Snowdonia VIP – Air Quality Assessment

HOCHTIEF (UK) Construction Ltd

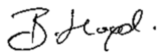
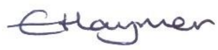
December 2024

Document Control Sheet

Identification	
Client	HOCHTIEF (UK) Construction Ltd
Document Title	Snowdonia VIP – Air Quality Assessment
Bureau Veritas Ref No.	AIR20761597

Contact Details		
Company Name	Bureau Veritas UK Ltd	HOCHTIEF (UK) Construction Ltd
Contact Name	Emma Haymer	David Grantham
Position	Principal Consultant	Environmental and Sustainability Manager
Address	Atlantic House, Atlas Business Park, Simonsway, Wythenshawe, Manchester, M22 5PR	Whitehill House Windmill Hill Business Park Whitehill Way Swindon Wiltshire SN5 6PE
E-Mail	emma.haymer@bureauveritas.com	David.Grantham@hochtief.co.uk

Configuration				
Version	Date	Author	Reason for Issue/Summary of Changes	Status
1.0	30/10/2024	B Lloyd	First issue	Draft
1.1	19/12/2024	E Thomas	Updated Version following Ecological Assessment	Final

	Name	Job Title	Signature
Prepared By	B Lloyd	Assistant Consultant	
Approved By	E Haymer	Principal Consultant	

Disclaimer

This Report was completed by Bureau Veritas on the basis of a defined programme of work and terms and conditions agreed with the Client. Bureau Veritas confirms that in preparing this Report it has exercised all reasonable skill and care taking into account the project objectives, the agreed scope of works, prevailing site conditions and the degree of manpower and resources allocated to the project.

Bureau Veritas accepts no responsibility to any parties whatsoever, following the issue of the Report, for any matters arising outside the agreed scope of the works.

This Report is issued in confidence to the Client and Bureau Veritas has no responsibility to any third parties to whom this Report may be circulated, in part or in full, and any such parties rely on the contents of the report solely at their own risk.
Unless specifically assigned or transferred within the terms of the agreement, the consultant asserts and retains all Copyright, and other Intellectual Property Rights, in and over the Report and its contents.

Any questions or matters arising from this Report should be addressed in the first instance to the Project Manager.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

HOCTIEF (UK) Construction Ltd has commissioned Bureau Veritas UK to undertake a detailed air quality assessment to support an environmental permit (EP) application for planned construction works that will be part of the Snowdonia Visual Impact Project (VIP), Garth, Snowdonia. The site location is presented in Figure 1.1.

The permit has been prompted due to the planned installation of six generators at the site, which will be in operation for at least 12 months. The environmental permitting regulations (EPR)[1], which transpose the Medium Combustion Plant Directive (MCPD)[2] specify that environmental permits must be sought if a site operates combustion plant between 1 MW_{th} and 50 MW_{th}.

The requirement for an air quality assessment was prompted by National Resources Wales (NRW) after an air quality modelling assessment screening using the Simple Calculation of Atmospheric Impact Limits (SCAIL) combustion tool indicated that dispersion modelling would be required in order to evaluate the potential air quality impacts arising from emissions from the proposed installation of the generators.

1.1 Process Description

A Tunnel Boring Machine (TBM) will need to be used for approximately 12 months, starting January 2025. The construction site concerned has a mains power supply. However, the TBM requires a separate supply because the mains supply is insufficient for the TBM. Therefore, the generators will also be classed as 'Specified Generators' (i.e., combustion plant that generates electricity), given their purpose is the supplement the power supply for the TBM. These generators would fall into the category of 'Tranche B' specified generators.

Therefore, HOCTIEF has identified a requirement to hold an MCP and specified generator environmental permit for the following generators at their site in Snowdonia:

- Six No. 1250 KVA units and one ancillary unit 1250 KVA.

Using a power factor of 0.8 to convert from KVA to kW_{th}, this means each unit is 1,000 kW_{th}, or 1 MW_{th}.

Three of the six generators will be operated from January 2025, with an additional two coming into operation in April. The sixth generator will be a backup and will not be operational unless required.

1.2 Scope of Assessment

An initial screening of emissions to air was carried out by Bureau Veritas UK using the SCAIL combustion tool as per the NRW guidance[3].

For those operational emissions not screened out by the SCAIL combustion tool as being either insignificant or not significant, detailed dispersion modelling is required in order to more precisely determine their significance. The SCAIL combustion tool screening assessment concluded the need for dispersion modelling of NO_x emissions from the proposed plant to more precisely assess the impacts from activities at sensitive ecological receptors located around the Site. Emissions of CO, PM_{10}, $PM_{2.5}$ and SO_2 have also been assessed for completeness.

1.3 Site Description

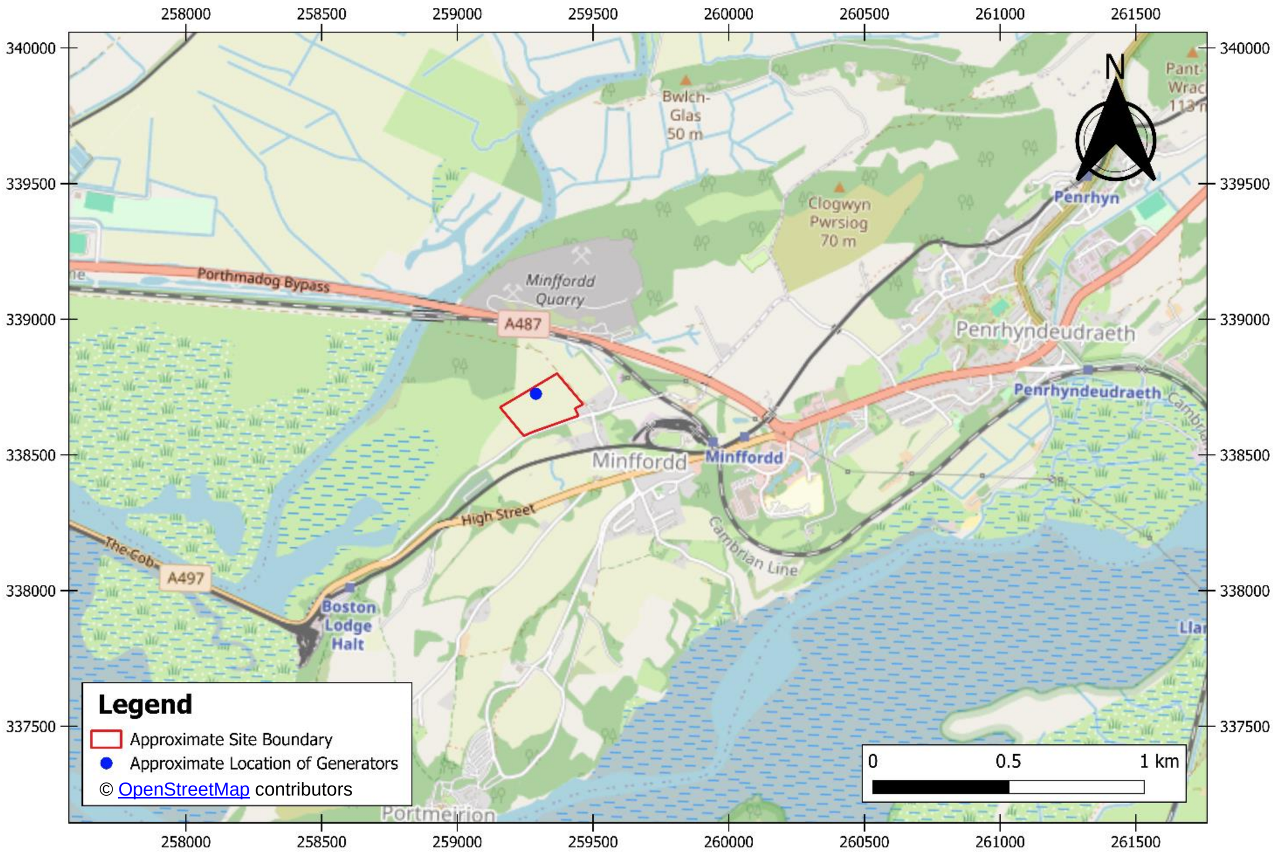
The Site is located along ffordd Tan-y-Glannau in the village of Minffordd within the Welsh county of Gwynedd. The surrounding land use is predominantly residential to the south-east of the Site, with agricultural land to the north-east. To the north-west of the Site lies open countryside, some of which is protected.

[1] https://www.legislation.gov.uk/uksi/2016/1154
[2] https://www.legislation.gov.uk/ukdsi/2018/9780111163023/regulation/16

[3]National Resources Wales, What to do before you apply for a standalone Medium Combustion Plant (MCP) permit between 1 and less than 20 MW thermal input, Available at: https://naturalresources.wales/permits-and-permissions/medium-combustion-plants-and-specified-generators/what-to-do-before-you-apply-for-a-standalone-medium-combustion-plant-mcp-permit-between-1-and-less-than-20-mw-thermal-input/?lang=en

The closest ecological receptors are Coedydd Derw a Safleoedd Ystlumod Meirion / Meirionnydd Oakwoods and Bat Sites, a Special Area of Conservation (SAC) designated as bog woodland, and Glaslyn, a Site of Special Scientific Interest (SSSI) designated as semi-natural woodland. These ecological receptors cover the same land bordering the north-west corner of the Site, approximately 77 m away from the emissions points.

Figure 1.1 – Site Location and Approximate Boundary



2 DISPERSION MODELLING METHODOLOGY

ADMS 6 (version 6.0.0.1) has been used for the dispersion modelling of process emissions from the Site. ADMS 6 is an advanced atmospheric dispersion model that has been developed and validated by Cambridge Environmental Research Consultants (CERC). The model has been used extensively throughout the UK for regulatory compliance purposes and is accepted as an appropriate air quality modelling tool by the Environment Agency and local authorities.

ADMS 6 parameterises stability and turbulence in the atmospheric boundary layer (ABL) by the Monin-Obukhov length and the boundary layer depth. This approach allows the vertical structure of the ABL to be more accurately defined than by the stability classification methods of earlier dispersion models such as R91 or ISCST3. In ADMS, the concentration distribution follows a symmetrical Gaussian profile in the vertical and crosswind directions in neutral and stable conditions. However, the vertical profile in convective conditions follows a skewed Gaussian distribution to take account of the inhomogeneous nature of the vertical velocity distribution in the Convective Boundary Layer (CBL).

A number of complex modules, including the effects of plume rise, complex terrain, coastlines, concentration fluctuations, radioactive decay and buildings effects, are also included in the model, as well as the facility to calculate long-term averages of hourly mean concentration, dry and wet deposition fluxes, and percentile concentrations, from either statistical meteorological data or hourly average data.

A range of input parameters is required including, among others, data describing the local area, meteorological measurements and emissions data. The data used in modelling the emissions are given in the following sections of this chapter.

2.1 Process Emissions

Details of the six proposed generators to be assessed at the Site have been provided to Bureau Veritas by Hochtief UK. Appropriate emission rates have been informed by the Exhaust Emission Declaration provided by Volvo Penta and the HVO Spec Sheet from Crown Oil Ltd.

Six generators will be installed at the site, with three expected to operate from January 2025 and an additional two coming into operation in April 2025. The sixth generator is a backup and will not operate unless any of the generators require replacing. Therefore, details for the individual generators included within the assessment are shown in Table 2.1 below.

Table 2.1 – Installation and Generator Details

Reference	Make and Model	Rated Thermal Input (MW)	Expected Annual Operating Hours	Fuel	Approximate Commissioning Date	Emissions Rate (g/s)			
						NO_x	SO_2	PM_{10}	CO
Generators 1-3	Volvo Penta Engine Type TWD1683GE (stage 5)	2.61	8760	HVO Fuel	January 2025	0.0590	0.000268	0.00197	0.0131
Generators 4&5	Volvo Penta Engine Type TWD1683GE (stage 5)	2.61	5880	HVO Fuel	April 2025	0.0590	0.000268	0.00197	0.0131

The emissions from individual generators will be combined and released to the air through two 20 m concrete silos on 0.75 m concrete bases. Therefore, the plant included within the assessment, defined as the Process Contribution (PC), are as follows:

- Silo 1 – Combined emissions stack for generators 1, 2 and 3;
- Silo 2 - Combined emissions stack for generators 4 and 5.

The parameters and emissions rates used within the assessment for each stack emission source are detailed in Table 2.2 below.

Table 2.2 – Model Input Parameters

Parameter	Silo 1	Silo 2
Operating Hours	8,760	5,880
Stack Height (m)	20.75	20.75
Stack Diameter (m)	0.85	0.85
Stack Gas Temperature (°C)	200.00	200.00
Stack Volume Flow (Am^3/s)	10.40	6.93
Stack Gas Velocity	18.33	12.22
NO_x (g/s)	1.77×10^{-1}	1.18×10^{-1}
SO_2 (g/s)	8.05×10^{-4}	5.36×10^{-4}
PM_{10} (g/s)	5.90×10^{-3}	3.93×10^{-3}
CO (g/s)	3.93×10^{-2}	2.62×10^{-2}
(X,Y)	(259301,338733)	(259283,338724)

2.2 Meteorology

For meteorological data to be suitable for dispersion modelling purposes, a number of meteorological parameters need to be measured on an hourly basis. These parameters include wind speed, wind direction, cloud cover and temperature. There are only a limited number of monitoring sites where the required meteorological measurements are made. The year of meteorological data that is used for a modelling assessment can also have a significant effect on ground level concentrations.

As the closest meteorological station (Capel Curi, 22 km away from the Site) showed a large difference in elevation from the Site, this assessment has utilised Numerical Weather Prediction (NMP) data across a five-year period (2019 to 2023). Figure 2.1 - Figure 2.5 illustrate the frequency of wind directions and wind speeds for the years considered.

ADMS cannot, as standard, model calm weather conditions, since this results in a discontinuity produced by a 'divide by zero' calculation. Most Gaussian plume models simply skip lines of meteorological data where calm conditions occur. Met lines will also be skipped where any of the required meteorological input parameters are missing. The generally accepted best practice requirement is to ensure that no more than 10% of meteorological data is omitted from the model run. Table 2.3 demonstrates that this requirement was satisfied for the meteorological 'met' data years proposed for the assessment.

Table 2.3 – Meteorological Data Capture

Year	Number of meteorological lines used	Number of meteorological lines with calm conditions (i.e. wind speed value <0.3 m/s)	Number of meteorological lines with inadequate data	Number of non-calm meteorological lines with wind speed less than the minimum value of 0.75 m/s	Percentage of meteorological lines used (%)
2019	8591	5	0	164	98.1
2020	8571	2	0	211	97.6
2021	8448	8	0	304	96.4
2022	8535	6	0	219	97.4
2023	8577	3	0	180	97.9

Figure 2.1 – 2019 Wind Rose

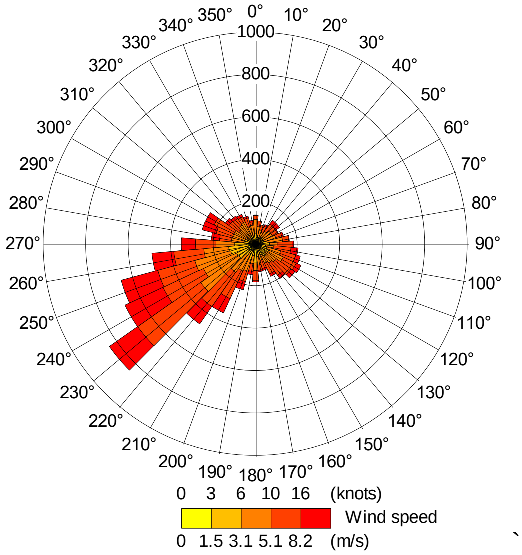


Figure 2.2 – 2020 Wind Rose

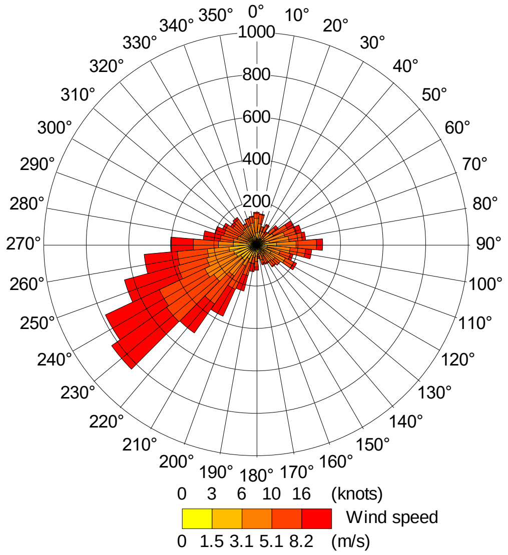


Figure 2.3 – 2021 Wind Rose

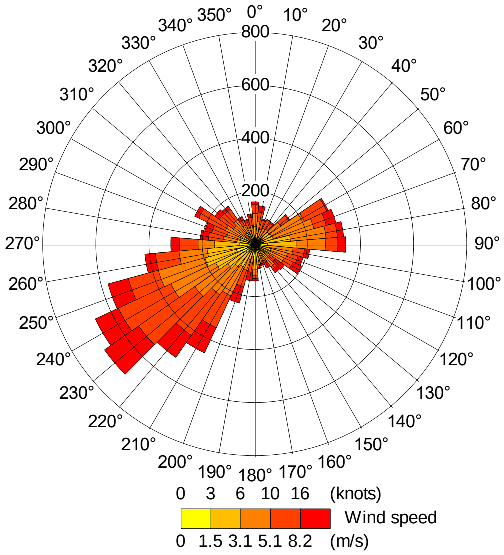


Figure 2.4 – 2022 Wind Rose

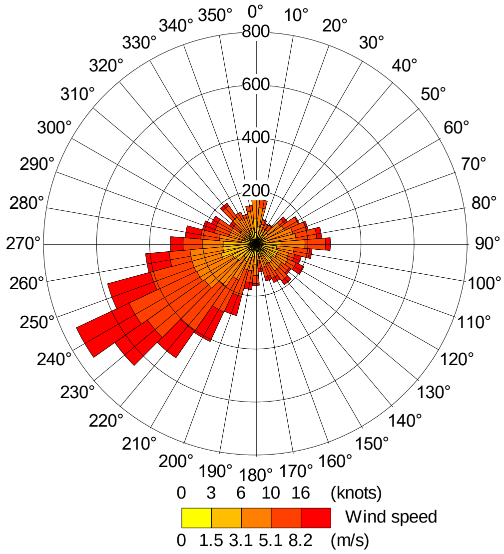
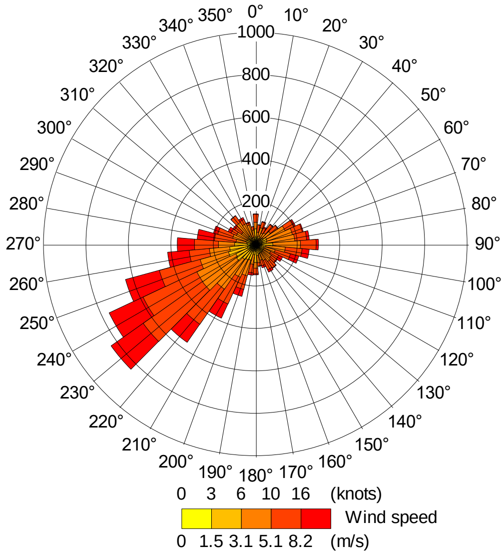


Figure 2.5 – 2023 Wind Rose



2.3 Surface Characteristics

The predominant surface characteristics and land use in a model domain have an important influence in determining turbulent fluxes and, hence, the stability of the boundary layer and atmospheric dispersion. Factors pertinent to this determination are detailed below.

2.3.1 Surface Roughness

Roughness length, z_0, represents the aerodynamic effects of surface friction and is physically defined as the height at which the extrapolated surface layer wind profile tends to zero. This value is an important parameter used by meteorological pre-processors to interpret the vertical profile of wind speed and estimate friction velocities which are, in turn, used to define heat and momentum fluxes and, consequently, the degree of turbulent mixing.

The surface roughness length is related to the height of surface elements; typically, the surface roughness length is approximately 10% of the height of the main surface features. Thus, it follows that surface roughness is higher in urban and congested areas than in rural and open areas. Oke (1987) and CERC (2003) suggest typical roughness lengths for various land use categories as presented within Table 2.4 below.

Table 2.4 – Typical Surface Roughness Lengths for Various Land Use Categories

Type of Surface	z_0 (m)
Ice	0.00001
Smooth snow	0.00005
Smooth sea	0.0002
Lawn grass	0.01
Pasture	0.2
Isolated settlement (farms, trees, hedges)	0.4
Parkland, woodlands, villages, open suburbia	0.5-1.0
Forests/cities/industrialised areas	1.0-1.5
Heavily industrialised areas	1.5-2.0

Increasing surface roughness increases turbulent mixing in the lower boundary layer. This can often have conflicting impacts in terms of ground level concentrations:

- The increased mixing can bring portions of an elevated plume down towards ground level, resulting in increased ground level concentrations closer to the emission source; however; and
- The increased mixing increases entrainment of ambient air into the plume and dilutes plume concentrations, resulting in reduced ground level concentrations further downwind from an emission source.

The overall impact on ground level concentration is, therefore, strongly correlated to the distance and orientation of a receptor from the emission source.

2.3.2 Surface Energy Budget

One of the key factors governing the generation of convective turbulence is the magnitude of the surface sensible heat flux. This, in turn, is a factor of the incoming solar radiation. However, not all solar radiation arriving at the Earth's surface is available to be emitted back to atmosphere in the form of sensible heat. By adopting a surface energy budget approach, it can be identified that, for fixed values of incoming short and long wave solar radiation, the surface sensible heat flux is inversely proportional to the surface albedo and latent heat flux.

The surface albedo is a measure of the fraction of incoming short-wave solar radiation reflected by the Earth's surface. This parameter is dependent upon surface characteristics and varies throughout the year. Oke (1987) recommends average surface albedo values of 0.6 for snow covered ground and 0.23 for non-snow-covered ground, respectively.

The latent heat flux is dependent upon the amount of moisture present at the surface. The Priestly-Taylor parameter can be used to represent the amount of moisture available for evaporation:

$$\alpha = \frac{1}{S(B+1)}$$

Where:

α = Priestly-Taylor parameter (dimensionless)

$$S = \frac{s}{s+\gamma}$$

$$s = \frac{de}{dT}$$

e_s= Saturation specific humidity (kg H_2O / kg dry air)

T = Temperature (K)

$$\gamma = \frac{c_{pw}}{\lambda}$$

c_{pw} = Specific heat capacity of water (kJ kg^{-1} K^{-1})

λ = Specific latent heat of vaporisation of water (kJ kg^{-1})

B = Bowen ratio (dimensionless)

Areas where moisture availability is greater will experience a greater proportion of incoming solar radiation released back to atmosphere in the form of latent heat, leaving less available in the form of sensible heat and, thus, decreasing convective turbulence. Holstag and van Ulden (1983) suggest values of 0.45 and 1.0 for dry grassland and moist grassland respectively.

2.3.3 Selection of Appropriate Surface Characteristic Parameters for the Site

A detailed analysis of the effects of surface characteristics on ground level concentrations by Auld et al. (2002) led to a conclusion, with respect to uncertainty in model predictions:

> *"…the energy budget calculations had relatively little impact on the overall uncertainty"*

In this regard, it is not considered necessary to vary the surface energy budget parameters spatially or temporally, and annual averaged values have been adopted throughout the model domain for this assessment.

As snow covered ground is only likely to be present for a small fraction of the year, the surface albedo of 0.23 for non-snow-covered ground advocated by Oke (1987) has been used whilst the model default α value of 1.0 has also been retained.

From examination of 1:10,000 Ordnance Survey maps and satellite imagery, it can be seen that within the immediate vicinity of the site, land use is predominately open land and residential. Consequently, a composite surface roughness length of 0.3 m was used in the model to account for the different surface roughness lengths within the model domain and around the meteorological site.

2.4 Buildings

Any large, sharp-edged object has an impact on atmospheric flow and air turbulence within the locality of the object. This can result in maximum ground level concentrations that are significantly different (generally higher) from those encountered in the absence of buildings. The building 'zone of influence' is generally regarded as extending a distance of 5L (where L is the lesser of the building height or width) from the foot of the building in the horizontal plane and three times the height of the building in the vertical plane.

The inclusion of buildings within the model can lead to a significant increase in predicted ground concentrations as plume dispersion is hindered by the presence of buildings and plume grounding occurs closer to the site than would otherwise be expected. As the nearest buildings are residential homes situated approximated 200 m away from the emissions points, it was not necessary to include buildings within the model.

2.5 Model Domain and Receptors

2.5.1 Model Domain

To assess the impact of atmospheric emissions from the site on local air quality, pollutant concentrations were output to a 2 km x 2 km Cartesian grid centred on the site, with an approximate receptor resolution of 10 m. This grid resolution has been selected to ensure that all local receptors are within the gridded area and the resolution is such that the maximum impact will be identified and is finer than the recommended minimum gridded resolution of 1.5 times the stack height.

2.5.2 Human Receptors

The receptors considered were chosen based on locations where people may be located and judged in terms of the likely duration of their exposure to pollutants and proximity to the site, following the guidance given in Section 4 of this report. Details of the locations of human receptors are given in Table 2.5 and illustrated in Figure 2.6. Human receptors have been modelled at a height of 1.5 m, representative of the normal 'breathing zone' height.

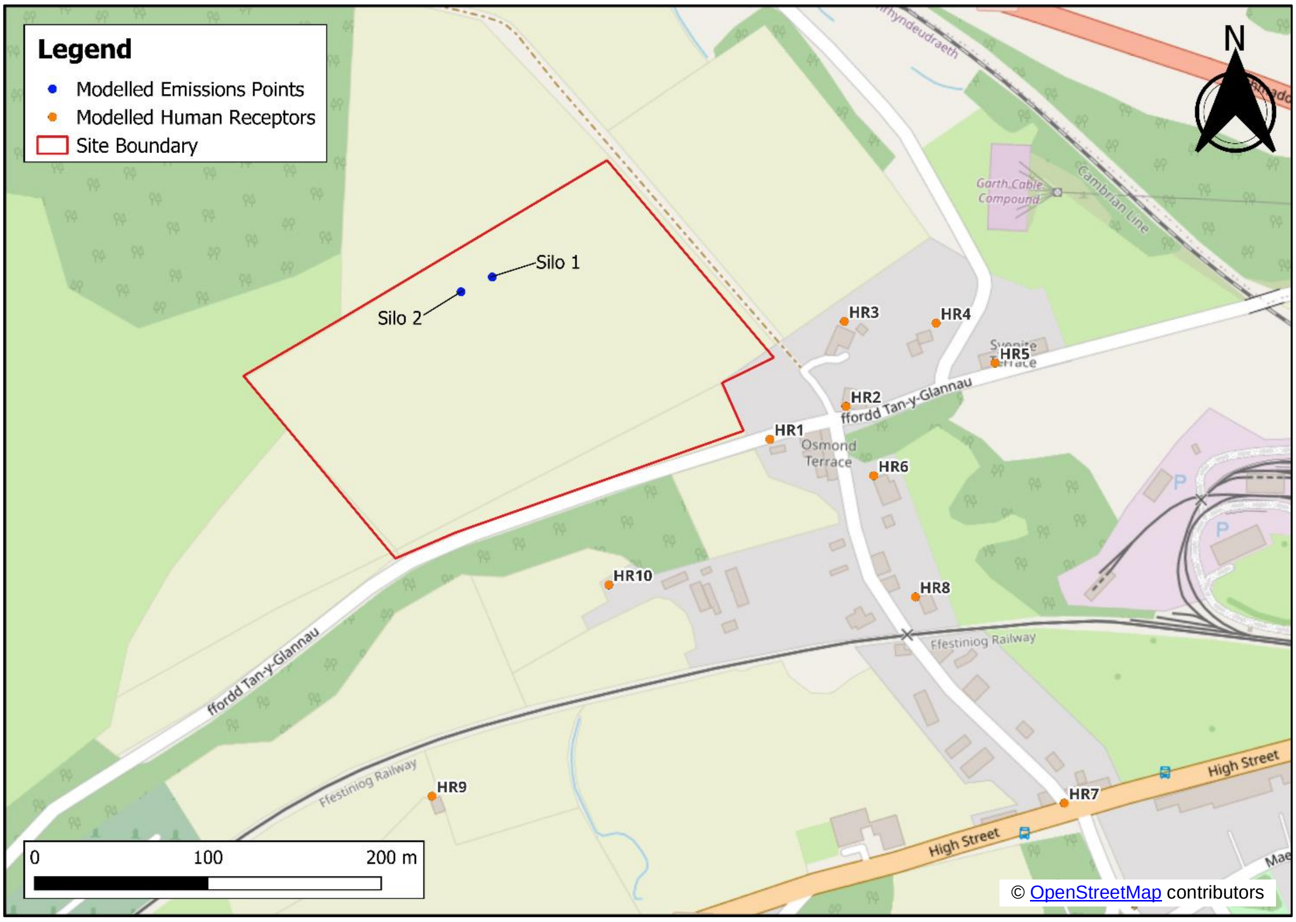
The majority of human receptors are locations where both long-term and short-term pollutant averaging periods will apply (see Table 4.1).

Workplace locations have been excluded in accordance with the guidance from Environmental Protection UK and the Air Quality Standards Regulations 2010. These guidance documents are detailed in Section 4 of this report.

Table 2.5 – Modelled Human Receptors

ID	Receptor Description	Easting (m)	Northing (m)	Height (m)
HR1	Osmond Terrace	259461	338639	1.5
HR2	ffordd Tan-y-Glannau/Osmond Terrace	259505	338658	1.5
HR3	Quarry Lane (North of ffordd Tan-y-Glannau)	259504	338707	1.5
HR4	ffordd Tan-y-Glannau	259557	338706	1.5
HR5	ffordd Tan-y-Glannau	259591	338683	1.5
HR6	Osmond Terrace	259521	338618	1.5
HR7	High Street/Quarry Lane	259631	338429	1.5
HR8	Quarry Lane (South of ffordd Tan-y-Glannau)	259545	338548	1.5
HR9	North of High Street	259266	338433	1.5
HR10	East of Osmond Terrace	259368	338555	1.5

Figure 2.6 – Modelled Human Receptors



2.5.3 *Ecological Receptors*

The Environment Agency's AER Guidance provides the following detail regarding consideration of ecological receptors:

- Check if there are any of the following within 10 km of your site (within 15 km if you operate a large electric power station or refinery):
  - Special Protection Areas (SPAs)
  - Special Areas of Conservation (SACs)
  - Ramsar Sites (protected wetlands)
- Check if there are any of the following within 2 km of your site:
  - Sites of Special Scientific Interest (SSSIs)
  - Local Nature Sites (ancient woods, Local Wildlife Sites (LWS), Sites of Nature Conservation Importance (SNCIs) and national and Local Nature Reserves (LNR)).

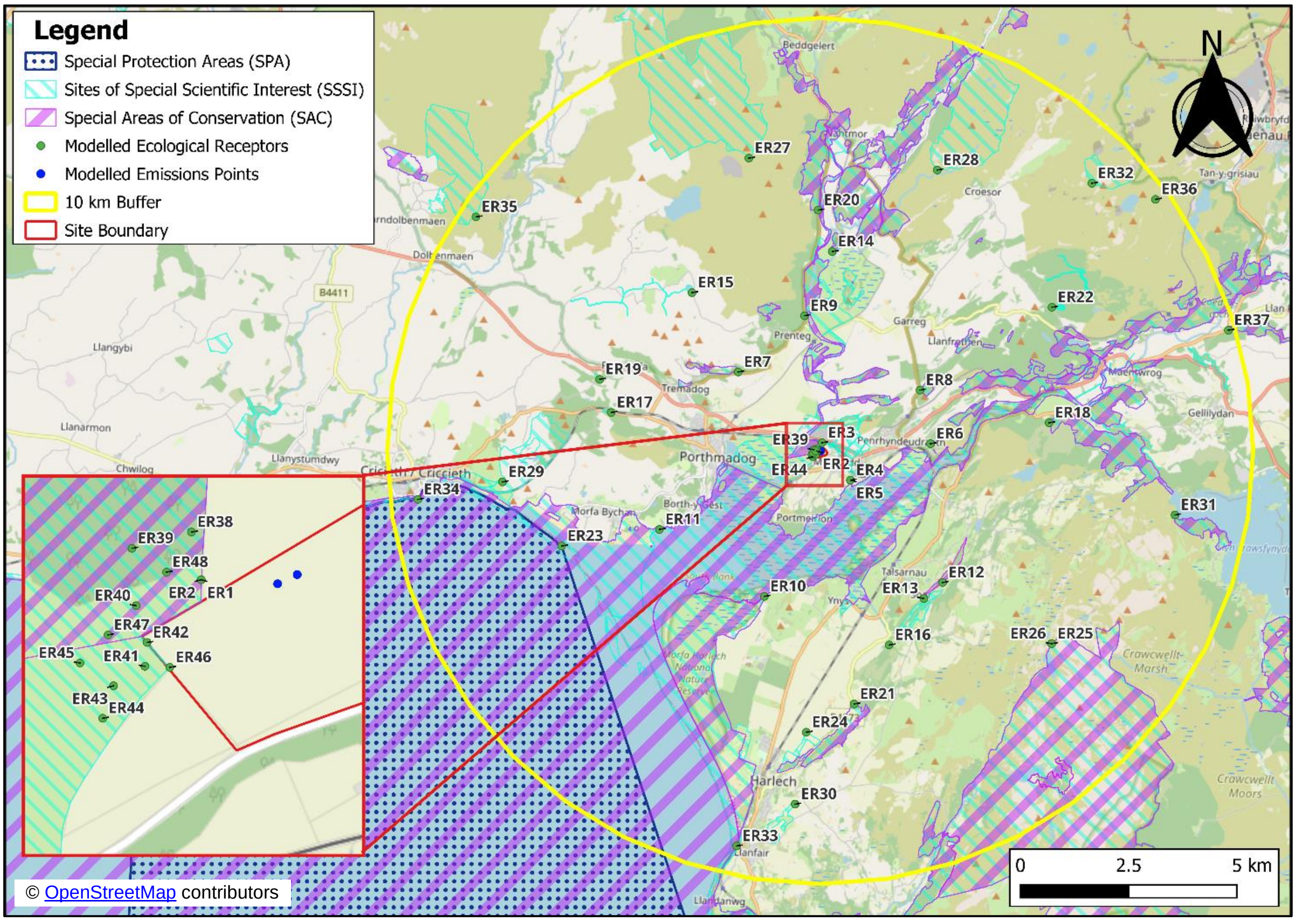
Following the above guidance, Table 2.6 and Figure 2.7 provide details of the ecological receptor points which have been considered within this assessment.

The closest ecological receptors are Coedydd Derw a Safleoedd Ystlumod Meirion / Meirionnydd Oakwoods and Bat Sites, an SAC designated as bog woodland, and Glaslyn, an SSSI designated as semi-natural woodland. These ecological receptors overlap and cover an area of land bordering the north-west corner of the Site, approximately 77 m away from the emissions points. Due to their proximity, additional ecological receptors were modelled within this area.

Table 2.6 – Modelled Ecological Receptors

Receptor ID	Receptor Description	Easting	Northing	Height (m)
ER1	Glaslyn SSSI	259212	338728	0
ER2	Coedydd Derw a Safleoedd Ystlumod Meirion / Meirionnydd Oakwoods and Bat Sites SAC	259212	338728	0
ER3	Ysbyty Bron y Garth SSSI	259335	338919	0
ER4	Pen Llyn a'r Sarnau / Lleyn Peninsula and the Sarnau SAC	259989	338057	0
ER5	Morfa Harlech SSSI	259989	338057	0
ER6	Coedydd Dyffryn Ffestiniog (Gogleddol) SSSI	261839	338897	0
ER7	Coed Tremadog SSSI	257396	340554	0
ER8	Mwyngloddiau Llanfrothen SSSI	261597	340135	0
ER9	Aberdunant SSSI	258931	341852	0
ER10	Morfa Harlech a Morfa Dyffryn SAC	258002	335373	0
ER11	Tiroedd a Glannau Rhwng Cricieth ac Afon Glaslyn SSSI	255578	336918	0
ER12	Dolorgan Barn SSSI	262119	335692	0
ER13	Maes Meillion a Gefail-y-cwm SSSI	261685	335323	0
ER14	Coedydd Nanmor SSSI	259568	343334	0
ER15	Afon Ddu SSSI	256331	342385	0
ER16	Glyn Cywarch SSSI	260883	334250	0
ER17	Wern Road Section SSSI	254464	339617	0
ER18	Coedydd De Dyffryn Maentwrog SSSI	264577	339380	0
ER19	Tyn-Llan SSSI	254198	340384	0
ER20	Coedydd Beddgelert a Cheunant Aberglaslyn SSSI	259243	344291	0
ER21	Coed Llechwedd SSSI	260074	332887	0
ER22	Trychiad Ffordd Coed Llyn-y-Garnedd SSSI	264644	342048	0
ER23	Northern Cardigan Bay / Gogledd Bae Ceredigion SPA	253318	336535	0
ER24	Cerrig y Gweunydd SSSI	258968	332234	0
ER25	Rhinog SAC	264636	334280	0
ER26	Rhinog SSSI	264636	334280	0
ER27	Moel Hebog SSSI	257644	345491	0
ER28	Yr Arddu SSSI	261996	345216	0
ER29	Rhiw-for-fawr SSSI	251954	338015	0
ER30	Muriau Gwyddelod SSSI	258712	330575	0
ER31	Coed y Rhygen SSSI	267487	337252	0
ER32	Moelwyn Mawr SSSI	265567	344911	0
ER33	Morfa Dyffryn SSSI	257360	329609	0
ER34	Glanllynnau a Glannau Pen-ychain i Gricieth SSSI	250000	337612	0
ER35	Craig-y-Garn SSSI	251340	344134	0
ER36	Trychiad Ffordd Craig Fach SSSI	267036	344539	0
ER37	Ceunant Cynfal SSSI	268717	341517	0
ER38	Glaslyn SSSI / Coedydd Derw a Safleoedd Ystlumod Meirion / Meirionnydd Oakwoods and Bat Sites SAC	259203	338772	0
ER39	Glaslyn SSSI / Coedydd Derw a Safleoedd Ystlumod Meirion / Meirionnydd Oakwoods and Bat Sites SAC	259148	338757	0
ER40	Glaslyn SSSI / Coedydd Derw a Safleoedd Ystlumod Meirion / Meirionnydd Oakwoods and Bat Sites SAC	259152	338704	0
ER41	Glaslyn SSSI	259160	338648	0
ER42	Glaslyn SSSI	259162	338670	0
ER43	Glaslyn SSSI	259131	338630	0
ER44	Glaslyn SSSI	259121	338600	0
ER45	Glaslyn SSSI	259100	338651	0
ER46	Glaslyn SSSI	259183	338647	0
ER47	Glaslyn SSSI / Coedydd Derw a Safleoedd Ystlumod Meirion / Meirionnydd Oakwoods and Bat Sites SAC	259126	338677	0
ER48	Glaslyn SSSI / Coedydd Derw a Safleoedd Ystlumod Meirion / Meirionnydd Oakwoods and Bat Sites SAC	259180	338735	0

Figure 2.7 – Modelled Ecological Receptors



2.6 Deposition

The predominant route by which emissions to air will affect land in the vicinity of a process is by deposition of atmospheric emissions. Potential ecological receptors can be sensitive to the deposition of pollutants, particularly nitrogen and sulphur compounds, which can affect the character of the habitat through eutrophication and acidification.

Deposition processes in the form of dry and wet deposition remove material from a plume and alter the plume concentration. Dry deposition occurs when particles are brought to the surface by gravitational settling and turbulence. They are then removed from the atmosphere by deposition on the land surface. Wet deposition occurs due to rainout (within cloud) scavenging and washout (below cloud) scavenging of the material in the plume. These processes lead to a variation with downwind distance of the plume strength and may alter the shape of the vertical concentration profile as dry deposition only occurs at the surface.

Near to sources of pollutants (< 2 km), dry deposition is the predominant removal mechanism (Fangmeier et al. 1994). Dry deposition may be quantified from the near-surface plume concentration and the deposition velocity (Chamberlin and Chadwick, 1953);

$$F_d = v_d C(x, y, 0)$$

where:

F_d = dry deposition flux (µg m^{-2} s^{-1})

v_d = deposition velocity (m s^{-1})

$C(x, y, 0)$ = ground level concentration (µg/m³)

Assuming irreversible uptake, the total wet deposition rate is found by integrating through a vertical column of air;

$$F_w = \int_0^z \Lambda C \; dz$$

where;

F_w = wet deposition flux (µg m^{-2} s^{-1})

Λ = washout co-efficient (s^{-1})

C = local airborne concentration (µg/m³)

z = height (m)

The washout co-efficient is an intrinsic function of the rate of rainfall.

Environment Agency guidance AQTAG06 (Environment Agency, 2014) recommends deposition velocities for various pollutants, according to land use classification (Table 2.7).

Table 2.7 - Recommended Deposition Velocities

Pollutant	Deposition Velocity (m s^{-1})	
	Short Vegetation	Long Vegetation/Forest
NO_x	0.0015	0.003
SO_2	0.012	0.024
Source: Environment Agency (2014) 'Technical Guidance on Detailed Modelling Approach for an Appropriate Assessment for Emissions to Air', AQTAG06 Updated Version (March 2014)'		

In order to assess the impacts of deposition, habitat-specific critical loads and critical levels have been created. These are generally defined as (e.g. Nilsson and Grennfelt, 1988):

"a quantitative estimate of exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge"

It is important to distinguish between a critical load and a critical level. The critical load relates to the quantity of a material deposited from air to the ground, whilst critical levels refer to the concentration of a material in air. The UK Air Pollution Information System (APIS) provides critical load data for ecological sites in the UK.

The critical loads used to assess the impact of compounds deposited to land which result in eutrophication and acidification are expressed in terms of kilograms of nitrogen deposited per hectare per year (kg N ha^{-1} y^{-1}) and kilo equivalents deposited per hectare per year (keq ha^{-1} y^{-1}). To enable a direct comparison against the critical loads, the modelled total wet and dry deposition flux (µg m^{-2} s^{-1}) must be converted into an equivalent value.

For a continuous release, the annual deposition flux of nitrogen can be expressed as:

$$F_{NTot} = \left(\frac{K_2}{K_3}\right) \cdot t \cdot \sum_{i=1}^{T} F_i \left(\frac{M_N}{M_i}\right)$$

where:

F_{NYot} = Annual deposition flux of nitrogen (kg N ha^{-1} y^{-1})

K_2 = Conversion factor for m^2 to ha (= 1x104 m^2 ha^{-1})

K_3 = Conversion factor for µg to kg (= 1x109 µg kg^{-1})

t = Number of seconds in a year (= 3.1536x107 s y^{-1})

i = 1,2,3…….T

T = Total number of nitrogen containing compounds

F = Modelled deposition flux of nitrogen containing compound (µg m^{-2} s^{-1})

M_N = Molecular mass of nitrogen (kg)

M = Molecular mass of nitrogen containing compound (kg)

The unit eq (1 keq ≡ 1,000 eq) refers to molar equivalent of potential acidity resulting from e.g. sulphur, oxidised and reduced nitrogen, as well as base cations. Conversion units are provided in AQTAG(06):

- 1 keq ha^{-1} y^{-1} = 14 kg N ha^{-1} y^{-1}
- 1 keq ha^{-1} y^{-1} = 32 kg S ha^{-1} y^{-1}

For the purposes of this assessment, dry deposition rates of nitrogen and acidic equivalents at the identified ecological receptors have been calculated by applying the ‘long vegetation’ deposition velocities (as detailed in Table 2.7) to the modelled annual mean concentrations of NO_x and SO_2. Wet deposition has not been assessed since this is not a significant contributor to total deposition over shorter ranges (Fangmeier et al., 1994; Environment Agency, 2006).

2.7 Other Treatments

Specialised model treatments, for short-term (puff) releases, coastal models, fluctuations or photochemistry were not used in this assessment.

2.8 Conversion of NO to NO_2

Emissions of NO_x from combustion processes are predominantly in the form of nitric oxide (NO). Excess oxygen in the combustion gases and further atmospheric reactions cause the oxidation of NO to NO_2. NO_x chemistry in the lower troposphere is strongly interlinked in a complex chain of reactions involving Volatile Organic Compounds (VOCs) and Ozone (O_3). Two of the key reactions interlinking NO and NO_2 are detailed below:

$$NO_2 + hv \xrightarrow{O_2} NO + O_3 \qquad (R_1)$$

$$NO + O_3 \longrightarrow NO_2 + O_2 \qquad (R_2)$$

Where *hv* is used to represent a photon of light energy (i.e., sunlight).

Taken together, reactions R_1 and R_2 produce no net change in O_3 concentrations, and NO and NO_2 adjust to establish a near steady state reaction (photo-equilibrium). However, the presence of VOCs and CO in the atmosphere offer an alternative production route of NO_2 for photolysis, allowing O_3 concentrations to increase during the day with a subsequent decrease in the NO_2:NO_x ratio.

However, at night, the photolysis of NO_2 ceases, allowing reaction R_2 to promote the production of NO_2, at the expense of O_3, with a corresponding increase in the NO_2:NO_x ratio. Similarly, near to an emission source of NO, the result is a net increase in the rate of reaction R_2, suppressing O_3 concentrations immediately downwind of the source, and increasing further downwind as the concentrations of NO begin to stabilise to typical background levels (Gillani and Pliem, 1996).

Given the complex nature of NO_x chemistry, the Environment Agency's Air Quality Modelling and Assessment Unit (AQMAU) have adopted a pragmatic, risk-based approach in determining the conversion rate of NO to NO_2 which dispersion model practitioners can use in their detailed assessments[4]. The AQMAU guidance advises that the source term should be modelled as NO_x (as NO_2) and then suggests a tiered approach when considering ambient NO_2:NO_x ratios:

- **Screening Scenario:** 50 % and 100 % of the modelled NO_x process contributions should be used for short-term and long-term average concentration, respectively. That is, 50 % of the predicted NO_x concentrations should be assumed to be NO_2 for short-term assessments and 100 % of the predicted NO_x concentrations should be assumed to be NO_2 for long-term assessments;
- **Worst Case Scenario:** 35 % and 70 % of the modelled NO_x process contributions should be used for short-term and long-term average concentration, respectively. That is, 35 % of the predicted NO_x concentrations should be assumed to be NO_2 for short-term assessments and 70 % of the predicted NO_x concentrations should be assumed to be NO_2 for long-term assessments; and
- **Case Specific Scenario:** Operators are asked to justify their use of percentages lower than 35 % for short-term and 70 % for long-term assessments in their application reports.

In line with the AQMAU guidance, this assessment has therefore used a NO_x to NO_2 ratio of 70% for long term average concentrations, 35% for short term concentrations.

[4] http://www.environment-agency.gov.uk/static/documents/Conversion_ratios_for__NOx_and_NO2_.pdf

3 EXISTING AMBIENT DATA

3.1 Local Air Quality Management

The Site is located within the Welsh county of Gwyned. The nearest Air Quality Management Area (AQMA) is the Chester City Centre AQMA (No. 5), is located 85.3 km northeast of the Site and is designated for exceedances of the NO_2 annual mean AQS Objective.

The nearest diffusion tube is located 22.2 km west of the Site on Penlan Street, Pwllheli. Due to the distances between the Site and the nearest air quality monitoring locations, any available local air quality data is unlikely to be representative of ambient conditions at the Site and has therefore not been included in this report.

3.2 Defra Mapped Background Concentrations

Defra maintains a nationwide model of existing and future background air quality concentrations at a 1 km grid square resolution. The datasets include annual average concentration estimates for NO_x, NO_2, PM_{10}, $PM_{2.5}$, CO and SO_2 and benzene. The model used is empirical in nature: it uses the National Atmospheric Emissions Inventory (NAEI) emissions to model the concentrations of pollutants at the centroid of each 1 km grid square but then calibrates these concentrations in relation to actual monitoring data.

3.2.1 Background Concentrations used in the Assessment

Annual mean background concentrations at the assessed human and ecological receptor locations have been derived from the Defra background maps for the 1 km grid square in which they are located.

The annual average process contribution is added to the annual average background concentration to give a total concentration at each receptor location. This total concentration can then be compared against the relevant Air Quality Standard/Objective (AQS/O) and the likelihood of an exceedance determined.

It is not technically rigorous to add predicted short-term or percentile concentrations to ambient background concentrations not measured over the same averaging period, since peak contributions from different sources would not necessarily coincide in time or location. Without hourly ambient background monitoring data available it is difficult to make an assessment against the achievement or otherwise of the short-term AQS/O. For the current assessment, conservative short-term ambient levels have been derived by applying a factor of two to the annual mean background data as per the recommendation in Environment Agency guidance. Those background annual mean concentrations used in the assessment are detailed in Table 3.1.

3.3 Background Deposition Rates

Estimated background deposition rates of nutrient nitrogen and total acid deposition for the UK are available via the Air Pollution Information Service (APIS) website (http://www.apis.ac.uk). Table 3.2 provides estimated deposition rates for the ecological receptors considered in this study, as obtained from the APIS website. It should be noted that the level of uncertainty associated with these modelled estimates is relatively high and the results are presented from the model across the UK on a 5 km grid square resolution.

Table 3.1 - Background Annual Mean Concentrations used in the Assessment

Grid square (E, N)	2024 Annual Mean Pollutant Concentrations (µg/m³)			2001 Annual Mean Pollutant Concentrations (µg/m³)	
	NO_x [a]	NO_2 [a]	PM_{10}[a]	SO_2[b]	CO[b]
259500,338500	4.84	3.90	9.43	1.53	0.14
261500,338500	3.61	2.93	8.49	1.44	0.14
257500,340500	3.43	2.79	8.08	1.39	0.14
261500,340500	3.43	2.79	8.49	1.35	0.14
258500,341500	3.29	2.68	8.24	1.33	0.13
258500,335500	3.05	2.49	7.96	1.31	0.13
255500,336500	3.06	2.50	7.91	0.00	0.00
262500,335500	3.07	2.50	8.06	1.37	0.13
261500,335500	3.27	2.66	8.26	1.36	0.13
259500,343500	3.10	2.53	7.91	1.31	0.13
256500,342500	3.10	2.53	7.90	1.30	0.13
260500,334500	3.27	2.66	8.17	1.34	0.13
254500,339500	3.62	2.94	8.11	1.34	0.14
264500,339500	3.34	2.72	8.20	1.39	0.13
254500,340500	3.57	2.90	8.15	1.30	0.14
259500,344500	3.07	2.50	8.10	1.30	0.13
260500,332500	3.12	2.54	8.06	1.43	0.14
264500,342500	3.08	2.51	8.04	1.37	0.13
253500,336500	3.03	2.47	7.89	1.31	0.00
258500,332500	3.35	2.73	8.03	1.41	0.14
264500,334500	3.02	2.46	8.34	1.38	0.13
257500,345500	2.96	2.42	8.14	1.29	0.13
261500,345500	2.97	2.43	7.97	1.31	0.13
251500,338500	3.49	2.84	8.26	1.34	0.13
258500,330500	3.31	2.70	8.06	1.61	0.13
267500,337500	3.02	2.46	8.08	1.44	0.13
265500,344500	2.98	2.44	8.29	1.37	0.13
257500,329500	3.44	2.80	8.13	1.33	0.13
250500,337500	3.14	2.56	8.04	1.69	0.13
251500,344500	3.10	2.53	7.91	1.26	0.13
267500,344500	3.16	2.57	8.10	1.40	0.13
268500,341500	3.33	2.71	8.09	1.48	0.14

[a] 2024 annual mean background concentrations of NO_x, NO_2 and PM_{10} taken from Defra's UK Air Quality Archive from a baseline year of 2018, (1 km x 1 km grid squares).
[b] 2001 annual mean background concentrations of SO_2 and CO taken from 2001 background maps.

Table 3.2 - Estimated Background Deposition Rates

ID	Background Nitrogen Deposition (kg N ha^{-1} y^{-1})	Background Nitric Acid Deposition (keq ha^{-1} y^{-1})	Background Sulphuric Acid Deposition (keq ha^{-1} y^{-1})
ER1	9.93	1.24	0.16
ER2	17.34	1.24	0.16
ER3	9.93	0.71	0.11
ER4	9.93	0.71	0.11
ER5	9.93	1.24	0.16
ER6	9.86	1.23	0.16
ER7	18.69	1.34	0.17
ER8	18.01	1.29	0.17
ER9	19.09	1.36	0.18
ER10	19.09	0.00	0.00
ER11	9.05	0.65	0.10
ER12	10.07	0.72	0.11
ER13	9.87	0.71	0.11
ER14	11.98	0.86	0.14
ER15	11.73	0.84	0.14
ER16	9.72	0.70	0.11
ER17	10.01	0.72	0.11
ER18	18.39	1.31	0.17
ER19	10.51	0.75	0.12
ER20	20.72	1.48	0.20
ER21	9.83	1.24	0.16
ER22	11.67	0.83	0.14
ER23	11.67	0.00	0.00
ER24	8.86	0.63	0.10
ER25	10.88	0.78	0.12
ER26	10.88	0.78	0.12
ER27	13.49	0.96	0.16
ER28	12.66	0.90	0.15
ER29	9.11	0.65	0.10
ER30	8.65	0.62	0.09
ER31	18.72	1.34	0.18
ER32	13.68	0.98	0.19
ER33	8.10	0.58	0.09
ER34	8.10	0.00	0.00
ER35	12.17	0.87	0.14
ER36	14.85	1.06	0.22
ER37	21.15	1.51	0.21
ER38	17.34	1.24	0.16
ER39	17.34	1.24	0.16
ER40	9.93	0.71	0.11
ER41	9.93	0.71	0.11
ER42	9.93	0.71	0.11
ER43	9.93	0.71	0.11
ER44	9.93	0.71	0.11
ER45	9.93	0.71	0.11
ER46	9.93	0.71	0.11
ER47	9.93	0.71	0.11
ER48	17.34	1.24	0.16

Source: Air Pollution Information Service (APIS) website (http://www.apis.ac.uk)

4 RELEVANT LEGISLATION AND GUIDANCE

4.1 UK Legislation

4.1.1 The Air Quality Standards Regulations 2010

The Air Quality Standards Regulations 2010 (the 'Regulations') came into force on the 11th June 2010 and transpose EU Directive 2008/50/EC into UK legislation. The Directive's limit values are transposed into the Regulations as 'Air Quality Standards' (AQS) with attainment dates in line with the Directive.

These standards are legally binding 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 of sensitive groups or on ecosystems.

Similar to Directive 2008/50/EC, the Regulations define ambient air as;

> *"…outdoor air in the troposphere, excluding workplaces where members of the public do not have regular access."*

With direction provided in Schedule 1, Part 1, Paragraph 2 as to where compliance with the AQS' does not need to be assessed:

> *"Compliance with the limit values directed at the protection of human health does not need to be assessed at the following locations:*
>
> *a) any location situated within areas where members of the public do not have access and there is no fixed habitation;*
>
> *b) on factory premises or at industrial locations to which all relevant provisions concerning health and safety at work apply;*
>
> *c) on the carriageway of roads and on the central reservation of roads except where there is normally pedestrian access to the central reservation."*

4.1.2 The Air Quality Strategy for England, Scotland, Wales and Northern Ireland

The 2023 Air Quality Strategy for England provides a framework for improving air quality at a national and local level and supersedes the previous strategy published in 2007 for England.

Central to the Air Quality Strategy are health-based criteria for certain air pollutants; these criteria are based on medical and scientific reports on how and at what concentration each pollutant affects human health. The objectives derived from these criteria are policy targets often expressed as a maximum ambient concentration not to be exceeded, without exception or with a permitted number of exceedances, within a specified timescale.

The AQOs, based on a selection of the objectives in the Air Quality Strategy, were incorporated into UK legislation through the Air Quality Regulations 2000, as amended.

Paragraph 4(2) of The Air Quality (England) Regulations 2000 states:

> *"The achievement or likely achievement of an air quality objective prescribed by paragraph (1) shall be determined by reference to the quality of air at locations –*
>
> *a) which are situated outside of buildings or other natural or man-made structures above or below ground; and*
>
> *b) where members of the public are regularly present*

Consequently, compliance with the AQOs should focus on areas where members of the general public are present over the entire duration of the concentration averaging period specific to the relevant objective.

4.1.3 Environment Act 2021

The Environment Act 2021 came into force on 9th November 2021, with Part 4 of the Act (and associated Schedules 11 and 12) reserved for matters pertaining to air quality.

The Environment Act 2021 includes amendments to Environment Act 1995 (further detail in Section 4.2) the Clean Air Act 1993 to give Local Authorities more power. It also requires the Secretary of State to set at least one long-term target in relation to air quality and, in addition, a short-term legally binding target to reduce $PM_{2.5}$.

4.1.4 Medium Combustion Plant and Specified Generators

This EP application will need to take into consideration the MCPD and Specified Generator requirements as detailed in the Environmental Permitting Regulations (EPR) 2018.

The Environmental Permitting (England and Wales) (Amendment) Regulations 2018 SI 110 were published in January 2018 to transpose the requirements of the Medium Combustion Plant Directive (MCPD) and to control emissions from the operation of Specified Generators. MCP refers to plant with a rated thermal input of between 1 – 50 MW_{th}, whilst Specified Generators comprise any combustion plant generating electricity.

4.2 Local Air Quality Management

Part IV of the Environment Act 1995 requires that Local Authorities periodically review air quality within their individual areas. As previously discussed, this Act has now been amended and supplemented by the Environment Act 2021 Schedule 11. Defra have said: “Responsibility for tackling local air pollution will now be shared with designated relevant public authorities, all tiers of local government and neighbouring authorities.”

This process of Local Air Quality Management (LAQM) is an integral part of delivering the Government’s AQOs.

To carry out an air quality Review and Assessment under the LAQM process, the Government recommends a three-stage approach. This phased review process uses initial simple screening methods and progresses through to more detailed assessment methods of modelling and monitoring in areas identified to be at potential risk of exceeding the objectives in the Regulations.

Review and assessments of local air quality aim to identify areas where national policies to reduce vehicle and industrial emissions are unlikely to result in air quality meeting the Government’s AQOs by the required dates.

For the purposes of determining the focus of Review and Assessment, Local Authorities should have regard to those locations where members of the public are likely to be regularly present and are likely to be exposed over the averaging period of the objective.

Where the assessment indicates that some or all of the objectives may be potentially exceeded, the Local Authority has a duty to declare an AQMA. The declaration of an AQMA requires the Local Authority to implement an Air Quality Action Plan (AQAP), to reduce air pollution concentrations so that the required AQOs are met.

4.3 Other Guideline Values

In the absence of statutory standards for the other prescribed substances that may be found in the emissions, there are several sources of applicable air quality guidelines.

4.3.1 Air Quality Guidelines for Europe, the World Health Organisation (WHO)

The updated WHO Global Air Quality Guidelines (WHO, 2021) provides a basis for protecting public health from adverse effects of air pollutants and to eliminate or reduce exposure to those pollutants that are known or likely to be hazardous to human health or well-being. These guidelines are intended to provide guidance and information to international, national and local authorities making risk management decisions, particularly in setting air quality standards.

4.3.2 Environmental Assessment Levels (EALs)

The Environment Agency's AER Guidance provides methods for quantifying the environmental impacts of emissions to all media. The AER guidance contains long and short-term Environmental Assessment Levels (EALs) and Environmental Quality Standards (EQS) for releases to air derived from a number of published UK and international sources. For the pollutants considered in this study, these EALs and EQS are equivalent to the AQS and AQOs set in force by the Air Quality Strategy for England, Scotland Wales and Northern Ireland.

4.4 Criteria Appropriate to the Assessment

Table 4.1 sets out those air quality standards and objectives that are relevant to the assessment with regard to human receptors.

Table 4.1 - Air Quality Standards, Objectives and Environmental Assessment Levels

Pollutant	Averaging Period	Value (µg m^{-3})
Nitrogen dioxide (NO_2)	Annual mean	40
	1-hour mean, not more than 18 exceedances a year (equivalent of 99.79 percentile)	200
Carbon monoxide (CO)	Maximum rolling 8-hour mean	10,000
	Maximum 1-hour mean	30,000
Particulate Matter (PM_{10})	Annual Mean	40
	24-hour mean, not more than 35 exceedances a year (equivalent of 90.41 percentile)	50
Sulphur Dioxide (SO_2)	15-minute mean, not more than 35 exceedances a year (equivalent of 99.90 percentile)	266
	1-hour mean, not more than 24 exceedances a year (equivalent of 99.73 percentile)	350
	24-hour mean, not more than 3 exceedances a year (equivalent of 99.18 percentile)	125

4.5 Critical Levels and Critical Loads Relevant to the Assessment of Ecological Receptors

A summary of the relevant AQS and EAL that apply to the emissions from the plant and their impact on ecological receptors are given in Table 4.2.

Table 4.2 - Relevant Air Quality Standards and Environmental Assessment Levels for Ecological Receptors

Pollutant	AQS/EAL[a]	Averaging Period	Value (µg/m^3)
Oxides of nitrogen (NO_x)	Target	24-hour mean	75
	AQS	Annual mean	30
Sulphur Dioxide (SO_2)	AQS	Annual Mean	20
[a] *Collectively referred to as Air Quality Assessment Level (AQAL).*			

The Air Pollution Information System (APIS) website[5] provides specific information on the potential effects of nitrogen deposition on various habitats and species. This information, relevant to habitats of some of the ecological receptors considered in this assessment, is presented in Table 4.3.

[5] http://www.apis.ac.uk/

Table 4.3 - Typical Habitat and Species Information Concerning Nitrogen Deposition from APIS

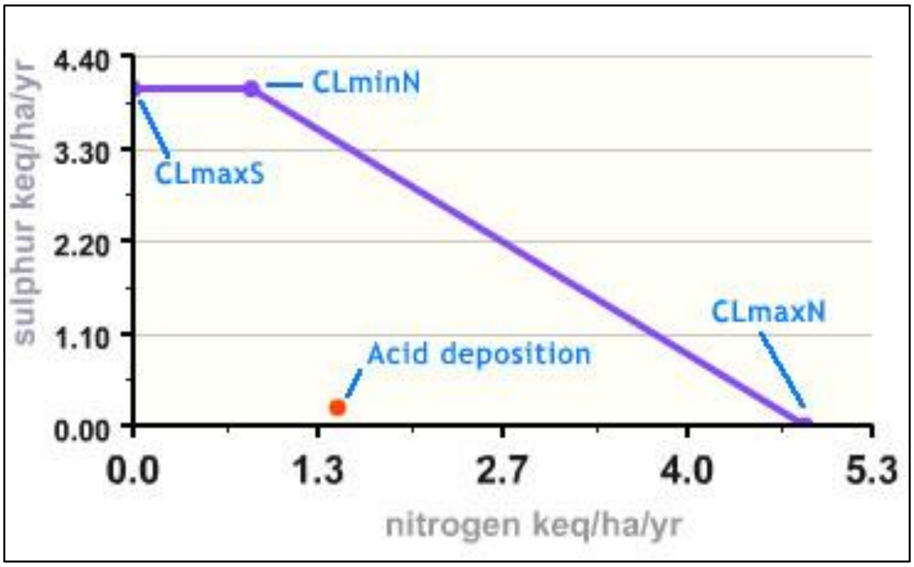
Habitat and Species Specific Information	Critical Load (kg N ha^{-1} yr^{-1})	Specific Information Concerning Nitrogen Deposition
Saltmarsh	30-40	Many saltmarshes receive large nutrient loadings from river and tidal inputs. It is unknown whether other types of species-rich saltmarsh would be sensitive to nitrogen deposition. Increase in late-successional species, increased productivity but only limited information available for this type of habitat.
Littoral Sediments	20 - 30	Increase late successional species, increase productivity increase in dominance of graminoids.
Coastal Stable Dune Grasslands	10-20	Foredunes receive naturally high nitrogen inputs. Key concerns of the deposition of nitrogen in these habitats relate to changes in species composition.
Alkaline Fens and Reed beds	10-35	Nitrogen deposition provides fertilization. Increase in tall graminoids (grasses or Carex species) resulting in loss of rare species and decrease in diversity of subordinate plant species.
Temperate and boreal forests	10-20	Increased nitrogen deposition in mixed forests increases susceptibility to secondary stresses such as drought and frost, can cause reduced crown growth. Also can reduce the diversity of species due to increased growth rates of more robust plants.
Hay Meadow	20-30	The key concerns are related to changes in species composition following enhanced nitrogen deposition. Indigenous species will have evolved under conditions of low nitrogen availability. Enhanced Nitrogen deposition will favour those species that can increase their growth rates and competitive status e.g. rough grasses such as false brome grass (Brachypodium pinnatum) at the expense of overall species diversity. The overall threat from competition will also depend on the availability of propagules
Acid Grasslands	10-25	Nitrogen deposition provides fertilization to acid grasslands, this increase robust grass growth that may limit other species reducing diversity.
Raised bog and blanket bog	5-10	Nitrogen deposition provides fertilization, this increase robust vegetation growth that may limit other species reducing diversity
Oak Woodland	10-15	Increased nitrogen deposition in Oak forests increases susceptibility to secondary stresses such as drought and frost, can cause reduced crown growth

Information relating specifically to acid deposition is provided using three critical load parameters:

- $CL_{max}S$: the maximum critical load of sulphur, above which sulphur alone would be considered to cause an exceedance;
- $CL_{min}N$: a measure of the ability of the habitat/ecosystem to 'consume' deposited nitrogen; and
- $CL_{max}N$: the maximum critical load of nitrogen, above which nitrogen alone would be considered to cause an exceedance.

These three parameters define the critical load function, as illustrated in Figure 4.1. The region under the three-node line represents results where critical loads are not exceeded, whereas combinations of deposition above this line would be considered an exceedance.

Figure 4.1 - Critical Load Function (sourced from APIS)



Source: http://www.apis.ac.uk/clf-guidance

5 ASSESSMENT RESULTS

This section sets out the results of the dispersion modelling and compares predicted ground level concentrations to ambient air quality standards. The predicted concentrations resulting from the process are presented with background concentrations and the percentage contribution that the predicted environmental concentrations would make towards the relevant Air Quality Assessment Level (AQAL), i.e., the relevant Air Quality Standard or Objective (AQS/AQO), Workplace Exposure Limit (WEL) or Environmental Assessment Level (EAL) – collectively referred to as AQAL.

Results are presented for the meteorological year resulting in the highest concentrations at any receptor location, as a worst-case assumption. Results that exceed the relevant AQAL are underlined within the results tables.

5.1 Model Results for Annual Mean Metrics

Results assessed against annual mean metrics for NO_x, NO_2, and SO_2 consider total continuous operation over the full annual period.

As such, results for annual mean metrics have been presented separately to short-term metrics. Summary results are presented in Table 5.1 for the worst-case receptor for each parameter. Full results tables are contained in Appendix B.

5.1.1 Concentrations in Air

The summary results show that annual mean results for NO_2 at human receptors and annual mean results for NO_x at ecological receptors are all comfortably below the relevant AQALs.

In terms of human receptors, the maximum annual mean NO_2 and PM_{10} concentrations were predicted at receptor HR3 (see Appendix B), located 205 m southeast of the Site.

The maximum annual mean NO_x and SO_2 concentrations at any ecological receptor (in terms of PC) were predicted to occur at ER45 Glaslyn SSSI, located 197 m southwest of the Site.

Table 5.1 - Maximum Annual Mean Concentrations in Air at Human and Ecological Receptors

Parameter	Annual Mean				
	AQAL µg/m^3	PC µg/m^3	PEC µg/m^3	% PC OF AQAL	% PEC OF AQAL
Human Receptors					
Annual mean NO_2	40	0.2	4.1	0.5	10.3
Annual mean PM_{10}	40	<0.1	9.5	0.2	23.7
Ecological Receptors					
Annual mean NO_x	30	0.21	5.01	0.7	16.7
Annual mean SO_2	10	<0.1	3.4	<0.1	33.8
AQAL = Air Quality Assessment Level PC = Process Contribution PEC = Predicted Environmental Concentration (PC + background)					

5.1.2 Deposition

The impact assessment for ecological receptors also includes an assessment of pollutants deposited to land in the form of nitrogen deposition and acid deposition. These are also based on annual mean metrics, as such, these results are presented in full in Table 5.2 for nitrogen deposition and Table 5.3 for acid deposition.

The results for acid deposition are presented in line with the Critical Load Function Tool as contained on the Air Pollution Information System (APIS) website[6]. As described on APIS: "the Critical Load Function is a three-node line on a graph representing the acidity critical load. Combinations of deposition above this line would exceed the critical load, while all areas below or on the line represent an "envelope of protection" where critical loads are not exceeded". Therefore, where 'no exceedance' is stated with regards to acid deposition, it denotes no exceedance of the critical load function. The map and gridded ADMS output, along with this report, was reviewed by the ecologist to further determine the impact significance of the operation of the generators at the Site. The accompanying technical note (reference 10846.001) published in December 2024[7] details the ecologists conclusions.

For the additional ecological receptors modelled within the area designated as both Glaslyn SSSI and Coedydd Derw a Safleoedd Ystlumod Meirion / Meirionnydd Oakwoods and Bat Sites SAC, the minimum critical load for each assessment criteria was selected to provide more conservative results.

The results for nitrogen deposition show exceedances of the CL at 34 modelled ecological receptors. However, this is due to the background deposition rate at all receptors exceeding the minimum critical load (CL). When taking the PC into account, this makes up less than 1% of the overall result at the majority (25) of ecological receptors, so the contribution from the plant at these locations can be considered not significant.

Nine receptors situated within Glaslyn SSSI (ER39-ER45 and ER47) had a modelled PC greater than 1% of the CL, with the greatest exceedance being 2.4% at ER39. These receptors were therefore identified as requiring further assessment. The exceedances identified within Glaslyn SSSI are a result of the low CL, which is attributed to the presence of the floating water-plantain Luronium natans (CL=2 kg N ha^{-1} yr^{-1}). As Glaslyn SSSI covers a large area of mixed vegetation types, further assessment was undertaken through consultation with an ecologist to confirm the specific locations of Luronium natans within the area, as well as a current appreciation of the condition of the site. The ecological technical note[7] concluded that nitrogen deposition would not be significant in the Glaslyn SSSI.

Results for acid deposition showed exceedances of the CL at 19 modelled receptors; when taking account of the PC the contribution from the plant can be considered insignificant at eight of these. Of the nine receptors that still showed exceedances, five are located within Glaslyn SSSI, while the remaining located in the region covered by Glaslyn SSSI and Coedydd Derw a Safleoedd Ystlumod Meirion / Meirionnydd Oakwoods and Bat Sites SAC. The exceedances in this area are due to the woodland habitats at these sites. Further impact assessment of these areas were undertaken by an ecologist and detailed in the technical note[7]. It was concluded, that there would be no long term impacts on the sensitive woodland species, as the works proposed are short term in nature.

As exceedances at some of the modelled receptors were identified, the gridded ADMS output was used to create a map of PC% exceedances within nearby ecological receptors. All modelling data and results were reviewed by an ecologist to determine the impact significance of the proposed MCP operation at the Site and are summarised in the technical note[7].

[6] http://www.apis.ac.uk/critical-load-function-tool

[7] The Environment Partnership, 2024, Technical Note reference 10846.001

Table 5.2 - Nitrogen Deposition Rates at Ecological Receptors

Receptor ID	CL (kg N ha^{-1} yr^{-1})	PC (kg N ha^{-1} yr^{-1})	%PC of CL_{min} (%)	Background Deposition rate (kg N ha^{-1} yr^{-1})	PEDR (kg N ha^{-1} yr^{-1})	%PEDR of CL_{min}	Impact
ER1	2.0	<0.1	0.2	9.9	9.9	496.7	Not significant
ER2	5.0	<0.1	0.2	17.3	17.3	347.0	Not significant
ER3	None	<0.1	N/A	9.9	10.0	N/A	Not significant
ER4	10.0	<0.1	0.1	9.9	9.9	99.4	Not significant
ER5	5.0	<0.1	0.1	9.9	9.9	198.7	Not significant
ER6	5.0	<0.1	0.1	9.9	9.9	197.3	Not significant
ER7	10.0	<0.1	<0.1	18.7	18.7	186.9	Not significant
ER8	10.0	<0.1	0.1	18.0	18.0	180.2	Not significant
ER9	10.0	<0.1	<0.1	19.1	19.1	190.9	Not significant
ER10	5.0	<0.1	<0.1	19.1	19.1	381.8	Not significant
ER11	5.0	<0.1	<0.1	9.1	9.1	181.0	Not significant
ER12	None	<0.1	N/A	10.1	10.1	N/A	Not significant
ER13	5.0	<0.1	<0.1	9.9	9.9	197.4	Not significant
ER14	5.0	<0.1	<0.1	12.0	12.0	239.6	Not significant
ER15	None	<0.1	N/A	11.7	11.7	N/A	Not significant
ER16	None	<0.1	N/A	9.7	9.7	N/A	Not significant
ER17	None	<0.1	N/A	10.0	10.0	N/A	Not significant
ER18	10.0	<0.1	<0.1	18.4	18.4	183.9	Not significant
ER19	None	<0.1	N/A	10.5	10.5	N/A	Not significant
ER20	10.0	<0.1	<0.1	20.7	20.7	207.2	Not significant
ER21	5.0	<0.1	<0.1	9.8	9.8	196.6	Not significant
ER22	None	<0.1	N/A	11.7	11.7	N/A	Not significant
ER23	2.0	<0.1	<0.1	11.7	11.7	583.5	Not significant
ER24	6.0	<0.1	<0.1	8.9	8.9	147.7	Not significant
ER25	2.0	<0.1	<0.1	10.9	10.9	544.0	Not significant
ER26	2.0	<0.1	<0.1	10.9	10.9	544.0	Not significant
ER27	5.0	<0.1	<0.1	13.5	13.5	269.8	Not significant
ER28	None	<0.1	N/A	12.7	12.7	N/A	Not significant
ER29	None	<0.1	N/A	9.1	9.1	N/A	Not significant
ER30	5.0	<0.1	<0.1	8.7	8.7	173.0	Not significant
ER31	10.0	<0.1	<0.1	18.7	18.7	187.2	Not significant
ER32	None	<0.1	N/A	13.7	13.7	N/A	Not significant
ER33	5.0	<0.1	<0.1	8.1	8.1	162.0	Not significant
ER34	None	<0.1	N/A	8.1	8.1	N/A	Not significant
ER35	None	<0.1	N/A	12.2	12.2	N/A	Not significant
ER36	None	<0.1	N/A	14.9	14.9	N/A	Not significant
ER37	10.0	<0.1	<0.1	21.2	21.2	211.5	Not significant
ER38	2.0	<0.1	0.8	17.3	9.9	867.8	Not significant
ER39	2.0	<0.1	2.4	17.3	10.0	869.4	Further assessment required
ER40	2.0	<0.1	1.0	9.9	10.0	497.5	Further assessment required
ER41	2.0	<0.1	1.1	9.9	10.0	497.6	Further assessment required
ER42	2.0	<0.1	1.1	9.9	10.0	497.6	Further assessment required
ER43	2.0	<0.1	1.3	9.9	10.0	497.8	Further assessment required
ER44	2.0	<0.1	1.1	9.9	10.0	497.6	Further assessment required
ER45	2.0	<0.1	1.5	9.9	10.0	498.0	Further assessment required
ER46	2.0	<0.1	0.8	9.9	9.9	497.3	Not significant
ER47	2.0	<0.1	1.4	9.9	10.0	497.9	Further assessment required
ER48	2.0	<0.1	1.5	17.3	9.9	868.5	Not significant

CL = Critical load – the CL selected for each designated site relates to its most N-sensitive habitat (or a similar surrogate) listed on the site citation for which data on Critical Loads are available and is also based on a precautionary approach using professional judgement.
PC = Process contribution
PEDR = Predicted environmental deposition rate (PC + background)

Table 5.3 - Acid Deposition Rates at Ecological Receptors

Receptor ID	N PC (keq ha^{-1} y^{-1})	Background (keq ha^{-1} y^{-1})	PEC (keq ha^{-1} y^{-1})	PC (% of CL function)	Background (% of CL function)	PEC (% of CL function)	Impact
ER1	<0.1	0.2	0.2	0.4	115.7	116.1	Not significant
ER2	<0.1	0.2	0.2	0.8	115.7	116.5	Not significant
ER3	<0.1	N/A	N/A	N/A	N/A	N/A	N/A
ER4	<0.1	N/A	N/A	N/A	N/A	N/A	N/A
ER5	<0.1	0.3	0.3	0.5	127.9	128.4	Not significant
ER6	<0.1	0.1	0.1	0.4	107.7	108.1	Not significant
ER7	<0.1	0.2	0.2	0.2	112.9	113.1	Not significant
ER8	<0.1	0.2	0.2	0.6	112.7	113.4	Not significant
ER9	<0.1	0.7	0.7	0.2	182.4	182.5	Not significant
ER10	<0.1	No exceedance	No exceedance	0.0	0.0	0.0	Not significant
ER11	<0.1	No exceedance	No exceedance	0.1	74.5	74.5	Not significant
ER12	<0.1	N/A	N/A	N/A	N/A	N/A	N/A
ER13	<0.1	N/A	N/A	N/A	N/A	N/A	N/A
ER14	<0.1	0.1	0.1	0.1	117.0	117.1	Not significant
ER15	<0.1	N/A	N/A	N/A	N/A	N/A	N/A
ER16	<0.1	N/A	N/A	N/A	N/A	N/A	N/A
ER17	<0.1	N/A	N/A	N/A	N/A	N/A	N/A
ER18	<0.1	0.5	0.5	0.2	156.8	157.0	Not significant
ER19	<0.1	N/A	N/A	N/A	N/A	N/A	N/A
ER20	<0.1	0.3	0.3	0.1	120.5	120.5	Not significant
ER21	<0.1	0.2	0.2	0.1	117.5	117.6	Not significant
ER22	<0.1	N/A	N/A	N/A	N/A	N/A	N/A
ER23	<0.1	N/A	N/A	N/A	N/A	N/A	N/A
ER24	<0.1	No exceedance	No exceedance	0.0	2.4	2.4	Not significant
ER25	<0.1	0.2	0.2	0.0	134.4	134.4	Not significant
ER26	<0.1	0.6	0.6	0.1	258.3	258.4	Not significant
ER27	<0.1	0.5	0.5	0.0	176.0	176.1	Not significant
ER28	<0.1	N/A	N/A	N/A	N/A	N/A	N/A
ER29	<0.1	N/A	N/A	N/A	N/A	N/A	N/A
ER30	<0.1	N/A	N/A	N/A	N/A	N/A	N/A
ER31	<0.1	0.5	0.5	0.1	154.0	154.0	Not significant
ER32	<0.1	N/A	N/A	N/A	N/A	N/A	N/A
ER33	<0.1	N/A	N/A	N/A	N/A	N/A	N/A
ER34	<0.1	N/A	N/A	N/A	N/A	N/A	N/A
ER35	<0.1	N/A	N/A	N/A	N/A	N/A	N/A
ER36	<0.1	N/A	N/A	N/A	N/A	N/A	N/A
ER37	<0.1	0.1	0.1	0.1	104.9	105.0	Not significant
ER38	<0.1	0.2	0.2	1.3	115.7	117.0	Further assessment required
ER39	<0.1	0.2	0.2	4.1	115.7	119.8	Further assessment required
ER40	<0.1	No exceedance	No exceedance	1.8	68.1	69.9	Not significant
ER41	<0.1	No exceedance	No exceedance	1.9	68.1	70.1	Further assessment required
ER42	<0.1	No exceedance	No exceedance	1.9	68.1	70.1	Further assessment required
ER43	<0.1	No exceedance	No exceedance	2.2	68.1	70.3	Further assessment required
ER44	<0.1	No exceedance	No exceedance	1.9	68.1	70.1	Further assessment required
ER45	<0.1	No exceedance	No exceedance	2.6	68.1	70.8	Further assessment required
ER46	<0.1	No exceedance	No exceedance	1.4	68.1	69.6	Not significant
ER47	<0.1	No exceedance	No exceedance	2.4	68.1	70.5	Further assessment required
ER48	<0.1	0.2	0.2	2.5	115.7	118.2	Further assessment required

CL = Critical load
PEC = Predicted environmental concentration (PC + background)
No exceedance as per the output of the critical load function tool available on APIS

5.2 Model Results for Short-term Mean Metrics

Table 5.4 details the assessment results for the predicted short-term mean concentration results. The summary table provides the maximum result at any receptor for each pollutant and averaging period under operating conditions.

Table 5.4 - Short-term Results at Human and Ecological Receptors

Parameter	Short-term Mean				
	AQAL µg/m³	PC µg/m³	PEC µg/m³	% PC of AQAL	% PEC of AQAL
Human Receptors					
99.79 percentile 1-hour mean NO_2	200	1.8	9.6	0.9	4.8
Maximum 1-hour mean CO	30,000	1379.3	1379.61	4.6	4.6
Maximum 8-hour rolling men CO	10,000	1160.1	1160.4	11.6	11.6
99.90 percentile 15-minute mean SO_2	266	<0.1	3.1	<0.1	1.2
99.73 percentile 1-hour mean SO_2	350	<0.1	3.1	<0.1	0.9
99.18 percentile 24-hour mean SO_2	125	<0.1	3.1	<0.1	2.5
90.41 percentile 24-hour mean PM_{10}	50	<0.1	9.5	<0.1	18.9
Ecological Receptors					
24-hour mean NO_x	75	3.7	12.7	4.9	17.0

Table 5.4 indicates that the results of the short-term assessment metrics for human receptors are comfortably below the relevant AQAL during operation of the site.

The short-term results for ecological receptors showed no exceedances of the 24-hour mean NO_x AQAL at any modelled receptor.

6 CONCLUSIONS

Bureau Veritas has been commissioned by Hochtief UK to undertake an air quality assessment for document provides supporting technical information for the Site's Environmental Permit in accordance with the requirements of the EPR, which transposes MCPD.

The proposed works include the operation of five HVO fuel generators. The assessment has used detailed dispersion modelling to undertake a study of emissions to air during the operation of the site.

Summary of Conclusions

The assessment has resulted in the following conclusions:

- Considering annual mean results, results at all human receptors (annual NO_2 and annual PM_{10}) and all ecological receptors (annual NO_x and annual SO_2) were well below the relevant assessment metrics.
- Considering short-term results, all results at human receptors were below the relevant assessment metrics for NO_2 (1-hour mean), CO (1-hour and 8-hour rolling means), SO_2 (1-hour and 24-hour means) and PM_{10} (24-hour mean).
- The short-term results for ecological receptors were below the 24-hour NO_x Air Quality Assessment Level (AQAL).
- The results for nitrogen deposition show exceedances at designated sites. The maximum total predicted environmental deposition rate (PEDR) is 869.4% of the Critical Level (CL). This is due to the background deposition rate at these receptors being relatively high when compared to the minimum CL. When taking the Process Contribution (PC), the impacts at eight of the modelled receptors can still be deemed significant, with the maximum %PC of CL being 2.4%. This is due to the relatively low CL in these areas.
- Results for acid deposition showed exceedances of the CL at 21 modelled receptors; when taking account of the PC the contribution, the impacts were still significant at nine receptors. These exceedances were a result of the EALs for woodland habitats within Glaslyn SSSI and Coedydd Derw a Safleoedd Ystlumod Meirion / Meirionnydd Oakwoods and Bat Sites SAC.
- Due to the selection of the minimum CL for the additional ecological receptors modelled within the area designated as both Glaslyn SSSI and Coedydd Derw a Safleoedd Ystlumod Meirion / Meirionnydd Oakwoods and Bat Sites SAC, these results are expected to be conservative. For those areas where exceedances were identified, further assessment was carried out through consultation with an ecologist as detailed in the accompanying technical note[7].