London Borough of Richmond upon Thames Air Quality Annual Status Report for 2020

Date of publication: 28th May 2021

This report provides a detailed overview of air quality in the London Borough of Richmond upon Thames during 2020. It has been produced to meet the requirements of the London Local Air Quality Management statutory process[1].

[1] LLAQM Policy and Technical Guidance 2019 (LLAQM.TG(19))

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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 2021 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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Tables

Abbreviations

Abbreviation	Description
AQAP	Air Quality Action Plan
AQMA	Air Quality Management Area
AQO	Air Quality Objective
BEB	Buildings Emission Benchmark
CAB	Cleaner Air Borough
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} (milligrams 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	**Standard/Objective (UK)**	**Averaging Period**	**Date[1]**
Nitrogen dioxide - NO_2	200 □g m^{-3} not to be exceeded more than 18 times a year	1-hour mean	31 Dec 2005
	40 □g m^{-3}	Annual mean	31 Dec 2005
Particles - PM_{10}	50 □g m^{-3} not to be exceeded more than 35 times a year	24-hour mean	31 Dec 2004
	40 □g m^{-3}	Annual mean	31 Dec 2004
Particles - $PM_{2.5}$	25 □g 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

Notes:

[1] Date by which to be achieved by and maintained thereafter

1. Air Quality Monitoring

The latest monitoring results for 2020 confirm that air pollution in the London Borough of Richmond upon Thames 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. The LBRuT have complied with EU limit values for these pollutants for a minimum of 3 years prior to cessation of monitoring.

1.1 Locations

Automatic Monitoring Sites

Our continuous monitors collect real time data, which are stored as 15-minute ‘means’ and can then be converted into the various averages. This type of equipment provides accurate measurements 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 College London Air Quality Network, as is the site at the National Physical Laboratory (NPL). This site is

also part of the government's UK Automatic Urban and Rural Network (AURN). Richmond also had a mobile Air Quality monitoring unit, which was stationed at Chertsey Road. Unfortunately, it was stolen during the summer of 2020. Due to limited data, results will not be 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 Imperial College London. Further details of the sites can be found at www.londonair.org.uk.

Table B. Details of Automatic Monitoring Sites for 2019

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	177166	Roadside	Y	8m	3m	2.35m	NO2, PM10	Chemiluminescent; TEOM
RI2	**Wetlands Centre**, Barnes	522993	176731	Suburban	Y	Children in adjacent play area/people attending Wetlands Centre	N/A	3.2m	NO2, PM10,O3	Chemiluminescent; TEOM

TD0	**NPL -** Teddington AURN	515542	170420	Suburban	Y	N/A	N/A	N/A	PM10, 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 and accurate method of monitoring, which allows samples to be taken across the whole LBRuT and gives a Borough-wide view. The results are provided as 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 then bias adjusted, with data from the more accurate continuous monitors. The Council had a network of 64 diffusion tube sites across the Borough in 2020. Three of the diffusion tubes sites are triplicate and co-located 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 area specific monitoring, at the beginning of each year.

Table C. Details of Non-Automatic Monitoring Sites for 2020

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. Side of Waitrose)	513217	169746	roadside	Y	1.3m	3.0m	2.2m	NO2	N
4	Hampton Rd, Hampton Hill (nr. Laurel Dene)	514607	171258	kerbside	Y	0.6m	9.8m	2.2m	NO2	N
7	Broad St, Teddington (Boots)	515695	170983	kerbside	Y	0.8m	2.5m	2.2m	NO2	N
9	Hampton Rd, Twickenham	514846	172348	kerbside	Y	0.6m	2.0m	2.2m	NO2	N
10	Twickenham Rd, Twickenham (opp. Fulwell golf course)	513390	172233	kerbside	Y	0.6m	7.2m	2.2m	NO2	N
11	Percy Rd, Whitton (nr. Percy Way)	514136	173389	kerbside	Y	0.6m	9.1m	2.2m	NO2	N
12	Hanworth Rd, Whitton	512612	173439	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

15	Richmond Rd, Twickenham (opp. Marble Hill Park)	517196	173933	kerbside	Y	0.6m	1.8m	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)	518643	176156	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
22	Castelnau, Barnes (nr. Hammersmith Bridge)	522845	177908	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
25	URRW, (nr. East Sheen Prim Schl)	521199	175460	roadside	Y	2.3m	2.5m	2.2m	NO2	N

26	URRW, Sheen (nr. Courtland Estate)	519168	175055	roadside	Y	3.2m	11.8	2.2m	NO2	N
27	Queens Rd, Richmond (nr. Russell Walk)	518847	174513	kerbside	Y	0.7m	6.8m	2.2m	NO2	N
28	Holly Lodge, Richmond Pk	519445	173991	urban background	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)	515434	174045	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	516098	173153	roadside	Y	3.3m	6.9m	2.2m	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	520540	175399	roadside	Y	2.1m	2.2m	2.2m	NO2	N
37	Wetlands, Barnes (static site)	522993	176731	urban background	Y	1160m	230m	2.2m	NO2	Y
39	Richmond Rd, nr. Richmond Bridge, East Twickenham	517516	174331	roadside	Y	1.2m	2.7m	2.2m	NO2	N
40	Staines Rd, Twickenham	514068	172435	roadside	Y	1.0m	11.4m	2.2m	NO2	N
41	Paradise Rd, Richmond	518164	174872	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	517759	174757	kerbside	Y	0.7m	1.6m	2.2m	NO2	N
44	Sheen Rd, Richmond (near shops)	518489	175056	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
50	URRW, nr. Clifford Av, Sheen	519922	175324	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	519773	175795	kerbside	Y	0.5	2.2	2.2m	NO2	N
53	co-located on mobile Air Quality unit, A316 nr RUTC	513360	173995	roadside	Y	varies	varies	2.2m	NO2	Y
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	N
56	A316 (nr St Margaret's roundabout)	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
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	514188	173801	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	522415	176537	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
70	Stag Brewery, Lower Richmond Rd, SW14	520465	175965	roadside	Y	1.8m	2.1m	2.2m	NO2	N
71	A316, St Stephens Primary School	516574	174456	roadside	Y	2.9m	9.9m	2.2m	NO2	N
72	St Margarets Rd, nr St Margaret's station, TW1	516839	174238	roadside	Y	0.8m	2.5m	2.2m	NO2	N
73	Hospital Bridge Rd, nr Homelink	513722	172873	roadside	Y	2.1m	8.4m	5.0m	NO2	N
74	Lower Richmond Rd (nr A316)	519856	175856	kerbside	Y	2.6m	5.9m	2.2m	NO2	N

75	Hampton Rd (opp Tedd Mem Hosp)	515459	171029	kerbside	Y	0.6m	6.3m	2.2m	NO2	N
76	Manor Rd, nr Ferry Rd, TW11	516588	171357	kerbside	Y	0.4m	3.3m	2.2m	NO2	N
77	Sixth Cross Rd, nr Wellington Rd,TW2	514705	172092	roadside	Y	0.6m	4.5m	2.3m	NO2	N
78 (34)	Upper Sunbury Rd, Hampton, TW12	513527	169513	roadside	Y	1.7m	2.7m	2.5m	NO2	N
79 (48)	South St, outside Lidl, TW2	514810	172041	kerbside	Y	1.0m	6.6m	2.2m	NO2	N
Rut 01	Civic Centre, York St, Twickenham	516415	173419	roadside	Y	2.9m	3.0m	5.0m	NO2	N
Rut 02	George Street, Richmond	517917	174928	kerbside	Y	0.7m	2.2m	2.2m	NO2	N

Site changes 2020: sites 75, 76, 77, 78 and 79 opened; sites 14, 24, 41 closed; sites 2, 4, 27 and 29 moved slightly (<20m) to better represent worst-case scenario following requests from residents/officer observation. Site 34 and 48 moved > 20m so re-named site 78 and 79 respectively.

1.2 Comparison of Monitoring Results with AQOs

The results presented are after adjustments for “annualisation” and for distance to a location of relevant public exposure (if required), the details of which are described in Appendix A. For results that indicate the exposure estimate, calculated for the nearest residential façade see Table N.

Table D. Annual Mean NO_2 Ratified and Bias-adjusted Monitoring Results (□g m-3)

Site ID	Site type	Valid data capture for monitoring period %[a]	Valid data capture 2020 %[b]	Annual Mean Concentration (µgm^{-3})						
				2014	2015	2016	2017	2018	2019	2020
Castelnau Library, Barnes (RI1)	Automatic Roadside	100%	100%	37	34	36	31	31	27	20
Wetlands Centre, Barnes (RI2)	Automatic Suburban	100%	82%	25	21	25	21	20	21	15
NPL - Teddington AURN (TD0)	Automatic Suburban	N/A	N/A	27	19	22	N/A	N/A	N/A	N/A

1	Diffusion tube (D/T) Roadside	100	100	**49**	**41**	**56**	**55**	**41**	35	25
2	D/T Roadside	100	83	33	28	31	29	32	29	21
3	D/T Roadside	100	Closed	**44**	**41**	**42**	39	closed	closed	closed
4	D/T Kerbside	100	100	**44**	36	**40**	36	35	31	27
5	D/T Kerbside	closed	Closed	closed	closed	closed	closed	closed	closed	closed
6	D/T Kerbside	100	Closed	**41**	36	37	30	34	closed	closed
7	D/T Kerbside	100	100	**54**	**47**	**49**	**43**	**45**	39	34
8	D/T Kerbside	closed	Closed	closed	closed	closed	closed	closed	closed	closed
9	D/T Kerbside	100	100	**48**	**42**	**45**	**40**	**40**	**35**	31
10	D/T Kerbside	100	100	**47**	**43**	**44**	**42**	**41**	**40**	33
11	D/T Kerbside	100	100	**48**	**44**	**48**	**47**	**46**	34	27
12	D/T Kerbside	100	100	**46**	**41**	**45**	**41**	**44**	**40**	31

13	D/T Kerbside	100	100	**47**	**42**	**42**	**40**	**39**	36	30
14	D/T Kerbside	closed	closed	**45**	39	**40**	36	36	33	closed
15	D/T Kerbside	100	92	**40**	37	**41**	38	34	32	26
16	D/T Roadside	closed	closed	**43**	41	**42**	38	37	closed	closed
17	D/T Kerbside	100	100	**68**	**63**	**69**	**60**	**54**	**50**	**40**
18	D/T Kerbside	100	100	**66**	**67**	**56**	**58**	**46**	**46**	**41**
19	D/T Kerbside	100	100	**55**	**48**	**49**	**49**	**42**	**37**	**30**
20	D/T Kerbside	100	92	**55**	**48**	**47**	**45**	38	38	30
21 (74)	D/T Roadside	closed	closed	**41**	37	39	36	closed	closed	closed
22	D/T Kerbside	100	100	**59**	**53**	**65**	**52**	**45**	32	**21**
23	D/T Roadside	100	100	38	35	35	35	31	26	20
24	D/T Kerbside	closed	closed	**40**	35	37	34	31	28	closed
25	D/T Roadside	100	92	**51**	**51**	**45**	**46**	38	36	34

26	D/T Roadside	100	100	**43**	**42**	**40**	**40**	36	34	32
27	D/T Roadside	100	92	38	37	**43**	**41**	37	32	21
28	D/T Urban background	100	100	18	17	21	17	18	17	12
29	D/T Kerbside	100	100	36	30	32	30	31	28	21
30	D/T Roadside	closed	closed	34	29	33	closed	closed	closed	closed
31	D/T Roadside	100	100	**62**	**54**	**54**	**52**	**49**	**45**	35
32	D/T Roadside	100	100	**73**	**62**	**64**	**59**	**56**	**47**	**40**
33	D/T Kerbside	100	92	**69**	**61**	**61**	**53**	**52**	**40**	34
34	D/T Roadside	closed	closed	40	33	36	35	32	30	closed
35	D/T Roadside	100	100	**48**	**43**	**46**	**45**	**42**	36	32
36	D/T Roadside	100	100	**56**	**49**	**50**	**60**	**63**	**61**	**56**
37	D/T Urban background	100	100	22	21	25	20	21	20	14
38	D/T Kerbside	closed	closed	closed	closed	closed	closed	closed	closed	closed

39	D/T Kerbside	100	92	**56**	**52**	**55**	**52**	**45**	39	32
40	D/T Kerbside	100	100	**40**	36	**45**	**42**	**41**	35	29
41	D/T Kerbside	closed	closed	**41**	38	39	36	34	32	closed
42	D/T Roadside	100	92	**54**	**47**	**82**	**89**	**72**	**62**	**60**
43	D/T Kerbside	100	92	**80**	**80**	**85**	**78**	**59**	**46**	**41**
44	D/T Kerbside	100	92	**45**	39	**42**	**41**	**40**	37	33
45	D/T Kerbside	100	100	**45**	35	37	35	33	32	26
46	D/T Kerbside	closed	closed	closed	closed	closed	closed	closed	closed	closed
47	D/T Roadside	closed	closed	37	32	33	31	29	closed	closed
48	D/T Roadside	closed	closed	**45**	39	**41**	**40**	**40**	33	closed
49	D/T Kerbside	closed	closed	**45**	39	**44**	31	closed	Closed	closed
50	D/T Kerbside	100	100	**60**	**57**	**55**	**53**	**52**	**50**	**45**
51	D/T Kerbside	100	100	34	28	32	35	33	30	24

52	D/T Kerbside	100	100	**62**	**55**	**57**	**50**	**59**	**55**	**46**
53	D/T varies	58	58	**48**	N/A	N/A	**44**	**43**	**41**	34
54	D/T Roadside	100	92	**56**	**51**	**49**	**48**	**40**	**40**	32
55	D/T Roadside	100	83	**55**	**50**	**50**	**45**	**41**	**40**	33
56	D/T Kerbside	100	100	38	37	**51**	**50**	**43**	39	31
57	D/T Kerbside	100	83	36	33	**44**	**42**	**43**	37	29
58	D/T Kerbside	100	100	**50**	**46**	**50**	**47**	**43**	**40**	33
59	D/T Kerbside	100	100	**42**	**40**	**44**	39	**40**	34	27
60	D/T Kerbside	100	closed	32	27	29	29	29	closed	closed
61	D/T Roadside	100	92	**54**	**48**	**49**	**45**	**43**	38	32
62	D/T Kerbside	100	100	**52**	**46**	**51**	**50**	**43**	**43**	32
63	D/T Kerbside	100	100	**42**	38	**41**	38	38	33	27
64	D/T Kerbside	100	100	**60**	**55**	**53**	**49**	**45**	**41**	34

65	D/T Kerbside	100	92	Not open	Not open	**75**	**68**	**55**	**50**	**40**
66	D/T Kerbside	100	100	Not open	Not open	**49**	**49**	**42**	**40**	32
67	D/T Roadside	100	92	Not open	Not open	Not open	**44**	**41**	32	23
68	D/T Roadside	100	92	Not open	Not open	Not open	Not open	**55**	**40**	31
69	D/T Roadside	100	100	Not open	Not open	Not open	Not open	38	31	22
70	D/T Roadside	100	100	Not open	Not open	Not open	Not open	Not open	**42**	33
71	D/T Roadside	100	100	Not open	Not open	Not open	Not open	Not open	**52**	**43**
72	D/T Roadside	100	100	Not open	Not open	Not open	Not open	Not open	**42**	33
73	D/T Roadside	100	100	Not open	Not open	Not open	Not open	Not open	**43**	36
74 (21)	D/T Roadside	100	92	Not open	Not open	Not open	Not open	**50**	**52**	**43**
75	D/T Kerbside	100	100	Not open	Not open	Not open	Not open	Not open	Not open	29
76	D/T Kerbside	100	100	Not open	Not open	Not open	Not open	Not open	Not open	35
77	D/T Kerbside	100	92	Not open	Not open	Not open	Not open	Not open	Not open	38

78 (34)	D/T Kerbside	100	100	Not open	Not open	Not open	Not open	Not open	Not open	25
79 (48)	D/T Roadside	100	92	Not open	Not open	Not open	Not open	Not open	Not open	33
Rut 01	D/T Roadside	100	100	**56**	45	**50**	**51**	38	36	29
Rut 02	D/T Kerbside	100	100	**96**	**88**	**96**	**82**	**72**	**63**	**52**

Notes:

The annual mean concentrations are presented as µg m^{-3}.

Exceedances of the NO_2 annual mean AQO of 40 µg m^{-3} are shown in orange and **bold**.

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 red, **bold and underlined**.

Means for diffusion tubes have been corrected for bias.

All means have been "annualised" in accordance with LLAQM Technical Guidance if valid data capture for the calendar year is less than 75% and greater than 33%. In 2020, this applied to site 53 only. This site had triplicate diffusion tubes alongside an automatic monitoring station. Unfortunately, the air quality station was stolen in August 2020. It therefore achieved 58%data capture – 7 months out of 12, so results have been annualised.

Results have been distance corrected where applicable.

(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%).

Maximum data capture for the monitoring period, for all diffusion tube sites except site 53 (see above), was a full 12 months – 100%. Missing tubes resulted in slightly reduced data capture at individual sites.

The bias adjustment factor used for **all roadside/kerbside** sites is **0.91** calculated using the local Castelnau roadside site for 2020. The bias adjustment factor for **background sites** 28 and 37 is **0.83** calculated using **the National bias adjustment factor** for Gradko. Data capture at Wetlands (RI2) was 82%, below the 90% required. For this reason the National bias adjustment factor for Gradko was used to bias adjust our two background sites. For more information, see Appendix A.2

Notes on sites:

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 6/1/16 site 57 was moved nearer the road, no longer behind a small section of green screening to better represent most of this section of the A316.

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 monitoring onwards. Please see our 2016 Annual Status Report for earlier coordinates.

From 2/1/18 sites 3 and 49 were closed; sites 68 and 69 opened; site 21 was moved approx. 200m in response to resident's requests and is now close to the junction at Chalkers Corner, so for clarity has been renamed site 74. Site 36 and 51 were moved slightly (<20m); See Table C for correct grid references for 2018 onwards and 2017 ASR for earlier grid references.

From 9/1/19 sites 6, 16, 47 and 60 were closed; sites 70, 71, 72 and 73 were opened.

From 6/1/20 sites 14, 24, 41 were closed; sites 75, 76, 77 opened; sites 2, 4, 27 and 29 moved slightly (<20m) to better represent worst case scenario following requests from residents/officer observation. Site 34 and 48 moved > 20m so for clarity have been renamed site 78 and 79 respectively.

Automatic Monitoring Site data

Table D provides the 2020 results of the NO_2 automatic monitoring and a comparison with the annual mean objective.

The 2020 NO_2 data capture for RI1 Castlenau was very good, representing 100% data capture and for RI2 Wetlands 82%. We were aware of some data loss for Wetlands due to equipment failure. Unfortunately, more data was lost following ratification when some data had to be withdrawn. Results for Wetlands may not be representative of the full year and should be used for guidance only.

The 2020 results show that both sites met the objective of 40 $\mu g\ m^{-3}$. The 2020 annual mean for the RI2 (Wetlands) was 15 $\mu g\ m^{-3}$ This site is a background site and therefore representative of low pollution in the Borough. The annual mean at the RI1 (Castelnau) roadside site was 20 $\mu g\ m^{-3}$.

This represents a slight decrease for Wetlands and a decrease for Castlenau from 2018 and 2019 data. However, all results for 2020 need to be treated with caution due to the COVID-19 pandemic which affected traffic patterns and in turn pollution levels. It should also be noted that Castlenau, although a roadside site, is no longer representative of typical roadside concentrations for LBRUT. This is because Hammersmith Bridge at the end of Castlenau was closed to all vehicles on 10th April 2019 for safety reasons until strengthening work is completed. This is likely to take at least 6 years.

Furthermore from Saturday 28 May 2016 -2020, in order to preserve the lifespan of Hammersmith Bridge, 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. This means there has been a large reduction in the number of vehicles along Castlenau from 2016-2020 and a corresponding reduction in levels of NO2. Consideration has been given to relocating the site. On balance, following discussions with the Council and Imperial College London, for data continuity and trend data purposes, it has been decided to leave it in situ. This will be reviewed annually. It is

hoped to replace the stolen air quality mobile with a static roadside automatic site in Richmond town centre as soon as funding is available.

Diffusion Tube Monitoring Data

Table D shows the NO2 diffusion tube monitoring results, with bias corrected values for each year from 2014 to 2020. (Note – see Table O for monthly data for 2020 and Table N 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 in **bold and 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 2020 for all sites was very good (96.35%). Only site 53, where triplicate diffusion tubes were co-located with the automatic analyser on our mobile air quality station, recorded a data capture of less than 75%. This site recorded 58%; sadly it was stolen in August, so all data ceased. In order to include data from this site, diffusion tubes have been annualised in line with LLAQM.TG(19) guidance and DEFRA guidance,TG (16).

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 2020 monitoring show that the objective of 40 μg m-3 was exceeded at 12 sites (18.75%), and complied with at 52 sites (81.25%). This is a significant improvement on 2019, where 27 sites (42.2%) exceeded with no sites recording double the objective. All sites – 100% - have reduced in 2020. None have increased or remained the same. After distance correction for nearest façade, the annual mean objective is exceeded at 4 sites, down from 24 in 2019. None 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. This is a significant improvement. Please note this is the first year bias adjusted rather than “raw” data has been used,as per LLAQM (19) guidance. Any comparison with earlier years’ distance corrected figures should be mindful of this fact.

However, as we are all aware, 2020, was far from a normal year. Whilst reductions are welcomed, they may be short lived. All reductions in monitored 2020 NO2 results must be viewed in light of lockdowns during the COVID-19 pandemic and resultant effects on traffic fleet, volume and mix. If there is any upside to the devastating COVID-19 pandemic, it must be the significant reduction in measured NO2, which seems to apply to LBRUT, London and the UK. This is good news. We now need to try to retain gains made. It follows on from the most significant percentage decrease in the last 20 years, measured in 2019.

Considering this, perhaps of concern, is that one of these sites, in Richmond town centre, site 42, still exceeded an annual mean of 60 μg m-3 which indicates that the 1 hour-mean objective may also have been exceeded. Site 42 is opposite Richmond station, the main transport hub in the borough. It exceeded the 1 hour-mean objective in 2018, measuring 72ug/m3, in 2019 measuring 62ug/m3 and in 2020 measured 60ug/m3. A good reduction from 2018 to 2019 but a far smaller reduction in 2020, especially considering COVID-19. Much work has been done at this location with taxi drivers through anti-idling signage and campaigns - most drivers now switch off. 16 bus routes serve Richmond station so work done by TfL to clean up the bus fleet was both very important and welcome. The work was delayed a little due to COVID-19 but by Feb 2021 all TfL buses, serving LBRUT were Euro VI compliant, either hybrid or retrofitted. This will continue to make a difference for years to come. Further improvements are challenging but necessary.

East Sheen, site 36, is down by 5ug/m3 from 61ug/m3 in 2019 to 56ug/m3 in 2020. This is welcome, but again, further significant reductions are still required. Time will tell if this current reduction can be maintained. Congestion along this section of the South Circular remains high, partly supplemented by diverted traffic from the closure of Hammersmith Bridge for major repairs. There is no quick fix, closure is likely to remain in place for at least 6 years. Pressure for major development nearby at the Stag Brewery site may further exacerbate matters.

It is hoped that the introduction of the extended ULEZ to the north and south circulars on 25th October 2021 will help the whole of LBRUT, especially the northern sector. In the early months/years, there is concern that non-ULEZ compliant vehicles, especially local

non-compliant delivery vehicles, will be displaced to outside the ULEZ – to areas such as Richmond and Twickenham, hindering improvement in these areas. We will watch results with interest.

Decreases in 2020 are borough wide, on most main roads in LBRUT together with town centres. Whilst changes in traffic flows due to COVID-19 may have helped, annual decreases have been apparent in most town centres and on most main roads since 2016. A small downward trend in levels of NO2 from 2017 to 2020 is now materialising and a return to higher levels of pre 2016 is looking unlikely. This is very encouraging. Teddington, Hampton Hill, Whitton and Barnes High Streets all complied with UK/EU limit values in 2020; more work is required in Twickenham, East Sheen and Richmond.

Many factors at all levels of central and local government contributed to this. Dieselgate was definitely beneficial and sparked a change for the air quality agenda. Recent 2020/21 Euro 6 diesel cars and light vehicles are delivering improvements on the earlier Euro 6 versions which on real world driving cycles really are cleaner. The announcement by government to move forward a ban on the sale of pure internal combustion engine cars from 2040 to 2030 will also help significantly. Council assessments for emission-based parking and a Clean Air Zone are resulting in new thought provoking enquiries which may influence residents when replacing vehicles. EV's are at last showing real increases in sales, which is encouraging. The renewal of the Council's waste and recycling contract at the end of March 2020 to all Euro VI dustcarts also helped. COVID-19 accelerated various traffic and transport interventions and encouraged individual modal shift away from the private car. The huge and immediate increase in working from home is likely to have benefited further. Changes due to COVID-19 will be discussed in Section 2.

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 benefits indicated by lower trend data at site 71, 57, 56, 31 and 18. George Street, Richmond, which had recorded some of the highest exceedances every year, has shown a marked decrease from 2016 – 2020 decreasing from 96 ug/m3 in 2016 to 52 ug/m3 in 2020. Good but more improvement needed.

As mentioned above, new hybrid/cleaner buses were introduced in 2017- Feb 2021. All town centre sites record decreases some of which is attributable to the cleaner bus fleet reducing NOx emissions by up to 95%.

On 1/3/19 LBRUT started using traffic wardens to enforce against engine idling. All traffic wardens now speak to idling drivers on a daily basis and require switch off. Any that refuse are issued with a fine. Enforcement was stopped for 4.5 months in summer 2020 due to COVID, but despite this pause, from March 2019 – March 2021 traffic wardens engaged with 22,101 drivers – far higher than most London authorities. This is having a noticeable impact on driver awareness for engine idling.

There has been strong encouragement for modal shift to more sustainable forms of transport in LBRUT throughout 2020 – accelerated by the COVID-19 pandemic. Post COVID-19, Re-assignment of street space in favour of walking and cycling is being considered and prioritised. This could be the real game changer, reducing the number of vehicles on the road as well as cleaning up the fleet.

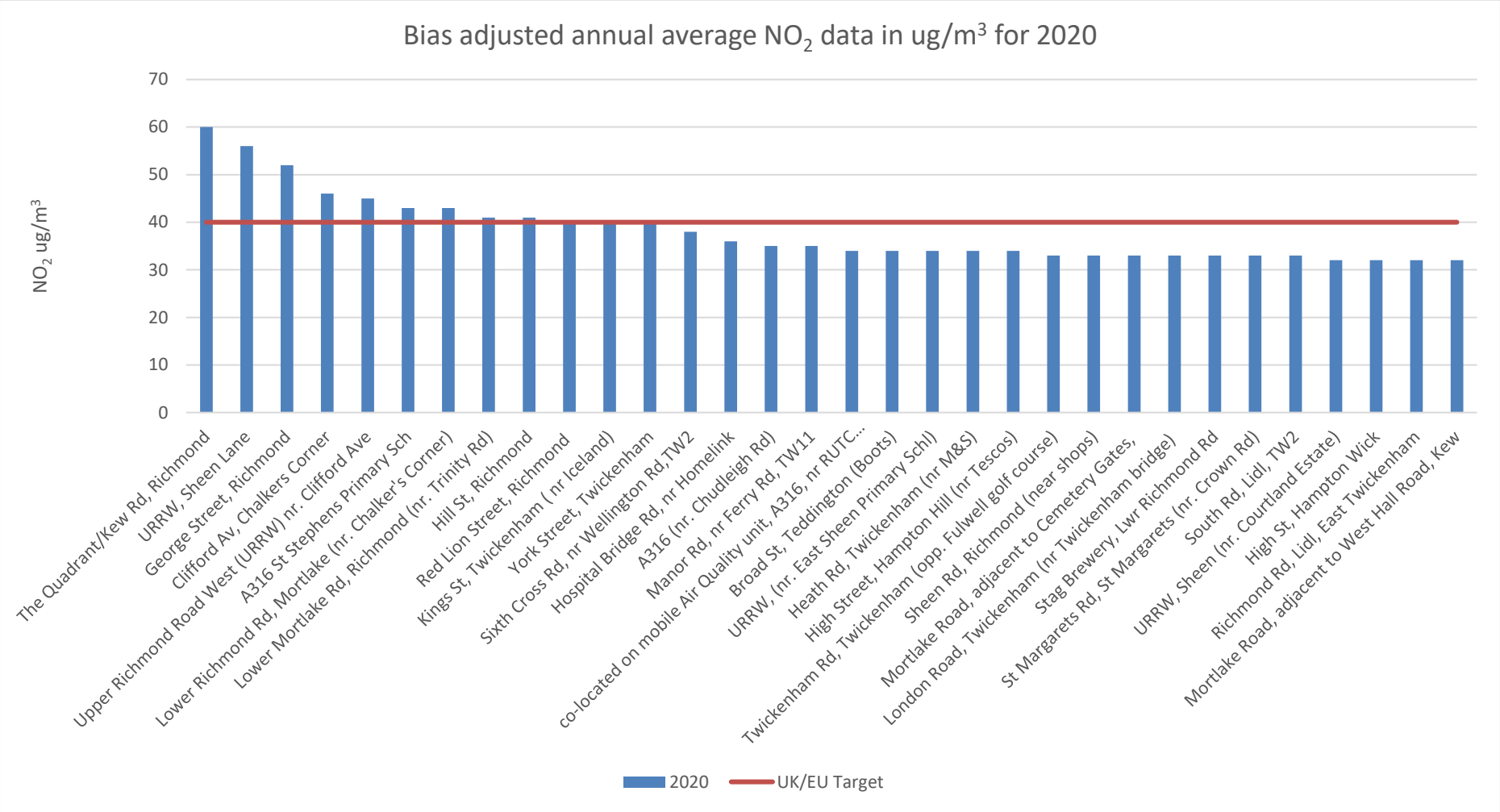
The overall monitoring results for the Borough therefore show that NO2 concentrations exceeded the UK annual mean objective (as it has done for each year since 2002). This is also in line with the modelling prediction of the Borough. Traffic volumes on the local road network already appear to be approaching pre COVID-19 levels and due to messaging to avoid public transport, may increase. It will be interesting to see the results for 2021 and 2022 as lockdown eases, the extended ULEZ commences and the new normal begins. More improvement is likely to be required.

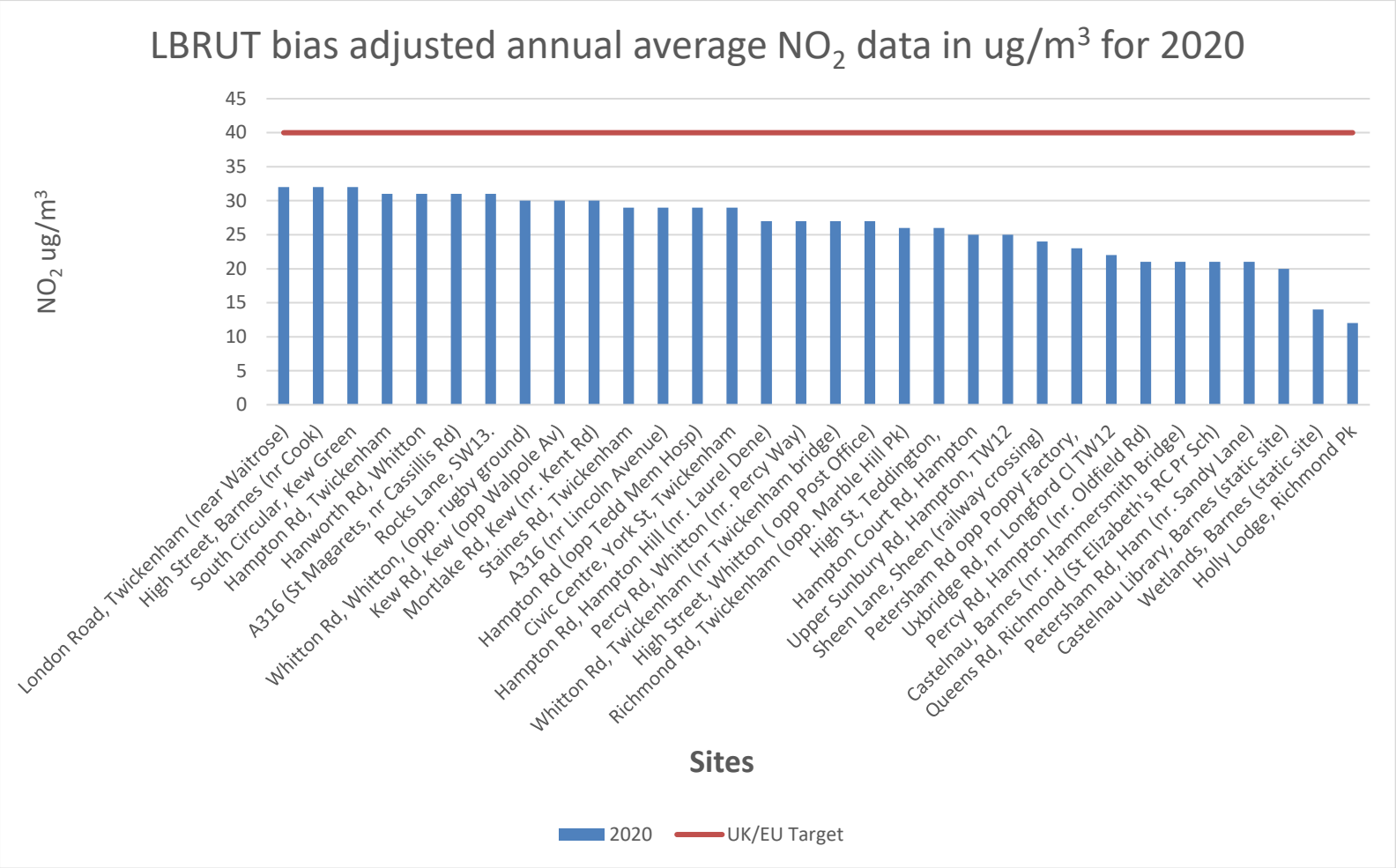
Below are charts, graphs and a map to help visualise results.

This year we have included bar charts of data for all sites ranked in order of exceedance and a map showing locations – indicating good coverage for the whole borough (NB LBRUT has 2x large areas of Royal Parks – Richmond and Bushy Park).

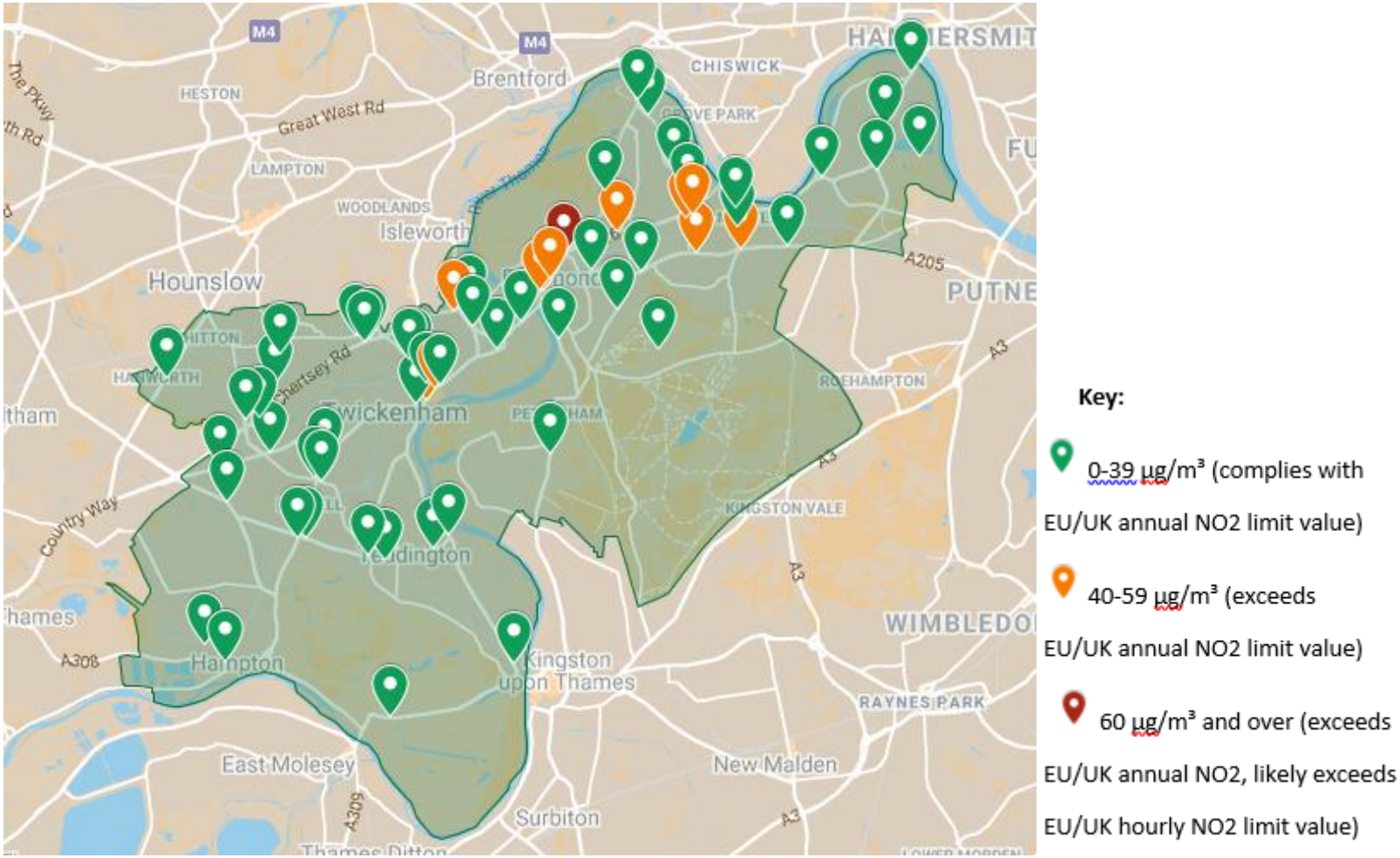
We have also looked at trends for 10 sites covering town centres, main roads, a level crossing and a background site from 2002 – 2020 to give more perspective to levels of NO2 over a long time period. We hope this is enlightening.

Figure 1: Nitrogen Dioxide Bias Adjusted Annual Average Concentrations for all sites for 2020 (split over 2 graphs)

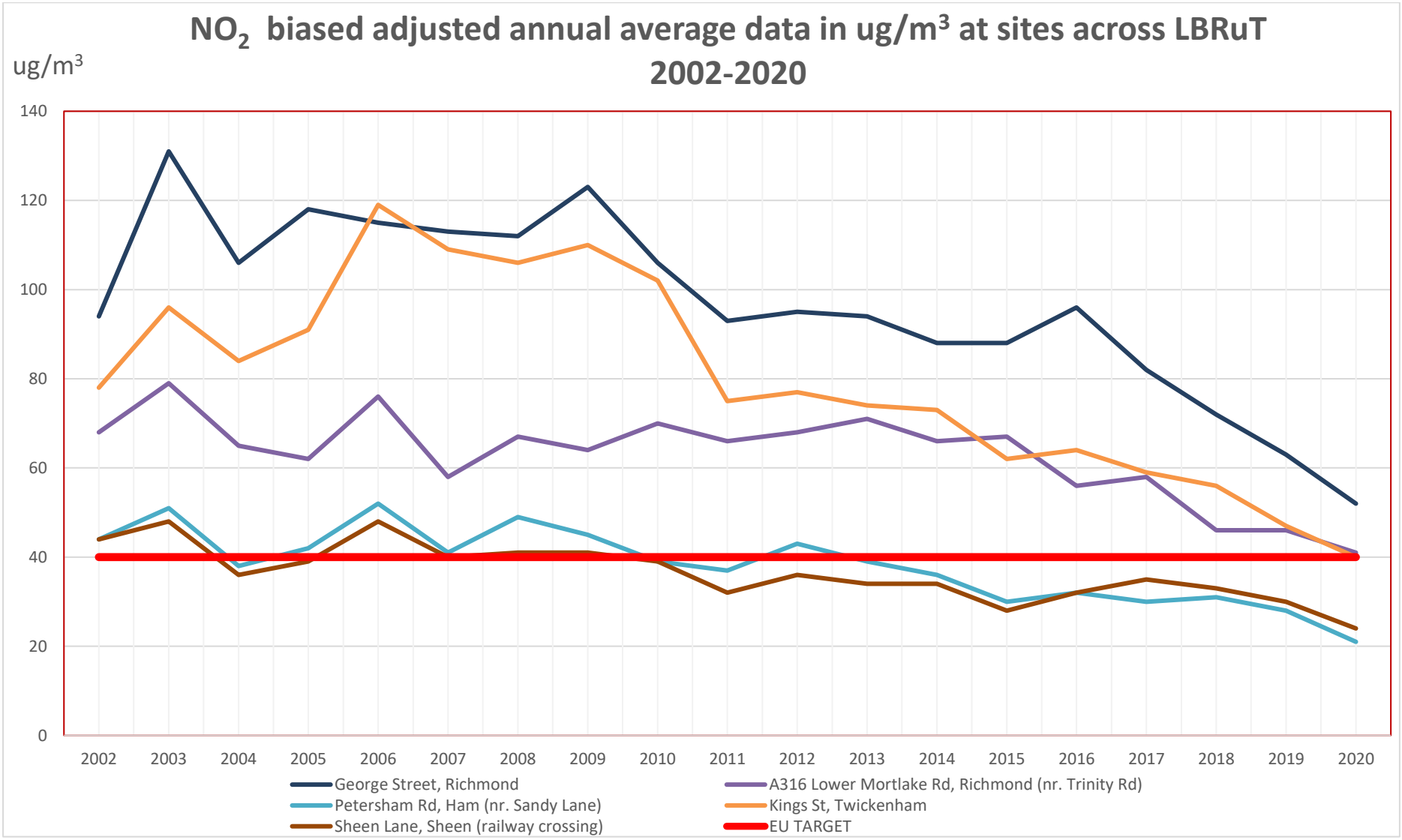



LBRUT bias adjusted annual average NO2 data in ug/m3 for 2020
NO2 ug/m3
45
40
35
30
25
20
15
10
5
0
London Road, Twickenham (near Waitrose)
High Street, Barnes (nr Cook)
South Circular, Kew Green
Hampton Rd, Twickenham
Hanworth Rd, Whitton
A316 (St Magarets, nr Cassillis Rd)
Rocks Lane, SW13.
Whitton Rd, Whitton, (opp. rugby ground)
Kew Rd, Kew (opp Walpole Av)
Mortlake Rd, Kew (nr. Kent Rd)
Staines Rd, Twickenham
A316 (nr Lincoln Avenue)
Hampton Rd (opp Tedd Mem Hosp)
Civic Centre, York St, Twickenham
Hampton Rd, Hampton Hill (nr. Laurel Dene)
Percy Rd, Whitton (nr. Percy Way)
Whitton Rd, Twickenham (nr Twickenham bridge)
High Street, Whitton (opp Post Office)
Richmond Rd, Twickenham (opp. Marble Hill Pk)
High St, Teddington,
Hampton Court Rd, Hampton
Upper Sunbury Rd, Hampton, TW12
Sheen Lane, Sheen (railway crossing)
Petersham Rd opp Poppy Factory,
Uxbridge Rd, nr Longford Cl TW12
Percy Rd, Hampton (nr. Oldfield Rd)
Castelnau, Barnes (nr. Hammersmith Bridge)
Queens Rd, Richmond (St Elizabeth's RC Pr Sch)
Petersham Rd, Ham (nr. Sandy Lane)
Castelnau Library, Barnes (static site)
Wetlands, Barnes (static site)
Holly Lodge, Richmond Pk
Sites
2020
UK/EU Target

Map of NO2 diffusion tube sites in LBRUT in 2020



https://www.google.com/maps/d/viewer?mid=1FXi3kxJxhB-OJOYKU1JqQp-IiTHfcCH5&ll=51.43908395006437%2C-0.33272889246094506&z=12


NO_2 biased adjusted annual average data in ug/m³ at sites across LBRuT 2002-2020
ug/m³
140
120
100
80
60
40
20
0
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
George Street, Richmond
A316 Lower Mortlake Rd, Richmond (nr. Trinity Rd)
Petersham Rd, Ham (nr. Sandy Lane)
Kings St, Twickenham
Sheen Lane, Sheen (railway crossing)
EU TARGET

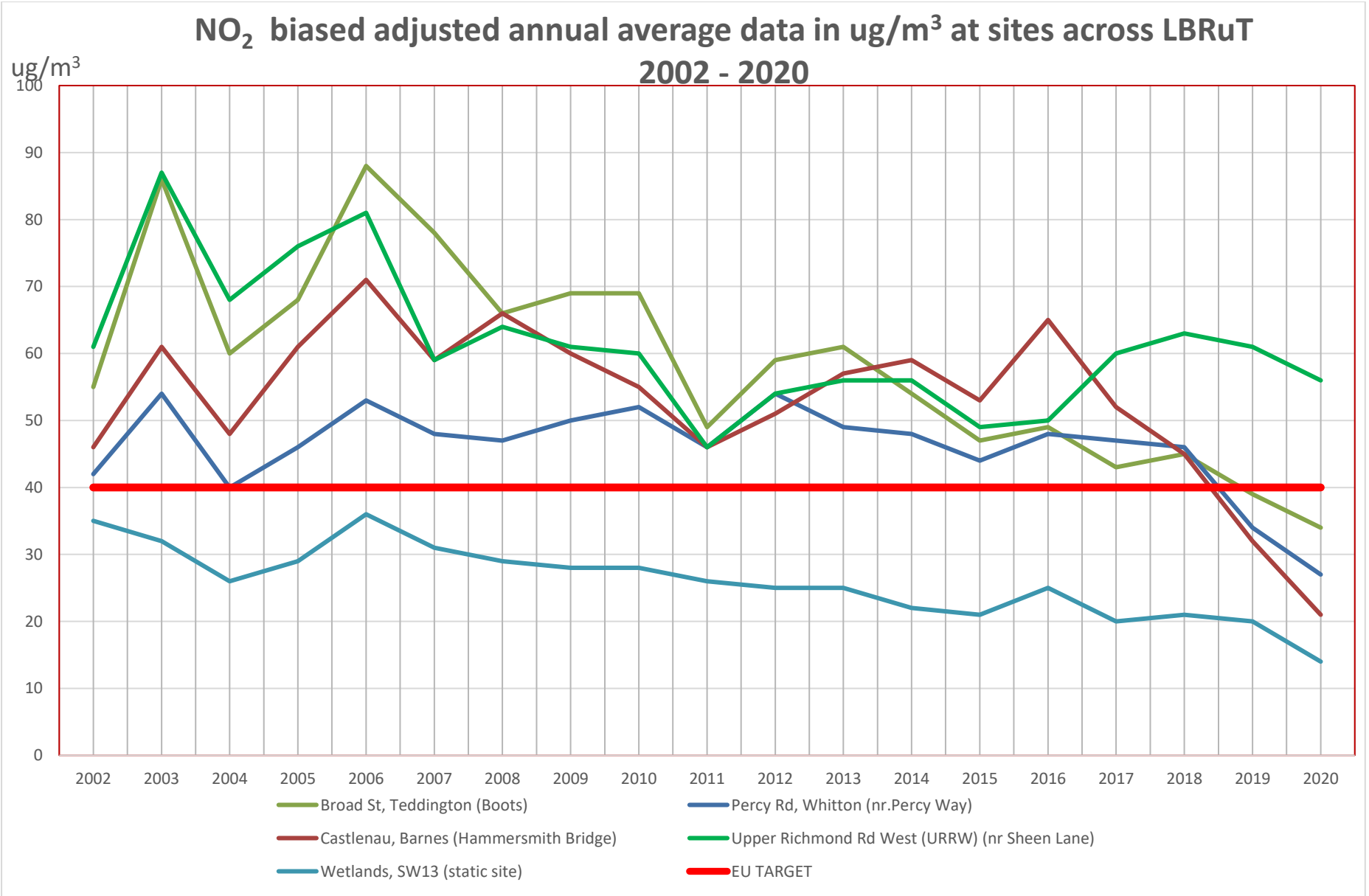

NO2 biased adjusted annual average data in ug/m3 at sites across LBRuT
2002 - 2020
ug/m3
100
90
80
70
60
50
40
30
20
10
0
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
Broad St, Teddington (Boots)
Percy Rd, Whitton (nr.Percy Way)
Castlenau, Barnes (Hammersmith Bridge)
Upper Richmond Rd West (URRW) (nr Sheen Lane)
Wetlands, SW13 (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 %([a])	Valid data capture 2020 %([b])	Number of Hourly Means > 200 µgm^{-3}						
			2014	2015	2016	2017	2018	2019	2020
Castelnau Library, Barnes (RI1)	100	100	0	0	0	0	0	0	0
Wetlands Centre, Barnes (RI2)	100	82	0	0	0	0	0	0	0 (0)

Notes

Results are presented as the number of 1-hour periods where concentrations greater than 200 µg m^{-3} have been recorded.

Exceedance of the NO_2 short term AQO of 200 µg m^{-3} over the permitted 18 hours per year are shown in **bold**.

If the period of valid data is less than 85%, the 99.8th percentile of 1-hour means is provided in brackets (relevant for RI2).

(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%)

Warning: **Barnes Wetlands - Nitrogen Dioxide achieved a capture rate less than 90% for the year (82%). Results may not be representative of the full year and should be used for guidance only.**

Table E provides the results of automatic monitoring for NO2 for the 1-hour mean objective of 200 μg m-3. It was met at all sites and for every year reported. This is encouraging news. The data for 2020 is fully ratified. The Council had a third automatic air quality monitoring station housed in the Mobile Air Quality Unit which was located at Chertsey Rd, Twickenham from 1/1/21. Unfortunately it was stolen overnight on 6/8/21. There were also problems with the NOx analyser from mid-May to late June 2021. It achieved an overall data capture rate for 2020 of 47%. This, combined with lower levels recorded in late March and April, due to lower traffic flows and hence lower emissions during the first COVID-19 lockdown, was considered to not be representative for the full year, so it was decided to exclude results for this report from this station. It is hoped to replace this station once funds are available.

Table F. Annual Mean PM_{10} Automatic Monitoring Results (µg m^{-3})

Site ID	Valid data capture for monitoring period % [a]	Valid data capture 2020 % [b]	Annual Mean Concentration (µgm^{-3})						
			2014	2015	2016	2017	2018	2019	2020
Castelnau Library, Barnes (RI1)	100	99	20	22	20	18	19	15	15
Wetlands Centre, Barnes (RI2)	100	95	18	17	16	15	15	16	16
NPL - Teddington AURN	100	87	N/A	N/A	N/A	N/A	N/A	N/A	13

Notes

The annual mean concentrations are presented as µg m^{-3}.

Exceedances of the PM_{10} annual mean AQO of 40 µg m^{-3} are shown in **bold**.

All means have been "annualised" in accordance with LLAQM Technical Guidance, if valid data capture is less than 75% and more than 33%.

(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%).

Warning: Calculation includes provisional data. PM10 data for 2020 has not been fully ratified. At RI1 and RI2 this was due to COVID-19 related delays at Imperial College London. It is not known when data will be ratified at TDO, the NPL site in Teddington.

PM10

Warning: The data for 2020 is provisional data and has not been fully ratified so should be treated with caution. RI1 and RI2 will be ratified shortly but not in time to be included in this report. Ratified PM10 data will be reported for both sites in the 2022 Annual Status Report. Dates for ratification are unknown at NPL.

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 Imperial College London, when they process our monitoring data. As mentioned in section 1, PM_{10} is a specified pollutant for the whole Borough AQMA.

Table F provides results of automatic monitoring of PM10 and a comparison with the annual mean objective. The objective of 40 μg m-3 was met at all sites for every year reported. **Please note the data for 2020 is provisional** and has not yet been fully ratified. However, ratification is very unlikely to result in an exceedance of the annual mean objective of 40 μg m-3 at all sites.

The 2020 annual mean for PM10 at both the roadside site in Castlenau Barnes and the background site at the Wetlands Centre in Barnes has remained the same, despite COVID-19 and any reduction in traffic. As has been pointed out under the NO2 section, Castlenau has seen significantly less traffic in 2019 and 2020 due to the closure of Hammersmith Bridge, at the end of Castlenau, to all traffic from 10th April 2019. The bridge is undergoing major repairs and is likely to remain closed for a number of years.

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 2014 to 2020 inclusive. PM10 measurement was undertaken at three sites and the data capture was good at R12 Wetlands achieving 95%, very good at RI1 Castelnau achieving 99% but achieved a capture rate less than 90% for the year (87%) at TDO, Teddington NPL. Results may not be representative of the full year and should be used for guidance only. As advised, PM10 data at all sites - RI1 Castlenau, R12 Wetlands and TDO NPL is **provisional** data.

PM10 is proving very difficult to reduce further. Over the 7 year period from 2014 – 2020 it has gone up and down slightly one year to the next but a slight downward trend overall has been achieved. This is encouraging. However, it has gone up as well as down fractionally year on year, so we cannot get complacent and need to keep an eye on this. It is particularly significant to note no decline at either site in 2020, despite reduced traffic due to COVID-19.

It should be noted that all three sites meet both the UK/EU limit value (40 μg m-3) and in 2020 meet the stricter WHO guidelines (20 μg m-3) for PM10. This is true for Wetlands 2014-2020 and for Castlenau 2017 – 2020. However, modelling indicates there are some exceedences of PM10 on some sections of major roads within the borough, including near Richmond on the A316, so vigilance is required. We hope to install a new automatic monitoring station in Richmond town centre, which will monitor both PM10 and PM2.5, as soon as funding is available. We will reassess this in next years' report.

Table G. PM_{10} Automatic Monitoring Results: Comparison with 24-Hour Mean Objective, Number of PM_{10} 24-Hour Means > 50 µg m^{-3}

Site ID	Valid data capture for monitoring period %[a]	Valid data capture 2020 %[b]	Number of Daily Means > 50 µgm^{-3}						
			2014	2015	2016	2017	2018	2019	2020
Castelnau Library, Barnes (RI1)	100	99	4	5	7	4	1	3	0
Wetlands Centre, Barnes (RI2)	100	95	3	1	3	3	0	3	0
NPL - Teddington AURN	100	87	N/A	N/A	N/A	N/A	N/A	N/A	2

Notes

Exceedances of the PM_{10} 24-hour mean objective (50 µg m^{-3} over the permitted 35 days per year) are shown in **bold.**

Where the period of valid data is less than 85% of a full year, the 90.4th percentile is provided in brackets.

(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%).

.

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. 2019 saw an increase at both sites compared to 2018 but a reduction in 2020. However, the number of days exceeding the daily standard remains relatively low at all sites for the last 7 years. Again, levels are going up and down year on year so vigilance is required.

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

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.

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

Site ID	Valid data capture for monitoring period %[a]	Valid data capture 2020 %[b]	Annual Mean Concentration (µgm^{-3})						
			2014	2015	2016	2017	2018	2019	2020
NPL Bushy Park, Teddington (TD5)	100	87	N/A	N/A	N/A	10	11	12	8

Notes: The annual mean concentrations are presented as µg m^{-3}.

Exceedances of the $PM_{2.5}$ annual mean AQO of 25 µg m^{-3} are shown in **bold**.

All means have been "annualised" in accordance with LLAQM Technical Guidance, if valid data capture is less than 75% and more than 33%.

(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%).

Warning: The data for 2020 is provisional data and has not been fully ratified so should be treated with caution.

Table H provides results of automatic monitoring of PM2.5 by NPL in Bushy Park and a comparison with the annual mean objective.

The objective of 25 μg m-3 was met for every year reported.

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. Impact of COVID-19 upon LAQM in LBRUT

Whilst COVID-19 had devastating effects on the people, the NHS and the economy of the UK it presented the AQ community with an unprecedented opportunity to monitor real life pollution levels when vehicle movements were restricted and traffic volumes reduced, sometimes significantly.

We decided as a borough that air quality monitoring was a priority and as far as possible, we would maintain all monitoring networks throughout lockdowns in LBRUT. We believe this data will contribute to many different areas of work and research including health and policymaking.

The first lockdown in mid-March – April 2020 saw significant decreases in both traffic and NO2 in LBRUT, London and the UK. The later restrictions and lockdowns in 2020/21 were less significant in terms of volumes of traffic or reductions in air pollution and have not been included in this section.

A few caveats - the many variables affecting air pollution such as temperature, weather, wind direction and local conditions make it very difficult and not always accurate to compare one year's data with the next. April/May 2020 was warmer and drier than average which may impact results. In addition to weather, there are a number of unknown variables that may or may not have affected these measurements, these include a potential increase in delivery vehicles during this period and the increase use of residential boilers.

However, monitored data does provide an 'indication' of local changes in air quality. NO2 is almost entirely linked to combustion and with road transport in particular. NO2 is a reliable local indicator, as it is well established that NO2 drops off quickly with distance from source. Particulates (PM) however, exist in the environment with many incidents or episodes of pollution caused globally or nationally. PM also travel long distances with around 40% of measured pollutant made up of background from various global sources.

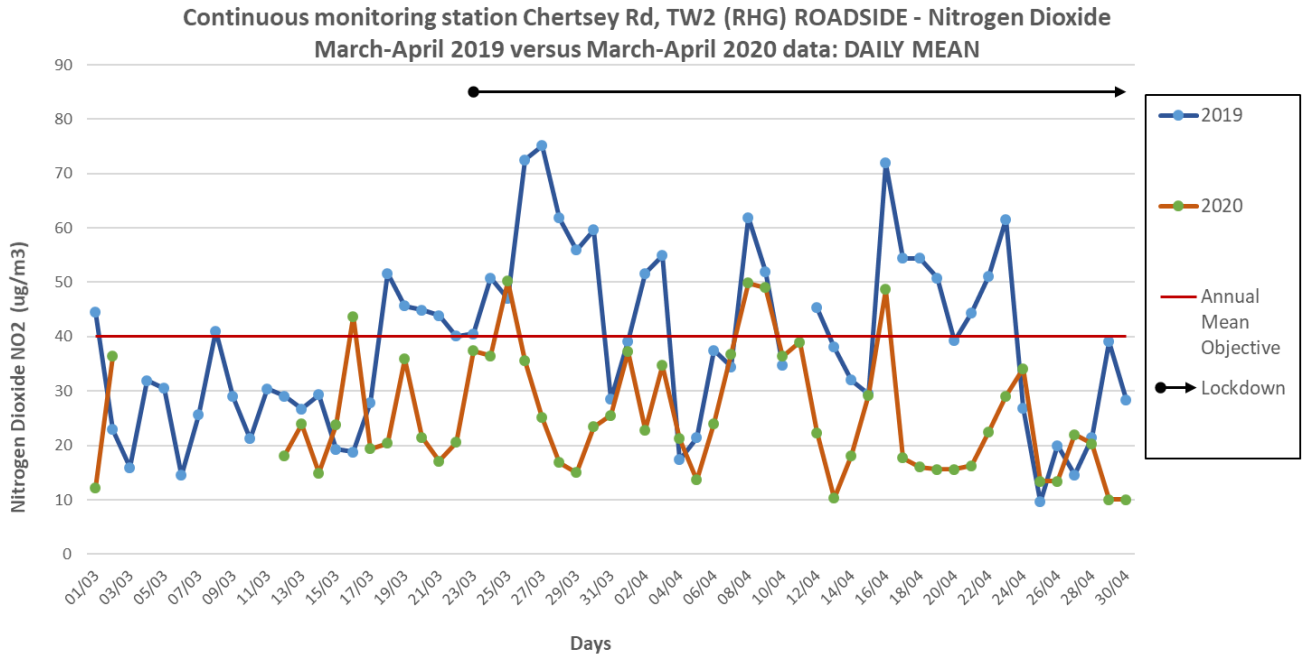
In LBRUT we compared March-April 2019 to March-April 2020 at all three automatic air quality monitoring stations for both NO2 and PM10 and along our diffusion tube network for NO2. Our laboratory, Gradko, was closed throughout April due to distancing restrictions, so exposed tubes were changed and collected in line with the

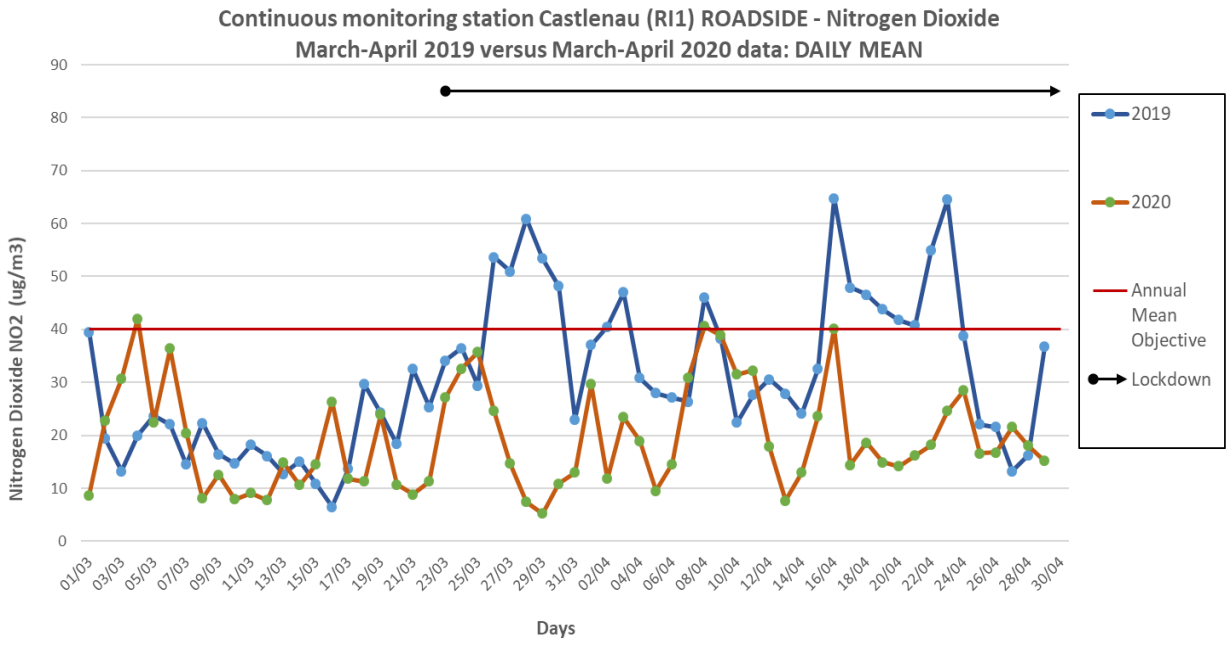
DEFRA calendar, then refrigerated and returned within date for analysis at the end of May.

The headline measurements show

- **37% decrease in NO2** when compared **March-April 2019 to March-April 2020** daily mean results recorded at all Richmond continuous monitoring stations.
- **24% NO2 daily mean average decrease** when compared **lockdown** data (24th March-30th April 2020) to **pre-lockdown** data (March 1st-23rd 2020) recorded at Richmond continuous monitoring stations.
- **20% decrease in NO_2** when compared **January-April 2019 to January-April 2020** monthly mean results recorded at 52 diffusion tube locations.

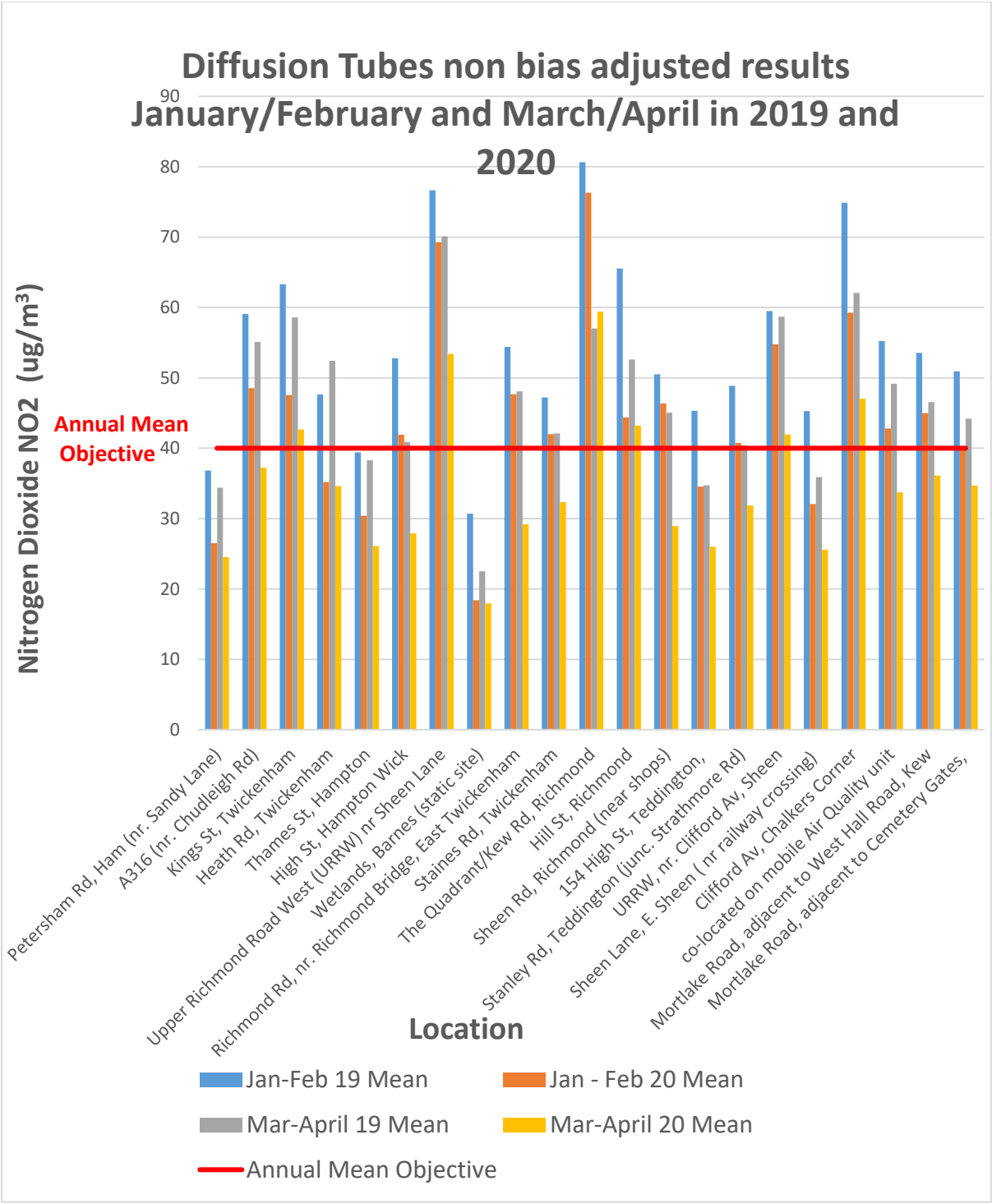
Data was calculated for all sites and both pollutants – NO2 and PM10. We have not included all data here but would like to include a few charts which indicate the above.

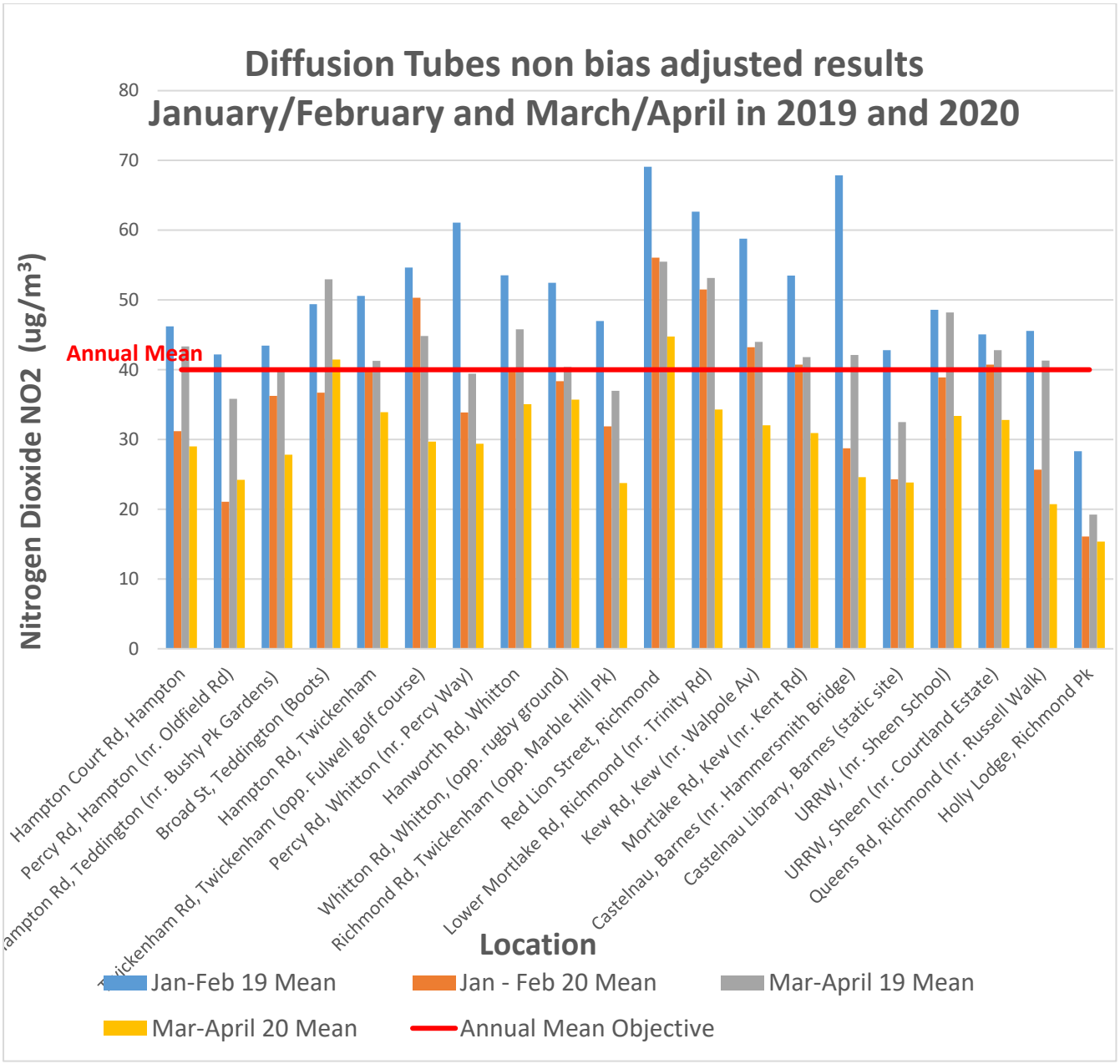


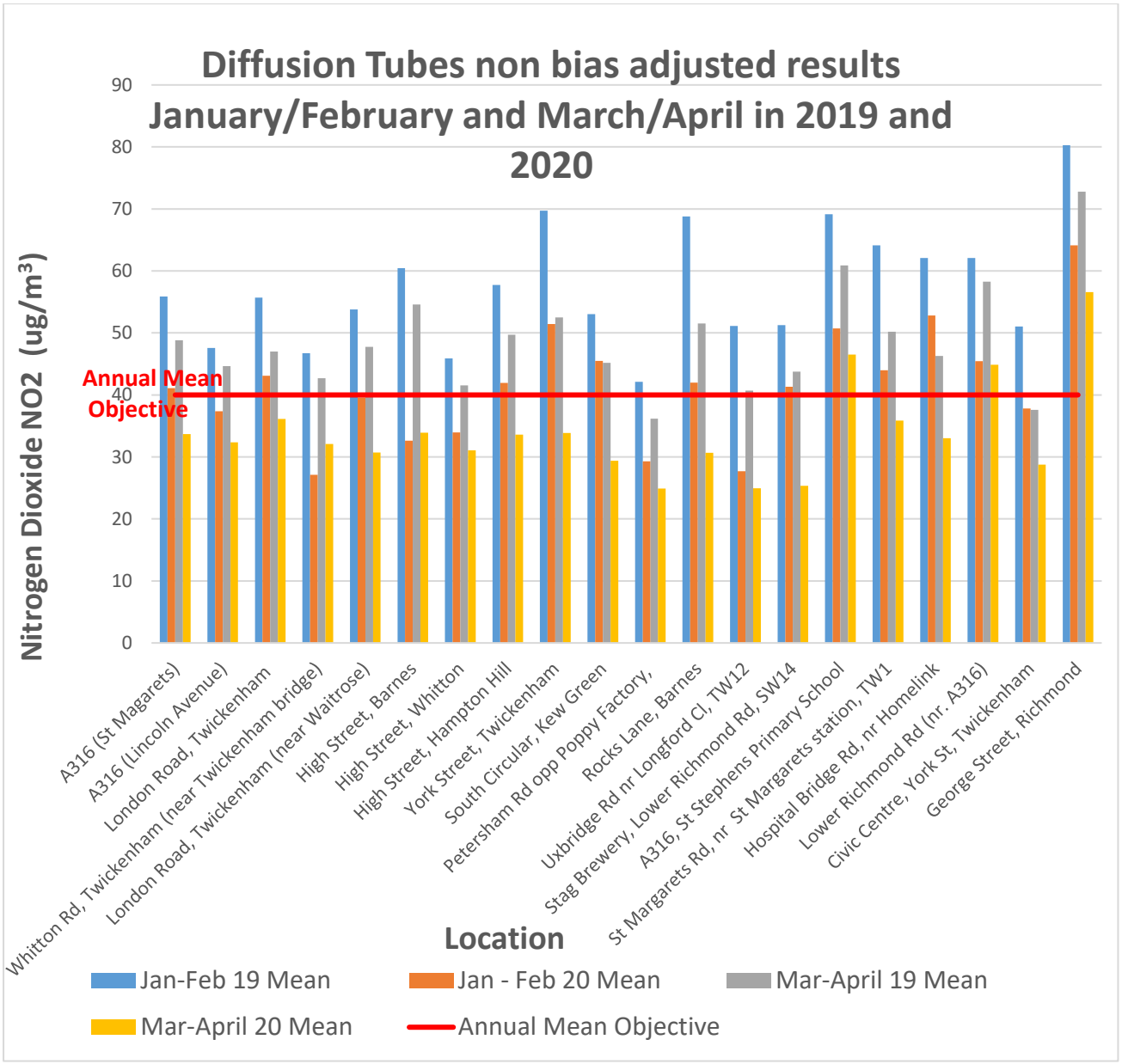


The following charts relate to our diffusion tube sites and compare 2019 to 2020 data during the period of lockdown.

The monthly mean results between January to April 2019 show that the objective of 40µgm^{-3} was exceeded for a total of 48 monitored locations. In contrast for the same period in 2020 the objective of 40 µg m^{-3} was exceeded for a total of 36 monitored locations. These reductions continued throughout the year as has been reported in the earlier section of the ASR. The below charts give an indication for January - February and March – April 2019 and 2020 (all comparative NO2 diffusion tube locations are shown below over 3 x charts).

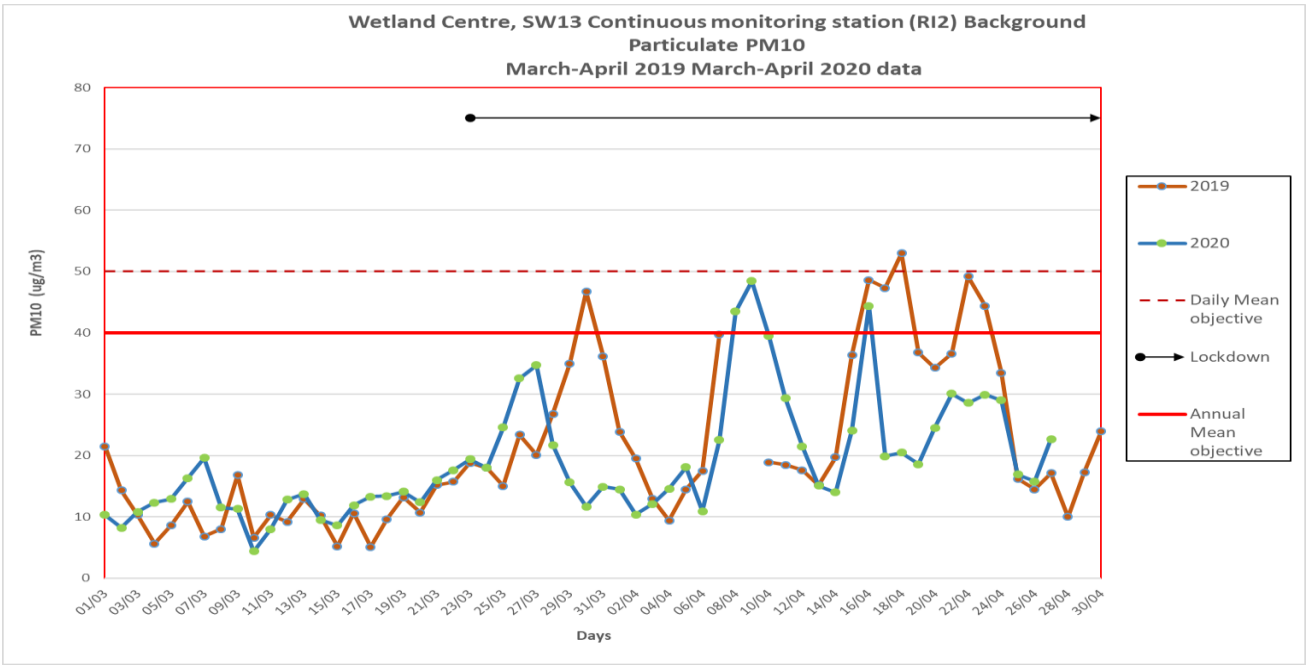

Diffusion Tubes non bias adjusted results January/February and March/April in 2019 and 2020
Nitrogen Dioxide NO2 (ug/m³)
Annual Mean Objective
90
80
70
60
50
40
30
20
10
0
Petersham Rd, Ham (nr. Sandy Lane)
A316 (nr. Chudleigh Rd)
Kings St, Twickenham
Heath Rd, Twickenham
Thames St, Hampton
High St, Hampton Wick
Upper Richmond Road West (URRW) nr Sheen Lane
Wetlands, Barnes (static site)
Richmond Rd, nr. Richmond Bridge, East Twickenham
Staines Rd, Twickenham
The Quadrant/Kew Rd, Richmond
Hill St, Richmond
Sheen Rd, Richmond (near shops)
154 High St, Teddington,
Stanley Rd, Teddington (junc. Strathmore Rd)
URRW, nr. Clifford Av, Sheen
Sheen Lane, E. Sheen (nr railway crossing)
Clifford Av, Chalkers Corner
co-located on mobile Air Quality unit
Mortlake Road, adjacent to West Hall Road, Kew
Mortlake Road, adjacent to Cemetery Gates,
Location
Jan-Feb 19 Mean
Jan - Feb 20 Mean
Mar-April 19 Mean
Mar-April 20 Mean
Annual Mean Objective

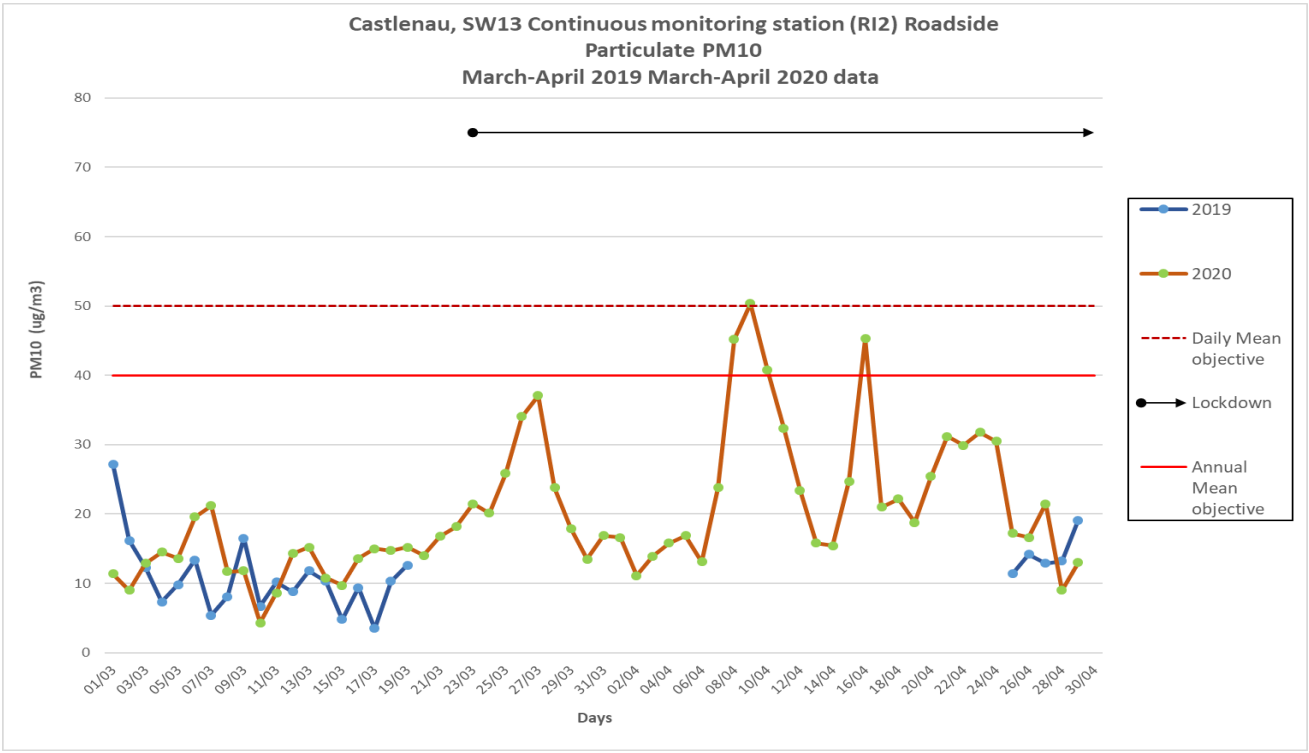

Diffusion Tubes non bias adjusted results
January/February and March/April in 2019 and 2020
Nitrogen Dioxide NO2 (ug/m³)
80
70
60
50
40
30
20
10
0
Annual Mean
Hampton Court Rd, Hampton
Percy Rd, Hampton (nr. Oldfield Rd)
ampton Rd, Teddington (nr. Bushy Pk Gardens)
Broad St, Teddington (Boots)
Hampton Rd, Twickenham
wickenham Rd, Twickenham (opp. Fulwell golf course)
Percy Rd, Whitton (nr. Percy Way)
Hanworth Rd, Whitton
Whitton Rd, Whitton, (opp. rugby ground)
Richmond Rd, Twickenham (opp. Marble Hill Pk)
Red Lion Street, Richmond
Lower Mortlake Rd, Richmond (nr. Trinity Rd)
Kew Rd, Kew (nr. Walpole Av)
Mortlake Rd, Kew (nr. Kent Rd)
Castelnau, Barnes (nr. Hammersmith Bridge)
Castelnau Library, Barnes (static site)
URRW, (nr. Sheen School)
URRW, Sheen (nr. Courtland Estate)
Queens Rd, Richmond (nr. Russell Walk)
Holly Lodge, Richmond Pk
Location
Jan-Feb 19 Mean
Jan - Feb 20 Mean
Mar-April 19 Mean
Mar-April 20 Mean
Annual Mean Objective

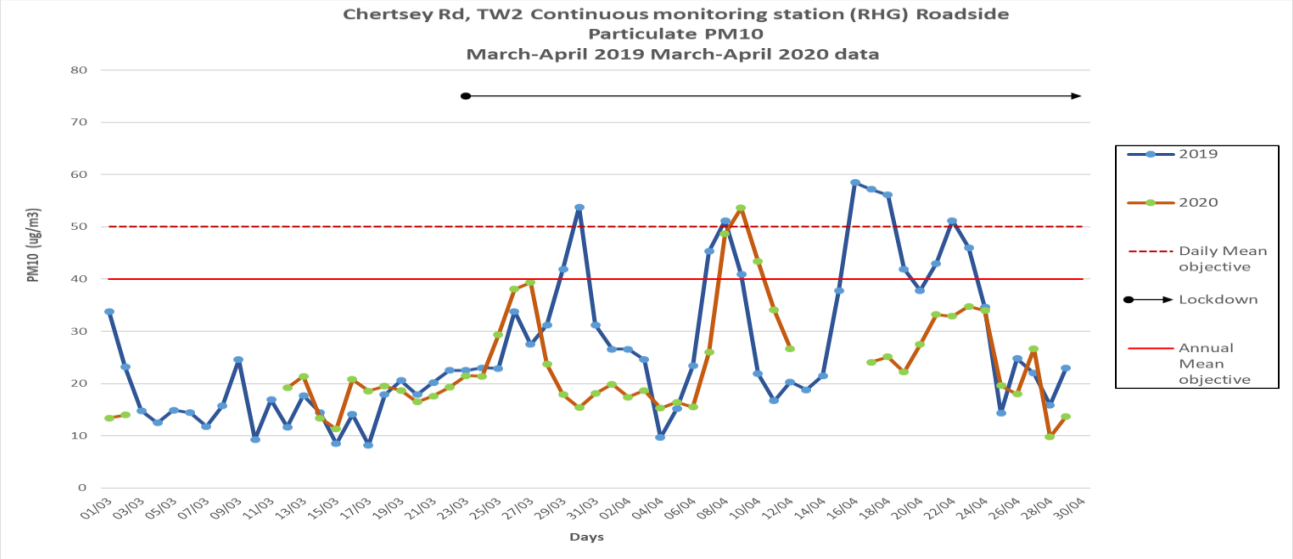


This is in line with London. Dr Gary Fuller at Imperial College London reported that during the first nine weeks of the UK lockdown, when compared with the preceding 11 weeks pre-lockdown, nitrogen dioxide along London's roads decreased by an average of 31% . Measurements from London show that initial improvements in nitrogen dioxide from traffic continued into April and May. Greatest reductions were in central and inner London (Guardian 8/10/20)

The same was not true for PM10. Episodes and elevated levels of PM are common in springtime, 2020 was no different. From LBRUT's monitoring no trend/increase/decrease in PM could be established. 2 episodes occurred during the March – April lockdown, making comparisons with 2019 difficult.


Wetland Centre, SW13 Continuous monitoring station (RI2) Background
Particulate PM10
March-April 2019 March-April 2020 data
PM10 (ug/m3)
Days
2019
2020
Daily Mean objective
Lockdown
Annual Mean objective


Castlenau, SW13 Continuous monitoring station (RI2) Roadside
Particulate PM10
March-April 2019 March-April 2020 data
PM10 (ug/m3)
Days
2019
2020
Daily Mean objective
Lockdown
Annual Mean objective



The results indicate that:

- There was no definitive overall reduction in **PM10** when compared pre-lockdown with the lockdown, this is likely due to 'episodes' blown over from the continent. These episodes show in the charts as peaks.
- A slight **decrease in PM10** at Wetlands and Chertsey Rd March –April 2020 as against March –April 2019 but an increase at Castlenau, There were no **daily mean objective exceedances recorded in either March-April 2019 or March – April 2020.**

Please note: all PM10 data for 2020 is PROVISIONAL.

Findings further demonstrate the difficulties around reducing PM. It is not just a local pollutant and although an important source, the main source is not road transport. More policy needs to be focused around behavioural change and reducing burning, an increasingly important source, aesthetically popular in LBRUT.

It should be noted that from an LAQM perspective, the COVID-19 pandemic has enabled the introduction and/or acceleration of many positive actions, some temporary, described below, on highways and streets throughout LBRUT. Many benefit reductions in NO2.

COVID had an immediate impact on travel choice and demand, with a large fall in travel by all modes, particularly public transport. Significant investment in temporary walking and cycling infrastructure occurred in order to motivate a public discouraged from using public transport to choose to travel on foot and by bike instead of by car. Temporary barriers were installed along high streets such as George St,

Richmond, and High St, Barnes, extending and widening pavements into road space to enable social distancing. Pavements on either side of Richmond bridge were made one way to help with social distancing for pedestrians. School streets were increased from 3 to 14 and installed at an unprecedented rate, to enable social distancing, once schools re-opened. Cycle paths were installed, including one along Kew Rd which it is hoped will be made permanent. Church Street, Twickenham was closed to enable the many restaurants to have tables in the street. It is proposed to make this permanent.

Transport, more recently, appears to be reverting closer to its pre-pandemic state but Transport colleagues do not expect it to return fully to earlier levels. A higher degree of working from home should result in a permanent reduction in peak period vehicular traffic, which should be beneficial for air quality. Travel is likely to be more evenly spread throughout the day. We are optimistic but more monitoring is required once new travel patterns are established; remote working could worsen air quality because energy consumption overall increases. Certainly more encouragement to return to/use public transport once safe again and avoid private car use is essential. Lower levels of public transport use is not welcome and may also have implications for the long term funding of transport, highway and air quality improvements due to lower levels of fare revenue. A big minus is that COVID has had a damaging impact on TfL's business model, affecting projects and programmes around the borough, although TfL's plans for the Ultra Low Emission Zone remain. Car club usage has fallen and is not expected to fully recover in the foreseeable future. A long term negative impact may be an increase in home deliveries with associated environmental harm from vehicles and packaging. Collection hubs and shop local/ecargo bike deliveries are being promoted and encouraged. Overall, LBRUT hope and believe that, from a LAQM perspective, the positives will outweigh the negatives. We need to continue to encourage many policies cited in our AQAP updates and especially modal shift away from the car wherever possible. 2021/22 will see how many temporary interventions can be made permanent where appropriate - schemes such as School Streets and the Kew Road cycle lane.

Key Focal Areas Post COVID:

- Encourage people to return to, and swap to, public transport once the pandemic is under control. Expanding public transport usage and extending to poorly

served sections of the borough must be at the core of long-term strategies for cleaner air. Extension will require TfL funding, which may be difficult under current funding restraints but is essential to gain modal shift in some areas.

- Move away from the reliance on private vehicles and encourage cycling and walking especially for local trips.
- Evaluate temporary active travel measures, including school streets, introduced during the pandemic and implement them where effective.
- Better understand our pollutants at a local and national level, especially PM.
- Prioritise policies to address and reduce local PM from all forms of burning in London and lobby the GLA and the government to bring about meaningful change.

It is essential that bold measures are taken to remove the dirtiest vehicles and reduce vehicle numbers to relieve congestion. Updates on interventions will be incorporated into AQAP updates for the ASR 2022.

3. Action to Improve Air Quality

3.1 Air Quality Action Plan Progress

The Council approved an updated AQAP for 2020 – 2025 on 10th March 2020. The new AQAP has involved direct consultation and engagement with community groups. The result is a more robust, more transparent, more accountable AQAP, which is public facing. Improving air quality in the borough is a top political commitment. The new AQAP reflects 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 2020 – 2025 is 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.

Table J provides a brief summary of the London Borough of Richmond upon Thames' progress against the new Air Quality Action Plan, showing progress made this year. New projects which commenced in 2021 are shown at the bottom of the table.

Table J. Delivery of Air Quality Action Plan Measures

Measure	LLAQM Action Matrix Theme	Action	Progress • Emissions/Concentration data • Benefits • Negative impacts / Complaints
1.1	Monitoring and other core statutory duties	Maintain our monitoring regime in the borough	LBRUT believes monitoring is the backbone of air quality, essential to identifying and understanding problem areas, vital to inform solutions and interventions. Throughout 2020, every attempt was made to maintain all of the Councils monitoring network despite problems related to COVID-19.

			LBRUT maintained 2 x automatic stations monitoring NO2, PM10 and O3 and 64 x permanent NO2 diffusion tube sites borough wide. Sadly our mobile air quality station was stolen overnight on 6/8/20. It is hoped to replace this as soon as funding is secured. LBRUT is part of the LAQN and values the work done by Imperial College to help achieve and maintain the highest possible standards. Bias adjusted annual results in ASR's published asap online
1.2	Monitoring and other core statutory duties	Present quarterly updates through the air quality action plan in simple to use format and ensure complete transparency	Results are continually updated and made publicly available. Latest raw data is available quarterly online: https://www.richmond.gov.uk/services/environment/pollution/air_pollution/air_quality_monitoring_and_data The AQAP is updated regularly and meetings held with community groups to ensure transparency and to listen to ideas and concerns.
1.3	Monitoring and other core statutory duties	Continuous review and improvement of the Air Quality Network throughout the borough	Sites are reviewed and updated annually. Review is carried out in December each year; new sites commence in January to enable full 12 month data sets. The Council listens to concerns from residents. Suggestions from community groups and individuals are received throughout the year and included where possible, sometimes for short term monitoring, sometimes for permanent sites.
1.4	Monitoring and other core statutory duties	Positively encourage and support citizen science activities where these actively contribute to identifying and tackling air pollution in the borough. Including the provision of Diffusion Tubes and hand held monitoring	Target: to support 4 projects including up to 150 additional diffusion tubes for locations borough wide. The Council exceeded its target; it installed a total of 220 x additional NO2 diffusion tubes at 5 sites. LBRUT have supported various projects during 2020, but due to COVID these were run and installed by LBRUT. In 2020 we conducted air quality monitoring at 2 x potential LENs and surrounding area - Burtons Rd, Hampton Hill LTN and East Sheen LTN - (consisting of 6 x sites and 12 x sites for NO2 and PM10) to aid Highways decision making and in response to residents requests. More joint working is planned. Trials have been extended and monitoring continued in 2021 in order to assess traffic and pollution levels post lockdown. In 2020 we also worked with the Royal Parks commencing monitoring in and around Richmond and Bushy Parks (consisting of 12 x sites monitoring NO2 and PM10) to aid decision making for the Royal Parks Movement Strategy and in response to residents' concerns for displacement traffic. Work continues in 2021.

			We also provided additional monitoring for White Hart Lane level crossing and Mortlake High St. Following monitoring and resident's concerns, a permanent monitor has been provided in Mortlake High St for 2021,
1.5	Monitoring and other core statutory duties?	All schools in areas of poor air quality to be incorporated into our monitoring network and regime	In 2020, St Stephens School on the A316 and East Sheen Primary on the South Circular were added to the permanent monitoring regime. These 2 schools are sited near higher polluting roads in the borough, so we will keep a keen eye on monitoring results. Both schools were part of the Mayors air quality audits in 2018 and received funding to mitigate exposure. Both were compliant in the playground where children play and inside classrooms. From modelling, no other schools are in areas of poor air quality. Air Quality monitoring offered to all schools; available but limited under COVID. Hot spot monitoring of all Primary Schools paused in 2020 due to closure during COVID.
1.6	Monitoring and other core statutory duties	Roll out monitoring to all schools in the borough to provide information	Paused during lockdown, as pupils mainly working from home. 4 schools were monitored in 2020 on pavements closest to main roads. Annual monitoring continued at 6 sites at East Sheen Primary School on the South Circular. 1 month's monitoring available to all schools. Target: max 12 monitoring sites per annum. The Council will monitor worst case scenario outside 12 schools per annum.
1.7	Monitoring and other core statutory duties	Implement a new interactive AQAP which will be updated regularly to provide transparent and concise updates to measure our performance as a borough. Air quality data to be updated quarterly.	AQAP was finally adopted by Cabinet on 10/3/20 and the new AQAP is available on the Council website. Air quality data is now updated quarterly and also available on Council website https://www.richmond.gov.uk/services/environment/pollution/air_pollution/air_quality_monitoring_and_data
1.8	Monitoring and other core statutory duties	Invest in new monitoring equipment as new technology moves forward. This could see enhancement to the diffusion tube network and help provide real time data	Target: 1 or 2 new monitors per year to be tested. Various products under consideration In 2019/20 LBRUT took part in Breathe London, gaining 3 x AQMesh low cost air quality sensors in Richmond and Twickenham town centres and outside East Sheen Primary School. In October 2020 it purchased 25 x personal pollution monitors for traffic wardens, school and Council staff to help them better understand their own exposure to air pollution. COVID delayed trials. These will recommence in 2021. Exciting new real time monitors are planned for late 2021 – see new actions at bottom.
2.1	Emissions from development	New buildings and development. We have embedded air quality in our Local Plan and will produce a Supplementary Planning Document	Air Quality is now embedded in our the new Local Plan and the borough has finalised a new Richmond specific AQ SPD focused on the council's priorities for new developments, including formalising the Section 106 conditions. This was adopted by Cabinet on 02/06/20, following a small pause in Council committees due to COVID-19.

	s and buildings	(SPD) that will help to deliver our aspirations for cleaner air in the borough. This document will cover all areas of planning and ensure developers focus on air quality throughout the build and for the life of the development	The AQ SPD is now applied to all major planning applications, which reinforces the Mayor's requirements relating to AQ neutral and CHPs (a significant source of local emissions). The AQ Officer requests S106 payments wherever possible from developers as part of mitigation measures on major developments. LBRUT push for AQ positive and healthy streets approach in major developments (Stag Brewery) at the pre-app stage for maximum benefits and inclusion. Car free developments are requested wherever PTAL rates permit. If parking is required, it is requested as a block near entrance. Car club spaces, electric vehicle charge points as per London Plan and robust travel and servicing plans are conditioned. Opportunities for local district heating network are identified wherever possible. Green space is important to LBRUT, so a lot of effort and negotiation both at pre-app and planning stage now takes place with developers and planners to ensure adequate, appropriate and well located green space is retained/ made available in all new developments; all mature trees are retained wherever possible, often aided by joint working of EH with Parks dept.
2.2	Emissions from developments and buildings	Delivering Cleaner Construction: demolition and construction can have a significant impact on local air quality. We will ensure that sites are regulated in accordance with the Mayor of London's Non Road Mobile Machinery (NRMM) LEZ where this is applicable. This project is currently being delivered throughout London by our joint regulatory service	LBRUT, together with LB Merton are mindful of the large proportion of emissions contributed by NRMM. All major sites are therefore visited and requirements enforced by our London wide NRMM team based in our LB Merton offices. NRMM regulations were updated in Sept 2020. In 2020 EH at LBRUT requested from Planning that NRMM conditions be imposed on 100% of all major construction sites. Compliance rates for NRMM equipment, on arrival at inspection by the NRMM team was 75%. This demonstrates the importance of continued inspection. For NRMM details see table K.
2.3	Emissions from developments and buildings	Continue to raise awareness of the fact that the whole borough is covered by a smoke control order and provide information to suppliers of solid fuels on restrictions within the borough. Actively press for more regulatory powers to cover the impact of wood burning appliances.	LBRUT understand that solid fuel burning is a major source of PM2.5 (up to 31% in London) that must be controlled at the local level. Addressing this source is crucial for achieving the LES target to meet WHO guideline levels for PM2.5 by 2030. Woodburning stoves and open fires are popular in LBRUT. In Autumn/Winter 2019 and again in 2020 communications ran a campaign on the Council website, social media and by e-letters to residents; letter and posters were sent to all businesses who sold fuel and/or appliances and requested the poster be displayed at point of sale to educate and inform staff and customers. All complaints investigated by EH on unauthorised burning. Bonfires banned in 2020 on all Council allotments at all times.

2.4	Emissions from developments and buildings	Promoting and delivering energy efficiency and energy supply retrofitting projects in workplaces and homes through EFL retrofit programs such as RE:FIT, RE:NEW and through borough carbon offset funds.	The new Climate Change Emergency team at LBRUT worked on many projects throughout 2020, one of which secured funding of £550k from BEIS in October 2020 through the Green Homes Grant Local Authority Delivery Scheme. This offers support to retrofit owner occupied and private rented homes across the borough where income is under £30k and EPC rating is E, F or G. The service launched in November 2020 and will deliver carbon emissions reductions via retrofit throughout 2021. Carbon savings will be included in our ASR in 2022. This is essential to help towards achieving the ambitious target for London to be a zero carbon city by 2050.
2.5	Emissions from developments and buildings	Reduced emissions from council operations, including from buildings, vehicles and all activities.	LBRUT has installed solar panels on the roof of the Civic Centre to help reduce emissions, insulated original windows, upgraded Council fleet and set conditions for contractor fleet through procurement. The Council fleet now consists of 44 X Euro VI, 7 X Euro V, 3 X Euro IV, 4 X Euro III.
3.1	Public health and awareness raising	A new communications strategy developed in partnership with the community and updated regularly to highlight initiatives and campaigns. This action plan needs to be owned by the community and not just the council. Many groups in our borough are actively tackling air pollution and raising awareness and we need to capture and promote this work	The new communications plan is updated quarterly by LBRUT communications dept. All initiatives are shared and promoted wherever possible, such as idling action awareness raising, Clean Air Day, Car Free day, Bike week, walk to school week, wood burning and more. New community pages, as part of the AQAP, were requested by the community as a hub for the community at group meetings to discuss the draft AQAP pre-launch. Community updates are encouraged and input on local initiatives are welcome. Much is going on borough wide - this is a useful place to share knowledge.
3.2	Public health and awareness raising	We will actively lead in important campaigns and initiatives that raise awareness within the borough, including clean air day, car free day, airTEXT and idling action campaign events, as well as proactive	LBRUT aim for at least 4 campaigns a year. COVID – 19 had a direct impact on physical events throughout 2020, which were put on hold due to advice from Public Health. 1 x Idling Action event, speaking to several hundred drivers did take place Jan 2020, pre COVID. However, most were online where publicity was provided and alternatives offered. Encouragement was given to schools to take part in an online Clean Air Day on 8/10/20; walk/cycle to shop local for Car Free Day on 22/9/20 and Idling Action training was promoted

		measures such as the use of road closures and park-lets .	online both by LBRUT and by London Idling Action. Despite a pause of 4.5 months due to COVID-19, traffic wardens engaged with 8,872 drivers idling their engines in 2020 and got them to switch off. Church Street in Twickenham was closed to traffic from 10am - midnight daily to enable outside dining and social distancing. Airtext, an early warning alert service for days of moderate or high air pollution levels, was supported and promoted on the Council website and in response to Council complaints and enquiries throughout 2020. LBRUT view Airtext as a critically important service providing direct alerts to vulnerable people, including those with COVID/long term COVID. Alerts are automatically forwarded to doctor's surgeries, schools and pharmacies. LBRUT consider this a low-cost way to raise awareness and reduce exposure amongst the most vulnerable. Much additional work was done in 2020 to permit social distancing – temporary widening of pavements and bus stops, additional cycle lanes, closed streets and a one way pedestrian system across Richmond bridge.
3.3	Public health and awareness raising	We will create a new Air Quality & Transport Committee specifically to look at Air Quality and actively engage with the community	A single Transport and Air Quality Committee was created to integrate transport and AQ in all decision making on a fundamental and daily basis with one cabinet member covering both departments. Officers organised community group meetings to listen to suggestions from representatives' borough wide. This helped structure the new AQAP and the two large, well-attended Air Quality and Climate Change summits in Oct 2019. This put Air Quality and Climate Change high on the political agenda and in 2020 resulted in much joint working between Air Quality and Climate Change departments on issues such as clean and green High St recovery from COVID and new e-cargo bike schemes (CAV3 and CAV4, see 4.1) and clean, electric ice cream pitches (see 7.5)
3.4	Public health and awareness raising	We will work with our Public Health partners and look at the opportunities to join up our campaigns and to deliver joint health benefits of active travel and healthy lifestyles	Early 2020 meetings held and agreements made with Director of PH to deliver joint messaging for health and air quality benefits of numerous strategies around schools, dementia, and equalities agenda. Little progress made in 2020 due to huge workloads for PH as a result of COVID-19. More joined up thinking/actions have been discussed and will be delivered as soon as possible.
3.5	Public health and awareness raising	We will work with our Communications Team to promote the use of low pollution, back roads for walking or cycling to reduce individual exposure to air pollution	The Air Quality team is working closely with Active Travel, School Travel Planner, schools, communications and via local presentations to promote low pollution walking routes. These were also included for Richmond town centre in LBRUT's Clean Air Villages 3 project with help from the Cross River Partnership and funded by DEFRA in 2020/2021.

3.6	Public health and awareness raising	We will create a joint action working group that will actively involve communities in the air quality agenda and that reports to the Chair of the new Air Quality & Transport Committee	This was created to inform and shape the new AQAP. Despite COVID it met online in November 2020 for an annual meeting. More meetings are planned for 2021. Useful updates and information on the air quality agenda were shared.
3.7	Public health and awareness raising	We will increase the number of schools with accredited travel plans by 20% per year with an aim to have up to 90% of all schools covered by 2024. We will encourage all schools to join TfL STARS programme.	LBRUT has a part time Travel Planning Officer to help schools draw up travel plans. LBRUT also organise road safety talks and encourage walking/cycling to school. LBRUT encourages all schools to sign up to the TfL STARS accreditation scheme. By Dec 2020, 56% schools in LBRUT had travel plans and were STARS accredited. All year 6 pupils receive cycling proficiency training before they leave for secondary school. LBRUT also helps schools introduce road safety schemes such as school streets. In 2020 LBRUT introduced 14 school streets, a significant increase from the 3 that were originally planned, pre COVID-19.
3.8	Public health and awareness raising	Better Legislation: We will actively campaign and participate in the call for a new Clean Air Bill that is fit for the future.	The Environment Bill has been delayed for a 3rd time. LBRUT together with other London authorities have lobbied government. LBRUT believe the Environment Bill is a good start but delays are unwelcome and targets lacking or not robust enough. Lobbying work will continue.
3.9	Public health and awareness raising	Burning in the borough: We receive regular complaints and concerns from residents about bonfires in the borough.	We have banned bonfires on all borough allotments and may consider further restrictions. Bonfires are a major source of harmful PM2.5's. We have substantial online information, strongly discourage all forms of burning, have contact forms and a contact number and respond to all complaints about bonfires. We take swift enforcement action against builder's bonfires. LBRUT witnessed an 800% increase in bonfires in April 2020 when compared to April 2019 when due to COVID-19 the Council Reuse and Recycling Centre (tip) was closed. LBRUT have serious concerns regarding TfL's refusal to exempt the Council tip from the extended ULEZ in Oct 2021. The only Council tip is 0.1 mile off the South Circular in a cul-de-sac within the ULEZ. LBRUT has sought dispensation from TfL. Whilst it is supportive of the extended ULEZ, it does not want to swap reduced NO2 in a third of the borough for increased PM's borough wide. Negotiations continue. We will report back in ASR 2022.
3.10	Public health and awareness raising	The impact of burning unauthorised fuel and the use of wood burning appliances is becoming more of an issue. We will lobby Government for additional powers to control burning unauthorised fuel and the use of wood burning appliances. We will take action	The whole of LBRUT is a smoke control zone. The Council receives complaints about dark smoke every year. All reported cases are investigated and enforced. Every year for the last 4 years it has launched smoke control campaigns for residents and written to all busineses that sell fuel and/or appliances with posters to inform customers at point of sale. It did so again in 2020.

		to address any complaint regarding unauthorised use.	LBRUT is on the newly formed GLA Wood burning Working Committee to discuss ways forward.
3.11	Public health and awareness raising	Audit all schools in areas of poor air quality and provide financial support for measures that tackle and reduce exposure to pollution	LBRUT has a target to audit all schools in areas of poor air quality. This was paused in 2020 due to COVID. Pollution team with Mayor's team have completed audits at the 3 schools in areas of poorest air quality – St Stephens Primary School, East Sheen Primary School and Windham Nursery School. All received substantial reports with short, medium and long-term recommendations. The 2 x Primary Schools received £10,000 from both the Mayor and LBRUT to help deliver improvements. From modelling, no other schools are in areas that exceed UK/EU annual limit values for NO2. However, we will continue to review this policy. Reducing exposure on the walk to school is also considered important. School projects can help to reduce exposure and emissions and help target one of the most vulnerable groups. LBRUT will encourage all schools to focus on cleaner walking routes to school for Clean Air Day 2021.
4.1	Delivery servicing and freight	Develop plans for business engagement, including optimising/greening deliveries, supply chain and waste removal	In 2020 LBRUT won a DEFRA bid – Clean Air Villages 3 (CAV3) for Richmond and East Twickenham town centres to help green up deliveries to customers by use of e-cargo bike and the use of dongles to demonstrate to independent traders cost savings of switching diesel for electric vans. Lockdown resulted in many closed premises but real benefits were witnessed. Lessons learnt will be used in 2021/22 for CAV4, a 2nd bid won from Defra for Twickenham town centre. Combined waste removal will also be investigated with the help of our partners CRP (Cross River partnership). In addition, LBRUT will support a new Mytowns project, to commence borough wide in summer/autumn 2021, following a successful trial combining online purchase and e-cargo bike deliveries in Barnes, Mortlake and Kew in 2020– (see **new projects** 4.2 at end).
5.1	Borough fleet	Richmond will upgrade its own fleet and that of our suppliers to the highest Euro Standards	Reducing emissions from LBRUT's own fleet and that of contractors is seen as key. LBRUT believes it is very important to lead by example, so has a target for the entire fleet to be the latest Euro standard or electric by 2024 By Dec 2020 76% of LBRUT's fleet was Euro VI. LBRUT's fleet consists of 44 x Euro VI, 7 x Euro V, 3 x Euro IV, 4 x Euro III. Contractors are incentivised via procurement (see 2.5)
6.1	Localised solutions	The introduction of a borough-wide 20 mph speed limit. This will help create an environment that is welcoming and safer for pedestrians and cyclists	Installation of 20 mph speed limit in over 90 % of all LBRUT roads was completed by April 2020 (implemented in 24 segments). This has helped create an environment that is welcoming and safer for pedestrians and cyclists to help increase the mode share for walking, cycling and public transport. COVID 19 has encouraged reprioritising of street space in favour of pedestrians and cyclists in Richmond, Twickenham, Kew, and the Hamptons,

6.2	Localised solutions	Independent assessment of the air quality benefits of the new 20 mph speed limit - monitor 3 locations before and after 20 mph limit implemented	Traffic survey complete and a reduction in speed on most roads confirmed by Feb 2021, contrary to increased speeds affecting much of London during lockdown. Air Quality report not yet available. LBRUT aware that comparison of air quality data Jan – Mar 2020 to Jan – Mar 2021 will be challenging due to change in traffic patterns due to COVID-19 and lockdown restrictions. This will be updated in ASR 2022.
6.3	Localised solutions	Additional speed reduction measures at A310 Kingston Bridge to Twickenham, A305 Staines Road Corridor and A308 Hampton Court Corridor	Traffic monitoring was proposed at 3 locations before and after speed reduction measures. The three corridors A310, A305 and A308 are identified for corridor studies and are being taken forward in 2021/22. Delays occurred due to COVID -19 but also cycle paths and 20mph plans were bought forward. So early in 2021, Hampton Court Rd had new interim cycle facilities built outside the Palace and 20mph was introduced along part of this corridor. Future plans are funding dependent.
6.4	Localised solutions	A new Clean Air Zone (CAZ) for Richmond Town Centre. This is the most polluted location in our borough and a hot spot for through traffic. We will tackle this by introducing a new Clean Air Zone with the ambition of reducing polluting vehicles and dissuading vehicles from unnecessarily using our town centre as a through route (subject to funding approvals)	LBRUT commissioned baseline data in Autumn 2019 with a view to bringing in the proposals for Richmond Town Centre by 2021. COVID 19 resulted in delays and fresh thinking. In 2021, LBRUT has wider plans for Richmond town centre, which are in development. A Clean Air Zone is still being considered as part of a package of wider interventions intended to improve air quality, public realm and the walking and cycling environment in Richmond town centre.
6.5	Localised solutions	Focus our policies and Local Implementation Plan on prioritising cycling and walking in the borough	Richmond Council published its Active Travel Strategy in 2020. The strategy includes a detailed list of actions that the council is pursuing to increase walking and cycling in the borough, including a strategic cycle network connecting the key town centres. Despite the pandemic, progress has already been made towards establishing this network with cycle improvements delivered on Kew Road, Hampton Court Road and Castelnau, with further improvements in development for Hampton Court Road, Hampton Wick Roundabout, Strawberry Vale and Staines Road. The target delivery date is 2024.

6.6	Localised solutions	Continuing the roll out of Electric Vehicle Charging in the borough. Target of 400 EV charging points by 2025	Ongoing - ambition to exceed target. LBRUT is keen to enable and encourage uptake of electric and hydrogen vehicles to meet zero emission vehicle targets. It accepts the need to provide space on borough roads and in borough car parks for fast and rapid chargers to ensure there is an effective network especially for business vehicles. It offers trickle charge lamppost chargers on residential roads for all without off street parking. A total of 370 public charging points (sockets) are now installed in LBRUT including 70 new lamp column chargers in late 2020/early 2021. The breakdown is 272 slow (lamp column) 93 fast (Source London) and 5 rapid (TfL). A further 75 lamp column chargers are planned in summer 2021 and the council is investigating options with private sector providers for further fast/rapid charger provision at no cost to the Council.
6.7	Localised solutions	Investing in Cycling Infrastructure in the borough - 1000 Cycle stands, 30 Cycle Hangers, 200+ Cycle Racks by 2023	In 2020/21, we installed our first round of 6 bike hangars in Richmond, providing space for 36 bikes, and have now undertaken a consultation on an additional 24 sites. We received a £27,000 grant from TfL for the installation of 68 Sheffield stands to be located on-street in various locations across the borough, providing parking spaces for 136 bikes. We are likely to exceed all cycling infrastructure targets including 1000 cycle stands by 2023. LBRUT does not monitor the number of cycle parking stands installed as part of new developments – they are conditioned as per London Plan 2020 and noted as part of the planning application but cumulative totals are not available.
6.8	Localised solutions	To reduce traffic around schools at drop off and pickup times we will be piloting ‘School Streets’ at selected schools with a view to extend these in the borough	LBRUT had a target of 3 school streets in March 2020. This target was significantly increased to 14 by Oct 2020 during COVID to help with both safety and social distancing around schools. School streets were introduced as a temporary measure in most cases. More work including consultation is required in 2021 but it is hoped to make permanent all 14. More schools will also be considered.
6.9	Localised solutions	Pilot internal air quality filtration in schools and take part in GLA assessment in effectiveness of different filtration units at nursery schools	Air filtration units were piloted at 2 x primary schools 2019 – 2020. It emerged that performance was dependent on routine maintenance - i.e. schools replacing/cleaning filters when necessary, which effected the value of the intended report. COVID and funding issues further disrupted this. In 2019, the GLA carried out an audit of 20 nursery schools in London including Windham Nursery School in LBRUT. All received reports and joint funding from the GLA and local authority to help with recommended improvements. In addition, the GLA selected 5 nursery schools for a detailed survey of 5 different air filtration systems. This resulted in a more robust report on the effectiveness of air pollution purifiers.

7.1	Cleaner transport	We will commission a Diesel Levy options paper and impact baseline for the borough. The implementation and the scope of that implementation will be considered at the Air Quality & Transport Committee. We will also benchmark against other leading boroughs that have considered and are implementing charges linked to vehicle emissions	Ongoing. An Emissions based parking levy report was completed in May 2020 looking at 5 options to address both harmful effects of traffic fumes and Climate Change Impacts to support a zero emission target for London by 2050. It reviewed a 2018 report on emission-based resident parking and considered options adopted elsewhere. LBRUT would like to incentivise and encourage a switch to cleaner vehicles. This requires further political consideration. Decisions/progress will be updated in ASR 2022.
7.2	Cleaner transport	Anti-idling: This is a priority action for the borough and we will be working tirelessly within given resources to ensure that this is tackled for all vehicles including taxis	This is a top political priority. LBRUT has spent much time working with black cabs outside Richmond and Twickenham stations. Work has included talking to drivers, talking to TfL, publishing articles in trade magazines, Idling Action events including taxi ranks. Most taxis are now compliant. Late 2019, traffic wardens were increased from 18 to 26 to enable more engine idling interventions. From March 2019 – March 2021, traffic wardens have engaged with 22,101 drivers (8,872 Jan – Dec 2020) (paused for 4.5 months – mid March – Aug 2020 due to COVID). LBRUT created its own pledge for engine idling for businesses and schools. It encourages all schools to pledge to not idle and issues large banners to those that sign up. These are displayed on school fences. Online resources to schools are promoted. LBRUT works both with London Idling Action and independently contacting companies directly to raise awareness of engine idling. Toolkits and online tutorials are promoted. All complaints are responded to and additional signage requests are investigated and erected where practical.
7.3	Cleaner transport	We need to lead by example so we will be developing a ‘benchmark test’ to gauge the impact of internal decision making around factors such as procurement	LBRUT has developed a benchmark test for procurement to help influence and incentivise suppliers to use the cleanest vehicles possible to reduce pollution from Council/contractor logistics and servicing. Euro VI/EV’s are required on new contracts. LBRUT ensured that the new 10 year waste and recycling contract, which commenced 1/4/20, used only Euro VI vehicles as soon as available. This represents a substantial improvement on the former fleet and will help reduce emissions borough wide.

7.4	Cleaner transport	Tackle Council work place emissions and promote the Council Travel Plan to the Council employees	2020 and COVID-19 witnessed the biggest switch to working from home ever. The impossible became possible. Much will continue and LBRUT will encourage working from home where practical in 2021/22. This will help reduce emissions from travelling to work. Throughout 2020 the Council continued to promote healthier travel habits for its staff, including walking, cycling and where safe, using public transport for business visits. Work Oyster cards are provided for business travel/site visits on public transport. Cycle to work scheme is encouraged. Cycle facilities on Twickenham campus include showers and changing rooms. Staff cycle parking is increased by removing car parking bays as demand increases. 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 all grades, has been abolished. All initiatives will help reduce emissions.
7.5	Cleaner transport	Licensing & Idling: We have a problem in the borough with food and ice cream vans that contribute to pollution when servicing certain areas. We will seek to ban diesel emissions when serving ice cream and require all non-itinerant food vans with licensed pitches to plug into an electrical source. We will work with our partners in our Licensing Team to introduce conditions at annual license renewal that provide the above controls to tackle this idling	LBRUT introduced this policy in its AQAP in March 2020 to address a specific concern with idling ice cream vans and food vendors. In 2021, the Air Quality team will progress this action with the Licensing and Climate Change teams to try to fund free electrical plug in points for all mobile food vendors by 2024 and to make it a condition at annual license renewal in 2022 to plug into an electrical source. This may have to be phased in over several years for funding reasons. In May 2021 when this report was written, an internal bid had been submitted to the Climate Change fund. LBRUT would like to combine this with more business engagement, help for street vendors and help for more local businesses to recover from CPOVID. In their bid to the Climate Change fund, the Air Quality team have proposed dual use pitches – ice cream in summer, hot refreshments in winter for our parks and open spaces – all newcomers to be electric, clean and green from outset .We will report on progress in the ASR 2022. .
7.6	Cleaner transport	Support the development and use of 'Car Clubs' in new residential developments, by station interchanges and in town centres.	Car clubs operate throughout the borough and are positively endorsed by the Council. In 2020, there were 73 car club bays in operation; however, some of these were unoccupied for a large part of the year due to the drop in demand caused by the Covid-19 pandemic. The council is working with Zipcar to bring the free-floating car club Zipcar Flex to the borough from summer 2021. A full review of car clubs in Richmond is planned for late 2021.
7.7	Cleaner transport	Tackle idling vehicles at schools as a priority	Traffic wardens target schools at pick up time on a regular basis. This was paused during COVID as most children worked from home. Active travel plans are encouraged and many more school streets were prioritised in 2020, which was considered a better option than targeting idling alone. However, traffic wardens and our Idling Action events, when permitted, will continue to target schools.

	New projects for 2021		
1.9	Monitoring and other core statutory duties	Further Investment in new monitoring equipment as new technology moves forward. This could see enhancement to the diffusion tube network and help provide real time data	In 2021, LBRUT won a joint bid for the Internet of Things. By late 2021, it hopes to install Vivacity monitors to assess vehicle, pedestrian and cycle movements and approx. 40 x real time Breathe London monitors to further assess air quality borough wide. Real time results will be available on the Londonair website. This is a much sought after development by residents and members. We will report on progress in the ASR 2022.
4.2	Delivery servicing and freight	Develop plans for business engagement, including optimising/greening deliveries, supply chain and waste removal	In Spring 2021, following a procurement process, the business development section of LBRUT selected Mytowns to deliver an innovative online website with clean e-cargo bike next day deliveries to support a green and clean recovery from COVID-19 for local high streets. Mytowns trialled this successfully in the north of the borough in 2020. Mytowns, with the support of LBRUT, enable all independent retailers to have a great online presence quickly, easily and at no cost to themselves. Residents sign up for free and can “shop” along the high street on the website. Residents then click and collect or have all purchases combined to a single delivery, which is delivered next day on e-cargo bike. In 2021, it will be rolled out to Richmond, East Twickenham and Twickenham with other towns to follow asap. The ambition is to cover the entire borough and possibly, to have a consolidation centre in the middle of the borough, with an electric van and extend this to purchases from any high street to all areas of LBRUT. A lot of joint working has already taken place and all avenues of funding are being considered. We will report on progress in ASR 2022.

4. Planning Update and Other New Sources of Emissions

Table K. Planning requirements met by planning applications in London Borough of Richmond upon Thames in 2020

Condition	Number
Number of planning applications where an air quality impact assessment was reviewed for air quality impacts	33
Number of planning applications required to monitor for construction dust	25
Number of CHPs/Biomass boilers refused on air quality grounds	0
Number of CHPs/Biomass boilers subject to GLA emissions limits and/or other restrictions to reduce emissions	3
Number of developments required to install Ultra-Low NO_x boilers	33
Number of developments where an AQ Neutral building and/or transport assessments undertaken	33
Number of developments where the AQ Neutral building and/or transport assessments not meeting the benchmark and so required to include additional mitigation	2
Number of planning applications with S106 agreements including other requirements to improve air quality	1
Number of planning applications with CIL payments that include a contribution to improve air quality	0
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 with the GLA through the relevant NRMM website and that all NRMM used on-site is compliant with Stage IIIB of the Directive and/or exemptions to the policy.	N/A
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.	9 conditions included 3 registered and compliant 1 unregistered/uncompliant 8 sites were complete upon engagement 0 site had no NRMM within scope (37-560kW)

NRMM is a standard planning condition applied to all major developments. In 2020, the Senior Air Quality Officer emailed current NRMM conditions to the Head of

Planning and ensured all Planning Officers were made aware of requirement to add NRMM to all planning applications at 2 x team meetings in March and October 2020. The RSP (LB Merton, LBRUT and LB Wandsworth) have 6 designated Officers based in Merton, who assess all major sites for NRMM compliance, visit sites and check the NRMM database for compliance in line with the Mayors Supplementary Planning Guide for Control of Dust and Emissions during Construction and Demolition.

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. All relevant Mayoral policies are applied by Environmental Health to all responses to Planning in all cases. All sites are considered for construction dust on a case-by-case basis, monitoring required and locations agreed, where a moderate or high risk to receptors is predicted. All CHP/biomass are 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 2020.

4.1 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 by the contractor, TRL, employed by LBRuT for LSO visits during 2020. Regular calibration visits of between 2-4 weeks were maintained throughout 2020, despite COVID-19. 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 Imperial's LAQN QA/QC procedure, to ensure optimum data quality.

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

PM_{10} Monitoring Adjustment

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 Imperial College London/King's College London Duty Officer checks the on-going performance of the monitor on-line. (KCL merged with Imperial in July 2020 – all services provided by ERG - Environmental Research Group - were maintained, ERG

now come under Imperial College London). 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 Imperial 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/Imperial LAQN QA/QC procedure, to ensure optimum data quality. Both sites are part of the LAQN and Imperial are responsible for the daily data collection, storage, validation and dissemination via the LAQN website (www.londonair.org.uk). Imperial ratifies the data periodically, viewing data over longer time periods and using the results from fortnightly checks, equipment services and equipment audits.

Measured mean PM_{10} concentration for both LBRuT's automatic monitoring sites for 2020 was 15-16µg/m3 based on data capture rates of 95% - 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.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 NO2 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 NO2 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 (Jan 2019 – October 2020)

- Summary of Precision Scores for 2018 – 2020

- UKAS schedule of accreditation (April 2020)

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 (Jan 2019 – October 2020)

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 in 2020 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 2020 is covered by rounds AR030 to AR040 of the AIR-PT scheme. For 2020 the laboratories results were deemed to be good for 97 participating local authorities and poor for 10 participating local authorities based upon a z score of ≤ ± 2.

In 2020, 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 11 participating local authorities and poor for 1 participating local authority.

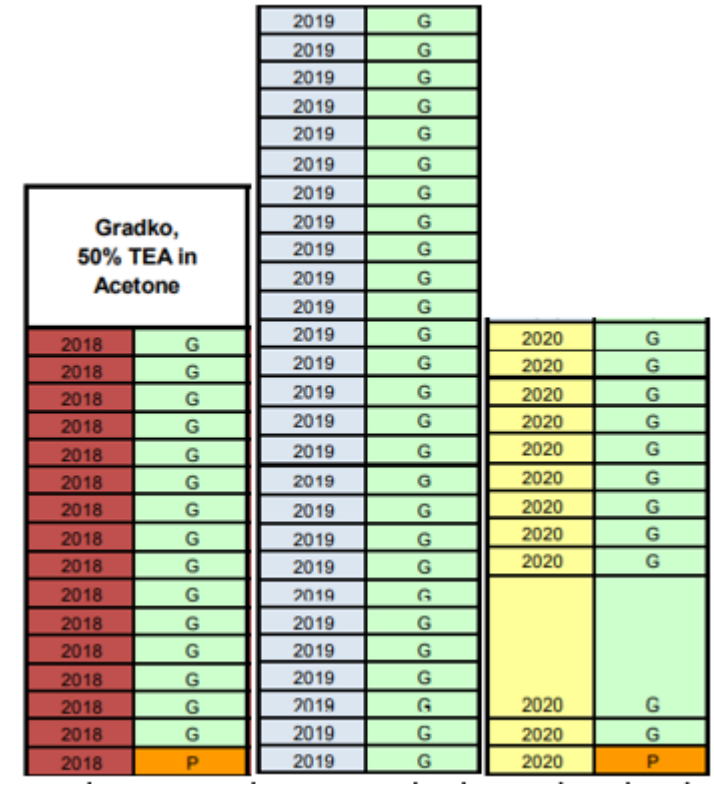
Table 1: Laboratory summary performance for AIR NO_2 PT rounds AR0030, 31, 33, 34, 36. 37, 39 and 40

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 ≤ ± 2 as defined above.

AIR PT Round	AIR PT AR030	AIR PT AR031	AIR PT AR033	AIR PT AR034	AIR PT AR036	AIR PT AR037	AIR PT AR039	AIR PT AR040
Round conducted in the period	January – February 2019	April – May 2019	July – August 2019	September – November 2019	January – February 2020	May – June 2020	July – August 2020	September – October 2020
Aberdeen Scientific Services	75 %	100 %	100 %	100 %	100 %	NR [4]	NR [4]	100 %
Cardiff Scientific Services	NR [3]	NR [3]	NR [3]	NR [3]	NR [3]	NR [4]	NR [4]	NR [3]
Edinburgh Scientific Services	100 %	NR [2]	100 %	25 %	50 %	NR [4]	NR [4]	100 %
SOCOTEC	87.5 % [1]	100 % [1]	100 % [1]	100 % [1]	100 % [1]	NR [4]	NR [4]	100 % [1]
Exova (formerly Clyde Analytical)	NR [3]	NR [3]	NR [3]	NR [3]	NR [3]	NR [4]	NR [4]	NR [3]
Glasgow Scientific Services	100 %	100 %	100 %	50 %	100 %	NR [4]	NR [4]	100 %
Gradko International	75 %	100 %	100 %	100 %	75 %	NR [4]	NR [4]	75 %
Kent Scientific Services	NR [3]	NR [3]	NR [3]	NR [3]	NR [3]	NR [4]	NR [4]	NR [3]
Kirklees MBC	NR [3]	NR [3]	NR [3]	NR [3]	NR [3]	NR [4]	NR [4]	NR [3]
Lambeth Scientific Services	50 %	100 %	50 %	100 %	100 %	NR [4]	NR [4]	100 %
Milton Keynes Council	100 %	100 %	50 %	100 %	100 %	NR [4]	NR [4]	25 %
Northampton Borough Council	NR [3]	NR [3]	NR [3]	NR [3]	NR [3]	NR [4]	NR [4]	NR [3]
Somerset Scientific Services	100 %	100 %	100 %	100 %	100 %	NR [4]	NR [4]	100 %
South Yorkshire Air Quality Samplers	100 %	100 %	100 %	75 %	100 %	NR [4]	NR [4]	100 %
Staffordshire County Council	100 %	75 %	75 %	75 %	100 %	NR [4]	NR [4]	50 %
Tayside Scientific Services (formerly Dundee CC)	100 %	NR [2]	100 %	NR [2]	100 %	NR [4]	NR [4]	100 %
West Yorkshire Analytical Services	100 %	100 %	100 %	50 %	100 %	NR [4]	NR [4]	NR [2]

[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] Cardiff Scientific Services, Exova (formerly Clyde Analytical), Kent Scientific Services, Kirklees MBC and Northampton Borough Council; no longer carry out NO2 diffusion tube monitoring and therefore did not submit results.
[4] Round was cancelled due to pandemic.

2018 - 2020 Summary of Precision Results for Nitrogen Dioxide Diffusion Tube Collocation Studies for Gradko Laboratory 50% TEA in Acetone



Numerical results for this data are contained in the National Bias Adjustment Spreadsheet version 03/20

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 17025:2017

Gradko International Ltd
(Trading as Gradko Environmental)

Issue No: 024 **Issue date:** 15 April 2020

St Martins House 77 Wales Street Winchester Hampshire SO23 0RH	Contact: Mr A Poole Tel: +44 (0)1962 860331 Fax: +44 (0)1962 841339 E-Mail: diffusion@gradko.co.uk Website: www.gradko.co.uk

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

Assessment Manager: RP

Page 1 of 2

UKAS TESTING 2187 Accredited to ISO/IEC 17025:2017	**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:** 024 **Issue date:** 15 April 2020

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		

NO_2 diffusion tube analysis method

NO_2 diffusion tubes are passive monitoring devices. They are made up of a Perspex cylinder, with two 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.

Factor from Local Co-location Studies

The local bias adjustment factors for the Borough are provided in Table L for 2014 to 2020. LBRUT always use a roadside correction factor for kerbside/roadside sites and a background correction factor for background sites, so for ease of understanding, we are not providing bias adjustment factors for previous years in the body of the report. Please see table L. In 2015, 2016 and again in 2020 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. In 2014 and 2019, 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 and 2019. In 2017 and 2018, the bias adjustment factor was the national bias adjustment factor for Gradko using the 50% TEA in acetone methodology. All background sites in the Borough for all years except 2020 were bias adjusted using the factor from the local urban background co-location site at the Richmond 2 Barnes Wetlands. In 2020, the National bias adjustment factor for Gradko (0.83) was used for both background suites instead of Wetlands (0.82) due to poor data capture rate at Wetlands. Data capture at Wetlands (RI2) was 82%, below the 90% required.

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

Diffusion Tube Bias Adjustment Factors from Local Co-location Studies

In 2020, the Borough undertook co-location studies at two continuous NO_2 monitoring sites, with triplicate NO_2 diffusion tubes at the following the locations:

- **Richmond 1 Castelnau (site 23):** a roadside site, in Castlenau Library Barnes. In 2020, the annual means for the Castelnau diffusion tubes (Nº 23) was 22.04 μg m^3; for the continuous site (RI1) it was 20.14 μg m^3. The bias adjustment factor is **0.91**
- **Richmond 2 Barnes Wetlands (site 37):** a suburban background site. In 2020, the annual means for the Wetlands diffusion tubes (Nº 37) was 19.08g m^{-3}; for the continuous site (RI2) it was 15.86μg m^3. The bias adjustment factor is **0.83.**

All LBRUT data was completed and returned in time for the co-location questionnaire and is included in the database bias adjustment factors v 03/21.

Discussion of Choice of Factor to Use

The National bias adjustment factor for Gradko using 50% TEA in acetone for March 2020 (v03/21) was **0.82.** Every year we consider which bias adjustment factor is best to use. In previous years, we have used Castlenau roadside site or the National bias adjustment factor for Gradko using 50% TEA in acetone or an average of all three LBRUT sites. In 2020 it was decided to use **the Castlenau roadside site** which was **0.91** to bias adjust all roadside sites and **the National bias adjustment factor** for Gradko which was **0.82** to bias adjust both background sites (see below).

Choice of bias adjustment factor was given very careful consideration. The overall precision and data capture for Castlenau for the co-location studies was very good (100%), as it has been over recent years. These are local results for the local area. Unfortunately, for the first time in many years, data capture for the monitor at Wetlands was 82%, below the 90% required. This was because between 14th May and 8th July 2020 we experienced equipment issues with the NOx/ NO_2 monitor at our Wetlands site, some required difficult to obtain parts during lockdown, some of which were not clear until ratification. This meant data had to be withdrawn after ratification, which resulted in a reduced data capture of 82% for the monitored data. For this reason we decided to use the National bias adjustment factor for Gradko (0.82) to bias adjust our

two background sites. In reality, having calculated results at both background sites using both bias adjustment factors of 0.82 for the National bias adjustment factor and 0.83 for Wetlands the results were the same but this may not have been the case. In order to best assess levels of NO2 throughout the borough for 2020 it was decided to use the Castlenau bias correction figure for all roadside sites and the national Gradko bias adjustment figure for both background sites. The result is slightly more conservative than using the national Gradko biased adjustment factor for both. We wish to neither under estimate or over report levels of NO2 in the borough.

Table L. Bias Adjustment Factor

Year	Local or National	If Local, Version of National Spreadsheet	Adjustment Factor Roadside	Adjustment Factor Background
2020	Local	Mar-21	0.91	0.83
2019	Local	Mar-20	0.9	0.99
2018	National	Mar-19	0.92	0.93
2017	National	Mar-18	0.97	1
2016	Local	Mar-17	0.98	1.08
2015	Local	Mar-16	0.92	1
2014	Local	Mar-15	0.95	1.09

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 should be “annualised” – i.e. adjusted using the methodology outlined in LLAQM.TG(19) before being compared to annual mean objectives. In 2020, due to the theft of the mobile air quality monitoring unit on 6/8/21, data capture at this site, site 53, was below 75%, so results must be annualised. Data capture for all other sites was very good and above 75%, so no other site needed to be annualised.

The Wetland Centre achieved a data capture rate 82%, less than the 85% required. It was therefore necessary to use the non-automatic diffusion tube background sites 37 Wetlands and site 28 Richmond Park, which fulfilled the criteria of LLAQM.TG (19).

Both background diffusion tube sites are within the London Borough of Richmond network. Both sites had data capture rates of 100% for 2020 - so greater than the 85% required. Usefully, site 37 Wetlands is a triplicate site, so monthly triplicate tubes were averaged. As two background sites were used the ratio of the Annual mean/Period mean were averaged. The full calculations are reproduced in table M.1 and M.2.

Table M.1 Short-Term to Long-Term Monitoring Data Adjustment

start date	end date	Tube average B1(37) Wetlands	Tube average B2 (28) Richmond Park	D1 (site 2) (53)	B1 when D1 is available	B2 when D1 is available
07/01/2020	05/02/2020	21.46	19.91	48.74	21.46	19.91
05/02/2020	02/03/2020	15.34	12.25	36.85	15.34	12.25
02/03/2020	31/03/2020	16.96	13.86	37.82	16.96	13.86
31/03/2020	29/04/2020	18.96	16.90	29.65	18.96	16.90
29/04/2020	04/06/2020	11.6	9.68	25.21	11.6	9.68
04/06/2020	01/07/2020	12.15	10.02	26.26	12.15	10.02
01/07/2020	29/07/2020	9.18	8.40	26.12	9.18	8.40
29/07/2020	02/09/2020	14.39	12.43			
02/09/2020	29/09/2020	18.62	14.23			
29/09/2020	03/11/2020	17.14	13.64			
03/11/2020	01/12/2020	27.39	20.27			
01/12/2020	05/01/2021	21.53	19.93			
annual mean		17.06	14.29	32.95	15.09	13.00

The ratio of the annual mean to the period mean (Am/Pm) for B1 is 17.06/ 15.09 = 1.13. The ratio of the annual mean to the period mean (Am/Pm) for B2 is 14.29/13 = 1.09. The average of these ratios (Ra) is 1.11. The measured period mean concentration M is 32.95. The annualised average of D1=MxR=32.95 x 1.11 = 36. The estimated annual mean for 2020 is therefore 36. This is summarised in Table M.2 below.

Table M.2 Short-Term to Long-Term Monitoring Data Adjustment

Site ID	Annualisation Factor Site 37 Wetlands	Annualisation Factor Site 28 Richmond Park	Average Annualisation Factor	Raw Data Annual Mean (µg m^{-3})	Annualised Annual Mean (µg m^{-3})
53	1.13	1.09	1.11	32.95	36.57

NO_2 Fall off With Distance Calculations

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 has been bias adjusted and annualised where necessary and the background concentration is derived from the Wetlands background site. Wetlands achieved more than 75% data capture (82%), as per LAQM guidance, which was checked for certainty with the LAQM helpdesk by LBRUT in May 2021.

Please note this is the first year bias adjusted rather than “raw” data has been used, as per LLAQM (19) guidance. Any comparison with earlier years’ distance corrected figures should be mindful of this fact.

Table N. NO_2 Fall off With Distance Calculations

Monitored Annual Mean NO2 compared to exposure at nearest façade (□g m-3)

Site ID	Distance (m): Monitoring Site to Kerb	Distance (m): Receptor to Kerb	Background Concentration (µg m^{-3})	Monitored Concentration (Annualised and Bias Adjusted (µg m^{-3})	Concentration Predicted at Receptor (µg m^{-3})	Comments
1	1.7	1.9	15.0	25	*24.7*	
2	1.3	3.0	15.0	21	*19.9*	
4	0.6	9.8	15.0	27	*20.9*	
7	0.8	2.5	15.0	34	*29.8*	
9	0.6	2.0	15.0	31	*27.5*	
10	0.6	7.2	15.0	33	*24.8*	
11	0.6	9.1	15.0	27	*21.0*	
12	0.6	7.4	15.0	31	*23.7*	
13	0.8	6.3	15.0	30	*24.0*	
15	0.6	1.8	15.0	26	*23.8*	
17	1.2	2.0	15.0	**40**	*37.3*	
18	0.9	9.3	15.0	**41**	*29.0*	
19	0.7	16.0	15.0	30	*21.2*	
20	0.6	2.8	15.0	30	*25.8*	
22	0.5	4.2	15.0	21	*18.7*	
23	3.3	9.0	15.0	20	*18.7*	
25	2.3	2.5	15.0	34	*33.6*	

26	0.6	11.8	15.0	32	*22.7*	
27	0.6	6.8	15.0	21	*18.3*	
29	3.6	3.6	15.0	21	*21.0*	
31	1.0	6.4	15.0	35	*27.5*	
32	1.0	3.2	15.0	**40**	*34.1*	
33	3.3	6.9	15.0	34	*30.3*	
35	1.3	1.4	15.0	32	*31.7*	
36	2.1	2.2	15.0	**56**	**55.5**	
39	1.2	2.7	15.0	32	*29.1*	
40	1.0	11.4	15.0	29	*22.1*	
42	0.7	2.1	15.0	**60**	**50.7**	
43	0.7	1.6	15.0	**41**	*37.0*	
44	0.5	0.5	15.0	33	*33.0*	
45	0.5	3.3	15.0	26	*22.3*	
50	0.7	2.7	15.0	**45**	*37.4*	
51	2.1	3.1	15.0	24	*23.2*	
52	1.9	3.6	15.0	**46**	**41.4**	
53	1.6	2.9	15.0	30	*28.0*	
54	0.6	1.3	15.0	32	*29.6*	
55	0.6	4.1	15.0	33	*26.7*	
56	1.0	9.6	15.0	31	*23.7*	
57	1.0	16.4	15.0	29	*21.1*	
58	0.7	6.4	15.0	33	*25.5*	
59	0.6	1.4	15.0	27	*25.1*	
61	1.8	4.3	15.0	32	*28.6*	
62	0.4	2.3	15.0	32	*26.9*	
63	0.8	3.2	15.0	27	*23.8*	
64	0.5	1.6	15.0	34	*30.1*	
65	0.5	2.7	15.0	**40**	*32.5*	

66	2.1	3.3	15.0	32	*30.2*	
67	1.4	2.7	15.0	23	*21.9*	
68	3.2	3.8	15.0	31	*30.3*	
69	2.0	4.9	15.0	22	*20.5*	
70	1.8	2.1	15.0	33	*32.4*	
71	2.9	9.9	15.0	**43**	*34.2*	
72	0.8	2.5	15.0	33	*29.0*	
73	2.1	8.4	15.0	36	*29.1*	
74	2.6	5.9	15.0	**43**	*37.3*	
75	0.6	6.3	15.0	29	*23.0*	
76	0.4	3.3	15.0	35	*27.8*	
77	0.6	4.5	15.0	38	*29.5*	
78	1.7	2.7	15.0	25	*24.0*	
79	1	6.6	15.0	33	*26.2*	
Rut 01	2.9	3.0	15.0	29	*28.9*	
Rut 02	0.7	2.2	15.0	**52**	**44.0**	

Appendix B Full Monthly Diffusion Tube Results for 2020

Table O. NO_2 Diffusion Tube Results

Site ID	Valid data capture for monitoring period2020 %(b)	Valid data capture 2020 %(b)	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sept	Oct	Nov	Dec	Annual mean – raw data	Annual mean – bias adjusted
1	100	100	37.49	24.93	30.14	27.87	21.28	21.08	23.43	28.41	30.66	29.74	32.88	25.97	28	25
2	100	83	25.51	16.64	25.64	22.79	14.81	16.92	12.64	missing	30.15	missing	33.87	30.26	23	21
4	100	100	38.88	33.64	30.43	25.20	21.46	22.19	26.87	30.74	31.87	30.77	37.56	30.71	30	27
7	100	100	39.42	34.02	42.53	40.41	29.35	32.59	30.99	40.38	44.84	31.12	42.70	35.48	37	34
9	100	100	45.27	35.38	36.19	31.64	22.83	29.92	22.55	33.46	36.19	38.68	41.78	37.20	34	31
10	100	100	52.39	48.26	36.57	22.86	23.19	28.87	30.30	37.41	42.80	41.86	42.41	34.56	37	33
11	100	100	36.05	31.70	32.03	26.77	18.89	21.02	20.30	25.42	32.76	39.42	41.65	31.76	30	27
12	100	100	45.31	34.26	38.29	31.83	27.77	27.58	25.81	32.07	33.41	38.44	40.43	33.33	34	31
13	100	100	41.82	34.90	37.48	33.92	23.94	25.37	19.93	30.14	34.48	32.25	44.74	35.97	33	30
15	100	92	38.10	25.64	missing	23.77	20.25	25.44	19.57	28.55	31.18	29.93	38.88	28.71	28	26
17	100	100	65.67	46.48	47.20	42.34	34.57	44.59	37.88	50.01	62.83	54.78	54.41	44.34	49	40
18	100	100	56.71	46.30	43.54	25.06	38.04	42.76	39.37	43.81	54.21	50.54	60.32	44.67	45	41
19	100	100	45.63	40.83	35.13	28.91	22.70	29.85	23.05	30.51	33.64	33.76	43.69	31.36	33	30
20	100	92	44.99	36.51	34.53	27.35	24.02	26.27	20.58	missing	36.81	35.40	42.81	35.00	33	30
22	100	100	35.96	21.51	26.97	22.24	13.74	14.79	13.10	18.43	23.54	22.94	36.46	27.83	23	21
23	100	100	26.90	21.67	23.98	23.70	15.99	16.51	13.14	19.69	22.12	20.87	33.34	22.61	22	20
25	100	92	38.03	39.77	30.24	36.53		36.54	31.20	39.22	41.01	35.20	46.20	38.54	37	34
26	100	100	44.89	36.62	35.98	29.64	22.17	29.66	30.35	34.65	41.07	38.62	48.15	33.20	35	32

27	100	92	28.21	23.17	23.59	17.88	15.79	17.62		22.41	23.36	25.17	32.40	26.37	23	21
28	100	100	19.91	12.25	13.86	16.90	9.68	10.02	8.40	12.43	14.23	13.64	20.27	19.93	14	12
29	100	100	31.89	21.10	26.39	22.69	17.88	20.02	16.63	21.08	24.61	23.27	29.54	25.53	23	21
31	100	100	50.09	46.96	41.47	32.98	24.07	30.77	25.62	37.69	40.43	36.03	50.33	40.40	38	35
32	100	100	53.27	41.87	45.23	40.09	34.47	41.32	30.68	46.47	50.94	45.77	52.70	40.11	44	40
33	100	92	40.76	29.63	31.82	37.42	32.42	29.41	29.43	missing	52.95	42.37	46.34	42.16	38	34
35	100	100	46.35	37.47	33.00	22.81	23.60	30.53	33.26	38.47	36.83	37.77	42.99	35.67	35	32
36	100	100	76.49	62.05	58.66	48.10	47.68	67.35	53.07	69.87	69.86	64.35	64.73	57.26	62	56
37	100	100	21.46	15.34	16.96	18.96	11.60	12.15	9.18	14.39	18.62	17.40	27.39	21.53	17	14
39	100	92	57.98	37.38	missing	29.19	23.75	25.97	28.50	31.22	38.67	35.25	43.53	30.57	35	32
40	100	100	43.01	40.98	36.42	28.29	18.95	23.21	27.85	27.84	37.36	31.10	37.17	27.43	32	29
42	100	92	85.08	67.50	63.40	55.44	missing	57.06	56.71	71.37	85.05	71.12	64.13	50.18	66	60
43	100	92	53.27	35.48	45.02	41.44	34.84	39.90	34.66	48.57	54.25	missing	63.49	42.95	45	41
44	100	92	50.53	42.19	missing	28.94	25.09	28.83	29.30	33.78	43.40	35.29	43.23	32.76	36	33
45	100	100	36.89	32.17	29.27	22.68	22.56	25.20	22.69	28.81	28.38	31.72	36.79	30.61	29	26
50	100	100	58.92	50.66	45.23	38.67	40.29	46.62	43.74	59.50	55.91	54.21	54.16	46.20	50	45
51	100	100	36.90	27.23	27.63	23.50	18.89	21.42	17.98	23.69	26.24	24.96	37.32	27.90	26	24
52	100	100	61.20	57.34	53.75	40.35	43.14	35.76	43.10	51.97	63.09	49.47	60.36	45.51	50	46
53	58	58	48.74	36.85	37.82	29.65	25.21	26.26	26.12	missing	missing	missing	missing	missing	33	30
54	100	92	49.94	40.01	36.10	missing	23.35	28.67	23.91	31.37	36.30	38.05	43.74	35.96	35	32
55	100	83	39.85	missing	34.71	missing	29.05	29.73	29.36	36.59	41.46	39.08	42.85	35.84	36	33
56	100	100	41.29	40.87	36.50	30.84	25.39	27.66	26.71	35.02	33.04	38.19	36.48	34.59	34	31
57	100	83	40.50	34.28	36.02	28.70	23.52	24.46	25.77	32.85	37.81	30.20	missing	missing	31	29
58	100	100	50.61	35.61	38.90	33.40	26.61	29.57	26.15	33.08	40.31	36.87	46.68	32.52	36	33
59	100	100	34.09	20.20	32.09	32.07	23.09	28.23	22.65	32.49	37.28	31.10	32.78	30.80	30	27

61	100	92	46.58	32.57	32.17	29.26	missing	26.24	30.19	33.71	39.33	36.10	39.31	35.34	35	32
62	100	100	29.10	36.19	34.19	33.63	28.30	27.81	31.14	35.47	46.89	34.32	47.53	37.38	35	32
63	100	100	38.41	29.46	35.43	26.75	20.55	24.10	22.34	29.38	31.71	35.20	35.53	30.63	30	27
64	100	100	46.27	37.59	39.03	28.15	26.58	29.24	38.69	37.55	43.86	37.93	43.68	34.43	37	34
65	100	92	54.32	48.54	missing	33.85	27.98	44.20	32.70	49.29	53.03	44.45	54.81	40.98	44	40
66	100	100	53.35	37.61	31.13	27.68	24.37	28.81	31.32	31.76	39.43	33.09	44.12	35.31	35	32
67	100	92	36.74	21.84	25.87	23.95	20.27	17.71	16.01	missing	25.51	24.43	34.25	26.99	25	23
68	100	92	46.46	37.47	34.31	27.04	missing	27.04	26.91	30.63	37.82	33.98	44.34	31.36	34	31
69	100	100	28.76	26.61	24.84	25.06	14.88	18.41	19.13	19.42	25.40	27.83	34.11	27.87	24	22
70	100	100	45.31	37.33	33.93	16.80	27.12	32.74	29.63	38.93	48.28	43.38	43.71	38.34	36	33
71	100	100	53.84	47.57	48.04	44.96	39.44	54.11	38.71	53.07	49.43	46.52	45.87	40.37	47	43
72	100	100	51.30	36.71	39.82	31.89	23.03	29.38	23.78	32.40	38.34	40.24	45.75	38.67	36	33
73	100	100	56.23	49.39	38.54	27.47	24.36	32.89	29.49	40.29	43.91	48.14	47.98	41.63	40	36
74	100	92	52.77	38.16	46.91	42.82	missing	44.36	33.66	50.83	55.29	47.24	57.24	47.34	47	43
75	100	100	41.32	36.11	32.27	28.29	21.33	27.09	25.34	31.54	34.50	32.72	34.70	31.61	31	29
76	100	100	47.19	33.69	32.92	30.46	25.59	37.84	29.67	41.09	44.73	45.06	47.48	41.11	38	35
77	100	92	57.56	46.08	36.81	39.85	32.33	42.59	32.40	44.05	missing	42.53	45.41	42.29	42	38
78(34)	100	100	37.33	23.50	27.61	24.57	18.50	23.72	21.26	26.04	30.64	30.27	37.31	29.26	28	25
79(48)	100	92	41.43	40.05	32.67	31.03	28.64	31.47	37.07	37.81	41.98	missing	39.73	36.12	36	33
Rut 01	100	100	37.52	38.13	31.07	26.45	21.82	26.31	21.12	33.06	33.44	33.92	48.68	31.71	32	29
Rut 02	100	100	72.13	56.14	61.88	51.30	48.95	47.10	48.69	59.38	72.64	57.18	62.29	48.75	57	52

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	28.05	22.08	24.26	22.80	16.47	16.17	13.48	19.66	21.46	20.10	33.45	27.56	22.13
23/2	28.47	22.76	23.84	23.08	16.21	17.06	12.97	20.22	22.73	21.51	33.25	23.75	24.17
23/3	24.17	20.17	23.84	25.23	15.30	16.29	12.95	19.20	22.16	21.00	33.31	28.53	21.85
Average	26.90	21.67	23.98	23.70	15.99	16.51	13.14	19.69	22.12	20.87	33.34	26.61	22.04
37	21.48	15.77	17.13	16.67	11.38	12.18	9.13	14.26	18.34	16.73	27.52	18.53	16.59
37/2	19.44	15.86	16.23	21.11	11.91	12.40	9.34	14.81	19.04	17.58	27.27	22.91	17.32
37/3	23.46	14.38	17.52	19.11	11.51	11.88	9.07	14.10	18.49	17.12	missing	23.16	16.35
Average	21.46	15.34	16.96	18.96	11.60	12.15	9.18	14.39	18.62	17.14	27.39	21.53	17.06
53	47.69	37.75	40.01	28.57	25.08	29.71	23.14	missing	missing	missing	missing	missing	33.14
53/2	50.52	38.26	35.55	29.99	26.17	25.61	28.96	missing	missing	missing	missing	missing	33.58
53/3	48.01	34.55	37.89	30.38	24.39	23.46	26.25	missing	missing	missing	missing	missing	32.13
Average	48.74	36.85	37.82	29.65	25.21	26.26	26.12	missing	missing	missing	missing	missing	37.25

Notes:

Concentrations are presented as µg m^{-3}.Exceedances of the NO_2 annual mean AQO of 40 µg m^{-3} are shown in **bold**.

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**.

All means have been "annualised" in accordance with LLAQM Technical Guidance if valid data capture for the calendar year is less than 75% and greater than 33%.

(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%).