AECOM

A6 Manchester Airport Relief Road
1 Year Post- Development Air Quality Monitoring

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1.0   Introduction

AECOM was commissioned to undertake a six-month programme of monitoring at numerous locations in the vicinity of the recently opened A6 Manchester Airport Relief Road (A6MARR), which runs from the B5166 Ringway Road near the airport to the A6 Buxton Road to the east of Hazel Grove.

As detailed in the 'Monitoring and Evaluation Plan' (Atkins, August 2014), the monitoring reported here is intended to inform a comparison with the six-month pre-construction monitoring survey undertaken in 2014. Where possible, the monitoring was undertaken at the exact same locations that were used in the 2014 monitoring to allow for the differences between the current and previous study to be readily observed. There were three additional locations added to the survey, not included in 2014, and one location not included due to landowner objection. A small number were relocated where the original lampposts no longer being present due to the MARR construction or other local changes.

The monitoring was undertaken using passive diffusion tubes to measure monthly concentrations of nitrogen dioxide (NO_2) in order to determine an average NO_2 concentration over the period of the monitoring at each location.

Monitoring was intended to be carried out for a period of six-months commencing on 16 December 2019, and ending in June 2020, however, the survey was interrupted during the UK Government's initial Covid-19 lockdown, which was imposed in March. The monitoring data collected is therefore in two three-month period running from 16th December 2019 – 13th March 2020 and 9th July 2020 – 13th October 2020. These data have been further adjusted using DEFRA tools and guidance to calculate an equivalent annual mean concentration.

2.0   Methodology

Monitoring Method

Monitoring of nitrogen dioxide (NO_2) was undertaken at 88 locations near the route of the A6MARR. Of these:

- 85 were at the same locations as the monitoring undertaken in 2009 which was used to support the modelling for the Environmental Statement,
- 3 additional sites were added in 2019; A63, D2 and QPS3 to provide greater detail on concentrations along the A6 in High Lane, in Disley, and at Queensgate Primary school respectively.
- 1 location, P4 at Mill Hill Hollow was a new site installed in the 2014 study was not included in the 2019/2020 monitoring survey due to the landlord refusing to allow access to the private road where the lamppost was located.

Monitoring was undertaken at 86 locations in 2014 and, where possible, the exact same locations were monitored in the 2019/2020 survey. However this was not possible at 17 locations due to the original lampposts no longer being present due to the MARR construction or other local changes; in these cases, tubes were installed on the nearest available lamppost as an appropriate comparable location. These locations are clearly identified in the following tables and plots.

A full list of the sites and coordinates are presented in Appendix A.

Photographs of relocated sites are provided in Appendix B.

The locations of all the sites are described in Appendix A, and shown in the figures in Appendix F.

Monitoring Equipment

The same equipment and approach was used, so as to be consistent with 2014.

Passive NO_2 diffusion tubes were installed in pairs. The tubes were provided and analysed by Gradko International Ltd using a preparation method of 20% TEA/water. The limit of detection was 0.020 μg. A lab blank and sample blank were included with each batch to account for any procedural drift.

Diffusion tubes are subject to possible sources of interference which can cause under, or over, estimation (bias) compared to a reference method. Therefore, duplicate collocation of diffusion tubes with a continuous reference method analyser was used to derive a local bias adjustment factor in accordance with the methodology defined in LAQM.TG(16) and the most recent version of the tool published on line on the Defra LAQM website .

The monitoring period was 6-months, but due to the fact that concentrations typically vary throughout the year to derive an 'annual' average the data were 'seasonally adjusted' by comparison with a number of regional background continuous monitoring stations operated by DEFRA as part of the Automatic Urban and Rural Network (AURN). An adjustment factor to determine an annual mean value was calculated in accordance with the methodology defined in LAQM.TG(16).

Details of the seasonal and bias adjustment calculations are provided in Appendix D.

The diffusion tubes were placed at approximately 2.5 m height in order to represent human exposure whilst being out of reach to reduce risk of theft or vandalism.

Quality Assurance and Quality Control

The analysis of the NO_2 diffusion tubes was carried out by Gradko International in accordance with documented in-house Laboratory Method GLM9 - QuAAtro Analyser using 20% TEA/Water. The laboratory takes part in the UKAS accreditation scheme.

In the summary of laboratory precision published by DEFRA Air Quality Helpdesk, tubes analysed by Gradko displayed 'Good' precision in 57 of 58 studies in 2019 and 30 out of 31 in 2019 for 20% TEA / Water (based on spreadsheet published September 2020).

Monitoring Period

Monitoring was carried out two periods of three-months running from 16th of December 2019 – 13th of March 2020 and from the 9th of July 2020 – 13th of October 2020 to make up the six-month survey; the two periods were due to the lock-down events in 2020 preventing the recording of valid data during this time.

The diffusion tubes were each exposed for one month, and therefore the whole period was split into six periods of one-month duration:

- 16/12/19 – 16/01/20
- 15/01/20 – 14/02/20
- 13/02/20 – 13/03/20
- 09/07/20 – 11/08/20
- 10/08/20 – 11/09/20
- 09/09/20 – 13/10/20

3.0   Results

The raw 6-month mean, bias-adjusted 6-month mean, and fully adjusted annual mean NO_2 concentrations are shown below in Table 1. The monthly diffusion tube results are presented in Appendix E, Table 5.

Data capture from the diffusion tubes was generally very high with only 13 sites achieving less than 100% data capture, including the St James' and Queensgate school sites where it was not possible to continue monitoring following the implementation of Covid-19 guidelines at the schools. All the other tubes without 100% data capture were only missing a single month of data. Results for tubes with less than 100% data capture were individually seasonally adjusted to compensate for the relevant missing periods.

A seasonal adjustment was applied using continuous monitoring data recorded for a 12-month calendar year in 2019 from local AURN sites. This process is presented in Appendix D.

The data was adjusted using 2019 as the reference year and 6 exceedances of the annual mean objective of 40 $\mu g/m^3$ were recorded; MO59, MO60, MO62 and STJ1, HG2, and N1. The site at MO59 recorded the highest concentration (49.5 $\mu g/m^3$)

Below in Table 1 is a comparison of the 2019 adjusted data to the monitoring results from the 2014 survey. Following the appropriate seasonal and bias adjustment steps, the greatest reduction in concentration was recorded at MO54 (-20.2 $\mu g/m^3$), and the greatest increase at STJ1 (+5.1 $\mu g/m^3$).

31 sites recorded higher annual mean values in 2019 compared to 2014, whereas 54 recorded lower values. The average concentrations recorded in 2019 were lower than in 2014, with a change of -2.4 $\mu g/m^3$. Three of these sites recorded concentrations exceeding the annual mean objective of 40 mg/m3 in both 2014 and 2019/2020; MO59, MO60 and STJ1.

The following sites were relocated in 2019 compared to 2014. The location and coordinates in 2014 and 2019 are provided in Appendix A, Table 3:
- MO1
- MO2
- MO13
- MO14
- MO15
- MO18
- MO27
- MO40
- MO57
- MO58
- STJ1
- STJ2
- QPS1
- A6-1
- A6-2
- HL1

The following sites were installed as new in 2019:
- QPS3
- D2
- A6-3

The 2009 ES did not present projections for individual monitoring locations. Overall it was predicted that concentrations would be lower in future years and that in the 2017 opening year (with scheme) the number of receptors exceeding the annual mean objective would reduce by 8%, whilst receptors in the lower 20-40 $\mu g/m^3$ bracket would increase by 9% compared to a without-scheme scenario.

A direct comparison of the concentrations is affected by background contributions and year-on-year changes to the vehicle fleet emissions profiles. However, the comparison of the monitoring in 2014 compared to 2019/2020 indicates trends were broadly consistent with the outcomes from the ES; the highest concentrations were generally lower, and locations with increased concentrations were mostly below the annual mean objective in both years.

The direct comparison of 2014 monitoring (pre-scheme) with the 2019/20 monitoring (post-scheme) indicate that 57.5% (42 sites) of locations recorded lower concentrations, although this may be partly related to year-on-year improvements. However, 37% (27 sites) of locations recorded decrease in excess of 2 $\mu g/m^3$, whilst only 13.7% (10 sites) of locations recorded increases greater than 2 $\mu g/m^3$, indicating overall beneficial effects between the two years broadly consistent with the ES.

Of the eight locations where concentrations were recorded in excess of the 40 $\mu g/m^3$ annual mean objective in 2014 (sites MO59, MO60, STJ1, HG1, HG2, HG3, HL2 and N1) these generally improved significantly, with only three sites on the A34 (MO59, MO60 and STJ1) recording increased concentrations between the two years. Therefore, with regard to the locations and magnitude of the data recorded in the two periods it is reasonable to attribute the overall trends, and some of the largest changes, to the scheme.

Table 1: NO₂ Diffusion Tube Monitoring Results, μg/m³

Site ID	Name	Annual Mean NO₂				Mon Data Capture in 2019/20
		ES Monitored, 2009	Monitored 2014	Monitored 2019/20	Change from 2014 – 2019/20 Monitoring	
MO1	Bleasdale Road N.	31.1	26.8	25.3	-1.4 *	100%
MO2	Bleasdale Road S.	33.5	24.5	26.0	1.5 *	100%
MO3	Cranham Road W.	34	29.9	27.8	-2.1	100%
MO4	Cranham Road E.	30.4	27.6	28.5	0.9	100%
MO5	Hucklow Drive	32.7	31.5	29.4	-2.1	83%
MO6	Hucklow Drive	32	26.2	27.1	1.0	100%
MO7	Selstead Road.	41.8	29.9	30.7	0.8	100%
MO8	Roxholme Walk.	23.3	20.3	23.6	3.3	100%
MO9	Woodhouse Road.	22	21.5	22.8	1.3	100%
MO10	Swithin Road.	26.4	25.1	25.9	0.7	100%
MO11	Wynfield Avenue.	**40.6**	29.0	21.1	-8.0	100%
MO12	Tedder Drive Transect S 9m.	**40.1**	27.0	22.9	-4.1	100%
MO13	Tedder Drive Transect S 17m	36.2	24.5	20.6	-3.8 *	100%
MO14	Tedder Drive Transect S 32m	25.1	23.0	14.5	-8.5 *	100%
MO15	Tedder Drive Transect S 41m	24.3	22.0	14.0	-8.0 *	100%
MO16	Emerald Road.	24	22.1	21.0	-1.1	100%
MO17	Cunningham Drive.	34.4	23.0	22.2	-0.8	100%
MO18	Styal Road N.	38.7	26.0	22.8	-3.2 *	100%
MO19	Styal Road S.	35.6	23.1	20.7	-2.5	100%
MO20	Manchester Road (steep hill).	44.9	30.7	28.3	-2.4	100%
MO21	Handforth Road S.	31.8	19.4	19.9	0.4	100%
MO22	Handforth Road S.	30	19.4	18.3	-1.0	100%
MO24	Wilmslow Road/Spath Lane.	31.9	20.8	21.3	0.5	100%
MO25	B5358/A555 roundabout.	34.2	19.9	21.6	1.7	100%
MO26	B5358 S of roundabout.	37.5	25.2	25.3	0.1	100%
MO27	Pickmere Road.	18.9	17.2	17.1	0.0 *	100%
MO28	Longsight Lane.	25.2	22.0	24.8	2.7	100%
MO29	Ack Lane West - E.	30.8	20.8	19.3	-1.5	100%
MO30	Ack Lane West - W.	28.5	20.4	18.4	-2.0	100%
MO31	Spath Lane East.	20.4	17.9	20.2	2.3	100%
MO32	Hall Moss Lane Transect N 21m	342	21.0	22.3	1.3	100%
MO33	Hall Moss Lane Transect N. 36m	33.6	22.5	22.2	-0.3	100%

Site ID	Name	Annual Mean NO$_2$				Mon Data Capture in 2019/20
		ES Monitored, 2009	Monitored 2014	Monitored 2019/20	Change from 2014 – 2019/20 Monitoring	
MO34	Hall Moss Lane Transect N. 68m	35.5	19.2	18.9	-0.3	100%
MO35	Hall Moss Lane Transect N. 105m	33.1	22.3	18.5	-3.8	100%
MO38	Hall Moss Lane Transect S. 57m	29.3	18.0	15.2	-2.8	100%
MO39	Hall Moss Lane Transect S. 75m	28.2	16.7	14.0	-2.7	100%
MO40	Woodford Road S of roundabout N.	**43.2**	30.2	22.4	-7.8 *	100%
MO41	Woodford Road S of roundabout S.	**49.2**	28.9	20.5	-8.4	100%
MO42	Woodford Road N of roundabout N.	**40.9**	27.7	29.8	2.1	100%
MO43	Woodford Road N of roundabout S.	**44**	28.5	26.1	-2.4	100%
MO44	Bramhall Lane South S.	**44.2**	32.8	31.6	-1.2	100%
MO45	Bramhall Lane South N.	35.9	24.9	19.9	-5.0	100%
MO46	Bramhall Lane South N.	39.8	25.9	25.4	-0.4	100%
MO47	Bramhall Lane South N.	**48.7**	32.3	27.6	-4.7	100%
MO48	Albany Road (school parking nearby).	17.3	14.3	16.7	2.4	100%
MO49	Meadway Urban BG.	19.5	14.9	15.2	0.3	100%
MO50	Longnor Road Urban BG.	15.7	13.6	14.5	1.0	100%
MO51	Macclesfield Road N.	**43.6**	29.0	30.1	1.0	83%
MO52	Macclesfield Road S.	35.7	23.1	27.4	4.2	83%
MO53	Ashbourne Road.	15.3	13.0	15.4	2.3	83%
MO54	A6 Buxton Road N.	**51.7**	35.9	15.8	-20.2	83%
MO55	A6 Buxton Road S.	**50.1**	31.0	14.6	-16.4	100%
MO56	Buxton Road, High Lane E.	**50.4**	34.1	30.5	-3.6	100%
MO57	Buxton Road, High Lane W.	**43.8**	31.4	32.5	1.0 *	83%
MO58	Torkington Road.	**43.8**	27.4	29.1	1.7 *	100%
MO59	A34 SB N.	**73.4**	**47.1**	**49.5**	2.5	100%
MO60	A34 SB S.	**69.7**	**41.5**	**42.9**	1.3	100%
MO61	A34 NB S.	**47.7**	31.0	28.2	-2.8	100%
MO62	A34 NB Centre near Gatley Road jct.	**72.4**	**50.6**	**43.3**	-7.3	83%
MO63	A34 NB near M60 jct.	**43.5**	35.3	32.7	-2.5	100%
MO64	Acre Lane E.	30.6	21.4	19.6	-1.8	100%
MO65	Acre Lane W.	38.7	25.0	22.8	-2.3	100%
MO66	A523/Clifford Road. (Poynton)	34.8	20.9	22.6	1.8	100%
MO67	A6 London Road. (Hazel Grove)	38.3	24.9	20.3	-4.6	100%
STJ1	A34	-	**41.3**	**46.4**	5.1 *	100%
STJ2	Stanley Road	-	36.1	35.2	-0.9 *	100%

Site ID	Name	Annual Mean NO_2				Mon Data Capture in 2019/20
		ES Monitored, 2009	Monitored 2014	Monitored 2019/20	Change from 2014 – 2019/20 Monitoring	
STJ3	St James' School – No.3	-	22.8	21.7	-1.1	100%
STJ4	St James' School – No.4	-	22.0	22.4	0.4	83%
STJ5	St James' School – No.5	-	23.6	24.5	1.0	67%
STJ6	St James' School – No.6	-	19.9	14.5	-5.3	67%
STJ7	St James' School – No.7	-	22.9	22.8	0.0	67%
QPS1	Queensgate Primary School – No.1	-	14.1	16.3	2.2 *	100%
QPS2	Queensgate Primary School – No.2	-	13.4	13.7	0.3	50%
QPS3	Queensgate Primary School – No.3	-	-	15.6	n/a	33%
P1	Glastonbury Drive, Poynton	-	14.2	13.5	-0.7	100%
P2	Residential Location on Chester Road (A5149)	-	34.0	25.4	-8.6	100%
P3	Residential Location on London Road (A523)	-	32.3	26.6	-5.7	100%
HG1	Hazel Grove (A6 / A523 junction)	-	**56.5**	**42.1**	-14.4	100%
HG2	Hazel Grove (A6 / A523 junction)	-	**44.2**	32.1	-12.1	100%
HG3	Hazel Grove (A6 / A523 junction)	-	**48.0**	38.4	-9.6	100%
A6-1	Greater Manchester AQMA A6 Eastern End	-	32.7	29.0	-3.7 *	100%
A6-2	Greater Manchester AQMA A6 Eastern End	-	31.9	23.4	-8.5 *	100%
A6-3	Greater Manchester AQMA A6 Eastern End	-	-	26.3	n/a	100%
HL1	High Lane (A6)	-	**49.9**	39.1	-10.9 *	100%
HL2	High Lane (A6)	-	21.7	17.6	-4.2	100%
D1	Disley (A6)	-	33.8	26.2	-7.6	100%
D2	Disley (A6)	-	-	32.7	n/a	100%
N1	Newtown (A6)	-	**48.7**	**40.3**	-8.5	100%

Note: Bold text denotes values greater than the UK annual mean objective of 40 µg/m³.
         * denotes site relocated in 2019 compared to 2014.
         n/a denotes comparison unavailable for new 2019 locations

Appendix A: Monitoring Locations

Table 2: Diffusion Tube NO₂ Monitoring Locations

ID	Name	Description	Coordinates (m)	
			X	Y
MO3	Cranham Road W.	Outside no. 34. LP 8	381379	386795
MO4	Cranham Road E.	Outside no. 40. LP 9	381402	386773
MO5	Hucklow Drive	LP4	381279	386860
MO6	Hucklow Drive	LP5	381259	386875
MO7	Selstead Road.	Outside no. 77. LP 11	381996	386158
MO8	Roxholme Walk.	Outside no. 6. LP 2	382385	385836
MO9	Woodhouse Road.	LP7	382504	385739
MO10	Swithin Road.	Outside no.45, LP9	383180	385425
MO11	Wynfield Avenue.	Telegraph pole outside no. 38	383632	385355
MO12	Tedder Drive Transect S 9m.	Sign post	383877	385308
MO16	Emerald Road.	LP 3 outside no. 5	383982	385422
MO17	Cunningham Drive.	SP outside electricity substation	384016	385629
MO19	Styal Road S.	LP 47	383836	384604
MO20	Manchester Road (steep hill).	LP 16	384890	381657
MO21	Handforth Road S.	LP 17 outside Dalebrook	386462	382413
MO22	Handforth Road S.	Post outside no. 1 Budworth Walk	386465	382384
MO24	Wilmslow Road/Spath Lane.	LP 17 opposite vets	385738	383951
MO25	B5358/A555 roundabout.	Cyclists Dismount sign	385545	384363
MO26	B5358 S of roundabout.	LP 26 outside no. 199	385586	384277
MO28	Longsight Lane.	Telegraph pole on track	386900	384355
MO29	Ack Lane West - E.	LP 15 outside no. 74	388093	385263
MO30	Ack Lane West - W.	LP 21 outside no. 98	388264	385174
MO31	Spath Lane East.	Caravan park LP	387398	384087
MO32	Hall Moss Lane Transect N 21m	Fence post	388036	383895
MO33	Hall Moss Lane Transect N. 36m	LP 6 outside no. 27	388024	383910
MO34	Hall Moss Lane Transect N. 68m	LP 5 opp. No. 23	387997	383941
MO35	Hall Moss Lane Transect N. 105m	LP 4 outside no. 15	387989	383979
MO38	Hall Moss Lane Transect S. 57m	LP 9 opposite Hall Moss Farm	388052	383818
MO39	Hall Moss Lane Transect S. 75m	LP 10	388063	383800
MO41	Woodford Road S of roundabout S.	LP 36 outside no. 171	389344	383517
MO42	Woodford Road N of roundabout N.	LP 53 outside no. 127	389197	383808
MO44	Bramhall Lane South S.	LP88 outside no94	389282	385021
MO45	Bramhall Lane South N.	TP opp. Penn House Close	389305	385513
MO46	Bramhall Lane South N.	LP12 outside no. 318	389538	387049
MO47	Bramhall Lane South N.	LP7 outside no336	389659	387141
MO48	Albany Road (school parking nearby).	LP 17 outside no. 80	389409	383770
MO49	Meadway Urban BG.	LP2 outside no. 10	390625	384021
MO50	Longnor Road Urban BG.	LP 2 outside no. 5	392114	385510
MO51	Macclesfield Road N.	LP 26 outside no. 63	392563	385802
MO52	Macclesfield Road S.	LP 38 outside no. 121	392525	385474
MO53	Ashbourne Road.	LP10 outside no. 44	392918	385497
MO54	A6 Buxton Road N.	LP 41 outside no. 170	393261	385784
MO55	A6 Buxton Road S.	LP 51 outside no. 211	393542	385665
MO56	Buxton Road, High Lane E.	Telegraph pole outside no. 167	395744	385217
MO59	A34 SB N.	LP 48 outside no. 177	385044	388577
MO60	A34 SB S.	LP outside cricket club	385074	388204
MO61	A34 NB S.	Solar panel outside no. 234	385075	388081

ID	Name	Description	Coordinates (m)	
			X	Y
MO62	A34 NB Centre near Gatley Road jct.	LP 59 outside no. 200	385017	388409
MO63	A34 NB near M60 jct.	LP 2 outside no. 182	385007	388583
MO64	Acre Lane E.	LP 34 outside no. 143	388570	384467
MO65	Acre Lane W.	LP 6 outside no. 20	387788	384511
MO66	A523/Clifford Road. (Poynton)	Continuous Monitoring site	391715	383063
MO67	A6 London Road. (Hazel Grove)	Continuous Monitoring site	391480	387637
STJ3	St James' School – No.3	Bus stop sign post	386873	384850
STJ4	St James' School – No.4	LP	386907	384868
STJ5	St James' School – No.5	LP	386833	384917
STJ6	St James' School – No.6	LP	386897	384925
STJ7	St James' School – No.7	Flood light facing playing pitches	386850	385053
QPS2	Queensgate Primary School – No.2	Heating pipe on north side	389371	383841
P1	Glastonbury Drive, Poynton	LP19	391686	384226
P2	Residential Location on Chester Road (A5149)	Opp no24 LP7	391811	383624
P3	Residential Location on London Road (A523)	LP outside hairdresser	391976	383596
HG1	Hazel Grove (A6 / A523 junction) – No. 1	outside no54, LP54	392518	386547
HG2	Hazel Grove (A6 / A523 junction) – No. 2	Outside no8, LP2	392605	386470
HG3	Hazel Grove (A6 / A523 junction) – No. 3	Outside Rising Sun PH, LP14	392544	386474
HL2	High Lane (A6) – No. 2	On Give Way sign	396391	384741
D1	Disley (A6) – No.1	LP Outside Euronics	397805	384812
N1	Newtown (A6)	LP119 outside bike shop	399344	384554

Note: P4 was excluded from the 2019/20 survey, as discussed in Section 2.

Table 3: Diffusion Tube NO$_2$ Monitoring Relocated in 2019

ID	Name	Description, 2019	2014 Coordinates (m)		2019 Coordinates (m)	
			X	Y	X	Y
MO1	Bleasdale Road N.	Lp opposite number 44	381258	386656	381264	386687
MO2	Bleasdale Road S.	Lp10	381257	386591	381264	386653
MO13	Tedder Drive Transect S 17m	Tedder Drive, 2nd on the left	383871	385302	383873	385287
MO14	Tedder Drive Transect S 32m	Tedder Drive, 3rd on the right	383867	385287	383853	385275
MO15	Tedder Drive Transect S 41m	Tedder Drive, 4th on the right	383857	385279	383853	385242
MO18	Styal Road N.	Lp88, outside number 2	383855	384914	383859	384942
MO27	Pickmere Road.	Tarvin way, outside number 2	385764	384416	385761	384424
MO40	Woodford Road S of roundabout N.	Lp399	389265	383636	389273	383647
MO43	Woodford Road N of roundabout S.	Lp333	389233	383734	389233	383714
MO57	Buxton Road, High Lane W.	Lp106	394829	385438	394834	385451
MO58	Torkington Road.	Lp13	392658	386877	392653	386867
STJ1	A34	Lp194	386856	384743	386847	384743
STJ2	Stanley Road	Lp198	386947	384703	386946	384698
QPS1	Queensgate Primary School – No.1	Fred Perry Way Sign	389394	383813	389400	383847
A6-1	Greater Manchester AQMA A6 Eastern End – No. 1	Lp88	394283	385619	394288	385618
A6-2	Greater Manchester AQMA A6 Eastern End – No. 2	Lp102	394758	385460	394694	385484
HL1	High Lane (A6)	Lp129	395415	385263	395413	385272

Table 4: New Diffusion Tube NO₂ Monitoring in 2019

ID	Name	Description	Coordinates (m)	
			X	Y
QPS3	Queensgate Primary School – No.3	Left side of the school	389384	383820
A6-3	Greater Manchester AQMA A6 Eastern End – No. 3	Lp104, "Welcome to High Lane Village"	394765	385463
D2	Disley (A6) – No.2	Lp outside House 97	397924	384749

Appendix B: Photographs of New or Relocated Monitoring Locations

Moved Locations

Photograph 1: MO1

Photograph 3: MO13

Photograph 2: MO2

Photograph 4: MO14

Photograph 5: MO15

Photograph 7: MO27

Photograph 6: MO18

Photograph 8: MO40

Photograph 9: MO57

Photograph 11: STJ1

Photograph 10: MO58

Photograph 12: STJ2

Photograph 13: QPS1

Photograph 15: A6-2

Photograph 14: A6-1

Photograph 16: HL1

New Locations

Photograph 17: QPS3

Photograph 19: D2

Photograph 18: A6-3

Appendix C: Co-location Study to Derive Bias Adjustment Factor

A co-location study was undertaken as part of the study using the continuous monitoring station operated by Stockport Metropolitan Borough Council on the A6 London Road, near Stepping Hill hospital. At the time of writing, this data was ratified up to 16th of July 2020.

The results of the co-located study and derived local bias adjustment factors are provided in Table 3 using the Precision Accuracy Bias spreadsheet (v4 dated February 2011).

The precision and data capture were all considered to be good.

The bias adjustment factor from the study was calculated to be 0.82.

Table 5: NO$_2$ Diffusion Tube Bias Adjustment Factor

Checking Precision and Accuracy of Triplicate Tubes — AEA Energy & Environment (From the AEA group)

Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 μgm^{-3}	Tube 2 μgm^{-3}	Tube 3 μgm^{-3}	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean	Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
1	17/12/2019	15/01/2020	18.5	18.4		18	0.1	0	0.7	19.0724	99.28264	Good	Good
2	15/01/2020	13/02/2020	22.5	26.2		24	2.6	11	23.5	21.7916	98.708752	Good	Good
3	13/02/2020	12/03/2020	19.8	19.4		20	0.3	1	2.6	14.3009	80.089153	Good	Good
4	09/07/2020	11/08/2020	12.9	13.5		13	0.4	3	3.8	11.082	78.688525	Good	Good
5	11/08/2020	10/09/2020	16.5	19.5		18	2.2	12	19.6	12	99.859353	Good	Good
6	10/09/2020	13/10/2020	23.6	22.0		23	1.1	5	10.1	17	91.172762	Good	Good
7													
8													
9													
10													
11													
12													
13													

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

Overall survey --> Good precision | Good Overall DC

Site Name/ ID:

Precision 6 out of 6 periods have a CV smaller than 20% (Check average CV & DC from Accuracy calculations)

Accuracy (with 95% confidence interval)
without periods with CV larger than 20%
Bias calculated using 6 periods of data
Bias factor A   0.82 (0.71 - 0.98)
Bias B   22%   (2% - 41%)
Diffusion Tubes Mean: 19 μgm^{-3}
Mean CV (Precision):   5
Automatic Mean: 16 μgm^{-3}
Data Capture for periods used: 91%
Adjusted Tubes Mean: 16 (14 - 19) μgm^{-3}

Accuracy (with 95% confidence interval)
WITH ALL DATA
Bias calculated using 6 periods of data
Bias factor A   0.82 (0.71 - 0.98)
Bias B   22%   (2% - 41%)
Diffusion Tubes Mean: 19 μgm^{-3}
Mean CV (Precision):   5
Automatic Mean: 16 μgm^{-3}
Data Capture for periods used: 91%
Adjusted Tubes Mean: 16 (14 - 19) μgm^{-3}

Jaume Targa, for AEA
Version 04 - February 2011

If you have any enquiries about this spreadsheet please contact the LAQM Helpdesk at: LAQMHelpdesk@uk.bureauveritas.com

Appendix D: Seasonal Adjustment

Short-term to Long-term Data adjustment
The diffusion tube monitoring sites were operational for 6-months. Therefore, these data were seasonally adjusted (annualised) by comparison with four regional automatic monitoring stations operated as part of the Defra Automatic Urban and Rural Network (AURN) at Glazebury, Ladybower, Stoke-on-Trent and Wigan.

As mentioned previously, the data was annualised by comparison to a 2019 reference year to allow the data to be scaled up to a year with more representative emissions.

The adjustment factor for sites with 100% data capture was 1.28, whilst the factor for sites with incomplete data ranged from 1.07 to 1.38 depending on the months of data lost. Details of the adjustments are shown in Table 4.

Table 6: Seasonal Adjustment of NO₂ Diffusion Tubes and Automatic Monitors 2019

ID	Name	Monthly Data Capture *	AURN Site				Average Ratio; Annual vs Period
			Glazebury	Ladybower	Stoke-on-Trent	Wigan	
			2019 Annual Mean µg/m³				
			14.6	6.1	24.0	19.4	-
			Period Mean, µg/m³				
	All Diffusion Tube Sites with 100% Data Capture		11.3	4.3	19.5	16.4	1.29
MO5	Hucklow Drive	83.3%	10.2	4.1	18.1	15.4	1.43
MO51	Macclesfield Road N.	83.3%	10.5	4.1	18.4	14.5	1.39
MO57	Buxton Road, High Lane W.	83.3%	10.5	4.1	18.4	14.5	1.39
QPS3	Queensgate Primary School – No.3	33.3%	14.3	4.9	23.5	19.4	1.02
MO62	A34 NB Centre near Gatley Road jct.	83.3%	11.2	4.4	19.5	16.3	1.31
MO52	Macclesfield Road S.	83.3%	12.4	4.4	21.0	18.1	1.17
MO54	A6 Buxton Road N.	83.3%	12.4	4.4	21.0	18.1	1.17
QPS2	Queensgate Primary School – No.2	50.0%	14.6	5.0	24.3	21.7	1.00
MO53	Ashbourne Road.	83.3%	12.0	4.5	20.5	17.5	1.22
STJ5	St James' School – No.5	66.7%	12.3	4.8	21.1	18.2	1.19
STJ6	St James' School – No.6	66.7%	12.3	4.8	21.1	18.2	1.19
STJ7	St James' School – No.7	66.7%	12.3	4.8	21.1	18.2	1.19
STJ4	St James' School – No.4	83.3%	11.4	4.5	19.8	16.7	1.28

Note: AURN data ratified up to 17th August 2020.

* Data capture based on 6-month monitoring period.

Data capture for AURN sites >95% in 2019.

Appendix E: Raw Monitoring Data

The raw data are presented below. As monitoring was undertaken in duplicate, as explained above, each number below is an average of two values. Where no number is shown this indicates that both tubes were lost during the course of the month.

Table 7: Raw Unadjusted Diffusion Tube NO2 Monitoring Data, µg/m³

ID	Dec-Jan 16/12/2019 to 16/01/2020	Jan-Feb 15/01/2020 to 14/02/2020	Feb-Mar 13/02/2020 to 13/03/2020	Jul-Aug 09/07/2020 to 11/08/2020	Aug-Sep 10/08/2020 to 11/09/2020	Sep-Oct 09/09/2020 to 13/10/2020	6-Month Raw Average
MO1	24.9	34.4	28.1	16.5	17.7	23.4	24.2
MO2	28.9	33.8	28.5	15.9	18.1	23.5	24.8
MO3	26.6	36.2	30.0	19.9	21.0	25.8	26.6
MO4	28.6	36.1	32.7	17.3	18.8	29.9	27.2
MO5	35.3		31.1	16.4	22.4	25.0	26.0
MO6	31.1	31.9	29.5	16.2	21.9	24.7	25.9
MO7	31.8	38.8	39.7	17.0	21.7	26.8	29.3
MO8	25.6	33.6	26.0	12.1	16.4	21.3	22.5
MO9	24.8	31.1	28.1	12.6	14.2	20.0	21.8
MO10	25.1	35.0	33.6	14.1	17.6	22.8	24.7
MO11	22.5	30.3	24.3	12.2	13.9	17.3	20.1
MO12	25.4	35.6	26.4	11.6	13.7	18.1	21.8
MO13	24.1	29.1	22.8	11.1	13.7	17.4	19.7
MO14	21.4	18.8	6.0	9.6	12.1	14.9	13.8
MO15	15.3	10.8	15.6	10.1	12.7	15.9	13.4
MO16	21.8	29.7	23.4	11.3	14.9	19.0	20.0
MO17	18.1	32.7	28.2	12.4	15.4	20.3	21.2
MO18	24.7	33.0	25.5	12.3	16.3	18.4	21.7
MO19	20.6	30.7	20.2	13.3	14.7	18.9	19.7
MO20	27.7	32.8	28.2	20.1	24.9	28.4	27.0
MO21	19.1	27.7	20.2	13.1	14.9	18.5	18.9
MO22	18.5	25.0	18.2	11.2	12.9	19.1	17.5
MO24	23.1	30.2	22.3	13.0	14.7	18.7	20.3
MO25	23.0	26.4	21.1	15.1	17.3	21.0	20.7
MO26	25.0	31.8	23.9	16.8	21.0	26.5	24.2
MO27	19.3	23.2	17.4	10.3	11.4	16.5	16.3
MO28	24.0	33.9	30.1	17.8	16.7	19.3	23.6
MO29	21.0	28.2	20.0	10.9	11.5	18.9	18.4
MO30	19.2	26.9	18.3	10.1	13.3	17.8	17.6

ID	Dec-Jan 16/12/2019 to 16/01/2020	Jan-Feb 15/01/2020 to 14/02/2020	Feb-Mar 13/02/2020 to 13/03/2020	Jul-Aug 09/07/2020 to 11/08/2020	Aug-Sep 10/08/2020 to 11/09/2020	Sep-Oct 09/09/2020 to 13/10/2020	6-Month Raw Average
MO31	20.3	27.8	21.7	12.1	14.9	19.0	19.3
MO32	21.5	26.2	25.2	14.2	17.2	23.3	21.3
MO33	22.7	30.1	24.2	13.5	16.3	20.2	21.2
MO34	19.8	26.1	19.1	11.2	14.2	17.9	18.1
MO35	13.0	27.6	19.4	12.4	14.2	19.2	17.6
MO38	15.2	20.1	14.1	9.4	11.7	16.5	14.5
MO39	11.8	19.1	12.5	12.3	10.0	14.3	13.3
MO40	22.9	25.7	25.7	16.2	16.5	21.3	21.4
MO41	19.7	26.4	19.1	15.3	16.9	20.1	19.6
MO42	28.6	35.6	29.2	21.0	24.3	31.7	28.4
MO43	22.5	35.9	27.7	19.3	19.5	24.7	24.9
MO44	27.0	37.1	31.1	23.4	29.1	33.4	30.2
MO45	5.8	30.5	23.5	13.9	17.5	22.8	19.0
MO46	20.9	35.5	28.9	11.6	21.8	27.0	24.3
MO47	27.3	38.6	32.8	8.8	24.6	25.9	26.3
MO48	17.2	23.0	17.4	10.1	11.5	16.4	15.9
MO49	16.2	21.9	15.1	9.1	10.5	14.3	14.5
MO50	14.8	21.8	13.7	8.4	10.3	14.2	13.9
MO51		37.3	28.9	18.7	23.7	24.4	26.6
MO52	27.5	37.0	30.9		20.5	23.9	28.0
MO53	15.2	23.2	14.7	10.1		14.3	15.5
MO54	16.1	20.5	14.8		11.8	17.4	16.1
MO55	13.0	21.2	13.1	9.4	11.4	15.5	13.9
MO56	25.9	38.5	32.0	24.7	23.2	30.1	29.1
MO57		33.4	24.2	23.2	29.0	33.8	28.7
MO58	24.2	36.3	28.8	22.3	25.4	29.4	27.7
MO59	48.3	56.2	55.0	36.5	41.1	46.5	47.3
MO60	40.8	51.5	46.9	33.9	30.8	41.6	40.9
MO61	31.5	32.7	27.6	17.6	25.0	26.9	26.9
MO62	50.4	44.3		27.8	41.5	42.2	41.2
MO63	36.5	37.4	28.9	20.8	31.9	32.1	31.2
MO64	21.4	27.8	20.2	11.2	12.9	18.4	18.7
MO65	22.5	32.2	25.0	14.7	15.4	20.5	21.7
MO66	22.6	28.8	23.1	14.6	19.1	21.5	21.6
MO67	18.5	24.4	19.6	13.2	18.0	22.8	19.4

ID	Dec-Jan 16/12/2019 to 16/01/2020	Jan-Feb 15/01/2020 to 14/02/2020	Feb-Mar 13/02/2020 to 13/03/2020	Jul-Aug 09/07/2020 to 11/08/2020	Aug-Sep 10/08/2020 to 11/09/2020	Sep-Oct 09/09/2020 to 13/10/2020	6-Month Raw Average
STJ1	41.3	58.7	52.3	33.1	36.6	43.6	44.3
STJ2	33.5	45.4	37.8	24.2	27.1	33.7	33.6
STJ3	26.6	33.0	27.8	11.3	4.0	21.4	20.7
STJ4	26.8	35.7	17.5	13.8	15.1		21.8
STJ5	27.1	33.4	27.6	14.7			25.7
STJ6	15.1	18.8	15.0	12.0			15.2
STJ7	25.4	33.0	23.5	13.8			23.9
QPS1	15.8	23.5	17.7	9.5	10.9	16.0	15.6
QPS2	14.9	20.2	13.8				16.3
QPS3		20.6	15.0				17.8
P1	16.7	21.2	13.7	6.6	8.1	11.0	12.9
P2	23.0	32.1	24.6	19.0	22.4	24.2	24.2
P3	25.4	33.8	26.0	18.9	22.7	25.6	25.4
HG1	37.6	43.8	38.8	32.5	41.8	46.7	40.2
HG2	29.3	40.7	32.7	23.3	25.7	32.0	30.6
HG3	35.2	45.6	37.3	27.6	35.7	38.5	36.7
A6-1	25.5	40.6	28.1	20.4	23.8	27.9	27.7
A6-2	22.3	32.6	24.1	16.0	17.2	21.7	22.3
A6-3	21.5	29.4	25.2	21.1	24.0	29.7	25.1
HL1	32.1	46.0	39.6	28.2	38.7	39.1	37.3
HL2	16.5	22.0	13.6	12.9	16.5	19.1	16.8
D1	24.3	29.6	23.8	19.9	24.2	28.3	25.0
D2	28.7	35.1	32.9	29.2	29.2	32.3	31.2
N1	32.9	43.0	42.4	35.8	36.4	40.0	38.4

Appendix F: Monitoring Location Plots
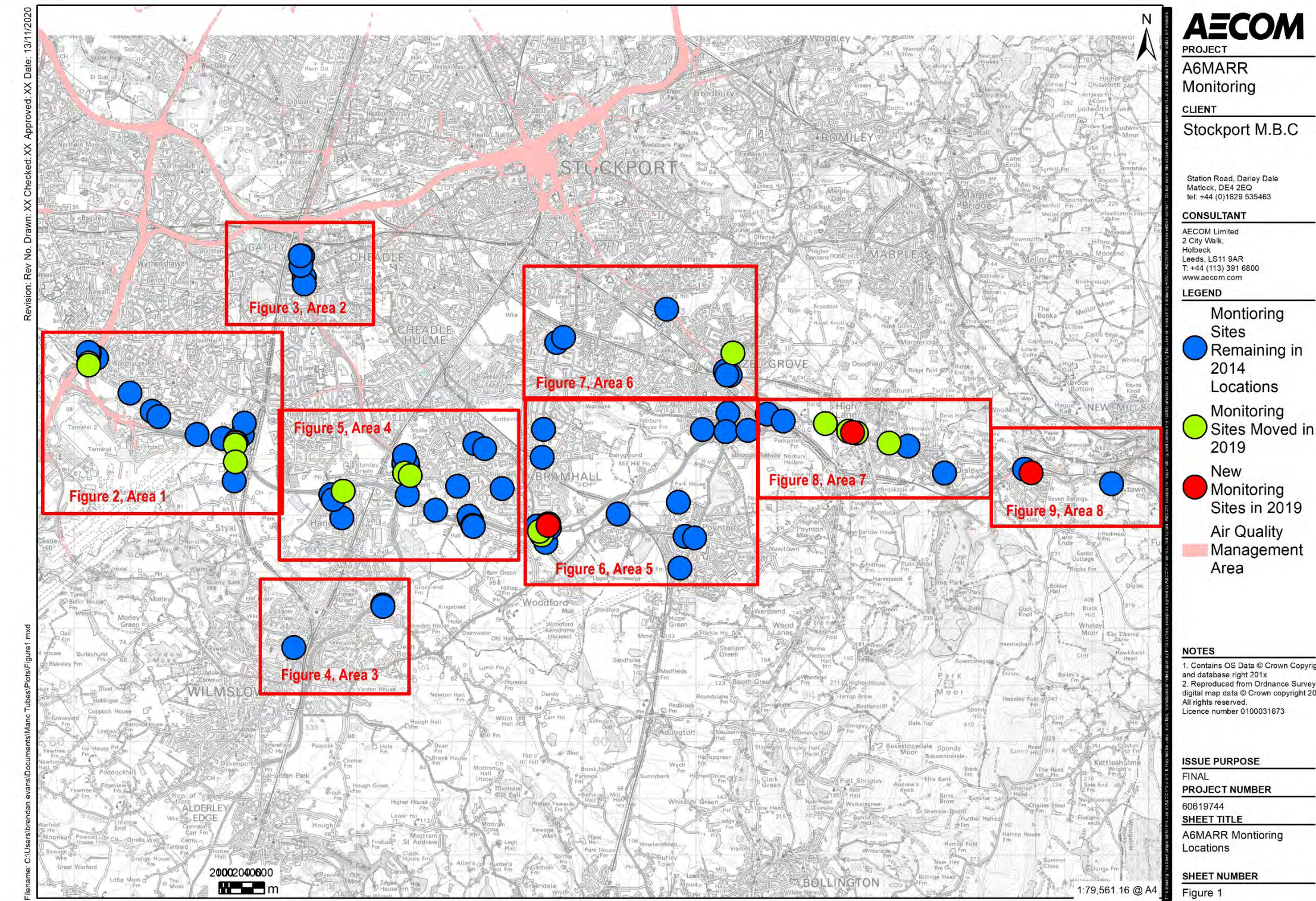
Figure 1: Air Quality Monitoring, Plot Area Key

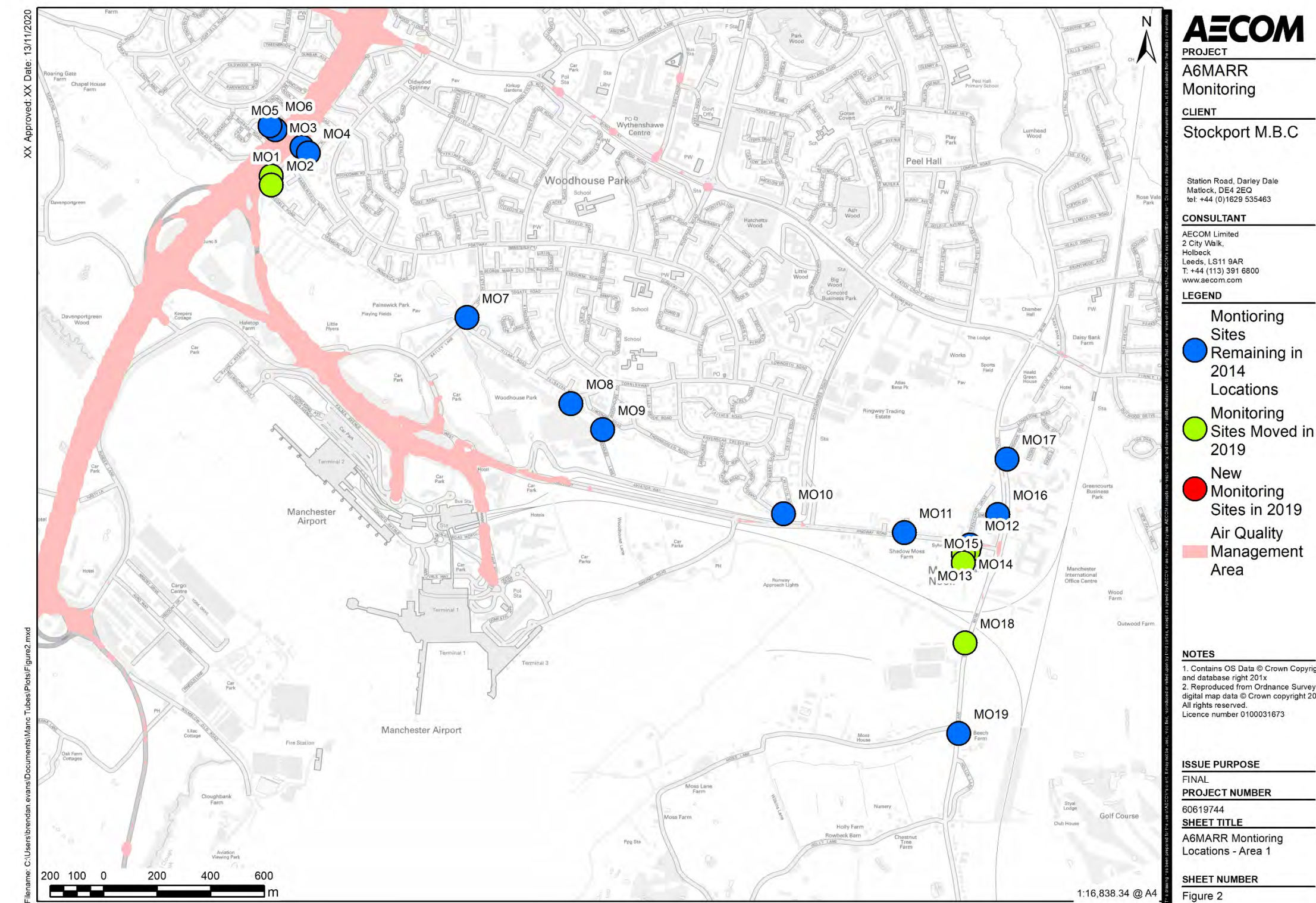**Figure 2: Air Quality Monitoring, Area 1**

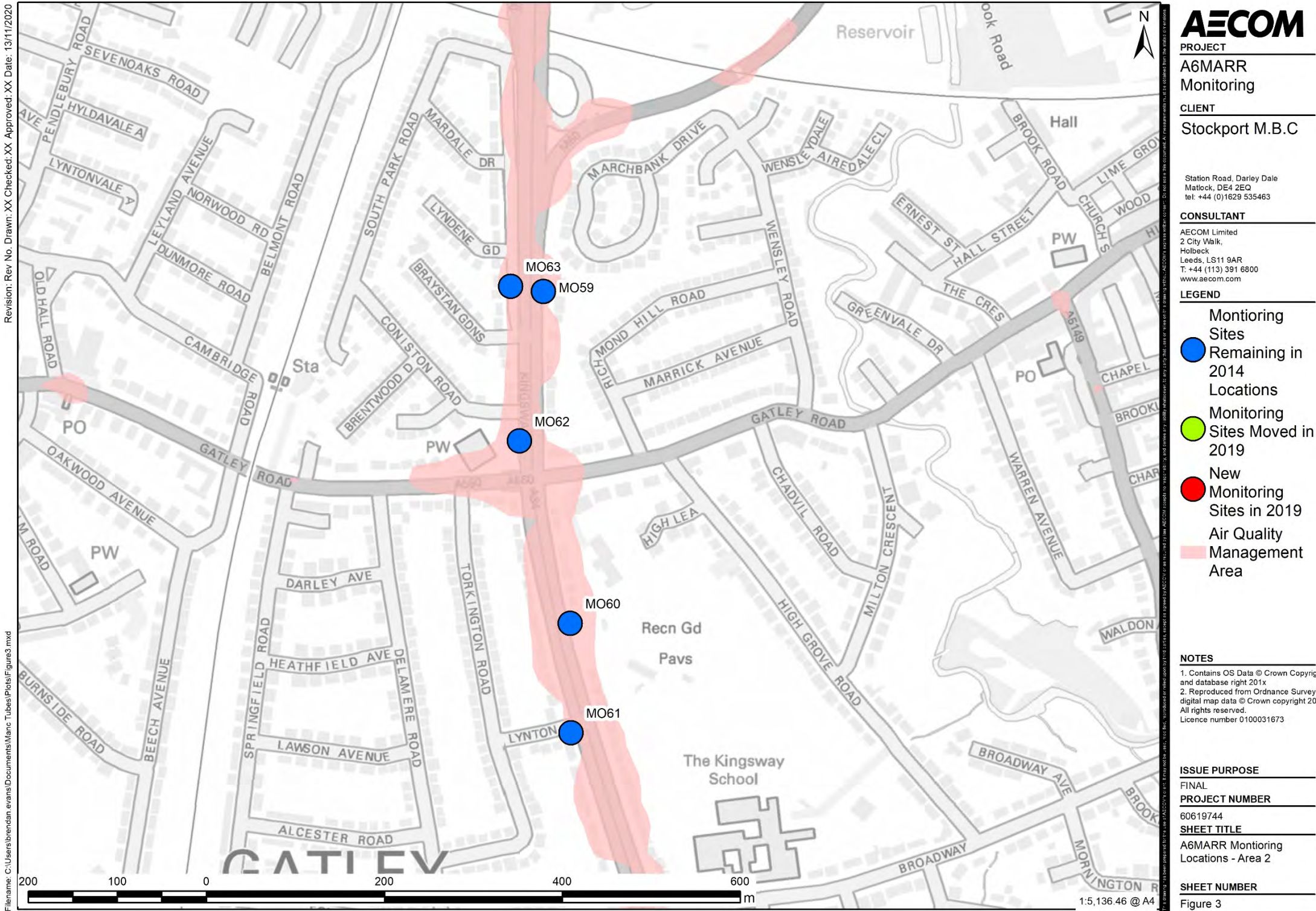**Figure 3: Air Quality Monitoring, Area 2**

Figure 4: Air Quality Monitoring, Area 3

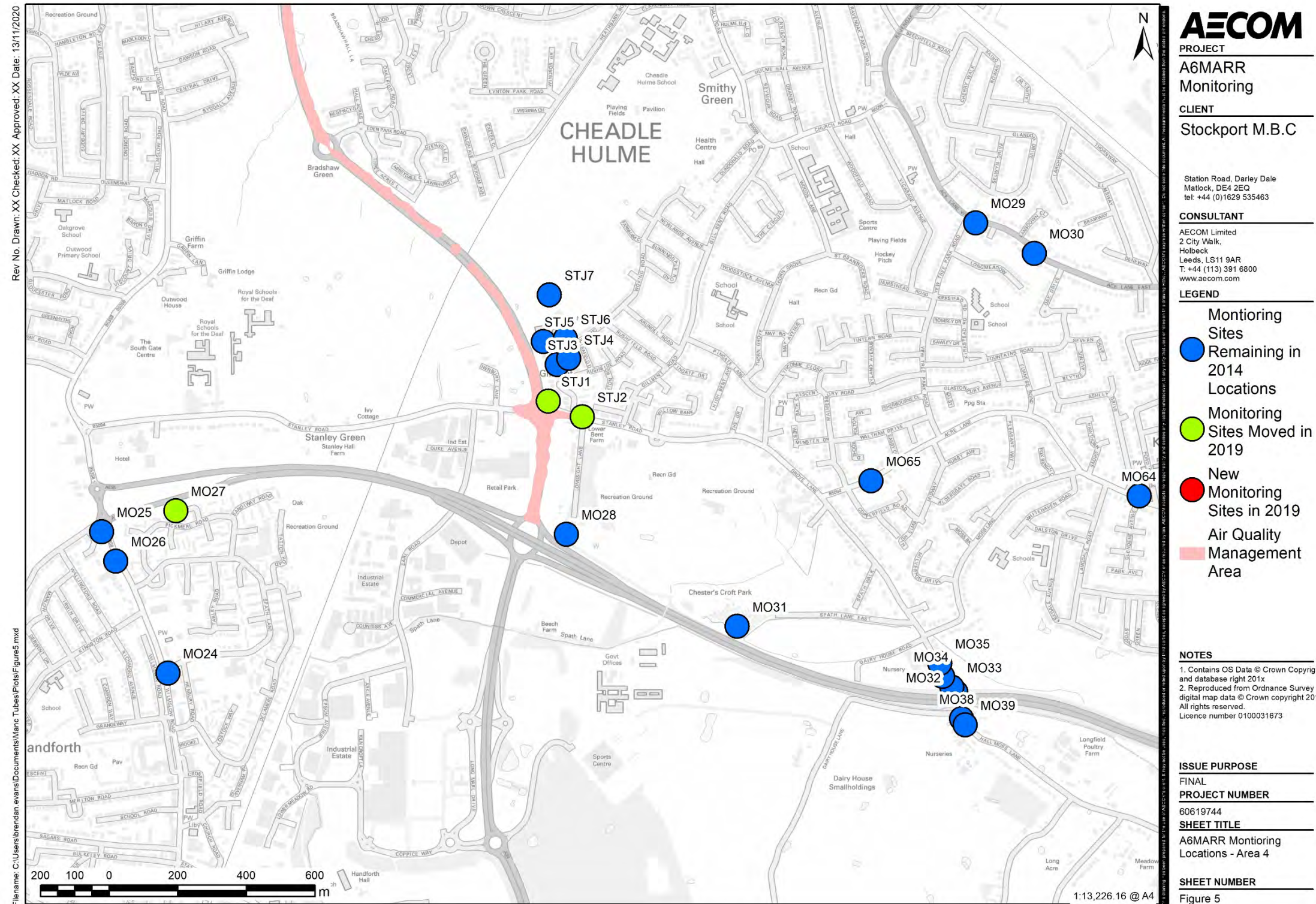**Figure 5: Air Quality Monitoring, Area 4**

Figure 6: Air Quality Monitoring, Area 5

Figure 7: Air Quality Monitoring, Area 6

Figure 8: Air Quality Monitoring, Area 7

Figure 9: Air Quality Monitoring, Area 8