y	1.0m	3.2m (2.8m pavement café)	2.2m	NO2	N
33	Heath Rd, Twickenham	515927	173129	roadside	Y	3.3m	6.9m	2.2m	NO2	N
34	Thames St, Hampton	513552	169498	roadside	Y	1.4m	1.3m	2.4m	NO2	N

35	High St, Hampton Wick	517524	169583	roadside	Y	1.3m	1.4m	2.2m	NO2	N
36	Upper Richmond Road West (URRW) nr Sheen Lane	520545	175400	roadside	Y	2.1m	2.2m	2.2m	NO2	N
37	Wetlands, Barnes (static site)	522989	176727	urban background	Y	1160m	230m	2.2m	NO2	N
39	Richmond Rd, nr. Richmond Bridge, East Twickenham	517592	174404	roadside	Y	1.2m	2.7m	2.2m	NO2	Y
40	Staines Rd, Twickenham	514278	172521	roadside	Y	1.0m	11.4m	2.2m	NO2	N
41	Paradise Rd, Richmond	518102	174854	kerbside	Y	0.9m	5.6m	2.2m	NO2	N
42	The Quadrant/Kew Rd, Richmond	518080	175259	roadside	Y	0.7m	2.9m	2.2m	NO2	N
43	Hill St, Richmond	517771	174701	kerbside	Y	0.7m	1.6m	2.2m	NO2	N
44	Sheen Rd, Richmond (near shops)	518458	175042	kerbside	Y	0.5m	0.5m	2.2m	NO2	N

45	154 High St, Teddington,	516383	171154	kerbside	Y	0.5m	3.3m	2.2m	NO2	N
47	Causeway, Teddington	515829	170967	roadside	Y	1.8m	2.7m	2.2m	NO2	N
48	Stanley Rd, Teddington (junc. Strathmore Rd)	515059	171758	roadside	Y	2.2m	5.4m	2.2m	NO2	N
50	URRW, nr. Clifford Av, Sheen	519962	175321	kerbside	Y	0.7	2.7	2.2m	NO2	N
51	Sheen Lane, E. Sheen (nr railway crossing)	520492	175695	kerbside	Y	0.4m	1.3m	2.2m	NO2	N
52	Clifford Av, Chalkers Corner	519776	175746	kerbside	Y	0.5	2.2	2.2m	NO2	N
53	co-located on mobile Air Quality unit	3 sites	3 sites	roadside	Y	varies	varies	2.2m	NO2	N
54	Mortlake Road, adjacent to West Hall Road, Kew	519585	176492	kerbside	Y	0.6	1.4	2.2m	NO2	N
55	Mortlake Road, adjacent to Cemetery Gates,	519793	176142	kerbside	Y	0.6	4.1	2.2m	NO2	Y

56	A316 (St Magarets)	516788	174519	roadside	Y	1.0m	9.6m	2.2m	NO2	N
57	A316 (Lincoln Avenue)	513915	172899	roadside	Y	1.00m	16.4m	2.2m	NO2	N
58	London Road, Twickenham	516039	173766	kerbside	Y	0.7m	6.4m	2.2m	NO2	N
59	Whitton Rd, Twickenham (near Twickenham bridge)	515980	173758	kerbside	Y	0.6m	1.4m	2.2m	NO2	N
60	Waldegrave Rd, Teddington	515894	171148	kerbside	Y	0.5m	2.2m	2.2m	NO2	N
61	London Road, Twickenham (near Waitrose)	516224	173444	roadside	Y	1.8m	4.3m	2.2m	NO2	N
62	High Street, Barnes	521651	176430	kerbside	Y	0.4m	2.3m	2.2m	NO2	N
63	High Street, Whitton	514181	173875	kerbside	Y	0.8m	3.2m	2.2m	NO2	N
64	High Street, Hampton Hill	514484	171251	kerbside	Y	0.5m	1.6m	2.2m	NO2	N

65	York Street, Twickenham	516339	173366	kerbside	Y	0.5m	2.7m	2.2m	NO2	N
66	South Circular, Kew Green	519060	177428	roadside	Y	2.1m	3.3m	2.2m	NO2	N
67	Petersham Rd opp Poppy Factory,	518042	174095	roadside	Y	1.4m	2.7m	2.2m	NO2	N
68	Rocks Lane, Barnes	522434	176507	roadside	Y	3.2m	3.8m	2.2m	NO2	N
69	Uxbridge Rd nr Longford Cl, TW12	513494	171729	roadside	Y	2.0m	2.9m	2.2m	NO2	N
Rut 01	Civic Centre, York St, Twickenham	516356	173365	roadside	Y	2.9m	3.0m	3.5m	NO2	N
Rut 02	George Street, Richmond	517917	174928	kerbside	Y	0.7m	2.2m	2.2m	NO2	N

Sites changes for 2018: sites 3 and 49 were closed, site 68 and 69 were opened, site 21 and 52 were moved closer to junction in response to resident's requests. All grid references in this chart are correct for 2018. Please see 2017 ASR for former grid references

1.2 Comparison of Monitoring Results with AQOs

The results presented are after bias adjustment and "annualisation" where required (annualisation required in LBRuT for 2018 at sites 33, 43 and 61 see Appendix A).

Table D. Annual Mean NO2 Ratified and Bias-adjusted Monitoring Results (□g m-3) For results that indicate the exposure estimate, calculated for the nearest residential façade see **Appendix A3**.

Site ID	Site type	Valid data capture for monitoring period %	Valid data capture 2018 %	Annual Mean Concentration (µgm^{-3})						
				2012	2013	2014	2015	2016	2017	2018
Castelnau Library, Barnes (RI1)	Roadside	100%	98%	37	39	37	34	36	31	31
Wetlands Centre, Barnes (RI2)	Suburban	100%	96%	25	24	25	21	25	21	20
Mobile- Chertsey Rd, TW2 (RHG)	Roadside	100%	93%	**44**	**43**	**42**	N/A	N/A	37	34
NPL - Teddington AURN (TD0)	Suburban	N/A	N/A	36	21	27	19	22	N/A	N/A

1	Roadside	100	100	**45**	**47**	**49**	**41**	**56**	**55**	**41**
2	Roadside	100	75	34	32	33	28	31	29	32
3	Roadside	100	closed	**44**	**44**	**44**	**41**	**42**	39	closed
4	Kerbside	100	100	**44**	**44**	**44**	36	**40**	36	35
5	Kerbside	closed	closed	33	closed	closed	closed	closed	closed	closed
6	Kerbside	100	100	**43**	**43**	**41**	36	37	30	34
7	Kerbside	100	100	**59**	**61**	**54**	**47**	**49**	**43**	**45**
8	Kerbside	closed	closed	34	closed	closed	closed	closed	closed	closed
9	Kerbside	100	100	**50**	**49**	**48**	**42**	**45**	**40**	**40**
10	Kerbside	100	100	**44**	**46**	**47**	**43**	**44**	**42**	**41**
11	Kerbside	100	100	**54**	**49**	**48**	**44**	**48**	**47**	**46**
12	Kerbside	100	100	**45**	**49**	**46**	**41**	**45**	**41**	**44**
13	Kerbside	100	100	**48**	**48**	**47**	**42**	**42**	**40**	**39**
14	Kerbside	100	92	**48**	**46**	**45**	39	**40**	36	36
15	Kerbside	100	100	**44**	**40**	40	37	**41**	38	34
16	Roadside	100	92	**45**	**44**	**43**	41	**42**	38	37
17	Kerbside	100	92	**70**	**68**	**68**	**63**	**69**	**60**	**54**
18	Kerbside	100	100	**68**	**71**	**66**	**67**	**56**	**58**	**46**
19	Kerbside	100	83	**56**	**53**	**55**	**48**	**49**	**49**	**42**
20	Kerbside	100	100	**53**	**51**	**55**	**48**	**47**	**45**	38
21	Roadside	100	92	**43**	**44**	**41**	37	39	36	**50**
22	Kerbside	100	100	**51**	**57**	**59**	**53**	**65**	**52**	**45**
23	Roadside	100	100	38	39	38	35	35	35	31
24	Kerbside	100	100	**40**	**40**	**40**	35	37	34	31
25	Roadside	100	100	**47**	**51**	**51**	**45**	**46**	38	38
26	Roadside	100	100	**42**	**43**	**42**	**40**	**40**	36	36

27	Roadside	100	92	**41**	**40**	38	37	**43**	**41**	37
28	Urban background	100	100	22	21	18	17	21	17	18
29	Kerbside	100	100	**43**	39	36	30	32	30	31
30	Roadside	100	100	36	38	34	29	33	closed	closed
31	Roadside	100	92	**59**	**61**	**62**	**54**	**54**	**52**	**49**
32	Roadside	100	100	**77**	**74**	**73**	**62**	**64**	**59**	**56**
33	Kerbside	100	58	**58**	**62**	**69**	**61**	**61**	**53**	**52**
34	Roadside	100	92	39	38	40	33	36	35	32
35	Roadside	100	100	**50**	**52**	**48**	**43**	**46**	**45**	**42**
36	Roadside	100	92	**54**	**56**	**56**	**49**	**50**	**60**	**63**
37	Urban background	100	100	25	25	22	21	25	20	21
38	Kerbside	closed	closed	closed	closed	closed	closed	closed	closed	closed
39	Kerbside	100	100	**62**	**56**	**56**	**52**	**55**	**52**	**45**
40	Kerbside	100	83	**43**	**41**	**40**	36	**45**	**42**	**41**
41	Kerbside	100	92	**45**	**42**	**41**	38	39	36	34
42	Roadside	100	92	**56**	**58**	**54**	**47**	**82**	**89**	**72**
43	Kerbside	100	50	**78**	**87**	**80**	**80**	**85**	**78**	**59**
44	Kerbside	100	100	**46**	**45**	**45**	39	**42**	**41**	**40**
45	Kerbside	100	100	**43**	**48**	**45**	35	37	35	33
46	Kerbside	closed	closed	**41**	closed	closed	closed	closed	closed	closed
47	Roadside	100	92	**40**	40	37	32	33	31	29
48	Roadside	100	100	**42**	45	**45**	39	**41**	**40**	**40**
49	Kerbside	100	100	**47**	45	**45**	39	**44**	31	closed
50	Kerbside	100	92	**63**	**61**	**60**	**57**	**55**	**53**	**52**

51	Kerbside	100	100	36	34	34	28	32	35	33
52	Kerbside	100	100	**59**	**59**	**62**	**55**	**57**	**50**	**59**
53	varies	100	100	**46**	**48**	**48**	N/A	N/A	**44**	**43**
54	Roadside	100	100	**55**	**54**	**56**	**51**	**49**	**48**	**40**
55	Roadside	100	92	**48**	**52**	**55**	**50**	**50**	**45**	**41**
56	Kerbside	100	100	**41**	**46**	38	37	**51**	**50**	**43**
57	Kerbside	100	92	38	39	36	33	**44**	**42**	**43**
58	Kerbside	100	92	**52**	**58**	**50**	**46**	**50**	**47**	**43**
59	Kerbside	100	100	**44**	**46**	**42**	**40**	**44**	39	**40**
60	Kerbside	100	92	**40**	32	32	27	29	29	29
61	Roadside	100	58	**55**	**58**	**54**	**48**	**49**	**45**	**43**
62	Kerbside	100	92	Not open	**54**	**52**	**46**	**51**	**50**	**43**
63	Kerbside	100	92	Not open	**43**	**42**	38	**41**	38	38
64	Kerbside	100	92	Not open	**54**	**60**	**55**	**53**	**49**	**45**
65	Kerbside	100	83	Not open	Not open	Not open	Not open	**75**	**68**	**55**
66	Kerbside	100	100	Not open	Not open	Not open	Not open	**49**	**49**	**42**
67	Kerbside	100	92	Not open	Not open	Not open	Not open	Not open	**44**	**41**
68	Kerbside	100	100	Not open	Not open	Not open	Not open	Not open	Not open	**55**
69	Kerbside	100	83	Not open	Not open	Not open	Not open	Not open	Not open	38
Rut 01	Kerbside	100	100	**53**	**60**	**56**	45	**50**	**51**	38
Rut 02	Kerbside	100	83	**95**	**94**	**88**	**88**	**96**	**82**	**66**

Notes: Exceedance of the NO_2 annual mean AQO of 40 μgm^{-3} are shown in **bold (orange/red)**.

NO_2 annual means in excess of 60 μg m^{-3}, indicating a potential exceedance of the NO^2 hourly mean AQS objective are shown in bold and underlined(red).
The bias adjustment factor used for all roadside/kerbside sites is 0.92 calculated using the national Gradko bias adjustment figure for 50%TEA/ACETONE.. The bias adjustment factor for background sites 28 and 37 is 0.93 calculated using the Wetlands site.
In 2015 the taxi rank was moved from outside Richmond station to opposite Richmond station. 6/1/16 site 42 moved along Quadrant from near bus stops to near new taxi rank
From 3/1/17 sites 25, 36, 49, 51, 56 were moved slightly (<20m) largely in response to residents requests for marginally better monitoring locations. All grid references are correct for 2017 and 2018 monitoring. Please see our 2016 Annual Status Report for earlier coordinates.
From 6/1/16 site 57 was moved nearer road, no longer behind small section of green screening to better represent most of this section of A316.
From 2/1/18 site 21 and 51 were moved closer to Chalker's Corner junction in response to resident's requests. Site 36 was moved slightly (<20m); sites 3 and 49 were closed; sites 68 and 69 opened. See Table C for correct grid references for 2018 and 2017 ASR for earlier grid references.

Diffusion Tube Monitoring Data

Table D shows the NO2 diffusion tube monitoring results, with bias corrected values for each year from 2012 to 2018. (Note – see Table M for monthly data for 2018 and Table K for the distance corrected). The results in bold(orange/red) indicate an exceedance of the annual mean objective of 40 μg m-3 and the results underlined (red) indicate NO2 annual means in excess of 60 μg m-3 indicating a potential exceedance of the NO2 hourly mean AQS objective.

The data capture for 2018 for most sites (86%) was very good (97.1%) but for the remaining 14% was disappointing – we appeared to suffer an unfortunate number of missing tubes at certain sites – more than in any single year since monitoring began in 1993. This is most unfortunate - whether or not this was deliberate is unknown. In particular, sites 33 and 61 suffered from missing tubes for 5 out of 12 months and 43 for 6 out of 12 months. Where data capture is less than 75%, as at these 3 sites, annualising in line with DEFRA guidance, TG(16) was required and was applied. Inevitably, data at these sites is possibly not as robust as at all other sites. Overall data capture for 2018, including sites 33, 43 and 61 was 87.2%.

The total number of sites where monitoring was undertaken was 64; 3 of these were triplicates, co-located next to real time analysers, 2 were background. The remainder were roadside or kerbside. The results from the 2018 monitoring show that the objective of 40 μg m-3 was exceeded at 41 sites, which is one more site than in 2017, though not always the same sites. 66% of sites have gone down, 20% of sites have gone up and 14% of sites have remained the same. This is good news in that far more have improved than worsened, though more improvement is required. Three 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. This is down from 6

exceedences of the 1 hour-mean objective in 2017, so half the number, which is significant. This represents a decrease in the highest concentrations from 2016 to 2017 to 2018. The highest exceedence at any site has decreased from 96 ug/m3 in 2016; 89 ug/m3 in 2017 and 72 ug/m3 in 2018 . This is encouraging. Although East Sheen, along Upper Richmond Road West remains high and has increased. The site was moved slightly this year (<20m). Congestion along this section of the South Circular remains high, so improvements in fleet appear to be negated by the number of vehicles on the road. This will not be helped in 2019 by the closure of Hammersmith Bridge for major repairs. The main decreases are concentrated around Richmond and Twickenham town centres and it is too early to be sure of a downward trend in levels of NO2. Looking generally at town centres, with the exception of East Sheen, there does appear to be a possible downward trend, although, as advised, it is rather early to be sure. Contributory factors are likely to be the introduction of cleaner buses and possibly the slow introduction of cleaner taxis and EV's into the fleet mix. Some main roads across the borough do not replicate this - some go up slightly, others down slightly year on year. 2011, 2015, 2017 and 2018 saw slightly lower levels but overall levels of NO2 have not reduced as quickly as desired. As is well known, Euro VI/6 standards have failed to deliver the forecast reductions in NO2 levels in real world driving conditions that were predicted. The sale of diesel cars has seen a significant reduction over the last 18 months but the rental market for diesels remains buoyant and the number of vehicles on the road has continued to increase, so congestion has continued to increase; this is a major hindrance to reductions in NO2. The LEZ, which has encouraged the use of Euro 4 or better for commercial vehicles , applicable along the A316, does seem to have resulted in some benefits indicated by lower trend data at site 18 and site 31 and also slight reductions at site 56, although 57 remains fairly static (NO2 diffusion tubes at both sites were moved slightly nearer the A316 on 2/1/16). George Street Richmond, which had recorded the highest exceedance each year since the site began, has shown a marked decrease in 2017 and 2018. The highest exceedance for 2018, as in 2017, was opposite Richmond station, The Quadrant Richmond, which is probably more a result of the new road layout, moving the taxi rank across the road. As mentioned above, new hybrid/cleaner buses were introduced in 2017 and 2018 on routes R68, R70, 65, 267 and 285. All sites along these routes show a small decrease – in 2018 site 42 and Rut 2 in Richmond, site 32 and 65 in Twickenham indicate encouraging reductions; site 64 in Hampton Hill and site 45 and 7 in Teddington are particularly affected, as these routes form a significant part of the bus fleet for these areas. This is encouraging and we will continue to monitor progress. The borough has lobbied the mayor for swifter upgrades across the bus fleet. We are promised that all bus fleets serving LBRuT will be hybrid or upgraded to cleaner buses by October 2020. Site 42 is next to the Richmond station taxi rank. Much work has been carried out during 2018 both top down and bottom up, with the

GLA and with the taxi drivers. We have had anti idling articles published in taxi trade magazines and Officer time and idling action campaigns have been spent talking to taxi drivers reminding them to not idle and this appears to be showing benefits. Taxi drivers are now switching off regularly when queuing in the taxi rank, which is very welcome.

The data for 2018 indicates that approximately two thirds (63%) of the sites exceed the objective of 40 μg m-3 with no sites recording double the objective. After the distance correction, the annual mean objective is exceeded at 27 sites. 3 sites exceed the annual mean concentration of 60 μg m-3, which as advised, indicates that the 1 hour-mean objective may also have been exceeded at these locations. These sites are:

Site 42 -The Quadrant, Richmond (72 μg m-3)

Site Rut 2 - George Street, Richmond (66 μg m-3)

Site 36 - Upper Richmond Rd West, near Sheen Lane, East Sheen (63μg m-3)

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.

The overall monitoring results for the Borough therefore show that NO2 concentrations exceeded the UK annual mean objective (as it has done for each year since 2002). This is also in line with the modelling prediction of the Borough (reported in the 2015 Annual Status Report). Improvements are still required.

This year as well as including bar charts of data for all sites ranked in order of exceedance, we have also looked back at 10 sites covering town centres, main roads, a level crossing and a background site from 2002 – 2018 to give more perspective to levels of NO2 over a longer time period. We hope this is enlightening.

Figure 1: Nitrogen Dioxide Bias Adjusted Annual Average Concentrations for all sites for 2018 (split over 2 graphs)

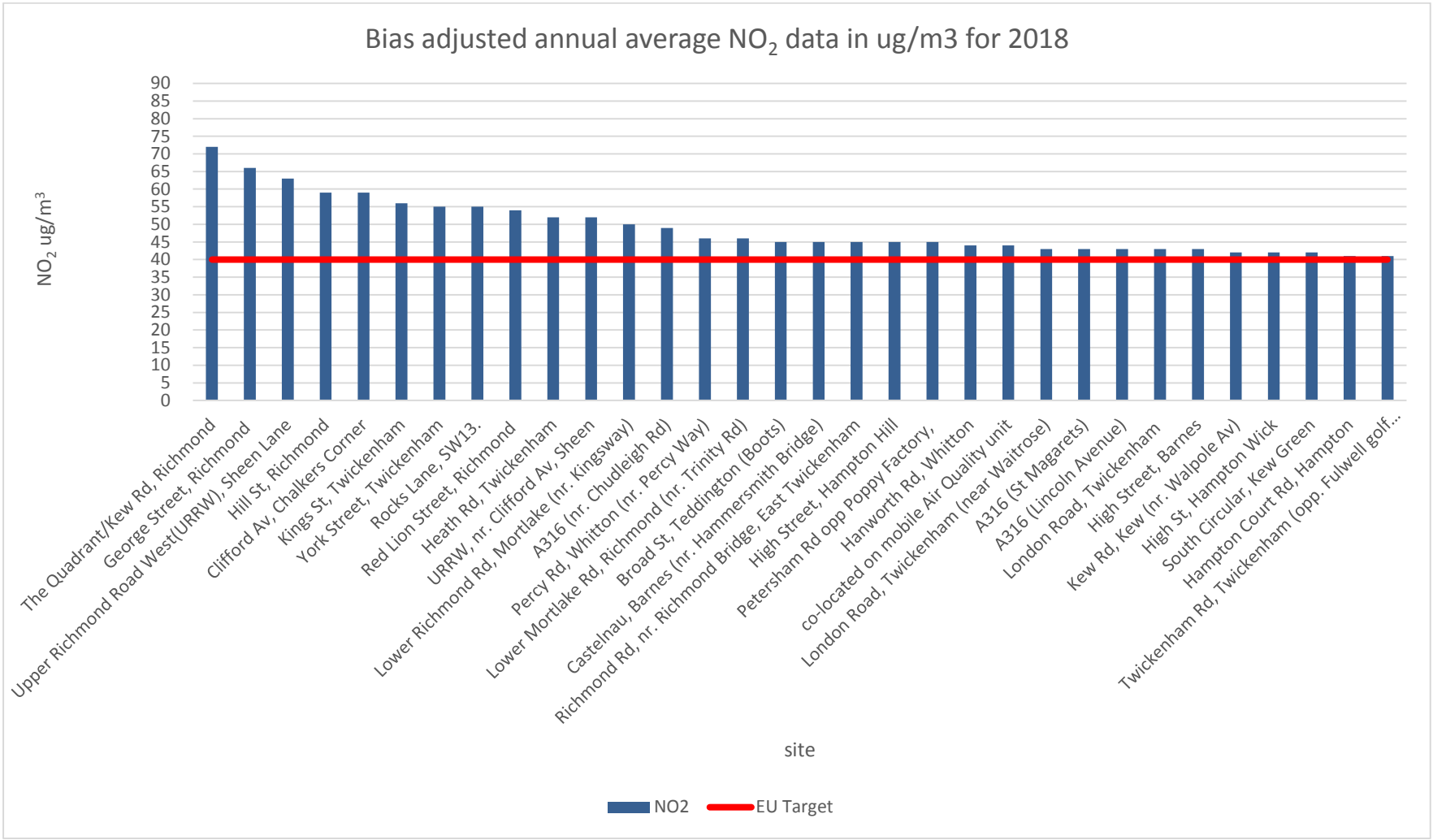


Figure 1: Nitrogen Dioxide Bias Adjusted Annual Average Concentrations for all sites for 2018 (split over 2 graphs)

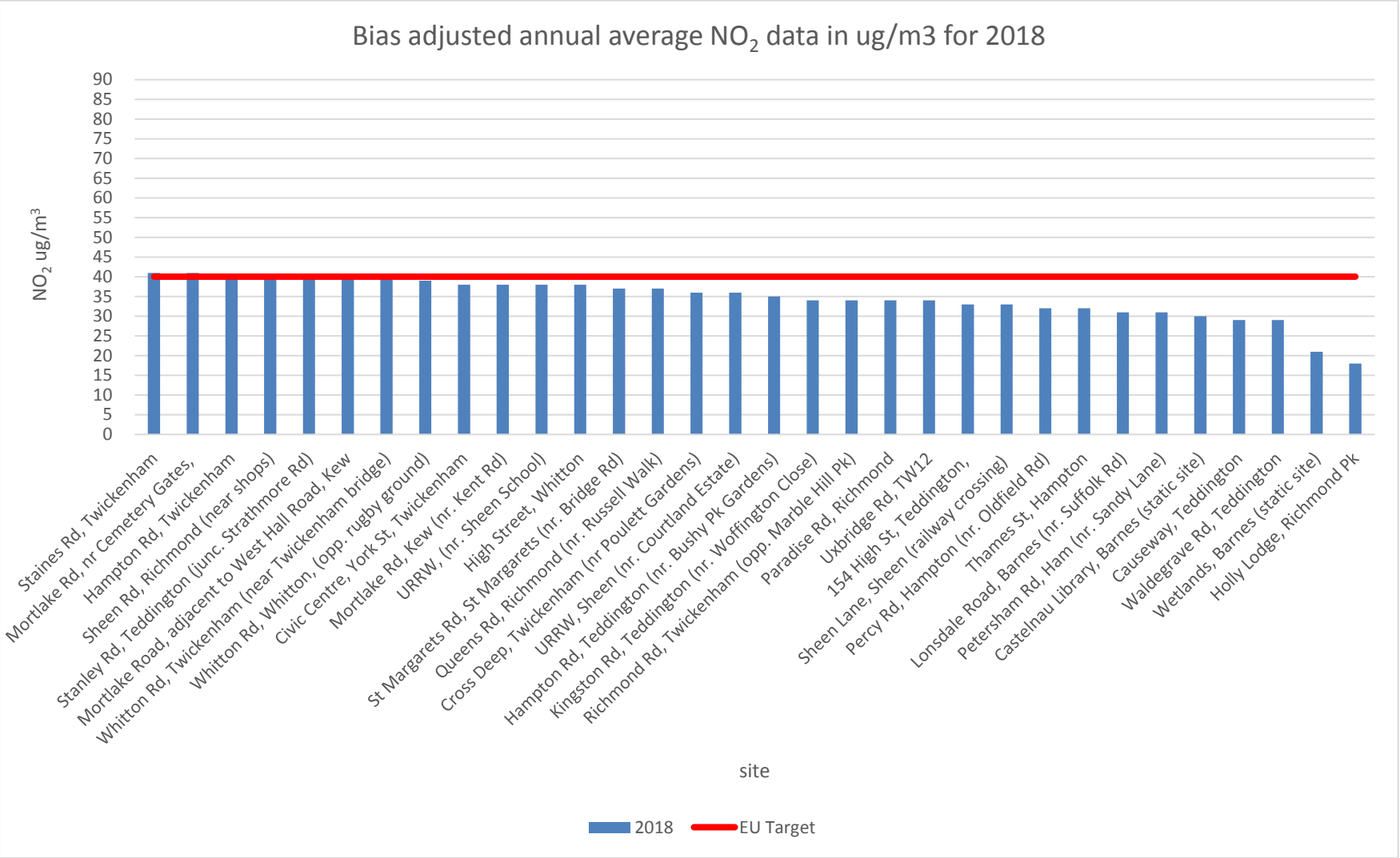
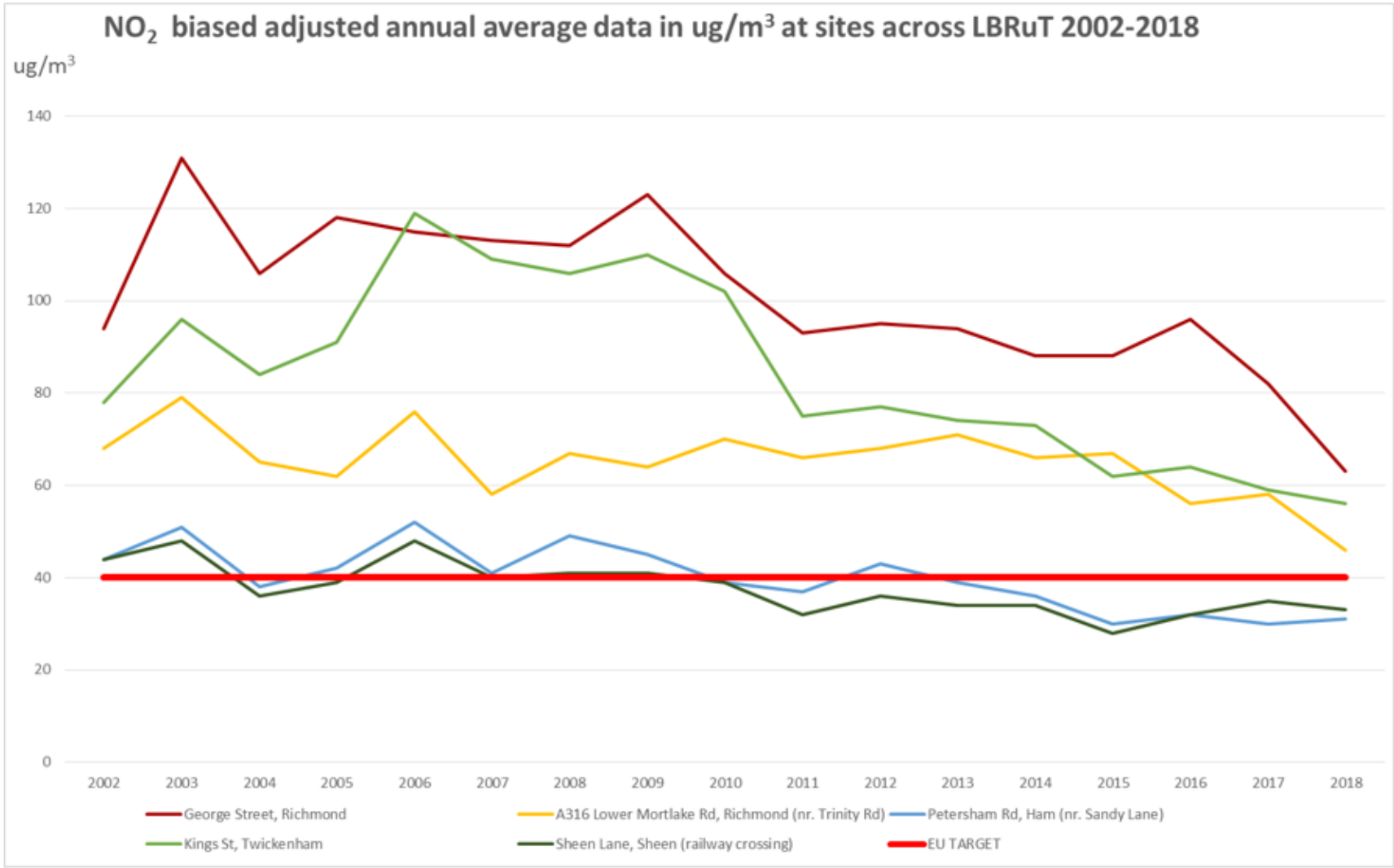


Figure 2: Nitrogen Dioxide Bias Adjusted Annual Average Concentrations for 10 sites across LBRuT 2002 -2018 (split over 2 graphs)



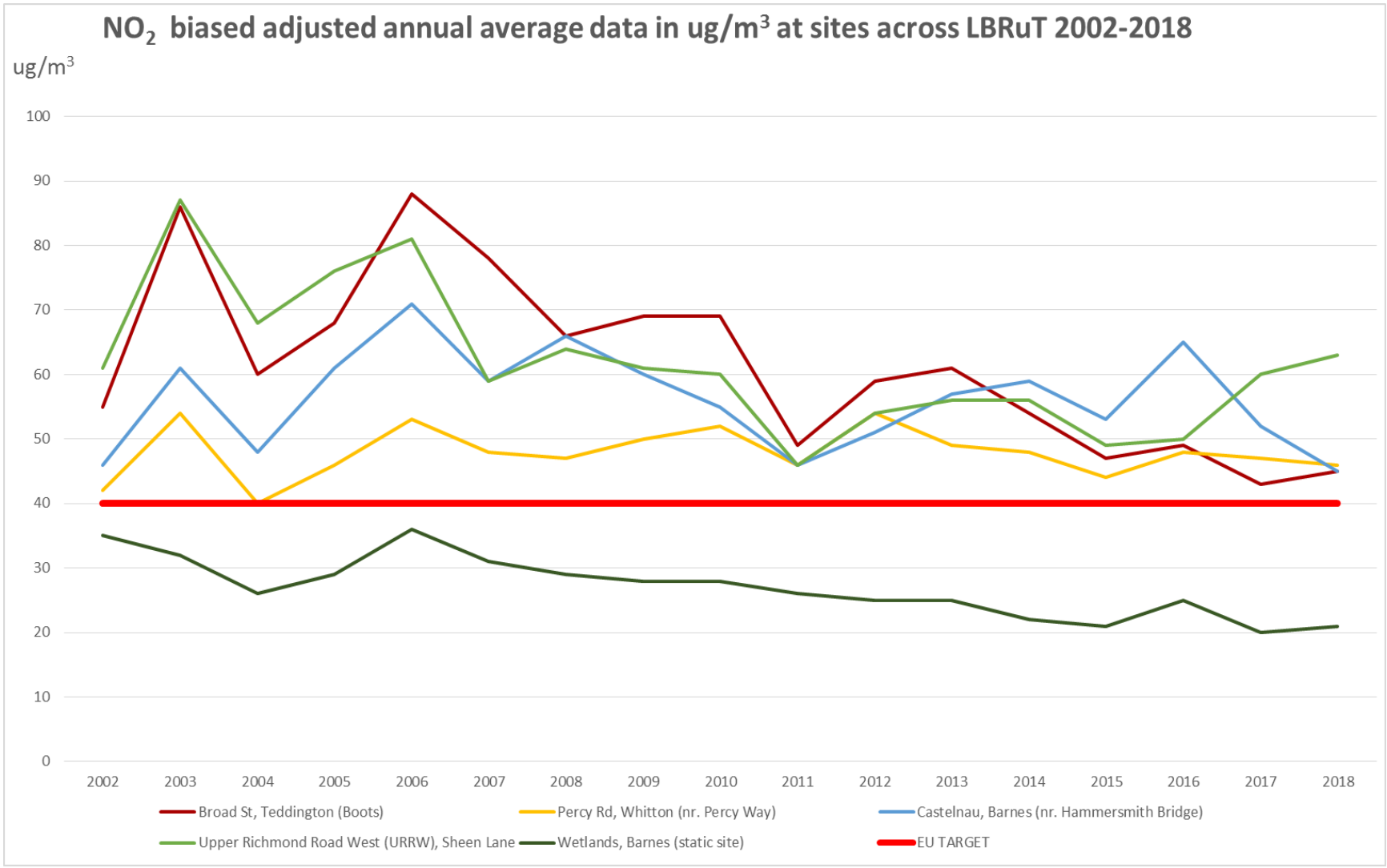

NO2 biased adjusted annual average data in ug/m3 at sites across LBRuT 2002-2018
ug/m3
100
90
80
70
60
50
40
30
20
10
0
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
Broad St, Teddington (Boots)
Percy Rd, Whitton (nr. Percy Way)
Castelnau, Barnes (nr. Hammersmith Bridge)
Upper Richmond Road West (URRW), Sheen Lane
Wetlands, Barnes (static site)
EU TARGET

Table E. NO_2 Automatic Monitor Results: Comparison with 1-hour Mean Objective

Site ID	Valid data capture for monitoring period %	Valid data capture 2018 %	Number of Hourly Means > 200 µgm^{-3}						
			2012	2013	2014	2015	2016	2017	2018
Castelnau Library, Barnes (R1)	100	98	0	2	0	0	0	0	0
Wetlands Centre, Barnes (R2)	100	96	0	0	0	0	0	0	0
Mobile- Chertsey Rd, TW2 (RHG)	100	93	0	0	0	0	0	0	0

Notes: Exceedance of the NO_2 short term AQO of 200 µgm^{-3} over the permitted 18 days per year are shown in **bold**.

Automatic Monitoring Site data

The NO_2 monitoring results for the three LBRuT automatic sites are compared directly to the annual mean and hourly mean objectives. The data for 2018 is fully ratified. The Mobile Air Quality Unit was located at Chertsey Rd, Twickenham throughout 2018. Data has therefore been included in this report.

The 2018 NO_2 data capture for Castlenau, Wetlands and the Mobile was very good, representing 98% data capture for the RI1 (Castelnau), 96% for RI2 (Wetlands) and 93% for RHG (the Mobile).

Table D provides the 2018 results of the NO_2 automatic monitoring and a comparison with the annual mean objective.

The 2018 results show that all three sites met the objective of 40 μg m^{-3}. The 2018 annual mean for the RI2 (Wetlands) was 20 μg m^{-3} This site is a background site and therefore representative of low pollution in the Borough. The annual mean at the RI1 (Castelnau) and RHG Mobile site on Chertsey Rd, Twickenham, both roadside sites was 31 μg m^{-3} and 34 μg m^{-3} respectively. There does seem to be a very slight downward trend at all sites. It should be noted for Castlenau site that from Saturday 28 May 2016 and throughout 2017 and 2018 in order to preserve the lifespan of Hammersmith Bridge, sited at the end of Castlenau, it was necessary to limit the number of buses using the structure. HGV's were also limited – the bridge had a weight restriction of 7.5 tonnes preventing many HGV's from crossing and therefore reducing their number past the air Quality cabin at the library. On 11th May 2019 the bridge was closed for safety reasons until strengthening work is completed. This means a large reduction in the number of vehicles along Castlenau and will have a significant effect on 2019 data. It should also be noted that pollution levels at Castlenau roadside site are generally lower than at many other roadside and kerbside sites around the borough. Consideration has been given to relocating the site. On balance, following discussions with the Council and Kings College London, for data continuity and trend data purposes, it has been decided to leave it in situ. This will be reviewed annually.

Table E provides the results of automatic monitoring for NO2 for the 1-hour mean objective of 200 μg m-3. This objective is less stringent than the annual mean and it was met at all sites and for every year reported with the exception of Castelnau where this standard was exceeded twice in 2013. This is good news.

Table F. Annual Mean PM_{10} Automatic Monitoring Results ($\mu g\ m^{-3}$)

Site ID	Valid data capture for monitoring period % [a]	Valid data capture 2018 %	Annual Mean Concentration (μgm^{-3})						
			2012	2013	2014	2015	2016	2017	2018
Castelnau Library, Barnes (RI1)	100	99	21	22	20	22	20	18	19
Wetlands Centre, Barnes (RI2)	100	94	18	20	18	17	16	15	15
Mobile- Chertsey Rd, TW2 (RI2)	100	94	24	25	N/A	N/A	N/A	18	21

Notes: Exceedance of the PM_{10} annual mean AQO of 40 μgm^{-3} are shown in **bold**.
In 2014, 2015 and 2016 the mobile was sited at more than 1 site. Annual data is therefore not available.

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, PM_{10} is a specified pollutant for the whole Borough AQMA.

The PM10 monitoring results for the LBRuT automatic sites are compared directly to the annual mean and 24 hour mean objectives. Tables F and G provide results for the period from 2012 to 2018 inclusive. The data for each year is fully ratified.

PM10 measurement was undertaken at three sites and the data capture was good. In 2018 the RI1 Castelnau site achieved 99% , the RI2 Wetlands site and the RHG mobile site both achieved 94%.

Table F provides results of automatic monitoring of PM10 and a comparison with annual mean objective. The objective of 40 μg m-3 was met at each site for every year reported.

The 2018 annual mean for PM10 at both the roadside site in Castlenau Barnes and at the background site at the Wetlands Centre in Barnes was the same or fractionally higher than in 2017 but generally over the last 7 years the trend is very slightly downwards. The background site in particular has gone down slightly each year for the last 4 years and remained the same for 2017 and 2018. This is encouraging and appears to be a slight gradual downward trend. It is however only fractional and did creep up again slightly at Castlenau in 2018, so we can not be complacent and need to keep an eye on this. We will reassess this in next years' report. The level at the Mobile can be compared to 2017 as it was at the same site – it can not be compared to former years as these were at different sites. It does indicate an increase in 2018 from 18μg m-3 to 21μg m-3. This means all sites meet the EU limit value (40 μg m-3) but the Mobile failed the much stricter WHO guidelines (20 μg m-3) for PM10. Moreover, modelling indicates there are some exceedences of PM10 on some sections of major roads within the borough, so vigilance is required.

Table G provides the comparison with the 24-hour mean objective for PM10. The objective of no more than 35 days exceeding 50 µg 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 low in all the last 5 years 2014, 2015, 2016, 2017 and 2018 and as a trend does appear to be falling gradually and not returning to pre 2011 levels.

Elevated PM10 levels can result from episodes, which are often the result of local combined with imported transboundary conditions from elsewhere in the UK and Europe.

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

Table G. PM_{10} Automatic Monitor Results: Comparison with 24-Hour Mean Objective

Site ID	Valid data capture for monitoring period %	Valid data capture 2018 %	Number of Daily Means > 50 µgm^{-3}						
			2012	2013	2014	2015	2016	2017	2018
Castelnau Library, Barnes (RI1)	100	99	14	10	4	5	7	4	1
Wetlands Centre, Barnes (RI2)	100	94	13	6	3	1	3	3	0
Mobile- Chertsey Rd (RHG)	100	94	10	8	N/A	N/A	N/A	1	1

Notes: Exceedance of the PM_{10} short term AQO of 50 µg m^{-3} over the permitted 35 days per year or where the 90.4th percentile exceeds 50 µg m^{-3} are shown in **bold**. Where the period of valid data is less than 90% of a full year, the 90.4th percentile is shown in brackets after the number of exceedances.

Table H. Annual Mean $PM_{2.5}$ Automatic Monitoring Results (µg m^{-3})

Site ID	Valid data capture for monitoring period %	Valid data capture 2018 %	Annual Mean Concentration (µgm^{-3})						
			2012	2013	2014	2015	2016	2017	2018
NPL Bushy Park, Teddington (TD5)	100	94	11.5	16.7	N/A	N/A	N/A	10	11

Notes: Exceedance of the $PM_{2.5}$ annual mean AQO of 25 µgm^{-3} are shown in **bold**.

Table H provides results of automatic monitoring of PM2.5 by NPL in Bushy Park and a comparison with annual mean objective. The objective of 25 µg m-3 was met for every year reported. The data capture was good (94%) but the data for 2018 is not fully ratified so should be treated with caution.

This does reinforce results of compliance for particulate matter in the London Borough of Richmond Upon Thames. The Council, together with many other local authorities in London, does not currently have a PM2.5 monitor.

2. Action to Improve Air Quality

Table J. Commitment to Cleaner Air Borough Criteria

Theme	Criteria		Achieved (Y/N)	Evidence
1. Political leadership	***1.a***	Pledged to become a Cleaner Air for London Borough (at cabinet level) by taking significant action to improve local air quality and signing up to specific delivery targets.	Y	In 2017 -18 Richmond established a cross-party Scrutiny Committee to review and monitor measures to improve air pollution in the Borough. Political leadership changed in the May 2018 Council elections. The new administration pledged strong support for air quality and have a Cabinet Member for Air Quality and Transport and Created a new Committee specifically covering Air Quality.
	1.b	Provided an up-to-date Air Quality Action Plan (AQAP), fully incorporated into LIP funding and core strategies.	Y	The redrafted AQAP for 2018-23 was put on hold following the May 2018 change of administration.. In 2019 the Council set up and consulted a group of community representatives to engage with residents before publication of the 2019 - 2024 AQAP. The intention is to make the new AQAP more robust, public facing and interactive and the best in London. The AQAP will go before Committee in July 2019
2. Taking action	**2.a**	Taken decisive action to address air pollution, especially where human exposure and vulnerability (e.g. schools, older people, hospitals etc) is highest.	Y	In 2018 we produced a new Local Implementation Plan (LIP3) supporting the local implementation of the Mayor's Transport Strategy. This includes the headline target for 75% of trips to be by walking, cycling and public transport from a baseline of 61%. The LIP also includes specific targets to reduce CO2, NOX, PM10 and PM2.5 emissions in the borough. We are working to introduce School Streets for 2019/20 school year at a small number of schools, which will be time closures at school start and finish times to reduce exposure to air pollution right outside the school gates and

				encourage more children to walk and cycle to school. We are updating our Cycling Strategy to encompass walking as well as cycling, and to be published late 2019 as the Active Travel Strategy. We are developing our plans for a strategic cycle network, which will see a comprehensive network of Cycleway-standard routes, with the initial routes from Hampton Court Bridge to Kingston Bridge, and Kingston Bridge to Twickenham town centre introduced in 2020. The Richmond Cycle Hub is due to be completed in 2020, and we will improve cycle routes to and from the Richmond Station to encourage more cycling. We are working on introducing contraflow cycling facilities on as many one-way streets as possible in the borough, with 12 due for completion in 2019/20.
	2.b	Developed plans for business engagement (including optimising deliveries and supply chain), retrofitting public buildings using the RE:FIT framework, integrating no engine idling awareness raising into the work of civil enforcement officers, (etc etc)	Y	We have drafted a new Code of Practice for the boroughs construction industry that incorporates NRMM & dust and emission controls, as well as embedding the best practice of construction logistics. We have developed London Wide NRMM guidance for Planners and EH professionals Through the Cycling and business engagement project we continue to work closely with businesses to develop pollution free cycling Maps for the borough. Retiming of deliveries to off peak became permanent in 2017 in St Margarets. This was trialled in 2017 -18 in Hampton Hill High Street but was discontinued due to noise complaints from nearby residents. In 2018 3 x successful Idling awareness events as part of the MAQF took place and hundreds of drivers were engaged and switched off. Preparations were made for civil enforcement for idling which went live 1/3/19.

	2.c	Integrated transport and air quality, including by improving traffic flows on borough roads to reduce stop/start conditions	Y	The borough works with TfL to identify junctions where traffic signal timings can be improved to help smooth traffic flows. As part of any wider transport schemes, opportunities are also taken to review signal timings and junction layouts where congestion is an issue. Chalkers Corner was reviewed as part of the Stag Brewery planning application in 2018. The borough is trying to increase the mode share for walking, cycling and public transport and improve bus speeds to help encourage sustainable transport, which in turn will help reduce reliance on the private car helping to ease congestion.
	2.d	Made additional resources available to improve local air quality, including by pooling its collective resources (s106 funding, LIPs, parking revenue, etc).	Y	The Council makes use of a range of funding sources to help deliver its transport schemes which in turn deliver air quality benefits. Sources include TfL LIP funding, Community Infrastructure Levy, Borough Cycle Programme, Bus Priority Programme, s106 funding, Council uplift funding, Council revenue funding and Mayor's Air Quality funding. The Council has continued to support school projects (see 2a) with successful implementation of additional fencing and green screening in 2018.
3. Leading by example	**3.a**	Invested sufficient resources to complement and drive action from others	Y	Maintain Revenue staff funding for air quality and monitoring. Access funding streams through Section106, Local Implementation Plan and the Community Infrastructure Levy
	3.b	Maintained an appropriate monitoring network so that air quality impacts within the borough can be properly understood	Y	All of the Councils monitoring network has been maintained and is continually updated. We also maintain mobile monitoring equipment that can be deployed for specific projects or loaned to other partner authorities.

	3.c	Reduced emissions from council operations, including from buildings, vehicles and all activities.	Y	LBRUT has installed solar panels on the roof of the Civic Centre to help reduce emissions, upgraded Council fleet and set conditions for contractor fleet through procurement.
	3.d	Adopted a procurement code which reduces emissions from its own and its suppliers activities, including from buildings and vehicles operated by and on their behalf (e.g. rubbish trucks).	Y	50% of the fleet are Euro 4 50 % of fleet are Euro 5/6 New refuse contract with strict emission criteria to be introduced Apr 2020.
4. Using the planning system	**4.a**	Fully implemented the Mayor's policies relating to air quality neutral, combined heat and power and biomass.	Y	All approved planning applications meet the Mayor's requirements relating to AQ neutral and CHPs
	4.b	Collect s106 from new developments to ensure air quality neutral development, ***where possible***	y	The AQ Officer requests S106 payments wherever possible from developers as part of mitigation measures on major developments. Air Quality is now a specific focus of the new Local Plan and the borough is finalising a new Richmond specific AQ SPD focused on the council's priorities for new developments, including formalising the Section 106 conditions.
	4.c	Provided additional enforcement of construction and demolition guidance, with regular checks on medium and high risk building sites.	Y	Strict planning conditions for construction and demolition applied to all major sites. Complaints responded to. NRMM conditions applied to all major sites. Site visits requiring compliance to NRMM carried out.
5. Integrating air quality into the public health system	**5**	Included air quality in the borough's Health and Wellbeing Strategy and/or the Joint Strategic Needs Assessment	Y	Health and Wellbeing Strategy includes air quality as a key theme. More joint working proposed in new AQAP 2019 – 2024.
6. Informing the public	**6.a**	Raised awareness about air quality locally	Y	LBRuT's Communication dept has played an important role in AQ awareness raising this year, through social media, website, newspapers , letters to local companies etc on priorities such as anti idling and use of authorised fuel/approved wood burning appliance in smoke control areas. airTEXT is promoted on the website and at

				local events. LBRuT continued to host 3 more successful idling action events in 2018-19 as part of the Mayor's campaign, involving many volunteers and speaking to large numbers of drivers. CEO's trained in anti-idling and are currently active in the borough. All events were based around schools and level crossings or town centres. More events are planned for later in 2019. Lessons are given to local schools to raise awareness for air quality.

2.1 Air Quality Action Plan Progress

Table K provides a brief summary of the London Borough of Richmond upon Thames' progress against the Air Quality Action Plan in place throughout 2018. New projects which commenced/continued/were completed in 2018 are mentioned throughout.

An updated AQAP for 2019 – 2024 will be taken before Committee in July. Delays have occurred due to the change in administration, following the local elections in May 2018. This put a hold on the consulted and approved AQAP for 2018 – 2023 and a substantial re-write. This will be beneficial for air quality in LBRuT. The new AQAP has involved direct consultation and engagement with community groups before the re-write. The result is a more robust, more transparent, more accountable AQAP, which is interactive and public facing. Improving air quality in the borough was a top manifesto commitment for the incoming Liberal Democrat administration. The new AQAP will reflect changes in air quality policy, creating an environment that is welcoming to sustainable transport and aimed at the pedestrian and/or cyclist, identifying specific bold and brave measures to tackle pollution in local 'hot-spots' within the borough and prioritising schools.

The updated AQAP, once finalised and approved, will be supported by the departmental Heads of Service for Environmental Health, Transport and Planning, Public Health; the Director of Public Health, the Director of Environment and Cabinet members. It will use an interactive dashboard and adopted measures will include quarterly updates and targets and include Community pages. It will be reported in the 2020 Annual Status Report.

Table K. Delivery of Air Quality Action Plan Measures

A. Londonwide and Regional Measures
B. Boroughwide Measures
C. Local Measures

A LONDONWIDE AND REGIONAL MEASURES

Measure	Action	Progress	Further information
1	Participate in the development of a low emission zone (LEZ) and engage with TfL for further measures to reduce pollution in London.	LBRUT has engaged fully with the Mayor and TfL in the implementation of the LEZ and all consultations, including the T (toxicity) charge, implemented in the central congestion charging zone in October 2017 and then ULEZ, implemented 24/7 in central London in April 2019. It has also engaged with the prosed extension of the ULEZ to the North and South circulars from 25th October 2021.	The LEZ has forced the most polluting commercial diesel vehicles driving in London to become cleaner. The introduction of the T charge in 2017 and the ULEZ in 2019 helped further. The Council has actively taken part in all engagement meetings with TfL and responded to every consultation, for LEZ, T charge and ULEZ. It is very keen to improve air quality but concerned at possible disbenefits of an expanded ULEZ. The Council will continue to engage as an active participant but will seek an exemption for the Council's main Waste and Recycling facility.

Measure	Action	Progress	Further information
2	Encourage Heathrow Airport Ltd to take action to reduce emissions at Heathrow from surface access traffic, site traffic, aircraft and other sources.	The topic of poor air quality continues to be of supreme concern with the evidence that many thousands of people will experience worse air pollution due to increases in air traffic and airport related road traffic.	Our concern remains that the use of an extra runway together with intensified runway use will lead to increases in aircraft movements in the sky, and increases in road traffic movements on the ground, both leading to greater pollution emissions. We oppose any increase in airport capacity which is at the expense of keeping any gains in air quality and noise improvements. We will continue to do this.
3	Lobby the Mayor of London to ensure that, as a minimum buses and taxis meet the LEZ EURO III and IV criteria	This standard has now been met. The bus fleet continues to improve. Zero Emission Capable taxis only (ZEC) have been registered from 1st January 2018. LBRUT has concerns regarding the contribution of emissions from buses and taxis in town centres, particularly in Richmond and will continue to encourage early upgrades by lobbying TfL	Areas with a concentration of buses and taxis should obtain a significant local benefit. Idling of buses and taxis is an ongoing issue and LBRuT are in regular contact with TFL to try and ensure compliance.
4	Lobby the Mayor to	Through the 2018 LIP Funding process we have delivered a number of successful cycling,	In 2018 we updated our Local Implementation Plan to reflect the Mayor's new Transport

Measure	Action	Progress	Further information
	achieve London-wide improvements for pedestrians, cyclists and public transport where there will be local benefits.	walking & bus schemes. LBRUT engaged in joint projects with Network Rail to identify additional cycle parking at stations throughout 2018. LBRuT have agreed plans with SW Trains for a Richmond cycling hub and cycle parking for 2020. 4 cycle hangers were installed in 2018 and discussions for more continue.	Strategy. The document has been approved by the Deputy Mayor for Transport and implementation of the plan is starting in 2019. The headline target of the plan is to increase the mode share for walking, cycling and public transport, with a decrease in car use. The Council is working on all aspects of the cycle programme to ensure successful delivery in 2018/19/20 and have firm ambitions for the borough. Cycle parking is ongoing. A Brompton docking station for Twickenham was installed in 2018 with a view to installing a similar one for Richmond. Improved facilities for pedestrians continue. LBRuT now has hybrid buses operating on routes R68, R70, 65, 267 and 285 and more are programmed for 2019/2020. By Oct 2020 the entire TfL bus fleet serving LBRuT will be hybrid or retrofitted.

Measure	Action	Progress	Further information
5	Work with other SW London Boroughs in SWELTRAC Schemes	The SWELTRAC partnership came to an end in 2011 It was replaced by a South London Transport Partnership and the South London Transport Strategy Board. One of the most important developments is the setting up and running of EV charge points by Source London. LBRUT adopted an Electric Vehicle Charging Strategy in November 2016, setting out proposals to add over 200 new chargepoints in the borough across 80 locations by 2025/26 and to encourage takeup of electric cars in the borough. Trialling of lamp column mounted chargepoints to allow overnight charging in residential areas for residents with no off-road parking was introduced in 2017 and promoted throughout 2018/2019 on LBRuT website, delivered by ubitricity.	This will be addressed in our new AQAP 2019 – 2024. Electric Vehicle Charging points are a priority and are being rolled out across the borough. Any resident with no off road parking can apply online for a lamp column EVCP. 46 Source London chargepoints were installed across the Borough in 2018 for Phase 1 and 2 in 18 locations, mainly on the Surrey side of the borough - in Kew, Barns, Mortlake and Barnes Common, North Richmond, East Sheen and South Twickenham. The public consultation of Phase 3, for the Middx side of the borough is complete and 25-35 sites will be decided in Summer/Autumn 2019. These will require planning permission; it is anticipated these will be installed in Autumn/Winter 2019. The wards covered by Phase 3 are: Hampton Wick, Heathfield, St. Margaret's and North Twickenham, Teddington, Twickenham Riverside, West Twickenham, and Whitton. 180 lamp column chargepoints were installed between February 2019 and April 2019 to allow overnight charging for residents with no off-road

Measure	Action	Progress	Further information
			parking available Another 60-80 lamp column chargepoints are planned to be installed across the Borough in Autumn 2019. 4 sites for rapid chargepoints have been selected by LBRuT and TfL to be submitted to planning for planning approval. These sites aim to support businesses who operate electric vehicles. Installation is expected in Autumn 2019.
6	Work with the adjacent Boroughs and West London Alliance local authorities, to develop co-ordinated AQAPs across the region.	The shared service of LBRUT and LB Merton has led the NRMM program to address pollution from development sites across 14 LA's. In 2018 they visited 181 development sites. Joint working with both South and West London authorities is ongoing and resulted in the Clean air4schools program funded by the MAQF This was continued by Officers, in house, in LBRUT in 2018	LBRUT and LB Merton will continue to lead the NRMM program in 2019/2020. This will have a significant effect on improving air quality in the local area around each development site and contribute to the improvement in air quality in London. LIP funding continued to support an Air Quality awareness programs with schools in 2018 which included members of the community.

B BOROUGHWIDE MEASURES

Measure	Action	Progress	Further information
8	Continue to pursue land use policies within the saved UDP and Local Development Framework to encourage travel choice with the aim of reducing emissions and to ensure that major new developments are accessible to public transport. The LDF will take such policies forward.	These actions have been completed The approved AQAP for 2018 – 2023 was put on hold following a change in administration in the May 2018 local elections. An updated AQAP for 2019 – 2024 will be taken before Committee in July. This has involved a substantial re-write. This will be beneficial for air quality in LBRuT.	The new AQAP has involved direct consultation with community groups before the re-write. The result is a more robust, more transparent, more accountable AQAP which is interactive and public facing. Improving air quality in the borough was a top manifesto commitment for the incoming Liberal Democrat administration. The new AQAP will reflect changes in air quality policy, creating an environment that is welcoming to sustainable transport and aimed at the pedestrian and/or cyclist, identifying specific bold and brave measures to tackle pollution in local 'hot-spots' within the borough and prioritising schools.
11	Promote the Council Travel Plan for the Council employees	Throughout 2018 the Council encouraged the use of Oyster cards for business travel on public transport and the use of personal cycles. Cycle facilities on Twickenham campus include showers and changing rooms The Council has become a corporate car club member. Parking is only provided for essential car users, usually for 2 days a week. Free parking for all other officers, of	The Council continues to promote healthier travel habits for its staff, including walking, cycling and using public transport which will help reduce emissions. .

Measure	Action	Progress	Further information
		all grades, has been abolished.	
12	Promote Travel Plans for schools Encourage both public and private sector schools to adopt school travel plans and associated walking and cycling initiatives Set up database to monitor progress of all Travel Plans	LBRUT strongly supports the TfL In school travel plan accreditation scheme – STARS. It rewards schools for their engagement with the school community and for carrying out initiatives which result in more pupils and staff travelling sustainably to school. We provide cycle, pedestrian and scooter training for school children and enjoy a very good take-up. We provide a Junior Citizenship week twice a year which includes promoting walking, cycling and public transport.	Support for cycle and scooter training is ongoing and strongly supported by LBRuT. LBRuT continues to support school travel plans which are part of the Education Strategy through the development control process. Applications for additional parking permits must be accompanied by up to date travel plans. It is expected that School travel plans will be included in the new AQAP 2019- 2024 and target driven. In 2018 we continued working with several schools, raising awareness for air pollution, including walking/cycling/scootering low pollution routes to school. We assisted and supported the Mayor's school audit team and match funded a Mayor's recommendation for a new acoustic fence and green wall at East Sheen Primary School installed in June 2018. This is already recording air quality benefits and helping to protect students from pollution from the South Circular, directly outside their playground. Support to more schools is ongoing and several school streets are planned.

Measure	Action	Progress	Further information
16	To continue to press for and promote travel choice through improvements for pedestrians, cyclists and public transport in terms of increased capacity, reliability, accessibility and quality	The Borough continues to promote www.Walkit.com through its website and advice from Officers. Please see measure 4 for cycle and pedestrian improvements.	Sustainable travel choices are promoted through the planning process. Many ongoing cycle projects to improve cycle facilities and increase a modal shift towards cycling were supported throughout 2018 (Please see measure 4) In 2019 we will be introducing a borough-wide 20mph speed limit, which will make roads safer and more hospitable to walking and cycling. In 2019 we will also see the Quietway from Ham to Richmond Park delivered, and we are working to develop additional strategic cycle routes from Hampton Court Bridge to Kingston Bridge, Kingston Bridge to Twickenham town centre and along the A307 Kew Road. These routes will provide safe, attractive options for cyclists and will connect several key locations within the borough. TfL are currently working to deliver their Cycleway scheme along the A316, running from Cole Park Road to Richmond Circus.
21	Concern for low emission vehicles to be used on Council business extends to the use of vehicles by contractors. The	Euro emissions on all fleet vehicles are euro IV or above. All contractor vehicle emissions are	Ongoing. Procurement contracts are currently under discussion for the renewal of the refuse fleet from April 2020. All contractors will be required

	Council seeks to control emissions from contractor's vehicles by checking that their environmental policy includes specifically its use of transport.	controlled through procurement.	to provide clean, ULEZ compliant vehicles for collections borough wide.
24	To continue to promote the Council's 'Smoke Control Zone'	An awareness raising campaign on correct fuels to burn in smoke control areas was launched in Feb/March 2017 and was repeated again in January 2018 and January 2019. Guidance is given about smoke control on the Council's website. A bid was submitted to Defra for a more substantial smoke control campaign but was unsuccessful.	In 2018 (as in 2017) all retail outlets selling fuel or appliances were written to by LBRUT and asked to display posters regarding correct fuel to be burnt in smoke control areas. We requested employers enlighten employees who could pass information to customers. A campaign was launched on social media, through e letters to community groups and on the website. All complaints about possible breaches are investigated and compliance required.
25	To continue to promote composting in preference to bonfires	The Council encourages people to avoid bonfires as they cause air pollution and the emissions can be harmful to health or a nuisance. There is advice for residents on the Council's website. The Council introduced new rules for bonfires on all Council allotments from 1/3/17 limiting bonfires from March – September to one bonfire a month on one specific morning. Progressively tighter rules have been introduced annually. Composting or Council green waste collection is encouraged as an alternative.	Poor air quality due to bonfires may be very localised but can cause considerable distress to neighbours and is actively addressed. In 2018 the Council banned bonfires on all Council allotments from 30th Apr – 16th Sept each year. From September 2019 there will be a complete ban on bonfires on all Council owned allotments.

26	To continue to inspect and enforce clean air requirements at 'Part B' processes in the Borough.	Annual inspections of premises producing industrial emissions. The database of premises for control is routinely updated.	Maintain established benefits of controlling emissions from certain industrial processes within the borough identified as 'Part B' of the Regulations.
28	Support the development and use of 'Car Clubs' in new residential developments, by station interchanges and in town centres.	On-going with support from the Council. Car free developments have already been secured in the borough through the development control process. Future car free developments will include the use of car clubs. The Council uses a car club for essential staff car journeys in preference to using pool cars.	Car clubs operate throughout the borough and are positively endorsed by the Council. Use and siting of car club bays is under ongoing scrutiny. If car club bays are proved not to be used their space is withdrawn, in agreement with the car club. In 2018 there were 73 car club bays in operation.

C. LOCAL MEASURES

Measure	Action	Progress	Further information
29	Refuse planning consent for activities, which are likely to lead to a significant worsening of air pollution in 'hot spot' areas.	All major planning applications are considered for air quality impacts and conditioned for required mitigation. Section 106 monies are requested. Consideration is also given to the cumulative effect of nearby developments. A draft Air Quality Special Planning Document is	Following the elections in May 2018, LBRuT has changed political administration. It is hoped that robust procedures, via a Supplementary Planning Document will be in place by Dec 2019 in line with our new Local Plan

Measure	Action	Progress	Further information
		awaiting approval. Biomass and CHP are generally discouraged.	
31	To consider ways to further reduce the impact of road traffic and parking problems on Twickenham RFU days.	"No engine idling" for taxis and PHV encouraged by ad hoc Officer intervention and CEO enforcement on major match days at RFU during 2018/19. EVCP required for new conference space for RFU built in 2018 and robust travel plan.	Support given to proposals by RFU to encourage non-car use as part of Travel Plan Idling enforcement by traffic warden commenced borough wide 1/3/19.
33	Consider controls for coach parking in Kew and Hampton Court, to protect residents, workers and visitors from the impact of vehicle emissions	On-going discussions with Kew Gardens in 2018 to ensure continued monitoring of no idling by coaches.	Summer of 2018 spot checks made by Council Officer to ensure driver compliance with no engine idling policy. Drivers spoken to by Officer. 100% compliance observed.

3. Planning Update and Other New Sources of Emissions

Table K. Planning requirements met by planning applications in the London Borough of Richmond Upon Thames in 2018

Action	Number	Notes
a) Number of planning applications where an air quality impact assessment was reviewed for air quality impacts	96	All major developments are passed to the Noise and Air Quality Officers in Environmental Health for comment. All major developments are required to submit an AQA. London Plan 2018 applied in all cases.
b) Number of planning applications required to monitor for construction dust	31	All sites considered on a case by case basis. If moderate or high risk to receptors, dust monitoring is required
c) Number of CHPs/Biomass boilers refused on air quality grounds	0	All CHP/biomass not recommended and developers urged to select non combustion/ultra low NOx. Requirements as per London Plan, which meant none could be refused on grounds of AQ in 2018.
d) Number of CHPs/Biomass boilers subject to GLA emissions limits and/or other restrictions to reduce emissions	11	All boilers subject to standard GLA emission conditions
e) Number of developments required to install Ultra-Low NO_x boilers	96	As a minimum all boilers in all developments subject to standard GLA emission conditions
f) Number of developments where an AQ Neutral building and/or transport assessments undertaken	All major developments	All major developments
g) Number of developments where the AQ Neutral building and/or transport assessments not meeting the benchmark and so required to include	7	AQ neutral benchmark is often not challenging enough. Mitigation is required due to expected worsening of NO2 in an AQMA and regularly results in hard fought battles.

additional mitigation		
h) Number of planning applications with S106 agreements including other requirements to improve air quality	1	S106 frequently requested for local policies. Rarely successful. More robust AQ SPD has been drafted and will be adopted post AQAP.
Number of planning applications with CIL payments that include a contribution to improve air quality	0	AQ not a specific CIL requirement.
i) NRMM: Central Activity Zone and Canary Wharf Number of conditions related to NRMM included. Number of developments registered and compliant. Please include confirmation that you have checked that the development has been registered at www.nrmm.london and that all NRMM used on-site is compliant with Stage IIIB of the Directive and/or exemptions to the policy.	Not applicable.	Not applicable
NRMM: Greater London (excluding Central Activity Zone and Canary Wharf) Number of conditions related to NRMM included. Number of developments registered and compliant. Please include confirmation that you have checked that the development has been registered at www.nrmm.london and that all NRMM used on-site is compliant with Stage IIIA of the Directive and/or exemptions to the policy.	During 2018 NRMM conditions were applied at all major planning sites. LB Merton undertook 7 Site Audits,1 Site achieved Self-Compliant status, 5 sites worked towards and achieved Compliance and 1 Site failed to achieve Compliance.	NRMM is standard planning condition applied to all major developments. We have 6 designated Officers based in Merton, who assess all major sites for NRMM compliance, visit sites and check the NRMM data base on a regular basis.

3.1 New or significantly changed industrial or other sources

No new sources identified.

Appendix A Details of Monitoring Site QA/QC

A.1 Automatic Monitoring Sites

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

Each NO2 continuous analyser is automatically calibrated every night and also manually checked and calibrated every two weeks by the contractor, TRL, employed by LBRuT for LSO visits from 1/4/18. 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).

The NO2 and ozone continuous analysers are serviced every six months by TRL and also audited by NPL every six months as part of the King's LAQN QA/QC procedure, to ensure optimum data quality.

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).

PM10 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 by TRL and also audited by NPL every six months as part of the King's LAQN QA/QC procedure, to ensure optimum data quality. Both sites are part of

the LAQN and KCL are responsible for the daily data collection, storage, validation and dissemination via the LAQN website (www.londonair.org.uk). KCL ratifies the data periodically, viewing data over longer time periods and using the results from fortnightly checks, equipment services and equipment audits.

A.2 Diffusion Tube Quality Assurance / Quality Control

Directive 2008/50/EC of the European Parliament and of the Council on ambient air quality and cleaner air for Europe (EC, 2008) sets air 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 using 50% TEA in acetone method of preparation. 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. Since April 2014 Gradko has taken part in a new scheme AIR PT , which combines two long running PT schemes: LGC Standards STACKS PT scheme and HSL WASP PT scheme.

This section contains details of Gradko International Ltd's Results of laboratory precision

- Performance in AIR NO2 PT Scheme (April 2016 – February 2018)

- Summary of Precision Scores for 2016 - 2018

- UKAS schedule of accreditation (January 2019)

Gradko International Ltd is a UKAS accredited laboratory and participates in laboratory performance and proficiency testing schemes. These provide strict performance criteria for participating laboratories to meet, thereby ensuring NO2 concentrations reported are of a high calibre.

Summary of Laboratory Performance in AIR NO2 Proficiency Testing Scheme (April 2017 – February 2019).

Gradko participate in the AIR PT NO_2 diffusion tube scheme which uses artificially spiked diffusion tubes to test each participating laboratory's analytical performance on a quarterly basis. The scheme is designed to help laboratories meet the European Standard. Gradko demonstrated "good" laboratory performance for every month in 2018 for 50% TEA in Acetone.

The laboratory follows the procedures set out in the Harmonisation Practical Guidance and participates in the AIR proficiency-testing (AIR-PT) scheme. Previously to the Air-PT scheme, Gradko participated in the Workplace Analysis Scheme for Proficiency (WASP) for NO2 diffusion tube analysis. Defra and the Devolved Administrations advise that diffusion tubes used for LAQM should be obtained from laboratories that have demonstrated satisfactory performance in the AIR-PT scheme.

Laboratory performance in the AIR-PT is also assessed by the National Physical Laboratory (NPL), alongside laboratory data from the monthly NPL Field Inter-Comparison Exercise carried out at for Gradko at Marylebone Road, central London. A laboratory is assessed and given a 'z' score, a score of ± 2 or less indicates satisfactory laboratory performance. Gradko International Ltd's performance for 2018 is covered by rounds AR019 to AR030 of the AIR-PT scheme. For 2018 the laboratories results were deemed to be good for 111 participating local authorities, satisfactory for 7 and poor for 7 participating local authorities based upon a z score of ≤ ± 2.

In 2018, the tube precision for NO2 Annual Field Inter-Comparison for Gradko International using the 50% TEA in acetone method was 'good' for the results of all 8 participating local authorities and poor for no participating local authority.

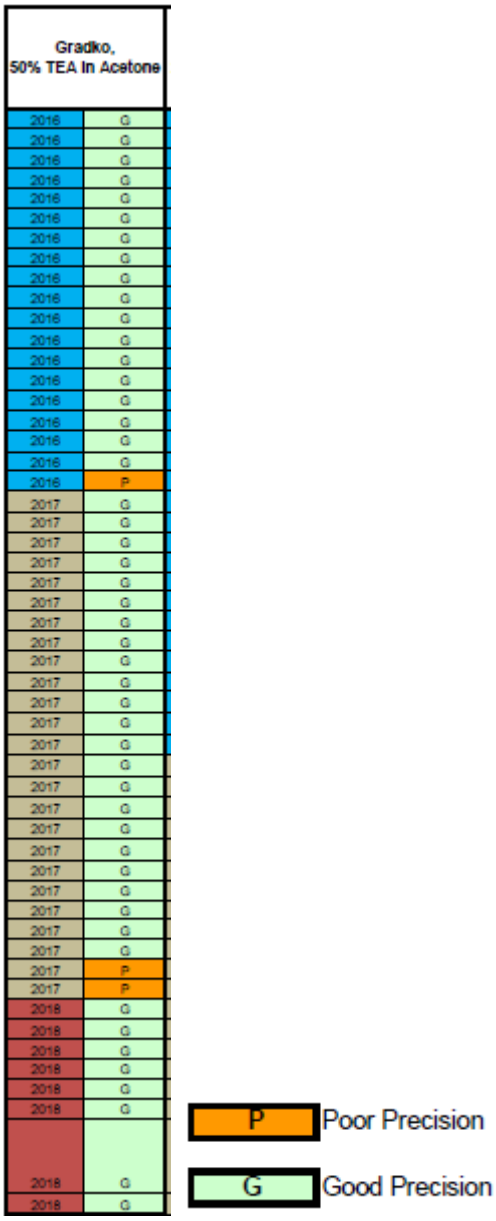
Table 1: Laboratory summary performance for AIR NO_2 PT rounds AR0019, 21, 22, 24, 25, 27, 28 and 30

The following table lists those UK laboratories undertaking LAQM activities that have participated in recent AIR NO_2 PT rounds and the percentage (%) of results submitted which were subsequently determined to be **satisfactory** based upon a z-score of $\leq \pm 2$ as defined above.

AIR PT Round	AIR PT AR019	AIR PT AR021	AIR PT AR022	AIR PT AR024	AIR PT AR025	AIR PT AR027	AIR PT AR028	AIR PT AR030
Round conducted in the period	April – May 2017	July – August 2017	September – October 2017	January – February 2018	April – May 2018	July – August 2018	September – October 2018	January – February 2019
Aberdeen Scientific Services	100 %	100 %	100 %	100 %	100 %	100 %	100 %	75 %
Cardiff Scientific Services	NR [3]	NR [3]	NR [3]	NR [3]	NR [3]	NR [3]	NR [3]	NR [3]
Edinburgh Scientific Services	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %
SOCOTEC	100 % [1]	100 % [1]	100 % [1]	100 % [1]	100 % [1]	100 % [1]	100 % [1]	87.5 % [1]
Exova (formerly Clyde Analytical)	NR [3]	NR [3]	NR [3]	NR [3]	NR [3]	NR [3]	NR [3]	NR [3]
Glasgow Scientific Services	50 %	0 %	100 %	100 %	100 %	50 %	100 %	100 %
Gradko International [1]	100 % [1]	100 % [1]	100 % [1]	100 % [1]	100 %	100 %	100 %	75 %
Kent Scientific Services	NR [3]	NR [3]	NR [3]	NR [3]	NR [3]	NR [3]	NR [3]	NR [3]
Kirklees MBC	NR [3]	NR [3]	NR [3]	NR [3]	NR [3]	NR [3]	NR [3]	NR [3]
Lambeth Scientific Services	NR [2]	NR [2]	100 %	NR [2]	NR [2]	NR [2]	25 %	50 %
Milton Keynes Council	75 %	0 %	75 %	100 %	75 %	100 %	100 %	100 %
Northampton Borough Council	NR [3]	NR [3]	NR [3]	NR [3]	NR [3]	NR [3]	NR [3]	NR [3]
Somerset Scientific Services	100 %	100 %	75 %	100 %	100 %	100 %	100 %	100 %
South Yorkshire Air Quality Samplers	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %
Staffordshire County Council	100 %	100 %	100 %	50 %	100 %	100 %	100 %	100 %
Tayside Scientific Services (formerly Dundee CC)	NR [2]	100 %	NR [2]	100 %	NR [2]	100 %	NR [2]	100 %
West Yorkshire Analytical Services	100 %	100 %	100 %	50 %	75 %	100 %	100 %	100 %

[1] Participant subscribed to two sets of test results (2 x 4 test samples) in each AIR PT round.
[2] NR No results reported
[3] Northampton Borough Council, Kent Scientific Services, Cardiff Scientific Services, Kirklees MBC and Exova (formerly Clyde Analytical) no longer carry out NO2 diffusion tube monitoring and therefore did not submit results.

2016 - 2018 Summary of Precision Results for Nitrogen Dioxide Diffusion Tube Collocation Studies for Gradko Laboratory 50% TEA in Acetone



2016 Results of study carried out in 2016

2017 Results of study carried out in 2017

2018 Results of study carried out in 2018

Numerical results for this data are contained in the National Bias Adjustment Spreadsheet version 03/19

Gradko is accredited by UKAS for the analysis of NO_2 diffusion tubes. It undertakes the analysis of the exposed diffusion tubes by ultra violet spectrophotometry.

Schedule of Accreditation

Issued by

United Kingdom Accreditation Service

2 Pine Trees, Chertsey Lane, Staines-upon-Thames, TW18 3HR, UK

2187

Accredited to ISO/IEC 17025:2005

Gradko International Ltd
(Trading as Gradko Environmental)

Issue No: 023 **Issue date:** 17 January 2019

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Testing performed at the above address only

DETAIL OF ACCREDITATION

Materials/Products tested	Type of test/Properties measured/Range of measurement	Standard specifications/ Equipment/Techniques used
ATMOSPHERIC POLLUTANTS Collected on diffusion (sorbent) tubes and monitors	Chemical Tests	Documented In-House Methods
	Ammonia as ammonium (NH_4^+)	GLM 8 by Ion Chromatography
	Benzene Toluene Ethyl benzene Xylene	GLM 4 by Thermal Desorption/ FID Gas Chromatography
	Hydrogen chloride as chloride (Cl^-) Nitrogen dioxide as nitrite (NO_2^-) Sulphur dioxide as sulphate (SO_4^{2-}) Hydrogen fluoride as fluoride (F^-)	GLM 3 by Ion Chromatography
	Hydrogen sulphide	GLM 5 by Colorimetric determination (UV Spectrophotometry)
	Ozone as nitrate (NO_3^-)	GLM 2 by Ion Chromatography
	Nitrogen Dioxide as nitrite (NO_2^-)	GLM 7 by Colorimetric determination (UV Spectrophotometry)
	Sulphur dioxide as sulphate (SO_4^{2-})	GLM 1 by Ion Chromatography
	Formaldehyde as formaldehyde-DNPH	GLM 18 by HPLC
	Volatile Organic Compounds including: Benzene Toluene Ethylbenzene p-Xylene o-Xylene	GLM 13 by Thermal Desorption GC-Mass Spectrometry

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Accredited to ISO/IEC 17025:2005

Schedule of Accreditation
issued by
United Kingdom Accreditation Service
2 Pine Trees, Chertsey Lane, Staines-upon-Thames, TW18 3HR, UK

Gradko International Ltd
(Trading as Gradko Environmental)

Issue No: 023 **Issue date:** 17 January 2019

Testing performed at main address only

Materials/Products tested	Type of test/Properties measured/Range of measurement	Standard specifications/ Equipment/Techniques used
ATMOSPHERIC POLLUTANTS Collected on diffusion (sorbent) tubes and monitors (cont'd)	Chemical Tests (cont'd)	
	Qualitative Analysis and Estimation of Volatile Organic Compounds on diffusion (sorbent) tubes and monitors	GLM 13 by Thermal Desorption GC-Mass Spectrometry with estimations in accordance with ISO standard 16000-6
	Naphthalene	GLM 13-1 by Thermal Desorption GC-Mass Spectrometry
	Tetrachloroethylene Trichloroethylene	GLM 13-2 by Thermal Desorption GC-Mass Spectrometry
	trans-1,2-Dichloroethene cis-1,2-Dichloroethene	GLM 13-3 by Thermal Desorption GC-Mass Spectrometry
	Indane Styrene	GLM 13-4 by Thermal Desorption GC-Mass Spectrometry
	1,2,3-Trimethylbenzene 1,2,4-Trimethylbenzene 1,3,5-Trimethylbenzene	GLM 13-5 by Thermal Desorption GC-Mass Spectrometry
	1,3-Butadiene	GLM 13-6 by Thermal Desorption GC-Mass Spectrometry
	Carbon Disulphide	GLM 13-7 by Thermal Desorption GC-Mass Spectrometry
	Vinyl Chloride	GLM 13-8 by Thermal Desorption GC-Mass Spectrometry
	Flexible scope for quantitative analysis of Volatile Organic Compounds on diffusion (sorbent) tubes and monitors in accordance with methods developed and validated by in-house procedure LWI 47	LWI 47 by Thermal Desorption GC-Mass Spectrometry
END		

Assessment Manager: RP

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NO_2 diffusion tube analysis method

NO_2 diffusion tubes are passive monitoring devices. They are made up of a Perspex cylinder, with 2 stainless steel mesh discs, coated with TEA absorbent held inside a polythene cap, which is sealed onto one end of the tube. Diffusion tubes operate on the principle of molecular diffusion, with molecules of a gas diffusing from a region of high concentration (open end of the tube) to a region of low concentration (absorbent end of the tube) (AEA, 2008). NO_2 diffuses up the tube because of a concentration gradient and is absorbed by the TEA, which is present on the coated discs in the sealed end of the tube. All Richmond NO_2 diffusion tubes are prepared by Gradko using 50% v/v TEA with Acetone as the absorbent.

Prior to and after sampling, an opaque polythene cap is placed over the end of the diffusion tube opposite the TEA coated discs to prevent further absorption. The NO_2 diffusion tubes are labelled and kept refrigerated in plastic bags prior to and after exposure.

Discussion of Choice of Factor to Use

Diffusion Tube Bias Adjustment Factors from Local Co-location Studies

In 2018 the Borough undertook co-location studies at two continuous NO_2 monitoring sites, with 3 x NO_2 diffusion tubes at the following the locations:

- **Richmond 1 Castelnau (site 23):** a roadside site, in Castlenau Library Barnes. In 2018 the annual average for the Castelnau diffusion tubes (№ 23) was 33.63 μg m^{-3}; for the continuous site (RI1) it was 31 μg m^3. The bias adjustment factor is **0.89**
- **Richmond 2 Barnes Wetlands (site 37):** a suburban background site. In 2018 the annual average for the Wetlands diffusion tubes (№ 37) was 22.03μg m^{-3}; for the continuous site (RI2) it was 20.65μg m^3. The bias adjustment factor is **0.93.**
- **The National bias adjustment factor** for Gradko using 50% TEA in acetone for 2018 was **0.92. This factor has been used to bias adjust all roadside sites for 2018.**

The overall precision and data capture for this co-location study was very good, as it has been over recent years. Following discussion with DEFRA and in order not to attempt to underestimate levels of NO2 throughout the borough for 2018 it was decided to employ the national Gradko bias adjustment factor of **0.92** for all roadside sites, as LBRuT did in 2017. This is slightly more conservative than the local bias adjustment factor of **0.89**

Factor from Local Co-location Studies

The local bias adjustment factors for the Borough are provided in Table A.1 for 2012 to 2018. From 2011 to 2016 all kerbside and roadside sites in the Borough are bias adjusted using the factor from the local roadside co-location site at Richmond 1 Castelnau. All background sites in the Borough are bias adjusted using the factor from the local suburban co-location site at the Richmond 2 Barnes Wetlands. This is with the exception of 2014 and 2017. In 2014 the bias adjustment factor was the average of the three static sites in the borough – the third was the Air Quality mobile, which was at the same roadside site for the duration of 2014. In 2017 and 2018 the bias adjustment factor was the national bias adjustment factor for Gradko using the 50% TEA in acetone methodology.

The methodology for calculating the bias adjustment was followed using the guidance on the AEA spreadsheet.

Table A.1 2012 to 2018 NO2 diffusion tube bias adjustment factors for the Borough

Source of bias adjustment factor	2012	2013	2014	2015	2016	2017	2018
Local roadside co-location study at Richmond 1 Castelnau	**1.06**	**0.96**	**0.95**	**0.92**	**0.98**	**0.97** [a]	**0.92** [a]
Local background co-location study at Richmond 2 Wetlands Barnes	**1.04**	**0.95**	**1.09**	**1.00**	**1.08**	**1.00**	**0.93**

[a] Gradko national bias adjustment factor 2017 and 2018

A.3 Adjustments to the Ratified Monitoring Data

Short-term to Long-term Data Adjustment

For monitoring sites where data capture is less than 75% of a full calendar year (less than 9 months), the mean of the 'raw' concentrations has been "annualised" in accordance with Box 7.10 of the LLAQM Technical Guidance (TG16) before being compared to annual mean objectives. This was necessary at site 33, 43 and 61 in 2018.

The Wetland Centre was used as the continuous background site that fulfilled the criteria of TG16 plus the non-automatic diffusion tube background site in Richmond Park. Both background sites were within the London Borough of Richmond network. Both sites had data capture rates of 100% for 2018 - so greater than the 85% required. As two background sites were used the ratio of the Annual mean/Period mean were averaged and applied to each of the three measured concentrations. The full calculations are reproduced in the table L.

Table L. Short-Term to Long-Term Monitoring Data Adjustment

start date	end date	Wetlands B1	D1 - 33	B1 when D1 is available	D2 - 43	B1 when D2 is available	D3 - 61	B1 when D3 is available
2/1/2018	30/1/18	19.9	42.09	19.9	58.18	19.9	38.98	19.9
30/1/18	28/2/18	25.7	55.58	25.7			52.95	25.7
28/2/18	28/3/18	26.5	62.05	26.5			51.05	26.5
28/3/18	2/5/2018	19.7	55.99	19.7				
2/5/2018	5/6/2018	19.5	73.41	19.5	73.61	19.5	47.63	19.5
5/6/2018	3/7/2018	14.5	66.26	14.5	66.17	14.5	43.41	14.5
3/7/2018	31/7/18	14.7						
31/7/18	4/9/2018	13.7	40.45	13.7			39.33	13.7
4/9/2018	3/10/2018	17.7			55.20	17.7	48.79	17.7
3/10/2018	31/10/18	22.6						
31/10/18	4/12/2018	26.9			64.64	26.9		
4/12/2018	9/1/2019	26.50			55.34	26.5		
Average		20.66	56.55	19.93	62.19	20.83	46.02	19.64
Ratio (Ra) Am/Pm (B1)				1.04		0.99		1.05

start date	end date	Richmond Pk B2	D1 - 33	B2 when D1 is available	D2 - 43	B2 when D2 is available	D3 - 61	B2 when D3 is available
2/1/2018	30/1/18	17.43	42.09	17.43	58.18	17.43	38.98	17.43
30/1/18	28/2/18	26.05	55.58	26.05			52.95	26.05
28/2/18	28/3/18	27.49	62.05	27.49			51.05	27.49
28/3/18	2/5/2018	18.12	55.99	18.12				
2/5/2018	5/6/2018	17.76	73.41	17.76	73.61	17.76	47.63	17.76
5/6/2018	3/7/2018	15.55	66.26	15.55	66.17	15.55	43.41	15.55
3/7/2018	31/7/18	15.15						
31/7/18	4/9/2018	14.54	40.45	14.54			39.33	14.54
4/9/2018	3/10/2018	15.60			55.20	15.60	48.79	15.60
3/10/2018	31/10/18	21.39						
31/10/18	4/12/2018	21.71			64.64	21.71		
4/12/2018	9/1/2019	21.32			55.34	21.32		
Average		19.34	56.55	19.56	62.19	18.23	46.02	19.20
Ratio (Ra) Am/Pm (B1)				0.99		1.06		1.01

Site ref:				33		43		61
Average Ra correction factors				1.01		1.03		1.03
measured mean 2018				56.55		62.19		46.02
annualised mean ug/m3				57.25		63.81		47.36

PM_{10} Adjustment

Measured mean PM_{10} concentration for all 3 x LBRuT automatic monitoring sites for 2018 was 15-21µg/m^3 based on data capture rates of 94 - 99%. Since this was above the 75% data capture threshold "annualisation" of data was not necessary. (This is in accordance with the procedure detailed in LLAQM Technical Guidance (TG16)).

A.3 Adjustments to the Ratified Monitoring Data

Distance Adjustment

All NO 2 diffusion tube results have been adjusted to represent exposure at the nearest façade. The concentration at the nearest receptor has been estimated using the LAQM NO2 Fall-off with Distance Calculator (Version 4.1) in line with the procedure detailed in LLAQM.TG(16).

The methodology consists of comparing the monitored annual mean NO_2 concentrations at a given point against known relationships between NO_2 concentrations and the distance from a road source.

The monitored annual mean value used in the calculation is the 'raw' value which has not been bias adjusted and the background concentration is derived from the Wetlands background site .

Table K. Distance Adjustment - Monitored Annual Mean NO2 compared to exposure at nearest façade (□g m-3)

Site ID	Address	Background Conc.	Measured Annual mean Conc.	Distance Corrected Conc.
1	Hampton Court Rd, Hampton	20	**44**	**43**
2	Percy Rd, Hampton (nr. Oldfield Rd)	20	35	32
4	Hampton Rd, Teddington (nr. Bushy Pk Gardens)	20	38	29
6	Kingston Rd, Teddington (nr. Woffington Close)	20	37	30
7	Broad St, Teddington (Boots)	20	**49**	**43**
9	Hampton Rd, Twickenham	20	**44**	39
10	Twickenham Rd, Twickenham (opp. Fulwell golf course)	20	**44**	33
11	Percy Rd, Whitton (nr. Percy Way)	20	**50**	35
12	Hanworth Rd, Whitton	20	**48**	35
13	Whitton Rd, Whitton, (opp. rugby ground)	20	**42**	33
14	Cross Deep, Twickenham (nr Poulett Gardens)	20	39	32
15	Richmond Rd, Twickenham (opp. Marble Hill Pk)	20	37	34
16	St Margarets Rd, St Margarets (nr. Bridge Rd)	20	**40**	36
17	Red Lion Street, Richmond	20	**58**	**54**

18	Lower Mortlake Rd, Richmond (nr. Trinity Rd)	20	**50**	36
19	Kew Rd, Kew (nr. Walpole Av)	20	**45**	30
20	Mortlake Rd, Kew (nr. Kent Rd)	20	**41**	35
21	Lower Richmond Rd, Mortlake (nr. Kingsway)	20	**55**	**48**
22	Castelnau, Barnes (nr. Hammersmith Bridge)	20	**49**	38
23	Castelnau Library, Barnes (static site)	20	34	30
24	Lonsdale Road, Barnes (nr. Suffolk Rd)	20	34	27
25	URRW, (nr. Sheen School)	20	**41**	**41**
26	URRW, Sheen (nr. Courtland Estate)	20	39	28
27	Queens Rd, Richmond (nr. Russell Walk)	20	**40**	31
28	Holly Lodge, Richmond Pk	20	19	19
29	Petersham Rd, Ham (nr. Sandy Lane)	20	34	34
31	A316 (nr. Chudleigh Rd)	20	**54**	**41**
32	Kings St, Twickenham	20	**61**	**52**
33	Heath Rd, Twickenham	20	**57**[c]	**50**
34	Thames St, Hampton	20	35	35
35	High St, Hampton Wick	20	**45**	**45**
36	Upper Richmond Road West(URRW), nr Sheen Lane	20	**68**	**68**
37	Wetlands, Barnes (static site)		22	22
39	Richmond Rd, nr. Richmond Bridge, East Twickenham	20	**49**	**44**
40	Staines Rd, Twickenham	20	**45**	33
41	Paradise Rd, Richmond	20	36	30
42	The Quadrant/Kew Rd, Richmond	20	**79**	**63**
43	Hill St, Richmond	20	**64**[c]	**57**
44	Sheen Rd, Richmond (near shops)	20	**43**	**43**
45	154 High St, Teddington,	20	36	31

47	Causeway, Teddington	20	31	30
48	Stanley Rd, Teddington (junc. Strathmore Rd)	20	**43**	38
50	URRW, nr. Clifford Av, Sheen	20	**56**	**47**
51	Sheen Lane, Sheen (railway crossing)	20	35	34
52	Clifford Av, Chalkers Corner	20	**64**	**58**
53	Mobile AQ unit, A316 nr Egerton Rd	20	**47**	**43**
54	Mortlake Road, adjacent to West Hall Road, Kew	20	**43**	**40**
55	Mortlake Road, adjacent to Cemetery Gates,	20	**45**	36
56	A316 (St Magarets)	20	**47**	35
57	A316 (Lincoln Avenue)	20	**47**	36
58	London Road, Twickenham	20	**46**	35
59	Whitton Rd, Twickenham (near Twickenham bridge)	20	**44**	**40**
60	Waldegrave Rd, Teddington	20	31	28
61	London Road, Twickenham (near Waitrose)	20	**47**[c]	**42**
62	High Street, Barnes	20	**47**	39
63	High Street, Whitton	20	**42**	36
64	High Street, Hampton Hill	20	**49**	**43**
65	York Street, Twickenham	20	**60**	**48**
66	South Circular, Kew Green	20	**46**	**43**
67	Petersham Rd opp Poppy Factory,	20	**45**	**44**
68	Rocks Lane, SW13.	20	**59**	**57**
69	Uxbridge Rd, nr Longford Cl, TW12	20	**41**	33
Rut 01	Civic Centre, York St, Twickenham	20	**42**	**42**
Rut 02	George Street, Richmond	20	**72**	**61**

Appendix B Full Monthly Diffusion Tube Results for 2018

Table M. NO_2 Diffusion Tube Results

Site ID	Valid data capture for monitoring period % [a]	Valid data capture 2018 % [b]	Annual Mean NO_2													
			Jan	Feb	March	Apr	May	June	Jul	Aug	Sept	Oct	Nov	Dec	Annual mean – raw data [c]	Annual mean – bias adjusted [d]
1	100	100	57.34	57.07	62.17	51.25	20.04	39.30	36.81	38.89	34.50	42.03	46.72	45.69	**44**	**41**
2	100	75	34.35	38.31	40.28	33.70	32.11	28.29				41.74	27.52	34.99	35	32
4	100	100	33.59	43.26	45.08	39.75	39.50	39.29	30.53	31.36	33.39	43.54	42.96	37.82	38	35
6	100	100	36.51	43.43	42.12	34.15	40.50	35.77	33.25	26.54	34.59	42.12	45.68	26.92	37	34
7	100	100	48.13	51.17	56.37	42.63	54.46	59.68	49.40	39.10	43.41	51.94	44.80	47.57	**49**	**45**
9	100	100	48.09	48.42	49.85	41.60	44.78	41.22	38.79	34.36	37.53	46.45	46.43	47.00	**44**	**40**
10	100	100	49.98	50.36	57.25	42.22	43.97	36.93	41.40	36.49	38.77	46.85	45.95	41.50	**44**	**41**
11	100	100	44.19	56.36	58.13	43.39	54.94	45.72	48.12	44.20	49.77	55.36	49.05	49.21	**50**	**46**
12	100	100	46.31	55.46	54.20	54.14	48.74	49.06	46.04	36.86	43.14	37.71	50.18	51.87	**48**	**44**
13	100	100	32.23	45.19	44.37	41.82	47.69	38.81	36.74	32.93	35.38	50.46	52.03	46.92	**42**	39
14	100	92	35.44	46.57	41.31	39.22	39.27	37.16	32.82		36.38	40.12	44.09	34.96	39	36
15	100	100	40.39	37.82	35.94	34.08	43.19	37.22	38.87	35.90	35.50	38.23	40.60	29.85	37	34
16	100	92	38.19	46.57	46.76	39.99	35.70	33.80		28.66	37.44	42.65	44.27	50.59	**40**	37
17	100	92	52.24	53.15	56.69	63.44	59.40	61.77	58.81	55.48	60.95		62.23	58.14	**58**	**54**
18	100	100	51.57	50.34	60.62	6.26	17.60	57.11	68.54	49.81	62.23	53.41	59.23	59.66	**50**	**46**
19	100	83	40.94	51.50		53.91	46.81	42.82		31.71	43.64	40.22	53.09	50.01	**45**	**42**
20	100	100	40.54	41.59	49.59	39.81	34.19	35.04	35.23	37.76	40.66	45.95	48.64	47.84	**41**	38
21	100	92	44.85	57.66	60.85	62.46	56.22	55.51	54.04	41.40	51.80	55.80	61.10	55.66	**55**	**50**
22	100	100	45.94	46.11	61.89	51.03	37.21	42.89	44.99	48.16	44.16	56.53	60.62	47.54	**49**	**45**
23	100	100	24.71	36.65	40.16	32.06	28.74	28.74	28.37	28.31	28.54	37.87	41.43	34.73	34	31
24	100	100	35.51	38.86	40.18	33.44	31.06	31.34	30.08	27.90	29.73	33.78	36.76	33.90	34	31
25	100	100	40.72	44.48	44.68	41.41	47.45	47.28	39.53	31.34	34.69	42.27	41.62	35.75	**41**	38

26	*100*	*100*	38.17	40.96	44.79	38.48	37.77	38.59	32.41	34.02	36.13	40.88	44.10	40.79	39	36
27	*100*	*92*	36.29	45.14	43.12	42.00	45.81	32.46	40.34	33.24		43.26	39.89	40.41	**40**	37
28	*100*	*100*	17.43	26.05	27.49	18.12	17.76	15.55	15.15	14.54	15.60	21.39	21.71	21.32	19	18
29	*100*	*100*	30.65	41.40	35.92	35.57	31.93	33.10	32.04	26.81	28.33	35.13	40.78	33.83	34	31
31	*100*	*92*		44.47	54.12	57.28	62.24	50.86	53.67	47.66	49.75	57.10	54.54	58.32	**54**	**49**
32	*100*	*100*	47.16	58.19	67.66	64.74	65.77	65.23	68.85	48.45	51.42	66.95	68.88	55.81	**61**	**56**
33	*100*	*58*	42.09	55.58	62.05	55.99	73.41	66.26		40.45					**57**[c]	**52**
34	*100*	*92*	36.57	40.40	48.66	28.97	33.17	35.65	34.44	28.39	29.34	36.56		36.11	35	32
35	*100*	*100*	47.42	51.29	53.58	47.33	39.73	32.66	41.73	45.31	42.89	48.86	46.90	47.53	**45**	**42**
36	*100*	*92*	68.98	58.76		76.15	61.79	65.67	80.06	62.64	64.73	69.53	76.10	66.80	**68**	**63**
37	*100*	*100*	19.90	27.75	28.25	18.92	22.73	18.27	18.17	17.04	18.21	24.85	28.67	23.00	22	21
39	*100*	*100*	51.63	54.38	58.17	51.18	54.92	48.28	46.32	40.48	46.34	45.39	45.15	43.95	**49**	**45**
40	*100*	*83*	44.96	53.33	54.67	43.81	51.53	43.98	39.22	37.19	36.60		45.18		**45**	**41**
41	*100*	*92*	32.31	35.27	37.33	30.13	30.75	34.91	32.14		37.82	36.64	44.37	48.98	36	34
42	*100*	*92*	61.03	60.57	84.47	77.10	86.07	76.71	86.12	74.62	85.87	92.13	80.72		**79**	**72**
43	*100*	*50*	58.18				73.61	66.17			55.20		64.64	55.34	**64**[c]	**59**
44	*100*	*100*	48.83	43.50	48.05	40.74	37.74	45.28	37.55	39.54	39.56	48.03	43.95	47.62	**43**	**40**
45	*100*	*100*	30.14	38.43	38.99	35.86	32.44	30.67	34.28	32.89	35.11	41.43	39.77	40.79	36	33
47	*100*	*92*	29.28		38.47	27.54	32.30	34.07	31.10	27.13	29.93	37.56	32.73	24.05	31	29
48	*100*	*100*	44.00	43.92	50.19	40.00	46.05	39.52	41.79	37.37	38.03	46.45	44.16	46.54	**43**	**40**
50	*100*	*92*	41.92	58.89	60.86		55.75	58.46	56.57	48.58	55.71	64.29	63.40	53.70	**56**	**52**
51	*100*	*100*	37.82	41.31	36.88	34.09	33.04	30.09	33.39	27.34	31.86	38.99	41.88	38.01	35	33
52	*100*	*100*	61.68	63.61	63.37	65.72	64.78	65.22	68.04	52.18	66.43	66.66	59.77	70.58	**64**	**59**
53	*100*	*100*	37.63	50.43	46.18	51.12	58.40	46.85	49.05	39.65	43.29	50.87	50.90	53.80	**47**	**43**
54	*100*	*100*	43.16	45.06	47.85	47.01	40.47	37.89	36.33	37.38	38.49	47.12	49.20	46.92	**43**	**40**

55	*100*	*92*	37.27	46.35	50.17	46.84	47.29	42.99	47.42		41.10	36.29	55.84	41.98	**45**	**41**
56	*100*	*100*	44.08	50.57	56.00	43.17	52.55	52.59	44.90	39.99	45.89	52.21	43.71	40.75	**47**	**43**
57	*100*	*92*	49.13	43.53	58.01	43.30	49.87	47.30	41.20	39.00		54.68	44.32	46.18	**47**	**43**
58	*100*	*92*	57.59	47.32	55.96	50.30		39.72	45.89	32.18	40.02	48.32	50.11	43.65	**46**	**43**
59	*100*	*100*	41.84	50.06	54.35	41.98	52.36	47.91	40.46	35.45	31.04	45.76	43.98	36.84	**44**	**40**
60	*100*	*92*	26.64	37.43	36.79		32.53	25.05	26.87	24.19	26.76	35.41	36.31	35.98	31	29
61	*100*	*58*	38.98	52.95	51.05		47.63	43.41		39.33	48.79				**47**[c]	**43**
62	*100*	*92*	47.04	46.68	52.79	44.61	46.02	48.05		40.44	46.92	62.01	41.07	42.01	**47**	**43**
63	*100*	*92*	31.60	43.65	47.96	43.89	45.92	35.72	43.75	34.61	38.56	44.73	48.17		**42**	**38**
64	*100*	*92*	44.23	50.14	51.18		52.87	48.80	47.61	38.66	48.04	60.01	50.28	43.45	**49**	**45**
65	*100*	*83*	50.10		54.80		66.56	62.56	64.91	58.85	57.54	58.93	70.06	54.65	**60**	**55**
66	*100*	*100*	43.54	47.24	51.93	45.28	43.48	41.06	48.56	40.07	38.44	52.69	49.72	51.22	**46**	**42**
67	*100*	*92*	36.54	51.95	49.59	48.12	49.42	46.06	48.92	42.02		41.21	40.27	38.07	**45**	**41**
68	*100*	*100*	64.81	47.32	58.05	61.46	62.72	57.77	65.43	56.85	64.14	59.95	58.85	55.34	**59**	**55**
69	*100*	*83*	34.85	43.97	45.92	34.33	34.27	30.36	28.52			54.12	55.45	51.12	**41**	38
Rut 01	*100*	*100*	33.89	40.60	34.58	45.08	48.93	45.00	43.86	39.01	41.42	42.21	44.62	41.86	**42**	**38**
Rut 02	*100*	*83*	50.68	61.83	72.80	79.50	78.16	90.35			70.38	81.25	65.18	64.94	**72**	**66**

Exceedance of the NO_2 annual mean AQO of 40 μgm^{-3} are shown in **bold**.

[a] data capture for the monitoring period, in cases where monitoring was only carried out for part of the year

[b] 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%)

[c] Means should be "annualised" in accordance with LLAQM Technical Guidance, if valid data capture is less than 75%

d The bias adjustment factor used for all roadside/kerbside sites is 0.92 which is calculated using the National Gradko 50% TEA in acetone adjustment factor for 2018 . The bias adjustment factor for both background sites 28 and 37 is 0.93 calculated using results from Wetlands

For Triplicate sites see below.

Triplicate NO2 diffusion tube results for sites 23, 37 and 53 in ug/m3

Site Code	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual mean
23	24.65	35.42	45.38	32.13	28.74	31.33	31.33	31.00	29.00	40.70	42.66	30.31	33.55
23/2	24.75	38.69	36.56	33.31	32.03	26.42	26.42	26.28	28.96	36.13	42.34	37.30	35.38
23/3	24.72	35.85	38.55	30.74	30.98	27.36	27.36	27.65	27.65	36.79	39.27	36.56	31.96
Average	24.71	36.65	40.16	32.06	30.58	28.37	28.37	28.31	28.54	37.87	41.43	34.73	33.63
37	19.91	29.88	27.50	21.08	22.73	18.27	18.40	17.42	17.06	25.84	29.78	22.78	22.55
37/2	18.07	28.54	29.52	21.32	22.62	18.00	18.42	16.82	18.79	25.68	27.92	21.93	22.30
37/3	21.73	24.84	27.73	14.36	19.96	17.33	17.69	16.87	18.77	23.02	28.32	24.31	21.24
Average	19.90	27.75	28.25	18.92	21.77	17.87	18.17	17.04	18.21	24.85	28.67	23.00	22.03
53	41.84	45.48	45.10	55.05	58.40	46.85	47.62	41.13	40.75	48.16	52.16	55.03	48.13
53/2	36.14	49.15	47.27	50.46	57.32	48.98	50.84	40.22	45.05	51.89	53.40	52.57	48.61
53/3	34.90	56.64	46.16	47.84	51.79	51.29	48.70	37.61	44.06	52.56	47.13		43.22
Average	37.63	50.43	46.18	51.12	55.84	49.04	49.05	39.65	43.29	50.87	50.90	53.80	46.65