Appendix 11.2

DIFFUSION TUBE SURVEY

11.2 Appendix 11.2 Diffusion tube data post processing

Buro Happold conducted air quality monitoring using diffusion tubes over the following periods:

- Period 1: 10/08/2022 - 07/09/2022
- Period 2: 07/09/2022 - 07/10/2022
- Period 3: 07/10/2022 - 03/11/2022
- Period 4: 03/11/2022 - 29/11/2022
- Period 5: 29/11/2022 - 04/01/2023
- Period 6: 04/01/2023 - 03/02/2023

Palmes-type diffusion tubes were used for this short-term monitoring survey. This mirrors the air quality monitoring that the majority of local authorities carry out as part of the Local Air Quality Management process. The diffusion tubes were supplied and analysed by Gradko, a UKAS accredited laboratory, and were prepared using the 50% TEA in acetone method. Tubes were deployed for four-to-five-week periods, providing an average concentration over this period.

Diffusion tubes were placed in locations that were accessible for safe collection and deployment. Locations were chosen to represent future exposure, sensitive receptors (such as Oxford Meadows) and evaluate the impact pollution sources (e.g. A44 and the railway line). In addition, suitability for dispersion model verification has been considered. The locations of the monitoring sites are shown in Figure 1, with additional information on each site presented in
Table 1 Buro Happold commissioned short term diffusion tube monitoring site information

Site ID	Site description	Type	X OS grid ref (m)	Y OS grid ref (m)	Height (m)	Photo
BID1	Science park entrance	Roadside	447725.9	213501.3	2.4	
BID2	A44 N	Roadside	447084.0	213837.4	2.4	
BID3	A44 Sandy Lane	Roadside	447477.4	213060.7	2.4	
BID4	Sandy Lane railway	Roadside	448507.4	213132.7	2.4	
BID5	Sandy Lane	Roadside	447740.4	213162.1	2.4	
BID6	A44 Shell garage	Roadside	447967.9	212581.5	2.4	
BID7	A44 S	Roadside	449123.9	211257.7	2.4	
BID8	A40 Oxford Meadows	Roadside	448358.0	210647.7	2.4	

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All diffusion tubes sites were:

- At least 5cm from any the surface it was placed on
- Above 2m in height
- Away from: boiler flues, overhanging vegetation, air conditioning outlets and extractor vents.

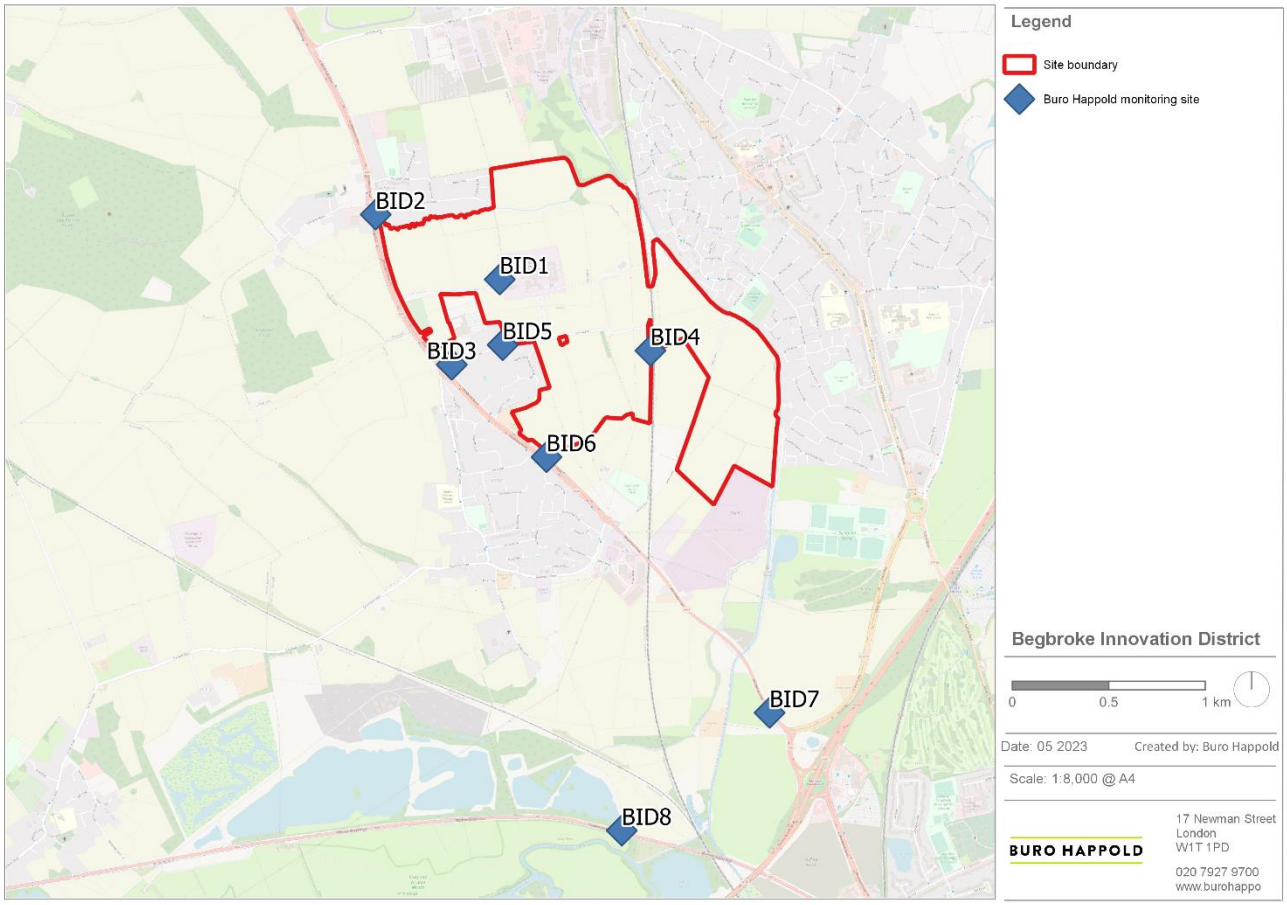

Figure 1 Buro Happold air quality survey monitoring sites

Table 1 Buro Happold commissioned short term diffusion tube monitoring site information

Site ID	Site description	Type	X OS grid ref (m)	Y OS grid ref (m)	Height (m)	Photo
BID1	Science park entrance	Roadside	447725.9	213501.3	2.4	

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BID2	A44 N	Roadside	447084.0	213837.4	2.4	
BID3	A44 Sandy Lane	Roadside	447477.4	213060.7	2.4	
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Site ID	Site description	Type	X OS grid ref (m)	Y OS grid ref (m)	Height (m)	Photo
BID6	A44 Shell garage	Roadside	447967.9	212581.5	2.4	
BID7	A44 S	Roadside	449123.9	211257.7	2.4	
BID8	A40 Oxford Meadows	Roadside	448358.0	210647.7	2.4	

Annualisation, bias adjustment and back projection

Annualisation is the process of adjusting short term monitoring to be representative of a full calendar year, allowing for comparison against long-term annual average air quality objectives. Annualisation has been carried out in line with Defra local air quality management technical guidance (TG22) to give the annual mean NO_2 concentration at each of the monitoring sites.

Four background automatic sites have been used to calculate the annualisation factor: Oxford St Ebbes, Swindon Walcot, Coventry Allesley and Northampton Spring Park.

Table 2 outlines the annualisation calculations. An annualisation factor of 0.92 has been used in this assessment for the majority of the monitoring sites. Where diffusion tubes were not retrieved, no data was returned for that monitoring period. For sites at which this occurred, a separate annualisation factor was calculated using only the monitoring periods for which data is available.

This was the case for BID4 and BID6, which had annualisation factors of 0.89 and 0.98 respectively.

Table 2 Annualisation factor derivation

Period	Oxford St Ebbes		Swindon Walcot		Coventry Allesley		Northampton Spring Park	
	Mean conc (µg/m^3)	*Data availability (%)*	*Mean conc (µg/m^3)*	*Data availability (%)*	*Mean conc (µg/m^3)*	*Data availability (%)*	*Mean conc (µg/m^3)*	*Data availability (%)*
1	11.5	100.0	7.6	96.0	12.1	98.4	6.6	99.1
2	11.2	99.9	8.9	99.9	14.1	99.5	7.9	84.9
3	10.4	99.7	7.8	99.9	16.4	99.4	10.6	99.6
4	10.6	99.7	8.9	99.8	18.8	100.0	12.1	99.7
5	17.0	99.9	16.5	100.0	22.4	99.7	15.6	99.4
6	14.4	99.1	15.6	99.6	12.7	99.2	11.9	98.4
Period mean (PM)	12.9	99.2	11.3	98.7	16.3	98.8	11.1	96.2
Annual mean (AM)	11.9	99.6	10.2	99.1	15.5	99.3	9.8	96.6
Site annualisation factor (AM/PM)	**0.92**		**0.90**		**0.95**		**0.88**	
Average factor	**0.92**							

The bias adjustment factor used in this assessment is 0.82, derived from the 2022 national bias adjustment factor for Gradko 50% TEA in acetone diffusion tubes. This was obtained from the national diffusion tube bias adjustment factor spreadsheet[1].

As the study period covered both 2022 and 2023, the data collected in 2023 has been back projected to a 2022 value, in line with TG22. In addition, the monitored results require scaling from a 2022 concentration to the 2019 baseline year of this assessment.

TG22 states that a ratio of roadside concentrations should be calculated from the Defra roadside projection factors[2]. The roadside projection factors provide estimated future ratio changes in roadside NO_2 concentrations up until 2030, based on a 2018 reference year.

The roadside projection factors for 'Rest of UK' are presented in Table 3. The back projection factor is determined by calculating the ratio of the emissions factors for the two years.

[1] Defra. (2023). National Bias Adjustment Factors https://laqm.defra.gov.uk/air-quality/air-quality-assessment/national-bias/
[2] Defra. (2018). Roadside NO2 Projection Factor. https://laqm.defra.gov.uk/air-quality/air-quality-assessment/roadside-no2-projection-factors/

Table 3 Roadside Projection Factors

Road Type	2019	2022	2023
Rest of UK (HDV = <10%)	0.953	0.807	0.765
2022 to 2019 scale back factor	**1.18**		
202023 to 2022 scale back factor	**1.05**		

A summary of the values used in the post processing of the short-term monitoring study are presented in Table 4.

Table 4 Summary of values used in post processing data from short term diffusion tube monitoring study.

Factor	Value	Derivation
Annualisation	0.92	Using monitoring data from four nearest background automatic monitoring sites with sufficient data availability
Bias adjustment	0.82	2022 national bias adjustment factor for Gradko 50% TEA diffusion tubes
2022 to 2019 scale back factor roadside	1.18	Defra roadside NO_2 projection factors
2023 to 2022 scale back factor	1.05	Defra roadside NO_2 projection factors

These factors are applied to the raw monitoring data following the process outlined below to obtain an annual average concentration at each site. This methodology is in line with TG22.

1. Calculate average concentration of the raw data over the study period (10 August 2022 – 3 February 2023)
2. Multiply data collected in 2023 by the 2023 to 2022 scale back factor
3. Multiply the 6-month average concentration by the annualisation factor to obtain a 2022 annual average concentration
4. Multiply by the bias adjustment factor to obtain a bias adjusted 2022 annual average concentration
5. Multiply by 2022 to 2019 scale back factor to obtain a bias adjusted 2019 annual average concentration.

Raw data

The raw data collected over the survey period is presented in Table 5. The processed results are presented in the body of the ES chapter.

Table 5 Raw monitored concentrations from Buro Happold survey

Site ID	Average NO_2 concentration over monitoring period ($\mu g/m^3$)							Raw average
	10/08/2022 - 07/09/2022	*07/09/2022 - 07/10/2022*	*07/10/2022 - 03/11/2022*	*03/11/2022 - 29/11/2022*	*29/11/2022 - 04/01/2023*	*04/01/2023 - 03/02/2023*		
						Raw	*2022 adjusted*	
BID1	7.84	7.71	11.03	12.77	17.88	13.51	14.25	**11.9**
BID2	24.62	22.62	30.42	29.44	27.64	29.28	30.89	**27.6**
BID3	14.50	14.12	18.16	20.57	24.21	19.91	21.01	**18.8**
BID4	-	10.98	13.08	11.53	18.86	14.34	15.12	**13.9**
BID5	12.57	13.22	15.71	18.72	22.59	20.41	21.53	**17.4**
BID6	-	16.89	20.13	20.12	-	20.43	21.55	**19.7**
BID7	26.37	24.96	24.54	21.52	29.56	21.33	22.50	**24.9**
BID8	16.96	17.46	20.06	17.76	21.80	20.26	21.37	**19.2**