



Glyn Rhonwy Pumped Storage Air Quality Baseline Monitoring



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Report for

Snowdonia Pumped Hydro

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Contents

1.	Introduction	2
1.1	Introduction	2
2.	Regulatory Framework	3
2.1	National legislation context	3
2.2	Local Air Quality Management	4
2.3	Technical guidance	6
3.	Methodology	7
3.1	Introduction	7
3.2	Sensitive receptors	7
3.3	Monitoring Locations	10
4.	Results	14
4.1	Summary of diffusion tube monitoring	14
4.2	Summary of dust deposition monitoring	14
5.	Conclusion	16
	APPENDIX A: Glossary	17
	APPENDIX B: NO₂ Monitoring data	18

1. Introduction

1.1 Introduction

- 1.1.1 WSP has been commissioned by Snowdonia Pumped Hydro to carry out air quality monitoring. The purpose of the monitoring is to determine the existing air quality prior to construction works of the proposed Glyn Rhonwy Pumped Storage, hereafter referred to as the 'Proposed Development'. This information can then be used to quantify any changes in the rate of dust deposition and the concentration of nitrogen dioxide (NO₂) associated with the construction phase.
- 1.1.2 Development Consent Order (DCO) Requirement 6 (d) of the Glyn Rhonwy DCO required a Dust Control and Air Quality Management Plan (DCAQMP) to be prepared. An outline DCAQMP was included in the submitted DCO and has been approved as a certified document. The certified DCAQMP included the provision of 6 months of baseline air quality monitoring to be undertaken pre-construction (as also required by Requirement 7 (a)).
- 1.1.3 The need for baseline air quality monitoring was outlined in the 2015 Environmental Statement (ES) chapter and the certified DCAQMP. The baseline conditions gathered as a result of air quality monitoring will be used to establish action trigger criteria which will be applied during all subsequent monitoring.
- 1.1.4 Passive monitoring measurements using NO₂ diffusion tubes and frisbee dust deposition gauges began in November 2022. The measurements are used to determine baseline conditions, compared against the annual air quality objective of 40 µg m⁻³.
- 1.1.5 This report summarises the diffusion tube and frisbee dust deposition gauge monitoring undertaken between November 2022 and May 2023.
- 1.1.6 A glossary of terms used in this report is provided in **Appendix A**.

2. Regulatory Framework

2.1 National legislation context

- 2.1.1 The legislative framework for air quality is based on legally enforceable EU Limit Values that were transposed into UK legislation as Air Quality Standards¹ (AQS) that must be at least as challenging as the EU Limit Values. Actions in the UK is then driven by the UK's Air Quality Strategy that sets the Air Quality Objectives (AQOs).
- 2.1.2 The EU Limit Values are set by the European directive on air quality and cleaner air for Europe (2008/50/EC)² and the European directive relating to arsenic, cadmium, mercury, nickel, and polycyclic aromatic hydrocarbons in ambient air (2004/107/EC)³ act as the principal instruments governing outdoor ambient air quality policy in the EU. The Limit Values are legally binding levels for concentrations of pollutants for outdoor air quality.
- 2.1.3 Article 7 of the European directive (2008/50/EC)² states that *'the location of sampling points for the measurement of sulphur dioxide, nitrogen dioxide and the oxides of nitrogen, particulate matter (PM₁₀, PM_{2.5})... in ambient air should be determined using the criteria listed in Annex III'*.
- 2.1.4 Annex III of the European directive 2008/50/EC² gives further information on the criteria for macroscale siting of sampling points. It states that a *'sampling points shall in general be sited in such a way as to avoid measuring very small micro-environments in their immediate vicinity, which means that a sampling point must be sited in such a way that the air sampled is representative of air quality for a street segment no less than 100 m length at traffic-orientated sites and at least 250 m x 250 m at industrial sites, where feasible'*. In terms of public exposure, sampling points should be representative of the exposure of the general population.
- 2.1.5 The two European directives, as well as the Council's decision on exchange of information were transposed into UK Law via the Air Quality Standards Regulations 2010⁴ and amended via the Air Quality Standards (Amendment) Regulations 2016⁵. Air Quality Standards are concentrations recorded over a given time period, which are considered to be acceptable in terms of what is scientifically known about the effects of each pollutant on health and on the environment.
- 2.1.6 The Air Quality Standards (Wales) Regulations⁶ were derived from European directive (2008/50/EC)² and set legally binding thresholds for the concentration of pollutants in air

¹ Department of Environment, Food and Rural Affairs (Defra) in partnership with the Scottish Executive, Welsh Assembly Government and Department of the Environment Northern Ireland. *The Air Quality Strategy for England, Scotland, Wales and Northern Ireland*. (2007) [online] Available here:

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69336/pb12654-air-quality-strategy-vol1-070712.pdf [Accessed June 2023]

² Official Journal of the European Union. *Directive 2008/50/EU of the European Parliament and of The Council of 21 May 2008 on Ambient Air Quality and Cleaner Air in Europe*. (2008) [online] Accessed here: <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32008L0050&from=en> [Accessed June 2023]

³ Official Journal of the European Union. *Directive 2004/107/EC of the European Parliament and of The Council of 15 December 2004 relating to Arsenic, Cadmium, Mercury, Nickel and Polycyclic Aromatic Hydrocarbons in Ambient Air*. (2004) [online] Accessed here: <https://www.legislation.gov.uk/eudr/2004/107/contents> [Accessed June 2023]

⁴ UK Statutory Instrument. *The Air Quality Standards Regulations 2010*. (2010) [online] Accessed here: <https://www.legislation.gov.uk/uksi/2010/1001/contents/made> [Accessed June 2023]

⁵ UK Statutory Instrument. *The Air Quality Standards (Amendment) Regulations 2016*. (2016) [online] Accessed here: <https://www.legislation.gov.uk/uksi/2016/1184/contents/made> [Accessed June 2023]

⁶ Wales Statutory Instrument. *The Air Quality Standards (Wales) Regulations* [online] <https://www.legislation.gov.uk/wsi/2010/1433/contents/made> [Accessed June 2023]

for the protection of health and ecosystems. In the Air Quality Standards (Wales) Regulations, the thresholds are referred to as 'limit values'. The limit values for NO₂ are the same concentration levels as the relevant AQOs.

2.2 Local Air Quality Management

- 2.2.1 The Air Quality Strategy sets the AQOs, which give target dates and some interim target dates to help the UK move towards achievement of the EU Limit Values. The AQOs are a statement of policy intentions or policy targets and as such, there is no legal requirement to meet these objectives except in as far as they mirror any equivalent legally binding Limit Values in EU legislation. The most recent UK Air Quality Strategy for England, Scotland, Wales and Northern Ireland was published in July 2007.
- 2.2.2 **Table 2.1** sets out the NO₂ AQOs and the dates by which they were to be achieved. Other pollutant standards and objectives are not included as they are not relevant to this assessment.

Table 2.1 Summary of relevant air quality standards and objectives

Pollutant	Objective	Averaging Period	Date to be achieved by and maintained thereafter (UK)
Nitrogen Dioxide (NO ₂)	200 µgm ⁻³ not to be exceeded	1-hour mean	31 Dec 2005
	more than 18 times a year 40 µgm ⁻³	Annual mean	31 Dec 2005

- 2.2.3 **Table 2.2** sets out where the AQOs should and should not apply.

Table 2.2 Summary of relevant air quality standards and objectives

Averaging period	Objective should apply at	Objectives should not apply at
Annual mean	All locations where members of the public might be regularly exposed Building façades of residential properties, schools, hospitals, care homes etc.	Building façades of offices or other places of work where members of the public do not have regular access. Hotels, unless people live there as their permanent residence. Gardens of residential properties. Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term.
24-hour mean	All locations where the annual mean objective would apply, together with hotels Gardens of residential properties.	Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term.
1-hour mean	All locations where the annual mean and 24 and 8-hour mean objectives apply. Kerbside sites (for example, pavements of busy shopping streets) Those parts of car parks, bus stations and railway stations etc which are not	Kerbside sites where the public would not be expected to have regular access.

Averaging period	Objective should apply at	Objectives should not apply at
	fully enclosed, where members of the public might reasonably be expected to spend one hour or more Any outdoor locations where members of the public might reasonably be expected to spend one hour or longer.	
15-minute mean	All locations where members of the public might reasonably be exposed for a period of 15 minutes	

- 2.2.4 Part IV of the Environment Act (1995)⁷ (amended in 2021⁸) requires UK Government to produce a national Air Quality Strategy which contains standards, objectives and measures for improving ambient air quality. The most recent AQS was produced by Defra and published in 2007. Under Section 72 of the Environment Act (2021) (Part IV/ Schedule 11), LAs are required to periodically review and assess air quality within their area of jurisdiction under the system of Local Air Quality Management (LAQM). This Review and Assessment of air quality involves comparing present and likely future pollutant concentrations against the AQOs. If it is predicted that levels at locations of relevant exposure, as summarised in **Error! Reference source not found.** are likely to be exceeded, the LA is required to declare an Air Quality Management Area (AQMA). For each AQMA the LA is required to produce an Air Quality Action Plan (AQAP), the objective of which is to reduce pollutant concentrations in pursuit of the AQOs.
- 2.2.5 The Air Quality (Wales) Regulations (2000) sets out objectives to reach a certain level of air quality within a given time period and work alongside Part IV of the Environment Act 1995. It requires county councils to produce an action plan and monitor the air quality in their area as part of a National Air Quality Strategy.

Dust deposition

- 2.2.6 Currently there is no statutory legislation in the UK governing dust deposition. A value commonly used^{9,10,11} in the UK to assess the potential for dust deposition to be noticeable and/or cause annoyance is a deposition rate of 200 mg/m²/day (as a monthly average). This value is said to represent the threshold for serious annoyance¹², although the literature contains a range of criteria from 133 mg/m²/day to 350 mg/m²/day and not a single figure. It is considered that serious annoyance arising from dust deposition would lead to complaints.

⁷ The Environment Agency. Environment Act 1995 (1995) [online] Accessed here: <https://www.legislation.gov.uk/ukpga/1995/25/contents> [Accessed June 2023]

⁸ The Environment Agency. Environment Act 2021 (2021) [online] Accessed here: <https://www.legislation.gov.uk/ukpga/2021/30/contents/enacted> [Accessed June 2023]

⁹ Pratt M S (1998) Heathrow 0.1 Terminal 5 Proof of Evidence Construction-Air Quality BAA/1471 and 1472.0.0.

¹⁰ Vallack, H.W. and Shillito, D.E. (1998) Suggested Guidelines for Deposited Ambient Dust. Atmospheric Environment, 32, pp. 2737-2744.

¹¹ Quality of Urban Air Group (1996), Airborne Particulate Matter in the United Kingdom, 3rd Report of the Quality of Urban Air Review Group, 1996.

¹² Bate K.J. and Coppin N.J. (1990) Impact of Dust from Mineral Workings, Paper presented to County Planning Officers Society Committee No. 3 Conference, Loughborough University, 19-21 Sept. 1990.

- 2.2.7 The Institute of Air Quality Management (IAQM) Guidance on Monitoring in the Vicinity of Demolition and Construction Sites¹³ also cites 200 mg/m²/day averaged over a 4-week period as a Suitable Site Action Level.

2.3 Technical guidance

- 2.3.1 Defra's Local Air Quality Management Technical Guidance (TG22) (LAQM.TG(22))¹⁴ provides guidance on understanding a diffusion tube survey and outlines the steps to be followed to process and annualise the data, where appropriate.
- 2.3.2 LAQM.TG(22) outlines the relationship between the annual mean and hourly (1-hour) mean NO₂ concentrations: 'For diffusion tube monitoring, it can be considered that exceedances of the NO₂ 1-hour objective may occur at roadside sites if the annual mean is above 60 µgm⁻³'.

¹³ IAQM (2018) Guidance on Monitoring in the Vicinity of Demolition and Construction Sites. [online] Accessed here: https://iaqm.co.uk/text/guidance/guidance_monitoring_dust_2018.pdf [Accessed June 2023]

¹⁴ Defra. Local Air Quality Management Technical Guidance 2022. [online] Accessed here: <https://laqm.defra.gov.uk/wp-content/uploads/2022/08/LAQM-TG22-August-22-v1.0.pdf> [Accessed June 2023]

3. Methodology

3.1 Introduction

- 3.1.1 The purpose of the air quality monitoring is to comply with the DCO Requirement 6 (d) (preparation of a DCAQMP) and Requirement 7 (a) (6 months of baseline air quality monitoring undertaken pre-construction) of the Proposed Development.
- 3.1.2 Consultation with the Environmental Health Officer of Gwynedd Council was undertaken in autumn 2022, with a method statement outlining the monitoring type and locations submitted. This was agreed in October 2022 with the monitoring commencing in November 2022.
- 3.1.3 Diffusion tube monitoring was undertaken at five locations of the eight agreed and monitoring of dust deposition using frisbee dust deposition gauges was undertaken at six locations. Some of these locations were shared between monitoring type.

3.2 Sensitive receptors

- 3.2.1 A sensitive receptor is defined as any location which may be affected by a change in air quality because of the Proposed Development. These receptors (identified in **Table 3.1** and **Figure 1**) were identified in the 2015 ES chapter as they may be near specific activities with a high potential to generate dust when construction activities start.

Figure 1: Location of sensitive receptors

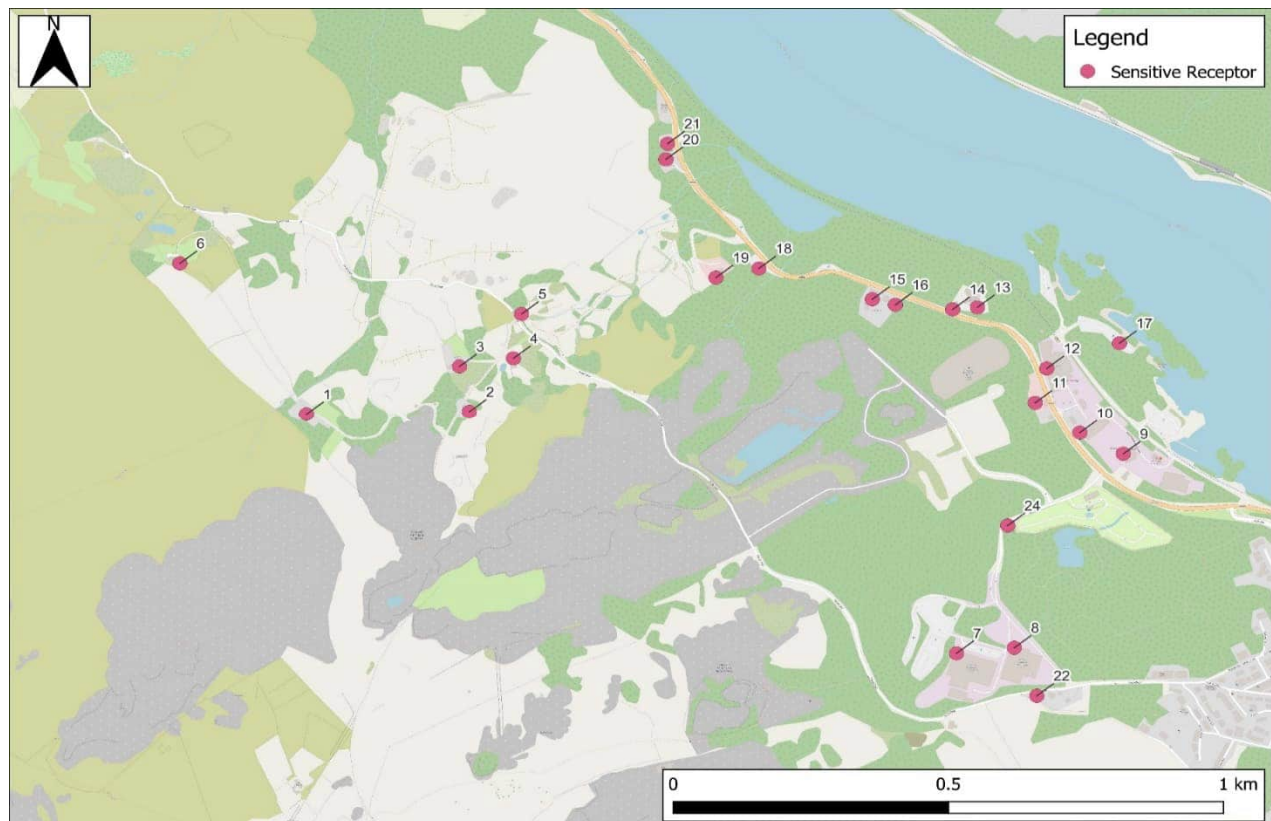


Table 3.1 Sensitive locations near construction activities

ID	Grid Co-ordinates		Location	Type	Approximate distance (m) to activities	
					Construction/excavation/ stockpiling	Temporary depot site
1	255796	360922	Llys Ellen	Residential	-	-
2	256092	360927	Ty-Newydd	Residential	410 (Q6)	-
3	256074	361017	Ty-Newydd	Residential	455 (Q6)	-
4	256172	361033	Ty-Newydd	Residential	375 (Q6)	500 (Turbine)
5	256187	361121	Groeslon	Residential	420 (Q6)	-
6	255566	361221	Pen-draw	Residential	-	-
7	256977	360447	Siemens	Hi-Tech	360 (Q6)	400 (Turbine)
8	257082	360458	Siemens	Hi-Tech	390 (Q6)	450 (Turbine)
9	257280	360842	Ynys-wen	Commercial	375 (Q6) 280 (Spillway)	460 (Depot)
10	257201	360884	Pen-gilfach	Industrial	300 (Q6) 200 (Spillway)	370 (Depot)
11	257120	360945	Gallt-y-glyn	Hotel	240 (Q6) 100 (Spillway)	390 (Turbine) 270 (Depot)
12	257141	361013	DMM	Industrial	280 (Q6)	440 (Turbine) 285 (Depot)

ID	Grid Co-ordinates		Location	Type	Approximate distance (m) to activities	
					Construction/excavation/ stockpiling	Temporary depot site
13	257015	361134	Mountain Centre	Amenity	190 (Q6) 70 (Spillway)	390 (Turbine) 200 (Depot)
14	256970	361130	Mountain Centre	Amenity	160 (Q6) 90 (spillway)	360 (Turbine) 170 (Depot)
15	256824	361150	Glyn Peris	Residential	60 (Q6) 130 (spillway)	300 (Turbine) 75 (Depot)
16	256866	361139	Glyn Peris	Residential/Commercial	85 (Q6) 115 (Spillway)	300 (Turbine) 100 (depot)
17	257273	361063	Car Park	Amenity	420 (Q6) 0 (Spillway)	360 (Depot)
18	256618	361211	Lake View Hotel	Residential/Commercial	180 (Q6) 300 (Spillway)	200 (Turbine) 360 (Depot)
19	256540	361193	Off A4086	Commercial	185 (Q6) 360 (Spillway)	245 (Turbine) 380 (Depot)
20	256449	361427	Hafod Wen	Residential	430 (Q6)	475 (Depot)
21	256452	361458	Tan-y-ffynnon	Residential	450 (Q6)	500 (Depot)
22	257123	360363	Ael-y-Glyn	Residential	490 (Q6)	-
23	-	-	Llyn Padarn	SSSI	0 (Spillway)	-
24	257070	360700	Permitted Caravan park	Residential/Amenity	200 (Q6) 300 (Spillway)	320 (Turbine)

3.3 Monitoring Locations

Passive diffusion tubes

- 3.3.1 The original location and number of sites were agreed with the EHO in October 2022. From the 11th November 2022, diffusion tube measurements were undertaken at five locations given in **Table 3.2** and as illustrated in **Figure 2**.
- 3.3.2 The NO₂ concentrations were measured using diffusion tubes that were prepared in accordance with SOCOTEC's standard operating procedure ANU/SOP/1015. This method meets the guidelines set out in Defra's 'Diffusion tubes for ambient NO₂ monitoring: practical guidance'¹⁵.
- 3.3.3 The tubes were prepared by spiking acetone-triethanolamine (50:50) onto the grids prior to the tubes being assembled. The tubes were desorbed with distilled water and the extract analysed using a segmented flow auto analyser with ultraviolet detection.
- 3.3.4 As only short-term monitoring was undertaken, annual data capture was below 75% for the year. Therefore, it was necessary to annualise the datasets in line with the guidance provided in Chapter 7, Section 2 of the LAQM.TG(22). Annualisation is required as pollutant concentrations vary throughout the year as a result of the prevailing meteorological conditions.
- 3.3.5 Data capture for the monitoring period was not 100% at all monitoring locations. This is since there were on-going road works in the area during the monitoring period which meant that access to diffusion tubes at monitoring locations 1,3 and 4 was limited.

Frisbee dust deposition gauges

- 3.3.6 From the 11th November 2022, frisbee dust deposition gauges were deployed at six locations, shown in **Figure 2** and **Table 3.2**Error! Reference source not found..
- 3.3.7 A dust sample is collected in a large capacity collection bottles at the base of the unit. Gauges are fitted with a stainless steel and nylon bird guard to avoid extraneous contamination and mounted on a tripod which can be spiked into the ground for increased stability.

¹⁵ AEA Energy and Environment *Diffusion tubes for ambient NO₂ monitoring: practical guidance (2008)* [online] Available at: https://laqm.defra.gov.uk/documents/0802141004_NO2_WG_PracticalGuidance_Issue1a.pdf [Accessed June 2023]

Figure 2: Air quality Monitoring Locations



Table 3.2 Site details for the monitoring locations

Site ID	Site Name	Grid Co-ordinates		Monitoring Method	Reason
1	Glyn Peris guesthouse	256866	361139	Diffusion tubes to measure the concentration of atmospheric NO ₂	The properties to the east of the site are in proximity to the tail pond and tailrace area and the main road. A conveyor route is also proposed to be located near this boundary that is a specific potential source of dust.
2	Lake View hotel	256618	361211	Frisbee gauge monitoring units to measure the rate of deposited dust. Diffusion tubes to measure the concentration of atmospheric NO ₂ .	Monitoring in this area will be used to protect these locations from potential emissions of dust and engine exhaust pollutants.
3	Site access/exit	257151	360746	Frisbee gauge monitoring units to measure the rate of deposited dust. Diffusion tubes to measure the concentration of atmospheric NO ₂ .	The main site access point represents a potential significant location for construction dust emissions due to vehicle track-out. It is not specifically near any sensitive locations but monitoring in this area is a cautious approach to protect receptors near the main access routes from emissions from track-out and engine exhaust pollutants.
4	Tailrace working area	256779	360782	Frisbee gauge monitoring units to measure the rate of deposited dust. Diffusion tubes to measure the concentration of atmospheric NO ₂ .	The working area from the tail pond to Llyn Padarn will be near commercial, industrial and amenity locations. Monitoring in this area will be used to protect these receptors from emissions during this work.
5	Southeast boundary of the head pond area	255365	359877	Frisbee gauge monitoring units to measure the rate of deposited dust.	Monitoring dust near the working areas of potentially significant dust generating activities will be used for the protection of the surrounding land and receptors.
6	Southwest boundary of the head pond area	255047	359888	Frisbee gauge monitoring units to measure the rate of deposited dust.	Monitoring dust near the working areas of potentially significant dust generating activities

Site ID	Site Name	Grid Co-ordinates		Monitoring Method	Reason
					will be used for the protection of the surrounding land and receptors.
7	West side of the tail pond area	256593	360768	Frisbee gauge monitoring units to measure the rate of deposited dust.	Monitoring dust near the working areas of potentially significant dust generating activities will be used for the protection of the surrounding land and receptors.
8	Public Highway through Llanberis	257161	360940	Diffusion tubes to measure the concentration of atmospheric NO ₂ .	Monitoring on the main route through Llanberis will be used to protect receptors from vehicle exhaust emissions on the road access route to the site.

4. Results

4.1 Summary of diffusion tube monitoring

- 4.1.1 Diffusion tube monitoring data was collected from the 11th November 2022 to 4th May 2023. Annual mean NO₂ concentrations are summarised in **Table 4.1**.
- 4.1.2 **Appendix B** details the diffusion tube exposure periods, as well as the raw monthly diffusion tube data.

Table 4.1 Annual mean NO₂ concentrations

Site ID	Site Name	Period data capture (%)	Annual data capture (%)	Unadjusted annual mean (µgm ⁻³)	Adjusted annual mean (µgm ⁻³)
1	Glyn Peris guesthouse	66.7%	30.7	23.2	9.8
2	Lake View hotel	100.0%	47.7	19.0	10.0
3	Site access/exit	83.3%	40.0	7.3	3.5
4	Tailrace working area	83.3%	40.0	3.1	1.5
8	Public Highway through Llanberis	100.0%	47.7	10.9	5.7

Table notes:

Adjusted annual mean has been annualised and bias adjusted. The diffusion tube data has been corrected for bias using a national adjustment factor of 0.76. The national database of diffusion tube co-location surveys provides bias factors for the relevant laboratory and preparation method. Spreadsheet version 03/23 was used. The laboratory used for this monitoring is SOCOTEC Didcot who use a 50% TEA in acetone preparation method.

- 4.1.3 All measured NO₂ concentrations at all locations were well below the annual mean AQO of 40 µgm⁻³. The maximum adjusted annual mean concentration of 10.0 µgm⁻³ was measured at monitoring location No.2 (Lake View Hotel).
- 4.1.4 The annual mean NO₂ concentrations measured at each site are well below 60 µgm⁻³, therefore, it is unlikely that exceedance of the hourly mean NO₂ AQO will have occurred during the course of the year.

4.2 Summary of dust deposition monitoring

- 4.2.1 Dust deposition measured using frisbee dust deposition gauges was collected from the 11th November to 4th May 2023. A summary of the data is shown in Table 4.2

Table 4.2 Average daily dust deposition (mg/m²/day)

Site ID	Site Name	November	December	January	February	March	April
2	Lake View hotel	27	26	28	11	78	123
3	Site access/exit	19	17	10	13	44	58
4	Tailrace working area	12	29	10	11	11	36
5	SE of head pond	11	7	5	6	2	26
6	SW of head pond	10	10	11	6	6	10
7	West of tail pond	28	8	7	5	2	-

- 4.2.2 The maximum monitored average daily dust deposition was observed at monitoring location No.2 (Lake View Hotel) in April. Dust deposition was well below the Site Action Level of 200 mg/m²/day recommended by the IAQM.

5. Conclusion

- 5.1.1 This report summarises the NO₂ diffusion tube and frisbee dust deposition monitoring undertaken between November 2022 and April 2023 at the Proposed Development.
- 5.1.2 Diffusion tube monitoring data collected from the 11th November 2022 to the 4th May 2023 at five sites (Nos. 1, 2, 3, 4 and 8) has been presented in this report. Over the monitoring period, the maximum adjusted NO₂ concentration was 10.0 µgm⁻³, measured at monitoring location No.2 (Lake View Hotel). At all monitoring locations, concentrations were well below the annual mean AQO of 40 µgm⁻³.
- 5.1.3 Dust deposition has been undertaken using frisbee dust deposition gauges collected from the 11th November 2022 to the 4th May 2023. A summary of the data has been presented in this report. Dust deposition was well below the Site Action Level recommended by the IAQM.
- 5.1.4 As a result of the ambient air quality monitoring undertaken, using both NO₂ diffusion tubes and frisbee dust deposition gauges, overall air quality within the study area over the monitoring period was considered to be good with results showing that levels are well within respective AQOs or recommended levels.
- 5.1.5 The purpose of this baseline monitoring (as secured by Requirement 6 and 7(a)), is to establish action trigger criteria to be applied in construction phase monitoring should occur once construction activities have commenced. Since results show to be well below the Site Action Level of 200 mg/m²/day (as recommended by the IAQM), this can be recommended as an action trigger level to consider for on-site monitoring during construction. This will help identify if levels of dust deposition from construction activities are likely to be affecting local air quality at the time.
- 5.1.6 It is therefore considered that representative baseline conditions have been monitored, against which further consultation with Gwynedd Council can be undertaken and the DCAQMP can be finalised with agreed limits for the construction phase activities.

APPENDIX A: Glossary

Term	Definition
Accuracy	A measure of how well a set of data fits the true value
Air Quality Objective	Policy target generally expressed as a maximum ambient concentration to be achieved, either without exception or with a permitted number of exceedances within a specific timescale
Air Quality Standard	The concentrations of pollutants in the atmosphere which can broadly be taken to achieve a certain level of environmental quality. The standards are based on the assessment of the effects of each pollutant on human health including the effects on sensitive subgroups (see also air quality strategy objective).
Annual mean	The average (mean) of the concentrations measured for each pollutant for one year
AQS	Air Quality Strategy
Data capture	The percentage of all the possible measurements for a given period that were validly measured
DCAQMP	Dust Control and Air Quality Management Plan
DCO	Development Consent Order
Defra	Department for Environment, Food and Rural Affairs
EHO	Environmental Health Officer
Exceedance	A period of time where the concentration of a pollutant is greater than the appropriate air quality standard.
IAQM	Institute of Air Quality Management
LAQM	Local Air Quality Management
NO₂	Nitrogen Dioxide
µgm⁻³ micrograms per cubic metre	A measure of concentration in terms of mass per unit volume. A concentration of 1µg/m ³ means one cubic metre of air contains one microgram (millionth of a gram) of pollutant.

APPENDIX B: NO₂ Monitoring data

Duplicate diffusion tubes are exposed at each monitoring location, ensuring anomalous data can be easily identified and discounted, where appropriate. Diffusion tubes are deployed in the field by WSP staff each month and are sent to the lab for subsequent analysis. The tables below provide a summary of the data processing.

Table B.1: Diffusion tube monitoring exposure periods

Month ID	Date on	Date off	Total exposure period (days)
November 2022	11/11/2022	07/12/2022	26
December 2022	07/12/2022	05/01/2023	29
January 2023	05/01/2023	02/02/2023	28
February 2023	02/02/2023	02/03/2023	28
March 2023	02/03/2023	05/04/2023	34
April 2023	05/04/2023	04/05/2023	29

Table B.2: Raw monthly diffusion tube monitoring results

Site ID	Site name	Duplicate	Raw monthly NO2 concentration (μgm^{-3})												Unadjusted annual mean (μgm^{-3})	Adjusted annual mean (μgm^{-3})
			Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct		
1	Glyn Peris guesthouse	DT1	23.2	24.3	22.1	-	-	26.3	-	-	-	-	-	-	22.5	8.0
		DT2	21.9	20.6	22.9	-	-	24.3	-	-	-	-	-	-		
2	Lake View hotel	DT1	19.1	16.6	16.5	17.2	19.5	23.3	-	-	-	-	-	-	18.6	9.0
		DT2	17.9	15.6	17.8	20.9	22.3	21.7	-	-	-	-	-	-		
3	Site access/exit	DT1	7.6	6.9	8.3	-	9.2	6.6	-	-	-	-	-	-	7.6	3.2
		DT2			7.7	-	5.8	5.1	-	-	-	-	-	-		
4	Tailrace working area	DT1			1.7	2.4	2.6	-	-	-	-	-	-	-	3.1	1.5
		DT2			3.0	1.8	2.7	-	-	-	-	-	-	-		
8	Public Highway through Llanberis	DT1			10.9	10.4	7.3	8.6	-	-	-	-	-	-	11.4	5.5
		DT2	14.0	14.9	12.1	10.1	8.9	8.2	-	-	-	-				

Adjusted annual mean has been annualised and bias adjusted. The diffusion tube data has been corrected for bias using a national adjustment factor of 0.76. The national database of diffusion tube co-location surveys provides bias factors for the relevant laboratory and preparation method. Spreadsheet version 03/23 was used. The laboratory used for this monitoring is SOCOTEC Didcot who use a 50% TEA in acetone preparation method. Annualisation of diffusion tube data is necessary where there is less than nine months of data and at least three months data available at a monitoring site.

Table B.3: Annualisation summary

Site ID	Site name	Diffusion tube ID	Annualisation factor Wrexham	Annualisation factor Marchlyn Mawr	Average annualisation factor	Raw data simple annual mean (μgm^{-3})	Annualised data simple annual mean (μgm^{-3})
1	Glyn Peris guesthouse	DT 1	0.6304	0.4840	0.5572	23.2	12.9
		DT 2	0.6304	0.4840	0.5572		
2	Lake View hotel	DT 3	0.7321	0.6531	0.6926	19.0	13.2
		DT 4	0.7321	0.6531	0.6926		
3	Site access/exit	DT 5	0.6907	0.5672	0.6290	7.3	4.6
		DT 6	0.6907	0.5672	0.6290		
4	Tailrace working area	DT 7	0.6795	0.5918	0.6357	3.1	2.0
		DT 8	0.6795	0.5918	0.6357		
8	Public Highway through Llanberis	DT 9	0.7321	0.6531	0.6926	10.9	7.5
		DT 10	0.7321	0.6531	0.6926		

Table B.4: Diffusion tube bias adjustment factor

Site	Annualised data annual mean	Bias adjusted (national factor 0.76)
1	23.2	9.8
2	19.0	10.0
3	7.3	3.5
4	3.1	1.5
8	10.9	5.7

Table notes:

The diffusion tube data has been corrected for bias using a 2022 national adjustment factor of 0.76. Bias represents the overall tendency of the diffusion tubes to under or over read relative to the reference chemiluminescence analyser. Overall factors have been calculated using orthogonal regression to allow for uncertainty in both automatic monitors and diffusion tubes.

The national database of diffusion tube co-location surveys provides bias factors for the relevant laboratory and preparation method. Spreadsheet version 03/23 was used. The laboratory used for this monitoring is SOCOTEC Didcot who use a 50% TEA in acetone preparation method.