

Monitoring and analysis of nitrogen dioxide and ammonia levels in Ashdown Forest SAC

Annual Monitoring Report (June 2022 - May 2023)

Wealden District Council

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1. Introduction

Overview

In 2022 AECOM was commissioned to set up a monitoring network to measure nitrogen dioxide (NO₂) and ammonia (NH₃) concentrations at two transects and various monitoring locations in the area of the Ashdown Forest Special Area of Conservation (SAC) / Site of Special Scientific Interest (SSSI). The monitoring period is for three years, and this report presents the first year of monitoring results from 6 June 2022 until 2 May 2023.

The monitoring survey is based on the June 2020 report, '*Recommendations for Post-2020 Air Quality Monitoring in Ashdown Forest*', prepared by Air Quality Consultants and AECOM for the Ashdown Forest Working Group (Ref 1). The report and recommendations were made following an extensive monitoring campaign across Ashdown Forest SAC between August 2014 and March 2020. The report outlined how the monitoring network could be restructured to reduce costs while still allowing useful information regarding air quality conditions in Ashdown Forest to be collected. The current monitoring network reflects that presented in the report.

As for the previous monitoring campaign, Local Site Operator (LSO) duties are performed by WeCare4Air, but managed by AECOM. The monitoring network comprises of:

- Monitoring of NO₂ concentrations using a network of diffusion tubes (26 sites, all in triplicate); and
- Monitoring of NH₃ concentrations using a network of Adapted Low-cost Passive High Absorption (ALPHA®) samplers (13 sites, all in triplicate as standard for ALPHA samplers).

Tubes and samplers are either attached to street furniture (lamp posts etc.) or to wooden posts. The sites across Ashdown Forest comprise roadside, transect and background locations. There are two transects made up of eight sites located at increasing distances from the roadside. The first site is 1.7m from the roadside, the next site is 2.5 m from the roadside, and then the next five sites are 5 m, 10 m, 22 m, 50 m, 100 m, and 200 m from the roadside. The two transects are as below:

- running west of the A22 between Nutley and Wych Cross (Transect 1 = Sites R1.1 to R1.8); and
- running east of the A22 between Nutley and Wych Cross (Transect 2 = Sites R2.1 to R2.8).

Consistent with the original monitoring campaign, the NO₂ diffusion tubes are prepared and analysed by Gradko International Ltd using a 20% triethanolamine (TEA) in water solution. The NH₃ ALPHA samplers are prepared and analysed by the UK Centre for Ecology and Hydrology (UKCEH).

In addition to monitoring results, this report notes where there have been gaps in monitoring data and the reasons for this e.g. missing samplers / tubes. Over the monitoring period, any unreliable data were discarded. Reasons for data rejection include tube contamination by water droplets, insects or spiders and their nests, and also when results were found to be spuriously low or high, relative to other similar sites.

Scope of the Survey

The purpose of the ongoing survey is to provide:

- monthly mean concentrations of nitrogen dioxide (NO₂) at locations ranging from zero to 200 metres from the roadside within the SAC/SSSI, and at locations representative of background conditions within the SAC/SSSI; and
- monthly mean concentrations of reduced nitrogen, as µg/m³ of ammonia (NH₃) at locations ranging from zero to 200 metres from the roadside within the SAC/SSSI, and at locations representative of background conditions within the SAC/SSSI.

The monthly mean concentrations can be used to calculate long term mean concentration values, such as annual mean concentrations, that can be compared against relevant air quality standards for the protection of ecosystems. These standards are listed below:

- The critical level of $30 \mu\text{g}/\text{m}^3$ of NO_x as an annual mean. This is set in the EU Ambient Air Quality Directive (Ref 2). This is transposed into UK law by the Air Quality Standards Regulations 2010 (Ref 3) for the protection of vegetation; and
- The critical level of $1 \mu\text{g}/\text{m}^3$ of NH_3 as an annual mean for the protection of lichen and bryophytes. For all other vegetation, the critical level is $3 \mu\text{g}/\text{m}^3$. These are set by the Convention on Long-Range Transboundary Air Pollution (CLRTAP).

Collected data will subsequently be used to track long-term trends as well as to inform the model verification process following detailed air quality dispersion modelling. The Ashdown Forest Working Group will use these data for the development of the Ashdown Forest SAC dispersion model, to be used to inform the Habitats Regulation Assessment (HRA) of the member authorities' Local Plans.

2. Monitoring Methodology

Survey Permissions

Ashdown Forest is a registered charity owned by the Ashdown Forest Trust and is managed by the Conservators of Ashdown Forest.

The monitoring survey uses passive methods to measure the concentrations of gases within the SAC/SSSI, and as such there was no need to carry out any works which could potentially affect the environment within the site.

As a statutory site of ecological importance, permission is sought and granted by Wealden District Council and The Conservators of Ashdown Forest to undertake works within the site each month.

As for the previous monitoring campaign, LSO duties are performed by WeCare4Air, but managed by AECOM.

Monitoring Locations

The monitoring survey is based on the June 2020 report, '*Recommendations for Post-2020 Air Quality Monitoring in Ashdown Forest*', prepared by Air Quality Consultants and AECOM for the Ashdown Forest Working Group (Ref 1).

There is safe access to the sites at all times of the year. At times where access is difficult e.g. overgrown gorse or grazing animals, the LSO and AECOM liaise with The Conservators of Ashdown Forest to identify alternative access.

Due to the nature of the study area, diffusion tubes and samplers were mounted on roadside street furniture where possible and on stakes elsewhere. Details of the locations including the height and distance to the road were consistent with the previous monitoring campaign, and photographs of the sampling sites saved to file.

The survey includes sampling positions representative of background air pollutant concentrations within the designated site. The background locations are remote from road traffic sources of the pollutants being sampled. In total, monitoring of NO₂ has been undertaken at 26 sites, and NH₃ at 13 of these sites. Details of all locations used in the survey are presented in Appendix A.

Sampling Methodology

NO₂ Monitoring

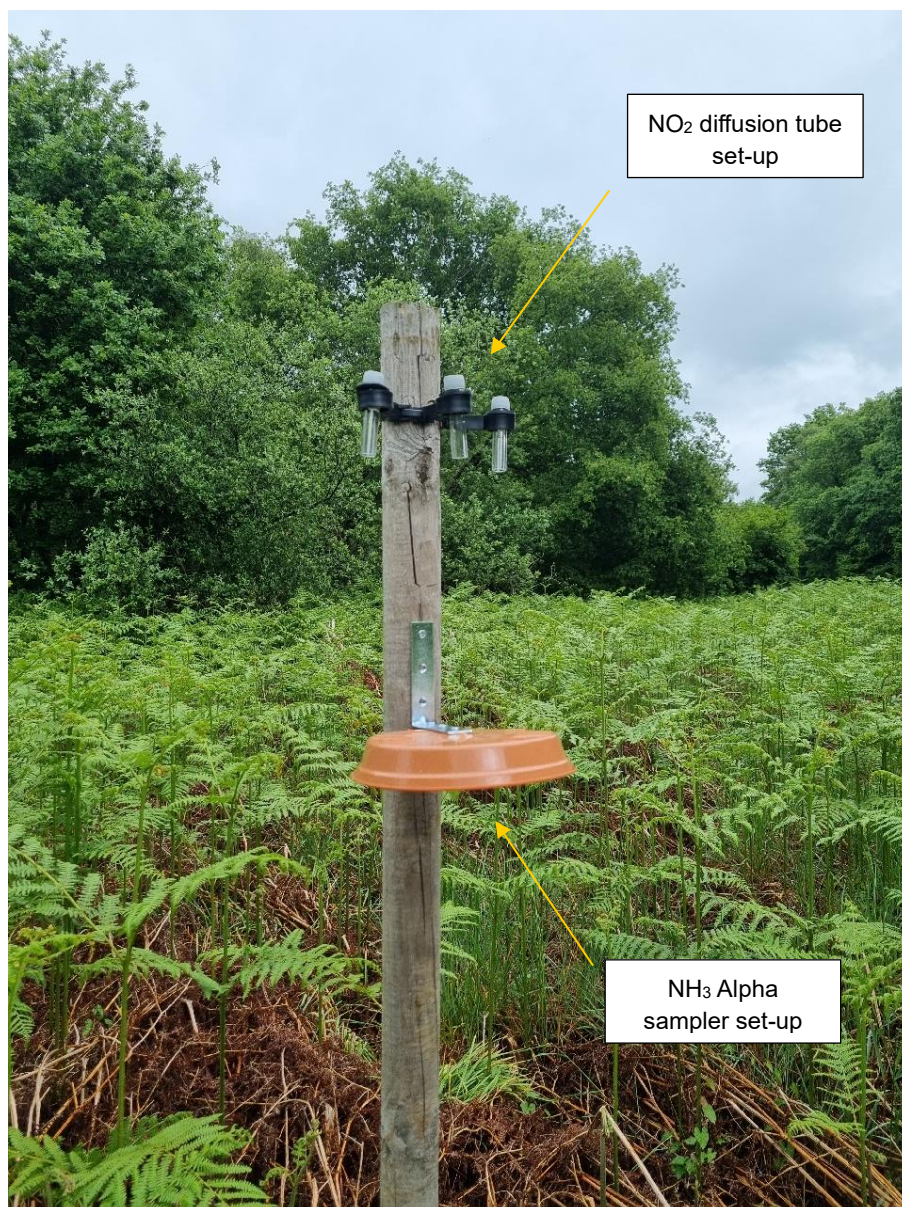
Pollutant specific passive diffusion tubes suitable for the measurement of NO₂ are commercially available from a wide range of organisations. So as to be consistent with the previous monitoring campaign, the NO₂ diffusion tubes were prepared and analysed by Gradko International Ltd using a 20% TEA in water solution. Gradko is a UKAS accredited laboratory (ISO: 17025). Analysis is carried out in accordance with documented Gradko Laboratory Method: GLM7. For the purposes of future assessment, the concentration of NO_x can be calculated from NO₂ monitoring results by using the current version (v8.1) of the NO_x to NO₂ calculator provided by Defra (Ref 4)

The diffusion tubes were stored in a refrigerator when not on-site and care was taken during transfer to and from the sampling site to avoid exposure of the tubes to intense UV light or extreme temperatures. The tubes were exposed on site for a period of approximately 4 weeks, consistent with the sampling advice provided by Gradko. Following exposure, the tubes were collected and re-sealed before being returned to the laboratory for analysis. Additional tubes were used as controls (travel blanks) during the survey. These tubes were not exposed to the air but were analysed. The controls serve to identify any potential issues with handling and use of the diffusion tubes.

The tubes were positioned at a height above local ground level of around 2 m. Appropriate fixings were used to hold the tubes at a suitable distance away from obstructions and at the correct angle.

An example of the NO₂ and NH₃ monitoring site setup is shown in Figure 1.

Figure 1 Example setup of the NO₂ and NH₃ monitoring method



NH₃ Monitoring

Passive monitoring of NH₃ is undertaken using ALPHA samplers prepared and analysed by UKCEH using their accredited laboratory service. The passive sampling system consists of three replicate ALPHA samplers attached to the underside of a shelter at about 1.5 - 2m above the ground. The samplers operate on the principle of diffusion with an acid-coated filter which serves to capture the ammonia. Replicate tubes are used in order to give more reliable results.

The samplers were stored in a refrigerator when not on-site and care was taken during transfer to and from the sampling site to avoid exposure of the tubes to intense UV light or extreme temperatures. The samplers were exposed on site for a period of approximately 4 weeks, consistent with the sampling advice provided by UKCEH. Following exposure, the samplers were collected and re-sealed before being returned to the laboratory for analysis.

3. NO₂ and NO_x Monitoring Results

This section presents the NO₂ annual mean equivalent results for 2022 and annual mean NO_x concentrations. The methodology used to derive the NO_x concentrations is presented below.

The monitoring period presented in this report are from June 2022 to May 2023. Appendix B presents the raw NO₂ monitoring data for each period of the monitoring survey. Any outlying data were flagged and excluded prior to analysis / data processing.

Data capture was generally good at all sites except for T40 (73.1%), R2.6 (57.7%), R2.7 (38.5%) and R2.8 (15.4%). Low data capture at R2.6, R2.7 and R2.8 is due to access issues caused by impenetrable gorse during the monitoring period. This issue has now been resolved and alternative access has been identified so as to avoid access issues in the future. Sampler loss at other sites e.g. T40 was due to the presence of grazing animals in the area.

The average NO₂ concentration at each monitoring site has been adjusted to give a 2022 annual mean equivalent concentration, as presented in Table 1. Annual mean NO_x concentrations have been derived from monitored NO₂ using Defra's NO_x-to-NO₂ toolkit and the 2018-based 1x1 km background maps (Ref 4).

An annual mean for R2.8 has not been presented for 2022 as the data capture is below the 25% annualisation threshold stated by Defra in TG.22 (Ref 5).

Table 1. Mean NO₂ and NO_x monitoring results annualised to 2022

Tube ID	Site type	Distance to road (m)	Data capture (%)	Annualised and Bias Adjusted NO ₂ mean (µg/m ³)	Derived annual mean NO _x (µg/m ³)
T2	Roadside	2.1	100	12.8	19.4
T4	Roadside	1.7	100	22.1	37.3
T21	Roadside	1.3	100	17.9	29.3
T36	Roadside	2	100	17.4	28.2
T40	Roadside	1.7	73	7.6	10.3
T41	Background	390	100	6.9	9.1
T48	Roadside	1.5	100	13.2	20.1
A1	Roadside	1.7	85	8.8	12.5
T68	Roadside	2.1	100	8.0	10.9
R1.1	Transect / Roadside	1.7	100	23.9	41.3
R1.2	Transect / Roadside	2.5	100	17.5	28.6
R1.3	Transect / Roadside	5	100	11.5	17.2
R1.4	Transect	10	100	9.9	14.3
R1.5	Transect	22	100	8.6	11.9
R1.6	Transect / Background	50	100	7.9	10.6
R1.7	Transect / Background	100	100	7.2	9.4
R1.8	Transect / Background	200	92	7.2	9.4
R2.1	Transect / Roadside	1.7	100	16.0	25.6
R2.2	Transect / Roadside	2.5	100	14.8	23.3
R2.3	Transect / Roadside	5	100	11.7	17.6
R2.4	Transect	10	100	10.8	15.9
R2.5	Transect	22	100	9.1	12.8

Tube ID	Site type	Distance to road (m)	Data capture (%)	Annualised and Bias Adjusted NO ₂ mean (µg/m ³)	Derived annual mean NO _x (µg/m ³)
R2.6	Transect / Background	50	58	6.1	7.8
R2.7	Transect / Background	100	39	7.2	9.5
R2.8	Transect / Background	200	15	-	-
R4.3	Roadside	5	100	13.5	20.9

Note: **Bold** denotes where NO_x concentration exceeds Critical Level of 30 µg/m³

The national bias adjustment factor for NO₂ diffusion tubes (20% TEA) for 2022 of 0.84 was applied to the raw diffusion tube monitoring results. Further details of the bias adjustment factor calculation can be found in version 06/23 of the National Bias Adjustment Factors spreadsheet (Ref 4).

Annualisation was undertaken by comparing the average concentration recorded at each monitoring location – over the period for which data were collected – with data from two continuous monitoring sites at background locations (Brighton Preston Park and Lullington Heath Automatic Urban & Rural Network (AURN)) within 50 miles of the SAC. This is in accordance with Defra guidance, LAQM-TG22 (Ref 5).

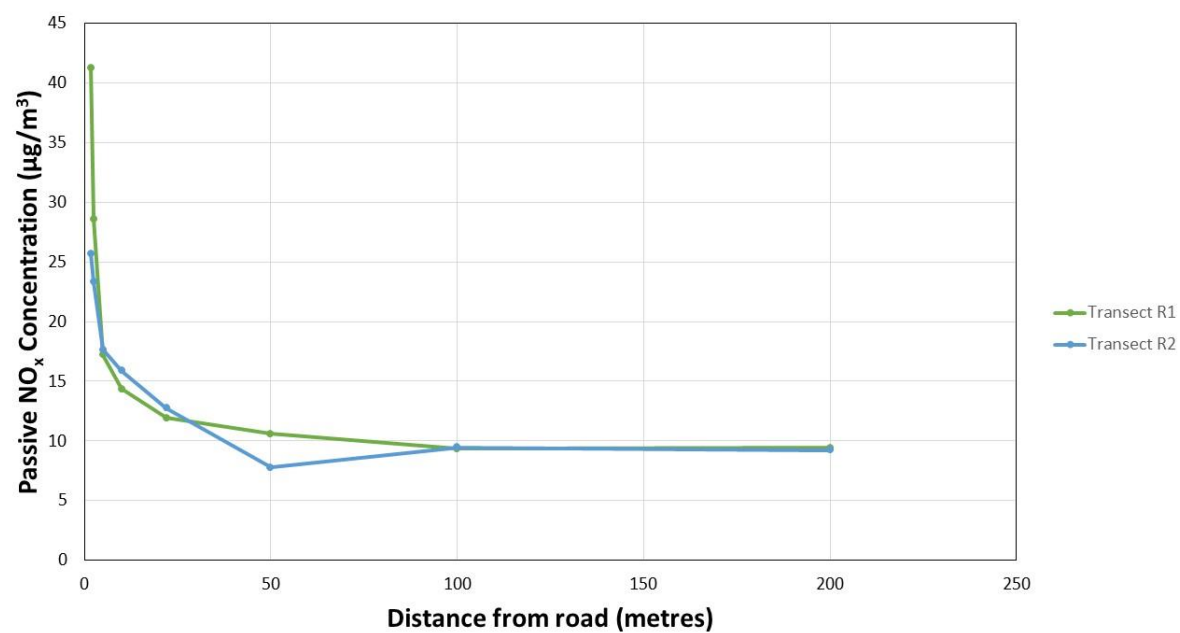
Good agreement was found between the monitored NO₂ concentrations at the background sites and Defra's 2018-based 1 km x 1 km background maps for 2022 across the grid squares covering Ashdown Forest. For the purposes of this summary, 2022 1 km x 1 km background maps were used as the background NO₂ concentration in Defra's NO_x to NO₂ calculator (Ref 4) to derive the annual mean NO_x concentrations for each monitoring location.

The 2022 annual mean equivalent NO₂ concentrations range from 6.1 µg/m³ at R2.6 (50m from the road) to 23.9 µg/m³ at the R1.1 roadside site (located less than 2 m from the road). Annual mean concentrations of NO_x range from 7.8 µg/m³ at R2.6, 51 m from the A22, to 41.3 µg/m³ at R1.1, close to the road edge at the start of transect R1. The results show that 2022 annual mean NO_x exceeded the Critical Level of 30 µg/m³ at both R1.1 and at T4. These are both roadside sites on the A22.

Annual mean NO_x for the previous monitoring campaign (2014-20) are presented in Table 11 and Table 12 of 'Air Quality Monitoring 2014-2020 – Main Report' (Ref 6). The Critical Level was exceeded at both T4 and R1.1 throughout the previous campaign. At these sites, the 2022 annual mean concentrations are lower than previously recorded.

Figure 2 presents the monitoring results from transects R1 and R2, with measured NO₂ concentrations plotted against increasing distance from the A22. The same trend was seen for both transects; the peak concentrations are recorded at the roadside locations, with concentrations decreasing with distance away from the road, tending towards background levels at 70-100m from the road edge.

Figure 2 Monitored NO_x at transect locations plotted against distance from the nearest road



4. NH₃ Monitoring Results

This section presents the mean NH₃ monitoring results for the seven months of ratified data available at the time of writing (06/06/2022 – 04/01/2023). Unfortunately, data for Period 2 (July to August 2022) were exposed but subsequently disposed of due to confusion regarding the labelling of the samplers. This issue was resolved in time for subsequent collections of samplers.

Table 2. Period mean ratified NH₃ monitoring results for 2022

Site ID	Site type	Distance to road (m)	Data capture (%)	Period mean NH ₃ (µg/m ³)
T41	Background	390	14.3%	0.15
A1	Roadside	1.7	71.4%	0.68
R1.1	Roadside	1.7	71.4%	1.85
R1.3	Roadside	2.5	85.7%	0.69
R1.4	Transect	5	85.7%	0.60
R1.5	Transect	10	85.7%	0.61
R1.7	Background	100	71.4%	0.57
R2.1	Roadside	1.7	57.1%	1.09
R2.3	Roadside	5	85.7%	0.76
R2.4	Transect	10	85.7%	0.60
R2.5	Transect	22	28.6%	0.32
R2.7	Transect/Background	100	28.6%	0.41
R4.3	Roadside	5	85.7%	1.21

Note: **Bold** denotes where NH₃ period mean exceeds the annual mean Critical Level of 1 µg/m³. There are no exceedances of the 3 µg/m³ Critical Level.

Table 2 shows the data capture and period mean NH₃ concentrations. The raw monthly NH₃ concentrations from the NH₃ monitoring survey in Ashdown Forest are presented in Appendix C. At the time of writing, seven months of ratified data are available from UKCEH.

The 2022 annual ratified data are calculated using the 2022 United Kingdom Eutrophying & Acidifying Network (UKEAP) National Ammonia Monitoring Network (NAMN) calibrated uptake rate for the ALPHA samplers. At nine NAMN sites around the UK, parallel measurements are made with both the UKCEH DENuder for Long-Term Atmospheric (DELTA®) sampling and passive UKCEH ALPHA samplers to:

1. Determine the annual uptake rate of the ALPHA as per the EN17346:2020 standard (now BS EN 17346:2020; and
2. To ensure that no bias is introduced into the sampling and to maintain the validity of long-term trends.

For the year 2022, the coefficient of determination (R²) was 0.92 showing good agreement between ALPHAs and DELTAs, with the calibrated uptake rate determined as 0.0037884 m³/hour. Further information are available within the 2022 UKEAP NAMN report (Ref 7).

The critical levels are calculated over an annual mean period, however preliminary comparison against the Ashdown Forest period means for 2022 indicate that there are no exceedances of the higher critical level (3 µg/m³). There are, however, exceedances of the lower critical level (1 µg/m³ for lichens and bryophytes) at roadside sites, R1.1, R2.1 and R4.3.

The period mean NH₃ concentrations range from 0.15 µg/m³ at T41 background location, to 1.85 µg/m³ at the Transect 1 roadside site, R1.1. The background concentrations recorded at T41, R1.7 and R2.7 are lower than the 2019-2021 APIS background concentration of 1.0 – 1.1 µg/m³ across the 1x1 km grid squares covering Ashdown Forest. The low data capture at some of these sites should be noted, and these preliminary results interpreted with caution. This analysis will be updated following receipt of additional ratified data.

Figure 3 Period mean NH_3 at transect locations plotted against distance from the nearest road

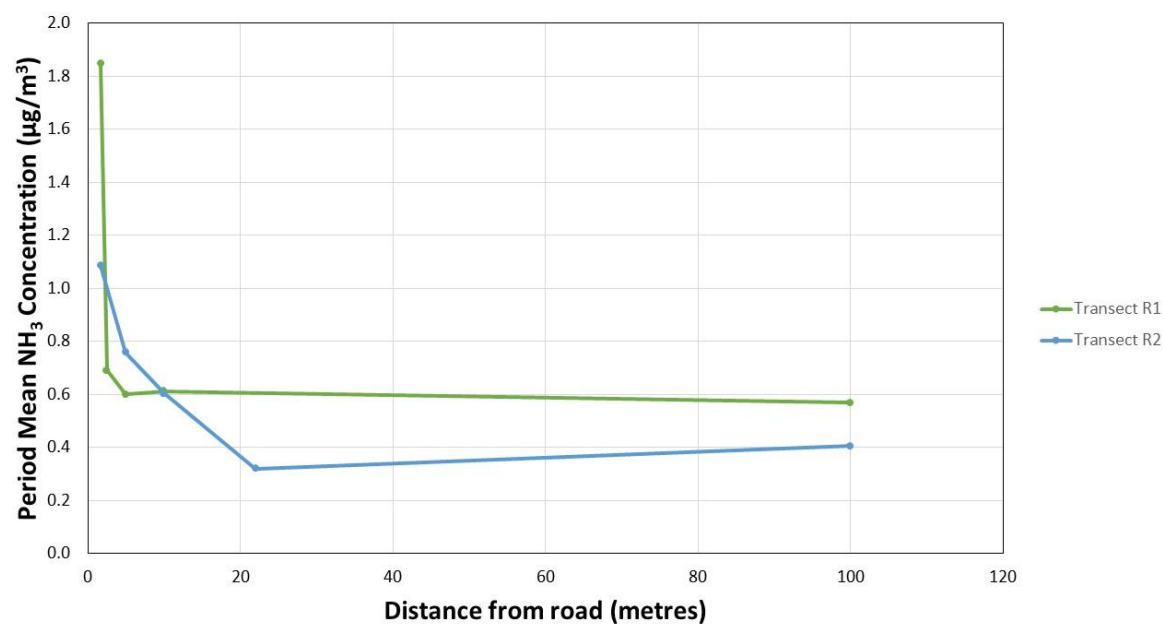


Figure 3 presents the period mean monitoring results from the transect locations plotted against increasing distance from the nearest road. The same trend was broadly seen for both transects; peaks in concentrations are recorded at the roadside locations, with concentrations decreasing with distance away from the road, tending towards background levels away from the road edge. Further analysis will be undertaken as data are received.

5. References

- Ref 1 Ashdown Forest Working Group (2020). Recommendations for Post 2020 Air Quality Monitoring in Ashdown Forest.
- Ref 2 Council of European Union (2008). Directive 2008/50/EC on Ambient Air Quality and Cleaner Air for Europe. Available at:
<https://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX:32008L0050>
- Ref 3 Legislation Government UK (2023). The Air Quality Standards Regulations 2010. Available at:
<https://www.legislation.gov.uk/ukxi/2010/1001/contents/made>
- Ref 4 Defra (2023). Local Air Quality Management Air Quality Assessment Tools. Available at:
<https://laqm.defra.gov.uk/air-quality-assessment/>
- Ref 5 Department for Environment and Rural Affairs (2022). Local Air Quality Management Technical Guidance (TG22). Available at: <https://laqm.defra.gov.uk/wp-content/uploads/2022/08/LAQM-TG22-August-22-v1.0.pdf>
- Ref 6 Air Quality Consultants (2021). Air Quality Monitoring 2014-2020 – Main Report.
- Ref 7 Environment Agency on behalf of Defra and the Devolved Administrations (2023). UKEAP 2022 annual report. Available at:
https://uk-air.defra.gov.uk/assets/documents/reports/cat09/2309281200_UKEAP_2022_annual_report.pdf

Appendix A Monitoring locations

ID	X,Y	Site type	Distance to road (m)	NO ₂ diffusion tube	NH ₃ ALPHA sampler
T2	542041,133770	Roadside	2.1	✓	
T4	541953,132229	Roadside	1.7	✓	
T21	548892,128853	Roadside	1.3	✓	
T36	543617,130337	Roadside	2	✓	
T40	546248,128652	Roadside	1.7	✓	
T41	546282,129073	Background	390	✓	✓
T48	541856,131411	Roadside	1.5	✓	
A1	547294,129153	Roadside	1.7	✓	✓
T68	544027,132499	Roadside	2.1	✓	
R1.1	543931,129550	Transect / Roadside	1.7	✓	✓
R1.2	543930,129549	Transect / Roadside	2.5	✓	
R1.3	543928,129549	Transect / Roadside	5	✓	✓
R1.4	543923,129547	Transect	10	✓	✓
R1.5	543912,129543	Transect	22	✓	✓
R1.6	543885,129535	Transect / Background	50	✓	
R1.7	543837,129519	Transect / Background	100	✓	✓
R1.8	543743,129489	Transect / Background	200	✓	
R2.1	543960,129493	Transect / Roadside	1.7	✓	✓
R2.2	543961,129494	Transect / Roadside	2.5	✓	
R2.3	543963,129494	Transect / Roadside	5	✓	✓
R2.4	543968,129496	Transect	10	✓	✓
R2.5	543980,129500	Transect	22	✓	✓
R2.6	544006,129508	Transect / Background	50	✓	
R2.7	544052,129522	Transect / Background	100	✓	✓
R2.8	544196,129429	Transect / Background	200	✓	
R4.3	548785,128799	Roadside	5	✓	✓

Figure 4 Air Quality Monitoring Sites in Ashdown Forest SAC

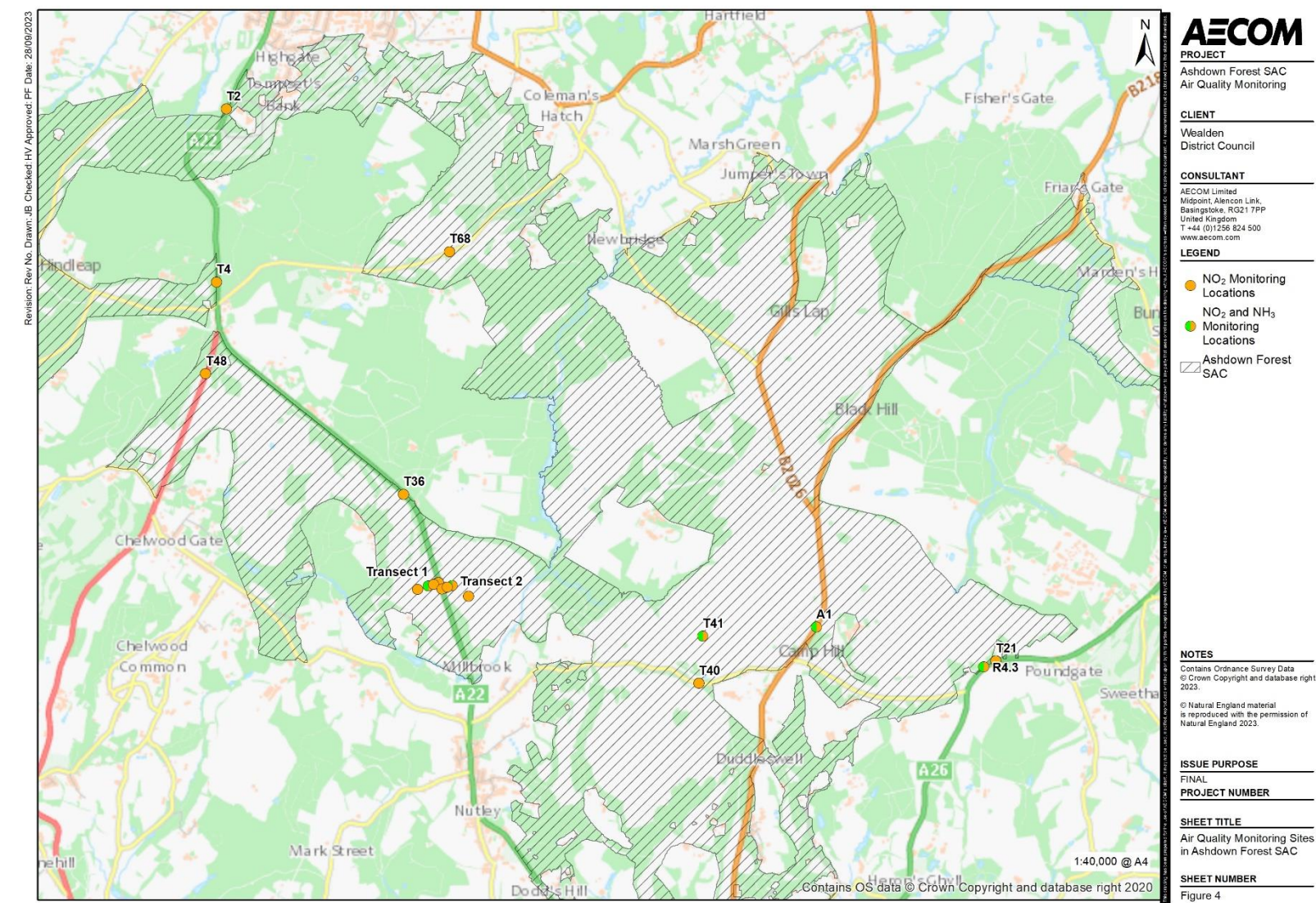
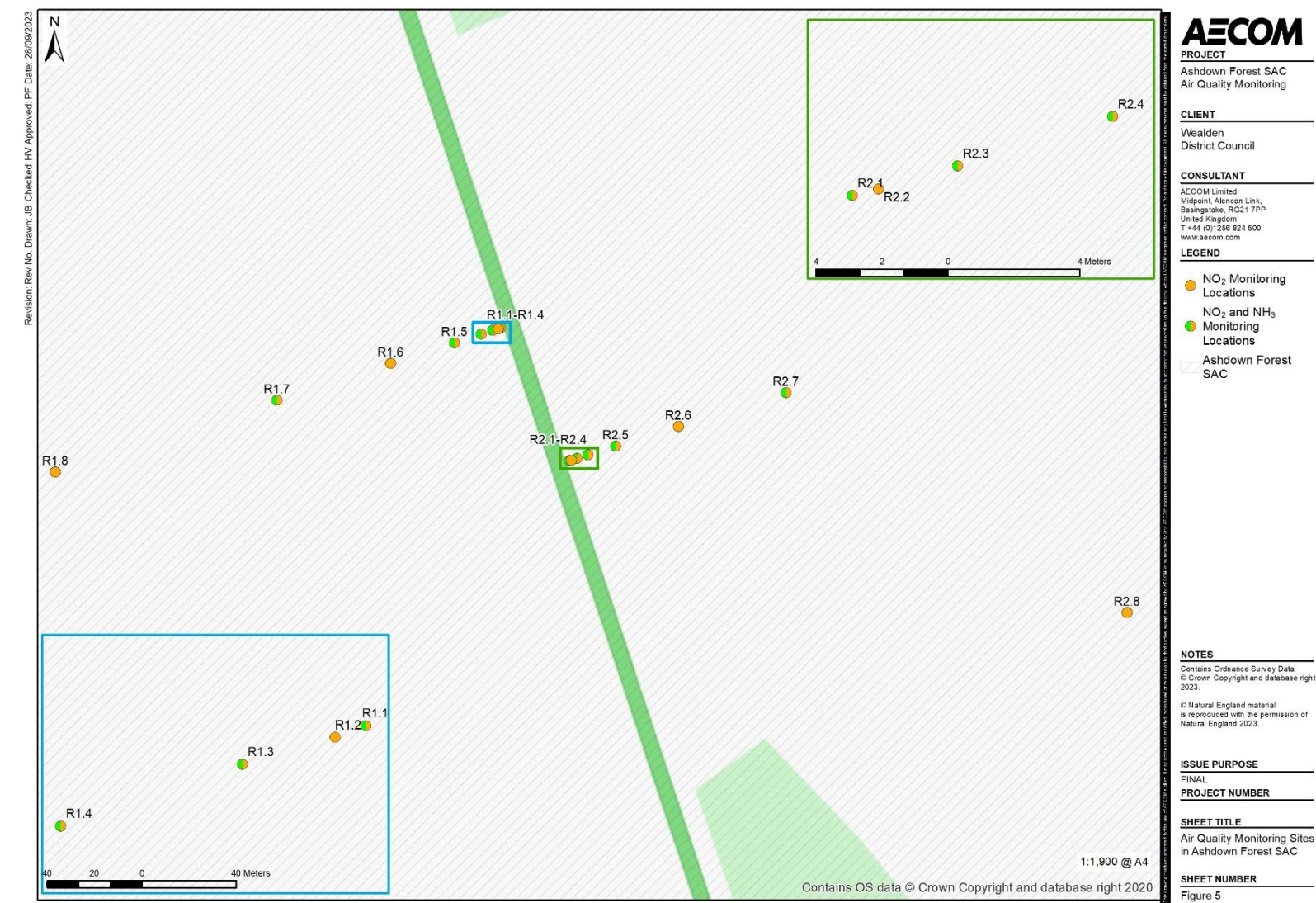


Figure 5 Air Quality Monitoring Sites in Ashdown Forest SAC (Transects R1 and R2)



Appendix B Raw NO₂ monthly data, µg/m³

		Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Period 7	Period 8	Period 9	Period 10	Period 11	Period 12
Site	Tube ID	06/06/22 - 06/07/22	06/07/22 - 02/08/22	02/08/22 - 02/09/22	02/09/22 - 28/09/22	28/09/22 - 02/11/22	02/11/22 - 28/11/22	28/11/22 - 04/01/23	04/01/23 - 01/02/23	01/02/23 - 27/02/23	27/02/23 - 04/04/23	04/04/23 - 02/05/23	02/05/23 - 30/05/23
T2	T2a	13.5	16.0	19.4	16.5	14.0	8.3	19.2	21.0	16.2	13.9	14.9	14.0
	T2b	13.6	17.3	19.9	17.4	8.0	-	19.6	22.7	16.5	14.4	14.9	13.8
	T2c	13.9	16.8	18.6	17.6	-	-	9.5	21.6	17.3	13.6	13.1	14.4
T4	T4a	25.8	33.8	34.3	32.2	28.9	23.1	26.7	12.9	27.4	22.4	26.4	25.1
	T4b	27.9	32.5	35.0	31.2	29.1	23.3	27.2	15.9	26.6	22.6	26.7	25.4
	T4c	28.0	32.5	32.8	31.4	27.0	22.9	27.2	12.9	26.9	22.3	25.4	25.6
T21	T21a	21.9	23.9	21.8	25.8	23.7	22.2	21.7	19.2	24.2	16.8	20.1	16.6
	T21b	20.7	23.7	23.6	25.2	23.2	20.8	21.6	16.7	25.1	17.2	21.5	17.5
	T21c	21.0	25.5	23.4	25.2	21.9	21.9	20.7	20.0	25.2	16.2	21.6	17.2
T36	T36a	14.5	23.1	30.2	26.2	18.1	12.7	25.7	21.3	25.0	20.2	23.3	10.8
	T36b	16.6	23.8	28.5	25.9	18.4	11.9	25.4	21.1	24.5	20.7	23.7	11.3
	T36c	18.0	23.1	28.8	26.4	16.3	12.0	26.4	20.5	24.8	20.9	23.9	10.9
T40	T40a	8.1	8.8	-	-	-	-	15.2	11.6	12.4	9.1	8.9	7.5
	T40b	7.2	9.8	-	-	-	8.9	14.7	11.3	12.0	9.1	8.7	6.6
	T40c	7.4	-	-	-	-	8.4	15.2	11.4	12.7	9.5	9.0	7.0
T41	T41a	5.6	6.4	7.4	8.4	7.2	7.7	14.8	11.0	9.1	7.9	6.7	6.6
	T41b	4.7	7.1	7.5	8.1	8.2	7.2	16.0	10.5	9.3	7.7	7.2	6.9
	T41c	5.1	6.5	7.4	8.2	6.9	7.4	15.3	10.6	10.4	8.4	6.5	6.4
T48	T48a	12.6	14.5	14.1	15.6	14.4	13.5	20.0	15.3	16.7	12.8	11.5	29.1
	T48b	12.5	13.9	14.0	15.9	15.0	12.4	18.9	15.3	16.9	12.6	12.2	30.1

		Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Period 7	Period 8	Period 9	Period 10	Period 11	Period 12
Site	Tube ID	06/06/22 - 06/07/22	06/07/22 - 02/08/22	02/08/22 - 02/09/22	02/09/22 - 28/09/22	28/09/22 - 02/11/22	02/11/22 - 28/11/22	28/11/22 - 04/01/23	04/01/23 - 01/02/23	01/02/23 - 27/02/23	27/02/23 - 04/04/23	04/04/23 - 02/05/23	02/05/23 - 30/05/23
	T48c	12.1	13.4	14.2	16.3	14.1	13.4	20.5	16.6	16.6	12.5	11.5	30.1
A1	A1a	-	-	10.1	10.3	8.6	-	16.7	12.3	13.1	11.1	9.2	9.1
	A1b	-	-	10.1	11.0	9.5	9.0	17.7	13.5	12.7	10.1	8.9	8.6
	A1c	-	-	10.0	10.2	-	8.8	15.8	14.4	13.0	10.8	9.0	8.4
T68	T68a	7.3	8.9	9.0	9.8	9.9	8.9	13.3	10.5	11.9	9.3	8.6	7.5
	T68b	7.6	8.9	9.1	9.9	9.9	9.2	13.4	10.6	11.8	8.6	8.5	7.3
	T68c	7.7	8.8	9.0	9.2	10.2	8.8	14.2	11.3	12.1	9.3	8.7	7.2
R1.1	R1.1a	34.6	37.5	27.2	34.0	26.7	21.3	32.8	26.5	27.5	22.6	27.6	28.9
	R1.1b	35.7	40.5	28.3	34.0	28.2	25.6	31.9	25.6	28.5	24.8	-	26.5
	R1.1c	34.3	-	35.2	33.5	26.6	13.4	29.0	23.3	29.8	23.9	28.8	26.7
R1.2	R1.2a	22.0	26.1	27.5	27.1	16.3	16.6	24.3	17.9	12.7	16.9	20.7	22.6
	R1.2b	22.6	-	26.8	28.4	17.9	16.0	22.9	17.5	21.6	18.1	22.3	23.0
	R1.2c	20.2	-	27.6	27.1	18.7	16.6	23.8	18.8	20.7	17.9	22.6	21.8
R1.3	R1.3a	10.7	13.7	16.6	16.3	11.1	8.5	20.7	13.6	14.5	12.8	13.4	14.2
	R1.3b	10.3	14.2	16.5	16.5	12.0	8.9	20.3	14.1	14.6	12.2	13.8	13.9
	R1.3c	11.0	13.1	16.0	16.0	12.2	8.5	18.8	14.2	14.7	12.7	13.3	14.2
R1.4	R1.4a	7.9	11.2	13.6	13.2	10.8	8.4	17.2	13.7	13.6	11.5	10.8	12.4
	R1.4b	8.2	11.4	13.5	12.8	10.8	8.5	15.0	13.1	13.0	11.2	12.2	12.3
	R1.4c	8.5	12.0	13.9	12.9	10.4	7.4	17.8	12.7	14.1	11.5	10.1	11.9
R1.5	R1.5a	7.6	9.2	11.4	11.3	8.8	7.2	16.9	11.2	12.5	9.4	10.0	9.7
	R1.5b	7.0	9.1	11.5	11.1	9.4	7.3	17.1	11.9	11.8	9.8	9.4	9.5
	R1.5c	7.2	8.8	11.3	10.8	9.2	7.3	16.1	11.1	11.5	9.9	9.1	9.6

		Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Period 7	Period 8	Period 9	Period 10	Period 11	Period 12
Site	Tube ID	06/06/22 - 06/07/22	06/07/22 - 02/08/22	02/08/22 - 02/09/22	02/09/22 - 28/09/22	28/09/22 - 02/11/22	02/11/22 - 28/11/22	28/11/22 - 04/01/23	04/01/23 - 01/02/23	01/02/23 - 27/02/23	27/02/23 - 04/04/23	04/04/23 - 02/05/23	02/05/23 - 30/05/23
R1.6	R1.6a	5.9	8.1	10.0	10.4	8.3	6.7	14.6	10.8	11.4	9.1	8.2	8.0
	R1.6b	6.1	12.7	10.1	9.7	8.6	6.8	15.4	9.9	11.4	8.7	8.3	7.5
	R1.6c	5.7	7.6	9.5	10.5	8.7	6.9	17.2	11.1	11.1	8.6	8.2	8.1
R1.7	R1.7a	5.9	6.9	8.6	9.4	7.7	6.1	15.3	10.4	9.8	8.3	7.5	7.1
	R1.7b	5.2	7.0	8.5	9.1	7.9	7.2	14.6	10.5	9.5	8.4	7.5	7.1
	R1.7c	5.4	7.2	8.6	9.1	8.0	6.5	16.8	10.6	10.1	8.0	7.0	7.1
R1.8	R1.8a	5.8	7.3	-	9.7	8.0	6.7	17.7	10.6	10.2	8.0	7.2	6.6
	R1.8b	5.9	6.8	-	9.4	8.0	6.7	15.9	9.7	10.2	8.7	7.5	7.3
	R1.8c	5.9	7.3	-	9.6	8.0	6.8	15.8	10.5	10.8	8.5	7.2	7.6
R2.1	R2.1a	19.4	20.8	20.7	24.4	17.4	13.0	22.8	20.2	21.5	17.8	17.7	15.0
	R2.1b	20.3	18.6	20.3	22.1	17.9	16.5	22.4	20.1	21.6	19.1	18.0	15.4
	R2.1c	16.9	19.5	20.6	22.1	16.6	16.1	24.1	20.1	21.7	18.1	18.0	15.6
R2.2	R2.2a	17.0	17.3	18.3	21.5	15.9	15.4	21.5	19.1	19.4	16.6	16.4	13.0
	R2.2b	16.8	18.2	18.3	20.5	14.9	16.6	22.2	19.6	20.3	16.1	15.9	13.8
	R2.2c	16.4	17.8	18.2	21.1	15.6	16.6	22.7	19.3	20.5	17.0	15.9	13.6
R2.3	R2.3a	13.7	14.1	14.1	16.2	11.9	13.9	19.1	14.6	15.5	13.1	12.9	10.5
	R2.3b	13.6	13.4	14.1	15.6	12.5	14.9	17.6	16.4	14.0	13.2	12.7	10.5
	R2.3c	14.0	13.4	14.2	16.0	13.1	14.0	17.0	15.6	15.9	13.3	12.6	10.3
R2.4	R2.4a	11.9	11.6	12.0	13.8	11.6	13.0	17.3	15.1	15.6	12.7	11.4	9.0
	R2.4b	11.7	11.2	12.3	13.6	11.6	13.3	17.7	15.6	15.3	13.2	12.3	9.2
	R2.4c	11.1	11.7	11.8	14.0	11.5	13.3	17.7	14.2	14.4	12.8	11.7	9.5
R2.5	R2.5a	9.0	9.8	10.2	11.8	10.1	10.7	16.0	13.4	13.2	10.0	9.0	7.8

		Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Period 7	Period 8	Period 9	Period 10	Period 11	Period 12
Site	Tube ID	06/06/22 - 06/07/22	06/07/22 - 02/08/22	02/08/22 - 02/09/22	02/09/22 - 28/09/22	28/09/22 - 02/11/22	02/11/22 - 28/11/22	28/11/22 - 04/01/23	04/01/23 - 01/02/23	01/02/23 - 27/02/23	27/02/23 - 04/04/23	04/04/23 - 02/05/23	02/05/23 - 30/05/23
	R2.5b	9.4	9.6	10.3	11.9	9.9	11.3	15.3	12.9	12.5	10.3	9.4	7.3
	R2.5c	9.6	9.9	10.8	11.9	10.2	10.9	14.3	12.9	13.3	9.5	9.6	7.8
R2.6	R2.6a	6.6	6.7	-	-	-	-	-	-	8.4	7.5	7.2	5.5
	R2.6b	6.9	7.0	-	-	-	-	-	-	9.4	7.7	6.9	6.1
	R2.6c	6.5	7.0	-	-	-	-	-	10.0	9.7	8.1	6.9	6.0
R2.7	R2.7a	6.7	7.2	-	-	-	-	15.1	10.6	10.1	-	-	-
	R2.7b	6.8	6.7	-	-	-	-	14.0	10.8	10.1	-	-	-
	R2.7c	6.7	7.0	-	-	-	-	13.5	10.7		-	-	-
R2.8	R2.8a	5.7	-	-	-	-	-	14.4	-	-	-	-	-
	R2.8b	6.0	-	-	-	-	-	14.8	-	-	-	-	-
	R2.8c	6.3	-	-	-	-	-	13.5	-	-	-	-	-
R4.3	R4.3a	14.5	12.8	14.7	14.6	18.4	18.5	19.5	14.0	20.4	17.0	18.6	12.1
	R4.3b	14.9	14.7	14.4	14.7	20.1	18.1	17.2	15.5	18.8	16.5	18.1	12.1
	R4.3c	14.8	15.7	14.0	14.8	19.5	17.9	18.4	12.5	19.1	16.8	19.5	11.4

Appendix C Ratified NH₃ monthly data, µg/m³

Site	06/06/22 - 06/07/22	06/07/22 - 02/08/22	02/08/22 - 02/09/22	02/09/22 - 28/09/22	28/09/22 - 02/11/22	02/11/22 - 28/11/22	28/11/22 - 04/01/23
T41	-	-	-	-	-	-	0.15
A1	-	-	1.32	0.72	0.58	0.53	0.26
R1.1	1.91	-	2.22	1.86	-	2.24	1.00
R1.3	0.74	-	1.32	0.70	0.66	0.43	0.29
R1.4	0.67	-	1.15	0.57	0.61	0.37	0.23
R1.5	0.68	-	1.16	0.60	0.60	0.34	0.29
R1.7	0.60	-	1.09	0.54	-	0.49	0.12
R2.1	1.16	-	1.44	1.13	-	-0.06*	0.61
R2.3	0.96	-	1.34	0.79	0.80	0.41	0.25
R2.4	0.82	-	1.14	0.51	0.58	0.35	0.22
R2.5	-	-	-	-	-	0.38	0.26
R2.7	0.69	-	-	-	-	-	0.12
R4.3	0.83	-	<u>3.47</u>	0.33	0.79	0.62	-

Notes:

Bold denotes exceedances of 1 µg/m³ Critical Level

Bold and underlined denotes exceedances of 3 µg/m³ Critical Level

* excluded from period mean calculations

