

DISPERSION MODELLING ASSESSMENT BRIDGE ROAD, WREXHAM INDUSTRIAL ESTATE, WREXHAM

ENSAFE REFERENCE: AQ109191

REPORT PREPARED FOR: ST LAND HOLDINGS LIMITED

DATE: JULY 2020



Issue/revision	Issue 1	Revision 1	Revision 2	Revision 3
Remarks		-		
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EXECUTIVE SUMMARY

Ensafe Consultants was commissioned by St Land Holdings Limited to undertake a Dispersion Modelling Assessment in support of a proposed Short-Term Operating Reserve Site at Bridge Road, Wrexham industrial Estate, Wrexham.

The proposals include the installation of a gas-powered electricity facility with a maximum capacity of 10 Megawatt Electrical, this will comprise a total of up to 6 generator units, alongside associated infrastructure. Combustion emissions from the selected plants will be released through dedicated stacks, subsequently, the facility may have the potential to increase pollutant concentrations in the vicinity of the site. As such, a Dispersion Modelling Assessment was required to quantify effects at sensitive locations.

Dispersion modelling was undertaken in order to quantify pollutant concentrations and effects at sensitive locations throughout surrounding area. It should be noted that predicted impacts were based on an assessment scenario of real time operations and as such, predicted results are likely to a robust prediction of actual impacts.

The dispersion modelling results predicted that Impacts upon existing pollutant concentrations at human and ecological sensitive receptors were predicted to be **insignificant** at all locations within the assessment extents.

Based on the assessment results, air quality issues are not considered a constraint to planning consent for the development.

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1. INTRODUCTION

1.1 Background

Ensafe Consultants (Ensafe) was commissioned by St Land Holdings Limited to undertake a Dispersion Modelling Assessment in support of the installation of a Short-Term Operating Reserve (STOR) site at Bridge Road, Wrexham Industrial Estate, Wrexham.

1.2 Site Location and Context

The proposed development is located at Bridge Road, Wrexham Industrial Estate, Wrexham, at approximate National Grid Reference (NGR): 338100, 349550. Reference should be made to Figure 1 for a map of the proposed generator locations and the surrounding area.

The proposals include the installation of a gas-powered electricity facility with a maximum capacity of 10 Megawatts (MWe), this will comprise a total of up to 6 generator units. Combustion emissions from the selected plants will be released through individually dedicated stacks which have potential to increase pollutant concentrations in the vicinity of the site. A Dispersion Modelling Assessment was therefore required to consider any effects associated with the installation. This is detailed in the following report.

1.3 Limitations

This report has been produced in accordance with Ensafes's standard terms of engagement. Ensafes has prepared this report solely for the use of the Client and those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from Ensafes; a charge may be levied against such approval.

2 LEGISLATION AND POLICY

2.1 European Legislation

European Union (EU) air quality legislation is provided within Directive 2008/50/EC, which came into force on 11th June 2008. This Directive consolidated previous legislation which was designed to deal with specific pollutants in a consistent manner and provided new air quality objectives for particulate matter with an aerodynamic diameter of less than 2.5µm (PM_{2.5}). The consolidated Directives include:

- Directive 99/30/EC - the First Air Quality "Daughter" Directive - sets ambient Air Quality Limit Values (AQLVs) for nitrogen dioxide (NO₂), oxides of nitrogen (NO_x), sulphur dioxide, lead and particulate matter with an aerodynamic diameter of less than 10µm (PM₁₀);
- Directive 2000/69/EC - the Second Air Quality "Daughter" Directive - sets ambient AQLVs for benzene and carbon monoxide; and
- Directive 2002/3/EC - the Third Air Quality "Daughter" Directive - seeks to establish long-term objectives, target values, an alert threshold and an information threshold for concentrations of ozone in ambient air.

The fourth daughter Directive was not included within the consolidation and is described as:

- Directive 2004/107/EC - sets health-based limits on polycyclic aromatic hydrocarbons, cadmium, arsenic, nickel and mercury, for which there is a requirement to reduce exposure to as low as reasonably achievable.

2.2 UK Legislation

The Air Quality Standards (Amendment) Regulations (2016) came into force on 31st December 2016. These Regulations amend the Air Quality Standards Regulations 2010 and transpose the EU Directive 2008/50/EC into UK law. AQLVs were published in these regulations for 7 pollutants, as well as Target Values for an additional 6 pollutants.

Part IV of the Environment Act (1995) requires UK government to produce a national Air Quality Strategy (AQS) which contains standards, objectives and measures for improving ambient air quality. The most recent AQS was produced by the Department for Environment, Food and Rural Affairs (DEFRA) and published in July 2007¹. The AQS sets out Air Quality Objectives (AQOs) that are maximum ambient pollutant concentrations that are not to be exceeded either without exception or with a permitted number of exceedances over a specified timescale. These are generally in line with the AQLVs, although the requirements for compliance vary slightly.

Table 1 presents the AQOs for pollutants considered within this assessment.

¹ The Air Quality Strategy for England, Scotland, Wales and Northern Ireland, DEFRA, 2007.

Table 1 Air Quality Objectives

Pollutant	Air Quality Objective	
	Concentration ($\mu\text{g}/\text{m}^3$)	Averaging Period
Nitrogen Dioxide (NO_2)	40	Annual mean
	200	1-hour mean; not to be exceeded more than 18 times a year
Carbon Monoxide (CO)	10,000	Maximum daily running 8-hour mean

Table 2 summarises the advice provided in DEFRA guidance LAQM (TG16)² on where the AQOs for pollutants considered within this report apply.

Table 2 Examples of Where the Air Quality Objectives Apply

Averaging Period	Objectives 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 and 8-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-hour mean and 8-hour 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 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	Kerbside sites where the public would not be expected to have regular access

2.3 Critical Loads and Levels

² Local Air Quality Management Technical Guidance 2016 LAQM (TG16), DEFRA, 2016.

The assessment will also consider critical loads (CL) in relation to potential ecological impacts. A CL is defined by the UK Air Pollution Information System³ (APIS) as:

"A quantitative estimate of exposure to deposition of one or more pollutants, below which significant harmful effects on sensitive elements of the environment do not occur, according to present knowledge. The exceedance of a critical load is defined as the atmospheric deposition of the pollutant above the critical load."

A critical level is defined as:

"Threshold for direct effects of pollutant concentrations according to current knowledge. Exceedance of a critical level is defined as the atmospheric concentration of the pollutant above the critical level."

A critical load refers to deposition of a pollutant, while a critical level refers to pollutant concentrations in the atmosphere (which usually have direct effects on vegetation or human health).

When pollutant loads (or concentrations) exceed the critical load or level it is considered that there is a risk of harmful effects. The excess over the critical load or level is termed the exceedance. A larger exceedance is often considered to represent a greater risk of damage.

Maps of critical loads and levels and their exceedances have been used to show the potential extent of pollution damage and aid in developing strategies for reducing pollution. Decreasing deposition below the critical load is seen as means for preventing the risk of damage. However, even a decrease in the exceedance may infer that less damage will occur.

Critical loads have been designated within the UK based on the sensitivity of the receiving habitat and have been reviewed for the purpose of this assessment.

2.4 Local Air Quality Management

Under Section 82 of the Environment Act (1995) (Part IV) Local Authorities (LAs) are required to periodically review and assess air quality within their area of administration under the system of Local Air Quality Management (LAQM). This review and assessment of air quality involves considering present and likely future air quality against the AQOs. If it is predicted that levels at sensitive locations where members of the public are regularly present for the relevant averaging period are likely to be exceeded, the LA is required to declare an 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.

2.5 Industrial Pollution Control Legislation

Atmospheric emissions from industry are controlled in England and Wales through the Environmental Permitting (England and Wales) Regulations (2018) and subsequent amendments.

2.6 Planning Policy Wales

The Planning Policy Wales (PPW) was published on November 2016 and sets out the Welsh

³ UK Air Pollution Information System, www.apis.ac.uk.

Government's core planning policies and principles with respect to land use planning, including air quality. The document includes the following considerations which are relevant to this assessment:

"Good design is essential to ensure that areas, particularly those where higher density development takes place, offer high environmental quality, including open and green spaces. Landscape considerations are an integral part of the design process and can make a positive contribution to environmental protection and improvement, for example to biodiversity, climate protection, air quality and the protection of water resources."

"Where pollution considerations, which may be relevant to a pollution control authorisation or licence or result from the need to comply with any statutory environmental quality standards or objectives, affect the use and development of land they can be material planning considerations. This provision extends to air quality objectives set out under Part IV of the Environment Act 1995 and the local authority's action plans for Air Quality Management Areas and, in the case of water, to environmental objectives developed as part of the implementation of the European Union's Water Framework Directive. The weight attached to such considerations will depend on the scope of the pollution control system in each case and the effect on land use and amenity."

"The potential for pollution affecting the use of land will be a material consideration in deciding whether to grant planning permission. Material considerations in determining applications for potentially polluting development are likely to include:

[...]

The risk and impact of potential pollution from the development, insofar as this might have an effect on the use of other land and the surrounding environment (the environmental regulatory regime may well have an interest in these issues, particularly if the development would impact on an Air Quality Management Area or a SAC)"

The implications of the PPW have been considered throughout this assessment.

2.7 Local Planning Policy

The Unitary Development Plan 1996 – 2011⁴ was adopted by Wrexham County Borough Council on the 14th February 2005 and provides framework for local decision making and the reconciliation of development and conservation interests in order that land use changes proceed coherently and with maximum community benefit.

A review of the Development Plan indicated the following policy in relation to air quality that is relevant to this assessment:

"Policy GDP1

All new development should:-

[...]

⁴ The Unitary Development Plan 1996 – 2011, Wrexham County Borough Council, 2005.

f) Ensure the safety and amenity of the public and safeguard the environment from the adverse effects of pollution of water, land or air, hazards from industry and quarrying, and associated noise, odour or vibration arising from development.

This policy has been considered throughout this report by assessing potential air quality impacts as a result of the proposed development.



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3 BASELINE

Existing air quality conditions in the vicinity of the installation were identified in order to provide a baseline for assessment. These are detailed in the following sections.

3.1 Local Air Quality Management

As required by the Environment Act (1995), Wrexham County Borough Council (WCBC) has undertaken Review and Assessment of air quality within their area of administration. This process has indicated that pollutant concentrations are below the relevant AQOs at locations of relevant exposure. As such, no AQMAs have been declared

3.2 Air Quality Monitoring

Monitoring of pollutant concentrations is undertaken by WCBC using both continuous and passive methods throughout their area of administration. There are currently 25 diffusion tubes and 3 automatic monitoring stations operated by WCBC, the closest of which is WBC-041, located at NGR: 335407, 347890 approximately 3.5km South west of the site. Due to the distance and differences in the surrounding urban context between the proposed site and the diffusion tubes similar concentrations would not be anticipated; as such this source of data has not been considered further within this report.

3.3 Background Pollutant Concentrations

Predictions of background pollutant concentrations on a 1km by 1km grid basis have been produced by DEFRA for the entire of the UK to assist LAs in their Review and Assessment of air quality. The proposed development site is located in grid square NGR: 338500, 349500. Data for this location was downloaded from the DEFRA website⁵ for the purpose of this assessment and is summarised in Table 3.

Table 3 Predicted Background Pollutant Concentrations

Pollutant	2018 Predicted Background Concentration ($\mu\text{g}/\text{m}^3$)
NO _x	13.56
NO ₂	10.01
CO	243.00

It should be noted that background concentrations of NO₂ and NO_x were predicted for 2018 in order to represent current conditions at the facility. The background concentration of CO was obtained from the 2001 predictions⁶. These are the most recent predictions available from DEFRA and are therefore considered to provide a reasonable representation of background concentrations in the vicinity of the site.

⁵ <https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2017>

⁶ <https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2001>

3.4 Sensitive Receptors

A sensitive receptor is defined as any location which may be affected by changes in air quality. These have been defined for human and ecological receptors in the following Sections.

3.4.1 Sensitive Human Receptors

A desk-top study was undertaken in order to identify any sensitive human receptor locations in the vicinity of the site that required specific consideration during the assessment. These are summarised in Table 4.

Table 4 Sensitive Human Receptors

Receptor		Height (m)	NGR (m)		Distance from Centre of Site Boundary (m)
			X	Y	
R1	Industrial Unit	1.5	338085.2	349572.9	<1
R2	Industrial Unit	1.5	338091.8	349562.1	<1
R3	Industrial Unit	1.5	338091.9	349552.2	4
R4	Nutrafeed Industrial Unit	1.5	338155.2	349528.6	2
R5	Nutrafeed Industrial Unit	1.5	338158.9	349545.5	8
R6	Tritech Industrial Unit	1.5	338188.9	349595.1	43
R7	Office units	1.5	338055.2	349530.3	31
R8	HTC Management Services	1.5	338098.0	349445.4	59
R9	Ardagh Group unit	1.5	337975.3	349623.4	112
R10	Ardagh Group unit	1.5	338021.9	349688.4	122
R11	Rawson Digital	1.5	338224.8	349699.9	118

The sensitive receptors identified in Table 4 represent worst-case locations i.e. the receptors at which air quality impacts from the proposals are expected to be the greatest. However, this is not an exhaustive list and there may be other locations within the vicinity of the site that may experience air quality impacts as a result of atmospheric emissions from the facility that have not been individually identified above. Reference should be made to Figure 1 within Appendix I for a graphical representation of sensitive human receptor locations. Predicted pollutant background concentration at specific receptor locations are summarised in Table 5.

Table 5 Predicted Background Pollutant Concentrations at Sensitive Human Receptors

Receptor		Predicted Background Concentration ($\mu\text{g}/\text{m}^3$)		
		NO ₂	NO _x	CO
R1	Industrial Unit	10.01	13.57	243.00
R2	Industrial Unit	10.01	13.57	243.00

Receptor		Predicted Background Concentration ($\mu\text{g}/\text{m}^3$)		
		NO ₂	NO _x	CO
R3	Industrial Unit	10.01	13.57	243.00
R4	Nutrafeed Industrial Unit	10.01	13.57	243.00
R5	Nutrafeed Industrial Unit	10.01	13.57	243.00
R6	Tritech Industrial Unit	10.01	13.57	243.00
R7	Office units	10.01	13.57	243.00
R8	HTC Management Services	10.01	13.57	243.00
R9	Ardagh Group unit	10.01	13.57	243.00
R10	Ardagh Group unit	10.01	13.57	243.00
R11	Rawson Digital	10.01	13.57	243.00

3.4.2 Sensitive Ecological Receptors

With regard to receptors of ecological sensitivity, Environment Agency (EA) guidance⁷ states:

"Note that conservation sites need only be considered where they fall within set distances of the activity:

- *Special Protection Areas (SPAs), Special Areas of Conservation (SACs) or Ramsar sites within 10km of the installation (or 15km coal or oil-fired power station);*
- *Sites of Special Scientific Interest (SSSIs), National Nature Reserves (NNRs), Local Nature Reserves (LNRs), Local Wildlife Sites (LWS) and Ancient Woodland (AW) within 2km of the location.*
- *Some larger emitters may be required to screen to 10km or 15km for SSSIs."*

Atmospheric emissions from the facility have the potential to impact on receptors of ecological sensitivity within the vicinity of the site. A study was undertaken to identify any statutory designated sites of ecological or nature conservation importance within the distances stated above. This was completed using the Multi-Agency Geographic Information for the Countryside (MAGIC) web-based interactive mapping service⁸ which draws information on key environmental schemes and designations. It should be noted that MAGIC does not contain information on Local Wildlife Sites (LWSs) and as such, COFNOD⁹ was commissioned to identify all LWSs within 2km of the proposed development site.

The receptor points chosen represent the closest points to the proposed facility and are displayed in Table 6. Reference should be made to Figure 1 within Appendix I for a graphical representation of the ecological designations.

⁷ <https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit>.

⁸ Multi-Agency Geographic Information for the Countryside, www.magic.gov.uk.

⁹ COFNOD - the North Wales Environmental Data Service - <http://www.cofnod.org.uk>

Table 6 Ecological Receptors

Ecological Receptor		NGR (m)		Distance from Centre of Site Boundary (m)
		X	Y	
E1R1	Cefn Park Land – Local Wildlife Site	338498	349499	401
E1R2	Cefn Park Land – Local Wildlife Site	338594	349497	496
E1R3	Cefn Park Land – Local Wildlife Site	338708	349459	615
E1R4	Cefn Park Land – Local Wildlife Site	338767	349386	689
E1R5	Cefn Park Land – Local Wildlife Site	338855	349375	777
E1R6	Cefn Park Land – Local Wildlife Site	338553	349412	476
E1R7	Cefn Park Land – Local Wildlife Site	338689	349364	621
E1R8	Cefn Park Land – Local Wildlife Site	338839	349294	786
E1R9	Cefn Park Land – Local Wildlife Site	338435	349336	406
E1R10	Cefn Park Land – Local Wildlife Site	338643	349248	628
E1R11	Cefn Park Land – Local Wildlife Site	338864	349182	854
E1R12	Cefn Park Land – Local Wildlife Site	339030	349179	1006
E2R1	Erlas Black Wood - Ancient Woodland	337761	349922	491
E2R2	Erlas Black Wood - Ancient Woodland	337782	350012	547
E2R3	Erlas Black Wood - Ancient Woodland	337801	350091	603
E2R4	Erlas Black Wood - Ancient Woodland	337668	349981	599
E3R1	Bryn Road - Grassland	338915	350094	966
E3R2	Bryn Road - Grassland	338877	350002	886
E3R3	Bryn Road - Grassland	338867	349982	868
E3R4	Bryn Road - Grassland	338887	349916	857
E3R5	Bryn Road - Grassland	338918	349901	879
E3R6	Bryn Road - Grassland	338948	349997	946

Critical loads have been designated within the UK based on the sensitivity and relevant features of the receiving habitat. A review of the Air Pollution Information System (APIS) website¹⁰ was undertaken in order to identify the most suitable habitat description and associated critical load for the designations considered within the model. The critical loads for nitrogen deposition are presented in Table 7.

¹⁰ UK Air Pollution Information System, www.apis.ac.uk.

Table 7 Nitrogen Critical Load

Ecological Designation	Feature	APIS Habitat	Nitrogen Critical Load (kgN/ha/yr)	
			Min	Max
Cefn Park Land - Wildlife site	Non-Mediterranean dry acid and neutral closed grassland	Neutral Grassland	10	20
Erlas Black Wood - Ancient Woodland	Broadleaved deciduous woodland	Broadleaved, Mixed and Yew Woodland	10	20
Bryn Road - Grassland	Non-Mediterranean dry acid and neutral closed grassland	Neutral Grassland	10	20

It should be noted that the information shown in Table 7 represents the most representative habitat within each designation for nitrogen deposition.

Table 8 shows the relevant critical loads for acid deposition.

Table 8 Acid Critical Load

Ecological Designation	Feature	APIS Habitat	Critical Load (ke/ha/yr)		
			CLma xS	CLma xN	CLmin N
Cefn Park Land - Wildlife site	Non-Mediterranean dry acid and neutral closed grassland	Neutral Grassland	4.00	1.071	5.071
Erlas Black Wood - Ancient Woodland	Broadleaved deciduous woodland	Broadleaved, Mixed and Yew Woodland	1.406	0.357	1.763
Bryn Road - Grassland	Non-Mediterranean dry acid and neutral closed grassland	Neutral Grassland	4.00	1.071	5.071

Background deposition rates at the ecological receptor location were downloaded from the APIS website¹⁰ and are summarised in Table 9.

Table 9 Background Deposition Rates

Ecological Designation	Background Deposition Rate		
	Nitrogen (kgN/ha/yr)	Acid (keq/ha/yr)	
		Nitrogen	Sulphur
Cefn Park Land - Wildlife site	23.94	1.71	0.16
Erlas Black Wood - Ancient Woodland	41.3	2.95	0.19
Bryn Road - Grassland	23.94	1.71	0.16

4 METHODOLOGY

Emissions associated with the proposed generators have the potential to cause increases in pollutant concentrations in the vicinity of the site. These have been quantified through dispersion modelling in accordance with the methodology outlined in the following Sections.

An industry standard atmospheric dispersion model, ADMS 5, was used to model releases of the identified substances. The dispersion modelling procedure was as follows:

- Information on stack dimensions and position were provided by St Land Holdings Limited;
- Process conditions were provided by St Land Holdings Limited;
- Emission rates were provided by the technology provider;
- Appropriate data to describe meteorological conditions in the vicinity of the site were obtained from Atmospheric Dispersion Modelling (ADM) Ltd;
- The above information was entered into the dispersion model;
- The dispersion model was run to determine pollutant concentrations in the vicinity of the site; and
- The study results were compared with the relevant assessment criteria.

4.1 Dispersion Model

Dispersion modelling was undertaken using ADMS 5 (v5.2), which is developed by Cambridge Environmental Research Consultants (CERC) Ltd. ADMS 5 is a short-range dispersion modelling software package that simulates a wide range of buoyant and passive releases to atmosphere. It is a new generation model utilising boundary layer height and Monin-Obukhov length to describe the atmospheric boundary layer and a skewed Gaussian concentration distribution to calculate dispersion under convective conditions.

The model utilises hourly meteorological data to define conditions for plume rise, transport and diffusion. It estimates the concentration for each source and receptor combination for each hour of input meteorology, and calculates user-selected long-term and short-term averages.

4.2 Modelling Scenarios

The scenarios considered in the modelling assessment are summarised in Table 10.

Table 10 Dispersion Modelling Scenarios

Parameter	Modelled As	
	Short Term	Long Term
NO ₂	99.79%ile 1-hour mean	Annual mean
NO _x	24 Hour Mean	Annual Mean
CO	Maximum daily running 8-hour mean	-

Some short-term air quality criteria are framed in terms of the number of occasions in a calendar year on which the concentration should not be exceeded. As such, the percentiles (%ile) shown in Table 10 were selected to represent the relationship between the permitted number of exceedances of short-period concentrations and the number of periods within a calendar year.

4.3 Stack Information

A maximum capacity of 10MWth will be provided on site, for the purposes of the assessment it was assumed that 6 units will be installed, however the capacity may be achieved through the installation alternative generator units. Critically, the total site capacity will not exceed a maximum of 10MWth.

The process conditions were based on the technical data sheet for a CAT G3520E model.

Combustion products from the proposed gas fired generators will be emitted from dedicated stacks. Relevant details are presented in Table 11.

Table 11 Stack Information

Stack Reference	Plant Reference	Stack Location NGR (m)	
		X	Y
G1	Generator 1	338087.4	349580.0
G2	Generator 2	338093.8	349573.8
G3	Generator 3	338096.9	349565.7
G4	Generator 4	338101.6	349558.5
G5	Generator 5	338104.7	349549.0
G6	Generator 6	338124.9	349560.3

Reference should be made to Figure 1 within Appendix I for a graphical representation of the stack locations.

4.4 Process Conditions

Process conditions were provided through correspondence with St Land Holdings Limited, and the technology provider and are identical for each of the generator units. A maximum capacity of 10MWth will be provided on site, for the purposes of the assessment it was assumed that four 6 units will be installed. The process conditions were based on the technical data sheet for a CAT G3520E model.

Reference should be made to Table 12 for dispersion modelling inputs, for each generator.

Table 12 Process Conditions

Category	Unit	Value
Stack diameter	m	0.55
Stack height	m	5.8
Flue gas efflux velocity (actual)	m/s	37.20
Volumetric flow rate (actual)	m ³ /s	8.83
Temperature	°C	441

4.5 Emissions

The pollutant mass emission rates for use in the assessment were provided by St Land Holdings and are summarised in Table 13. This represents a conservative assessment approach with emissions from the generators assumed to be the maximum permitted.

Table 13 Emission Rates Per Generator Unit

Pollutant	Mass Emission Rate (g/s)
NO _x	0.61
CO	2.69

4.6 Time Varied Emissions

Based on the information provided by St Land Holdings Limited the generators would be in use typically for 3000 hours per year, as such, plant shut-down and periods of reduced workloads are fully reflected in the modelled emissions.

Specific operating hours are not known and total flexibly is required throughout the year to reflect the ever-changing UK energy market. As such, it is therefore difficult to assess the short-term impacts for NO₂ concentrations, given that objectives are based on the number of allowances that the mean can be exceeded for a specified averaging period.

Therefore, the ADMS model was run for a full calendar year (8760 hours) of continuous operation to ensure that the varying hourly meteorological conditions were captured. However, as the annual operational hours (3,000 hours) are significantly lower than the full calendar year (8,760 hours) an approach utilising hypergeometric probability distribution was undertaken. The methodology is provided within the EA Guidance "Specified generators: air dispersion modelling example short term statistical analysis"¹¹. It should be noted that when the proposed operating period is continuous of more than 1-hour then the calculated probability is multiplied by a factor of 2.5.

With relation to the annual mean assessment, this again was undertaking in accordance with the EA guidance¹¹ which suggests the annual mean PCs can be calculated by scaling down long term predictions by the total number of operational hours over the total number of hours in the operating envelope.

In this instance a scaling factor of **0.342** was applied to annual mean PC results. The factor equates to the operational hours per year of 3,000 divided by the operational envelope of 8760 hours. Annual mean PECs were then calculated by adding the annual mean background concentration detailed in Table 11.

4.7 Assessment Extents

Ambient concentrations were predicted over the area NGR: 337950, 349400, to 338250, 349700. One Cartesian grid with a resolution of 5m and a height of 1.5m was included in the model. Results were subsequently used to produce contour plots within the Surfer software package.

¹¹ Specified generators: air dispersion modelling example short term statistical analysis, Environment Agency, 201

4.8 Terrain Data

Ordnance Survey Landform Panorama terrain data was included for the site and surrounding area in order to take account of the specific flow field produced by variations in ground height throughout the assessment extents. This was pre-processed using the dedicated function within ADMS 5.

4.9 Building Effects

The dispersion of substances released from elevated sources can be influenced by the presence of buildings close to the emission point. Structures can interrupt the wind flows and cause significantly higher ground-level concentrations close to the source than would arise in the absence of the buildings.

Analysis of the site layout indicated that a number of structures in the vicinity of the stacks should be included within the model in order to take account of effects on pollutant dispersion. Building input geometries are shown in Table 14.

Table 14 Building Geometries

Building		NGR (m)		Height (m)	Length (m)	Width (m)	Angle (°)
		X	Y				
1	Gen Set 1	338090.3	349581.6	2.4	4.2	17.8	147.2
2	Gen Set 2	338095.7	349575.0	2.4	4.2	17.8	147.3
3	Gen Set 3	338099.8	349567.6	2.4	4.2	17.9	147.5
4	Gen Set 4	338104.0	349559.8	2.4	4.2	17.9	147.8
5	Gen Set 5	338107.2	349550.5	2.4	4.2	17.9	147.8
6	Gen Set 6	338124.3	349563.8	2.4	17.8	4.1	172.4
7	Radiator 1	338090.5	349576.3	2.0	2.5	4.9	148.3
8	Radiator 2	338095.5	349570.2	2.0	2.5	4.9	148.2
9	Radiator 3	338100.0	349562.7	2.0	2.5	4.9	148.2
10	Radiator 4	338104.0	349554.7	2.0	2.5	4.9	148.3
11	Radiator 5	338107.0	349545.6	2.0	2.5	4.9	148.5
12	Radiator 6	338120.8	349556.7	2.0	5.0	2.5	171.9
13	Storage	338106.9	349580.2	2.0	2.5	2.0	148.2
14	Storage	338113.2	349568.4	2.0	2.5	2.0	148.0
15	Gas Kiosk	338119.6	349602.5	2.5	2.4	6.5	144.7
16	Gas Kiosk	338104.1	349592.6	2.5	2.6	11.0	145.9
17	DNO Building	338123.5	349589.9	2.5	8.7	3.4	180.0
18	DNO Building	338123.4	349578.9	2.5	8.8	4.0	180.0

Building		NGR (m)		Height (m)	Length (m)	Width (m)	Angle (°)
		X	Y				
19	Industrial Unit	338077.9	349560.8	6.0	13.1	24.7	148.1
20	Industrial Unit	338085.7	349553.3	3.0	8.8	8.7	148.0
21	Industrial Unit	338042.1	349531.6	2.6	5.9	25.5	200.0
22	Industrial Unit	338041.3	349526.3	5.0	4.4	25.0	200.0
23	Industrial Unit	338183.4	349535.0	7.0	43.4	30.6	148.2
24	Industrial Unit	338168.6	349518.4	7.0	31.2	12.1	148.0
25	Industrial Unit	338233.3	349584.8	7.0	65.3	63.0	147.1

Reference should be made to Figure 1 within Appendix I for a graphical representation of the modelled building layout and the ADMS 5 model input.

4.10 Meteorological Data

Meteorological data used in this assessment was taken from Hawarden meteorological station over the period 1st January 2013 to 31st December 2017 (inclusive). Hawarden meteorological station is located at approximate NGR: 381745, 383960, which is approximately 15km north of the proposed development site.

All meteorological data used in the assessment was provided by ADM Ltd, which is an established distributor of meteorological data within the UK. Reference should be made to Figure 2 within Appendix I for wind roses of utilised meteorological data.

4.11 Roughness Length

A roughness length (z_0) of 0.5m was used in the dispersion modelling study. This value of z_0 is considered appropriate for the morphology of the assessment area and is suggested within ADMS 5 as being suitable for 'Parkland, open suburbia'.

A z_0 of 0.3m was utilised to represent the morphology of the meteorological station location and is suggested as being suitable for 'agricultural areas (max)'.

4.12 Monin-Obukhov Length

The Monin-Obukhov length provides a measure of the stability of the atmosphere. A minimum Monin-Obukhov length of 30m was used in the dispersion modelling study. This value is considered appropriate for the nature of the assessment area and is suggested within ADMS 5 as being suitable for 'mixed urban/industrial'.

A Monin-Obukhov length of 10m was utilised to represent the nature of meteorological station location and is suggested within ADMS 5 as being suitable for 'small towns <50,000'.

4.13 Deposition Rates

Deposition rates were calculated using the conversion factors provided within EA document

'Technical Guidance on Detailed Modelling approach for an Appropriate Assessment for Emissions to Air AQTAG 06'. Predicted pollutant concentrations were multiplied by the relevant deposition velocity and conversion factor to calculate the speciated dry deposition flux. The conversion factors used are presented within Table 15.

Table 15 Conversion Factors to Determine Dry Deposition Flux

Pollutant	Grassland Deposition Velocity (m/s)	Forest Deposition Velocity (m/s)	Conversion Factor ($\mu\text{g}/\text{m}^2/\text{s}$ to $\text{kg}/\text{ha}/\text{yr}$ of pollutant species)
NO ₂	0.0015	0.0030	96.0

Acid deposition occurs as a result of NO₂. Predicted ground level pollutant concentrations were converted to kilo-equivalent ion depositions ($\text{keq}/\text{ha}/\text{yr}$) for comparison with the critical load for acid deposition at each of the identified ecological receptors.

The conversion to units of equivalents, a measure of the potential acidifying effect of a species, was undertaken by multiplying the dry deposition flux by the standard conversion factors shown in Table 16.

Table 16 Conversion Factors to Units of Equivalents

Species	Conversion Factor from $\text{kg}/\text{ha}/\text{yr}$ to $\text{keq}/\text{ha}/\text{yr}$
Nitrogen	0.07143

4.14 Assessment Criteria

Predicted ground level pollutant concentrations and deposition rates were compared with the relevant AQOs, critical levels and critical loads identified within Section 3.4.2. These criteria are collectively referred to as Environmental Quality Standards (EQSs).

4.15 Baseline Concentrations

A review of existing data in the vicinity of the site was undertaken in Section 3 of this report in order to define baseline pollutant levels. The background concentrations provided by DEFRA, as summarised in Table 3, were used in the assessment to represent existing pollutant levels in the vicinity of the site.

It is not possible to add short-term peak baseline and process concentrations. This is because the conditions which give rise to peak ground-level concentrations of substances emitted from an elevated source at a particular location and time are likely to be different to the conditions which give rise to peak concentrations due to emissions from other sources. This point is addressed in EA guidance⁷, which advises that an estimate of the maximum combined pollutant concentration can be obtained by adding the maximum predicted short-term concentration due to emissions from the source to twice the annual mean baseline concentration. This approach was adopted throughout the assessment.

4.16 NO_x to NO₂ Conversion

Emissions of NO_x from combustion processes are predominantly in the form of NO. Excess oxygen in the combustion gases and further atmospheric reactions cause the oxidation of NO to NO₂.

Ground level NO_x concentrations were predicted through dispersion modelling. NO₂ concentrations reported in the results section assume 70% conversion from NO_x to NO₂ for long term concentrations and 35% conversion for short-term concentrations, based upon EA guidance¹².

4.17 Significance of Predicted Impacts

Predicted pollutant concentrations are summarised in the following formats:

- Process contribution (PC) - Predicted pollutant concentration as a result of emissions from the facility only; and
- Predicted environmental concentration (PEC) - Total predicted pollutant concentration as a result of emissions from the facility and existing baseline levels.

The significance of predicted impact has been assessed in accordance with EA criteria and through consideration of likely effects as a result of the proposals. EA guidance⁷ states that process contributions can be considered insignificant if the PC for each substance meets the following criteria:

- The short-term PC is less than 10% of the short-term environmental standard for protected conservation areas;
- The long-term PC is less than 1% of the long-term environmental standard for protected conservation areas

Should the PC meet both of the above criteria, no further assessment of the substance is required. If the PC exceeds the criteria, a second stage of screening should be undertaken to determine the impact significance of the PEC.

- The short-term PC is less than 20% of the short-term environmental standards minus twice the long-term background concentration;
- The long-term PEC is less than 70% of the long-term environmental standards

Should these criteria be exceeded then the PEC should be checked against the EQS. If the predicted long-term PC is greater than 1% and the PEC is less than 70% of the long-term environmental standard, the emissions can be considered insignificant.

If the emissions associated with the development affect SPAs, SACs, RAMSAR sites or SSSIs meet both of the following criteria, can be considered insignificant:

- the short-term PC is less than 10% of the short-term environmental standard for protected conservation areas;
- the long-term PC is less than 1% of the long-term environmental standard for protected conservation areas

¹² Conversion Ratios for NO_x and NO₂, Environment Agency, undated.

Should these criteria be exceeded then the PEC should be checked against the standard for protected conservation areas. PEC is not required for short-term targets. Should the short-term PC exceed the screening criteria, a detailed modelling is required.

If the predicted long-term PC is greater than 1% and the PEC is less than 70% of the long-term environmental standard, the emissions can be considered insignificant. Should the predicted PEC be greater than 70% of the long-term environmental standard, a detailed dispersion modelling is required.

When considering impacts at local nature sites and the emissions meet both of the following criteria, impacts can be considered insignificant and there is no further assessment required:

- The short-term PC is less than 100% of the short-term environmental standard; and
- The long-term PC is less than 100% of the long-term environmental standard.

Should the PC exceed the screening criteria, detailed dispersion modelling is required. Calculations relating to the PEC of local nature sites is not required as stated with the EA guidance⁷.

4.18 Modelling Uncertainty

Uncertainty in dispersion modelling predictions can be associated with a variety of factors, including:

- Model uncertainty - due to model limitations;
- Data uncertainty - due to errors in input data, including emission estimates, operational procedures, land use characteristics and meteorology; and
- Variability - randomness of measurements used.

Potential uncertainties in model results were minimised as far as practicable and worst-case inputs used in order to provide a robust assessment. This included the following:

- Choice of model - ADMS 5 is a commonly used atmospheric dispersion model and results have been verified through a number of studies to ensure predictions are as accurate as possible;
- Meteorological data - Modelling was undertaken using four annual meteorological data sets from the closest observation site to the site to take account of local conditions;
- Plant operating conditions - Plant operating conditions were provided by St Land Holdings Limited. As such, these are considered to be representative of operating conditions;
- Emission rates - Emission rates were obtained for the proposed generators were provided by St Land Holdings Limited. As such, these are considered to be representative of likely emissions;
- Background concentrations - Background concentrations were obtained from the DEFRA mapping study;
- Receptor locations - A Cartesian Grid was included in the model in order to calculate maximum predicted concentrations throughout the assessment extents; and
- Variability - All model inputs are as accurate as possible and worst-case conditions were considered as necessary in order to ensure a robust assessment of potential pollutant concentrations.

Results were considered in the context of the relevant Environmental Quality Standard (EQS). It is considered that the use of the stated measures to reduce uncertainty and the use of worst-case assumptions when necessary has resulted in model accuracy of an acceptable level.

4.19 Dispersion Modelling Report Requirements

Table 17 provides the checklist of dispersion modelling report requirements.

Table 17 Dispersion Modelling Report Requirements

Item	Location within Report
Location map	Figure 1
List of pollutants modelled and relevant air quality guidelines	Table 1, Table 7, and Table 8
Details of modelled scenarios	Table 10
Details of relevant ambient concentrations used	Table 5 and Table 9
Model description and justification	Section 4.1
Special model treatments used	Section 4
Table of emission parameters used	Table 12
Details of modelled domain and receptors	Section 3.4, Section 4, Table 4 and Table 6
Details of meteorological data used (including origin) and justification	Section 4.10
Details of terrain treatment	Section 4.8
Details of building treatment	Section 4.9 and Table 14

5 RESULTS

Dispersion modelling was undertaken with the inputs described in Section 4. Reference should be made to Figure 3 4 for graphical representations of predicted pollutant concentrations throughout the assessment extents.

5.1 Maximum Pollutant Concentrations

The maximum predicted pollutant concentrations at the most affected Human Sensitive Receptor location within the modelling extents for any meteorological data set are summarised in Table 18 for all modelled pollutants.

It should be noted that long term pollutant concentrations of NO₂ and CO have not been contoured across the site as site users will not be present for extended periods of time. All sensitive locations within the vicinity of the site consist of commercial and industrial land uses, where members of the public do not have regular access. As a result, annual mean exposure has not been assessed. This assessment approach accords to the LAQM TG(16)², reference should be made to Table 2 for further information.

Table 18 Maximum Predicted Pollutant Concentrations

Pollutant	Averaging Period	EQS (µg/m ³)	PC		PEC	
			Concentration (µg/m ³)	Proportion of EQS (%)	Concentration (µg/m ³)	Proportion of EQS (%)
NO ₂	1-Hour	200	58	29	78	39
CO	8-Hour Rolling	10,000	614	6	1100	11

As indicated in Table 18, there are no predicted exceedances of any EQS throughout the assessment extents for any pollutant.

5.2 Sensitive Human Receptors

5.2.1 Annual Mean NO₂

Predicted annual mean NO₂ concentrations inclusive of baseline levels are summarised in Table 19. It should be noted that although commercial and industrial receptor locations are not considered sensitive to annual mean concentrations², they have been included in this report to ensure a robust assessment.

Table 19 Predicted Annual Mean NO₂ Concentrations

Receptor		Predicted Annual Mean NO ₂ Concentration (µg/m ³)		Proportion of EQS (%)	
		PC	PEC	PC	PEC
R1	Industrial Unit	5.90	15.91	15	40
R2	Industrial Unit	5.01	15.02	13	38
R3	Industrial Unit	2.01	12.02	5	30

Receptor		Predicted Annual Mean NO ₂ Concentration (µg/m ³)		Proportion of EQS (%)	
		PC	PEC	PC	PEC
R4	Nutrafeed Industrial Unit	5.87	15.89	15	40
R5	Nutrafeed Industrial Unit	5.78	15.79	14	39
R6	Tritech Industrial Unit	5.92	15.94	15	40
R7	Office units	1.29	11.30	3	28
R8	HTC Management Services	1.05	11.07	3	28
R9	Ardagh Group unit	2.64	12.65	7	32
R10	Ardagh Group unit	5.35	15.36	13	38
R11	Rawson Digital	3.07	13.08	8	33

Note: Predicted concentrations were assessed against the relevant EQSs: *Annual mean AQO of 40µg/m³*.

As indicated in Table 19, predicted annual mean NO₂ concentrations were below the relevant EQS at all sensitive receptor locations for all meteorological data sets.

Although the PC proportion of the EQS is greater than 1% at all receptor locations, the EQS remains well below 70% of the PEC and as such, impacts on annual mean NO₂ concentrations can be considered **not significant** according to EA guidance.

5.2.2 1-hour Mean NO₂

Reference should be made to Figure 3 within Appendix I for a graphical contour plots representing maximum predicted 1-hour mean NO₂ concentrations throughout the assessment extents.

Predicted 1-hour mean NO₂ concentrations at sensitive human receptor locations are summarised in Table 20.

Table 20 Predicted 1 Hour Mean NO₂ Concentrations

Receptor		Predicted Annual Mean NO ₂ Concentration (µg/m ³)		Proportion of EQS (%)		
		PC	PEC	PC	PEC ^b	PEC ^c
R1	Industrial Unit	32.26	52.29	16	18	26
R2	Industrial Unit	24.76	44.79	12	14	22
R3	Industrial Unit	18.08	38.11	9	10	19
R4	Nutrafeed Industrial Unit	32.36	52.39	16	18	26
R5	Nutrafeed Industrial Unit	34.73	54.75	17	19	27
R6	Tritech Industrial Unit	24.45	44.48	12	14	22
R7	Office units	27.43	47.46	14	15	24

Receptor		Predicted Annual Mean NO ₂ Concentration (µg/m ³)		Proportion of EQS (%)		
		PC	PEC	PC	PEC ^b	PEC ^c
R8	HTC Management Services	16.85	36.88	8	9	18
R9	Ardagh Group unit	17.36	37.39	9	10	19
R10	Ardagh Group unit	16.75	36.77	8	9	18
R11	Rawson Digital	12.12	32.15	6	7	16

Note: Predicted concentrations were assessed against the relevant EQSs: 1-hour mean AQO of 200µg/m³.

b: PEC proportion of the EQS minus twice the long-term background

c: PEC proportion of the EQS

As indicated in Table 20, 1-hour NO₂ concentrations were below the relevant EQS at all sensitive receptor locations.

The PC proportion of the EQS remains below 10% of the PEC at six of the eleven receptor locations which can be screened out as **insignificant** in accordance with the EA criteria. At the remaining five receptor location, the PEC proportion of the EQS remained below 20% minus twice the long term background concentration. As such, these four locations are considered to be **not significant** in accordance with the EA criteria⁷.

5.2.3 Carbon Monoxide

Reference should be made to Figure 4 for a graphical representation of predicted maximum daily running 8-hour mean CO concentrations throughout the assessment extents.

Predicted CO concentrations at sensitive receptor locations are summarised in Table 21.

Table 21 Predicted 8-hour Rolling Mean CO Concentrations

Receptor		Predicted Maximum Daily Running 8-hour Mean CO Concentration (mg/m ³)		Proportion of EQS (%)		
		PC	PEC	PC	PEC ^b	PEC ^c
R1	Industrial Unit	438.36	924.36	4	5	10
R2	Industrial Unit	307.19	793.19	3	3	8
R3	Industrial Unit	216.44	702.44	2	2	7
R4	Nutrafeed Industrial Unit	506.85	992.85	5	5	10
R5	Nutrafeed Industrial Unit	517.12	1,003.12	5	5	11
R6	Tritech Industrial Unit	345.89	831.89	3	4	9
R7	Office units	428.08	914.08	4	4	10
R8	HTC Management Services	240.07	726.07	2	3	8

Receptor		Predicted Maximum Daily Running 8-hour Mean CO Concentration (mg/m ³)		Proportion of EQS (%)		
		PC	PEC	PC	PEC ^b	PEC ^c
R9	Ardagh Group unit	254.45	740.45	3	3	8
R10	Ardagh Group unit	249.32	735.32	2	3	8
R11	Rawson Digital	178.77	664.77	2	2	7

Note: Predicted concentrations were assessed against the relevant EQSs: 8-Hour Rolling mean AQO of 10,000µg/m³.

b: PEC proportion of the EQS minus twice the long-term background

c: PEC proportion of the EQS

As indicated in Table 21, predicted CO concentrations are below the relevant EQS at all sensitive receptor locations.

The PC proportion of the EQS is less than 10% at all receptor locations, furthermore the PEC proportion of the EQS is less than 20% at all receptor locations. As such, impacts on 8-hour rolling mean CO concentrations are considered to be **insignificant** in accordance with EA screening criteria⁷.

5.3 Sensitive Ecological Receptors

Predicted concentrations and deposition rates of each pollutant at the ecological receptor locations identified in Table 6 are summarised in the following Sections.

5.3.1 Oxides of Nitrogen

Predicted annual mean and 24-hour NO_x concentrations for sensitive ecological receptors are summarised in Table 22 and Table 23. It should be noted that the results presented in Table 22 and Table 23 represent the maximum concentrations predicted across all meteorological datasets.

Table 22 Predicted Annual Mean NO_x Concentrations

Receptor	Predicted Annual Mean NO _x Concentration (µg/m ³)		Proportion of EQS (%)	
	PC	PEC	PC	PEC
E1-R1	1.28	16.36	4	55
E1-R2	0.93	16.01	3	53
E1-R3	0.69	15.77	2	53
E1-R4	0.61	15.69	2	52
E1-R5	0.52	15.60	2	52
E1-R6	1.06	16.14	4	54
E1-R7	0.72	15.80	2	53
E1-R8	0.53	15.61	2	52
E1-R9	1.53	16.61	5	55

Receptor	Predicted Annual Mean NO _x Concentration (µg/m ³)		Proportion of EQS (%)	
	PC	PEC	PC	PEC
E1-R10	0.78	15.86	3	53
E1-R11	0.51	15.59	2	52
E1-R12	0.41	10.94	1	36
E2-R1	1.43	17.43	5	58
E2-R2	1.48	19.98	5	67
E2-R3	1.38	19.88	5	66
E2-R4	1.02	17.02	3	57
E3-R1	0.47	18.89	2	63
E3-R2	0.52	18.94	2	63
E3-R3	0.53	15.61	2	52
E3-R4	0.51	15.59	2	52
E3-R5	0.48	15.56	2	52
E3-R6	0.47	15.55	2	52

As indicated in Table 22, predicted annual mean NO_x concentrations were below the relevant EQS at all sensitive receptor locations for all meteorological data sets.

Additionally, the PC proportion of the EQS is below the 100% EA threshold at all ecological receptor locations. As such, impacts on annual mean NO_x concentrations are considered to be **insignificant** in accordance with the EA screening criteria

Table 23 Predicted 24-hour Mean NO_x Concentrations

Receptor	Predicted 24-hour Mean NO _x Concentration (µg/m ³)		Proportion of EQS (%)	
	PC	PEC	PC	PEC
E1-R1	11.82	41.98	16	56
E1-R2	8.84	39.00	12	52
E1-R3	6.13	36.29	8	48
E1-R4	5.72	35.88	8	48
E1-R5	4.59	34.75	6	46
E1-R6	10.68	40.84	14	54
E1-R7	7.33	37.49	10	50
E1-R8	5.27	35.43	7	47
E1-R9	11.88	42.04	16	56

Receptor	Predicted 24-hour Mean NO _x Concentration (µg/m ³)		Proportion of EQS (%)	
	PC	PEC	PC	PEC
E1-R10	5.92	36.08	8	48
E1-R11	3.77	33.93	5	45
E1-R12	3.60	24.66	5	33
E2-R1	8.63	40.63	12	54
E2-R2	8.29	45.29	11	60
E2-R3	7.47	44.47	10	59
E2-R4	6.10	38.10	8	51
E3-R1	3.56	40.40	5	54
E3-R2	3.60	40.44	5	54
E3-R3	3.53	33.69	5	45
E3-R4	3.24	33.40	4	45
E3-R5	3.18	33.34	4	44
E3-R6	3.07	33.23	4	44

As indicated in Table 23, predicted 24-hour mean NO_x concentrations are below the relevant EQS at all sensitive receptor locations.

In addition, the PC proportion of the EQS is less than 100% at all receptor locations. As such, impacts on 24-Hour mean NO_x concentrations are considered to be **insignificant** in accordance with the EA screening criteria.

5.3.2 Nitrogen Deposition

Predicted annual mean nitrogen deposition rates are summarised in Table 24. Reference should be made to Table 9 for details of the site-specific Low and High EQSs.

Table 24 Predicted Annual Mean Nitrogen Deposition Rates

Receptor	Predicted Annual Mean Nitrogen Deposition Rate (kgN/ha/yr)		Proportion of EQS (%)			
	PC	PEC	Low EQS		High EQS	
			PC	PEC	PC	PEC
E1-R1	0.18	24.12	2	241	1	121
E1-R2	0.13	24.07	1	241	1	120
E1-R3	0.10	24.04	1	240	0	120
E1-R4	0.09	24.03	1	240	0	120

Receptor	Predicted Annual Mean Nitrogen Deposition Rate (kgN/ha/yr)		Proportion of EQS (%)			
	PC	PEC	Low EQS		High EQS	
			PC	PEC	PC	PEC
E1-R5	0.07	24.01	1	240	0	120
E1-R6	0.15	24.09	2	241	1	120
E1-R7	0.10	24.04	1	240	1	120
E1-R8	0.08	24.02	1	240	0	120
E1-R9	0.22	24.16	2	242	1	121
E1-R10	0.11	24.05	1	241	1	120
E1-R11	0.07	24.01	1	240	0	120
E1-R12	0.06	24.00	1	240	0	120
E2-R1	0.21	41.51	2	415	1	208
E2-R2	0.21	41.51	2	415	1	208
E2-R3	0.20	41.50	2	415	1	207
E2-R4	0.15	41.45	1	414	1	207
E3-R1	0.07	24.01	1	240	0	120
E3-R2	0.08	24.02	1	240	0	120
E3-R3	0.08	24.02	1	240	0	120
E3-R4	0.07	24.01	1	240	0	120
E3-R5	0.07	24.01	1	240	0	120
E3-R6	0.07	24.01	1	240	0	120

As indicated in Table 24, the PC proportion of the EQS is less than 100% for receptor locations. As such, impacts on annual mean NO₂ concentrations at these locations are considered to be **insignificant** in accordance with EA screening criteria⁷.

5.3.3 Acid Deposition

Predicted acid deposition rates are summarised in Table 25. It should be noted all results relate to the maximum predicted by any meteorological dataset. It should be noted that the acid deposition rate for sulphur is the background deposition rate only, as sulphur is not emitted by the proposed installation.

Table 25 Predicted Annual Mean Acid Deposition Rates

Receptor	Predicted Annual Mean Acid Deposition Rate (keq/ha/yr)	Proportion of EQS (%)		Exceedance of CL Function (keq/ha/yr)
		PC	PEC	
E1-R1	0.0264	1	37	None
E1-R2	0.0191	0	37	None
E1-R3	0.0142	0	37	None
E1-R4	0.0125	0	37	None
E1-R5	0.0107	0	37	None
E1-R6	0.0218	0	37	None
E1-R7	0.0148	0	37	None
E1-R8	0.0110	0	37	None
E1-R9	0.0315	1	37	None
E1-R10	0.0161	0	37	None
E1-R11	0.0106	0	37	None
E1-R12	0.0084	0	37	None
E2-R1	0.0294	2	178	None
E2-R2	0.0304	2	178	None
E2-R3	0.0283	2	178	None
E2-R4	0.0210	1	178	None
E3-R1	0.0097	0	37	None
E3-R2	0.0108	0	37	None
E3-R3	0.0110	0	37	None
E3-R4	0.0106	0	37	None
E3-R5	0.0099	0	37	None
E3-R6	0.0097	0	37	None

As indicated in Table 25, acid deposition rates were below the relevant EQS at all sensitive receptor locations.

In addition, the PC proportion of the EQS is less than 100% at all receptor locations. As such, impacts on annual mean nitrogen deposition rates can be screened out as **insignificant** in accordance with the EA screening criteria. The APIS site relevant critical load tool¹⁰ indicated that no receptors exceeded the CL function for acid deposition

6 CONCLUSION

Ensafe was commissioned by St Land Holdings Limited to undertake a Dispersion Modelling Assessment in support of the proposed STOR site at Bridge Road, Wrexham industrial estate, Wrexham.

Atmospheric emissions from the selected plants have the potential to cause increases in ground level pollutant concentrations. As such, a Dispersion Modelling Assessment was required to quantify impacts in the vicinity of the site.

Dispersion modelling of a number of pollutants was undertaken using ADMS 5 (v5.2). Impacts at sensitive receptors were quantified and the results compared with the relevant EQSs.

Predicted concentrations of NO₂ and CO for the protection of human health were below the relevant EQSs and EA significance criteria at all sensitive human receptor locations. Impacts on NO₂ and CO concentrations were therefore deemed **not significant**.

Nitrogen and acid gas deposition rates were also predicted at the relevant ecological sites. Impacts upon sensitive ecological designations as a result of emissions from the installation were deemed **not significant** at all designations.

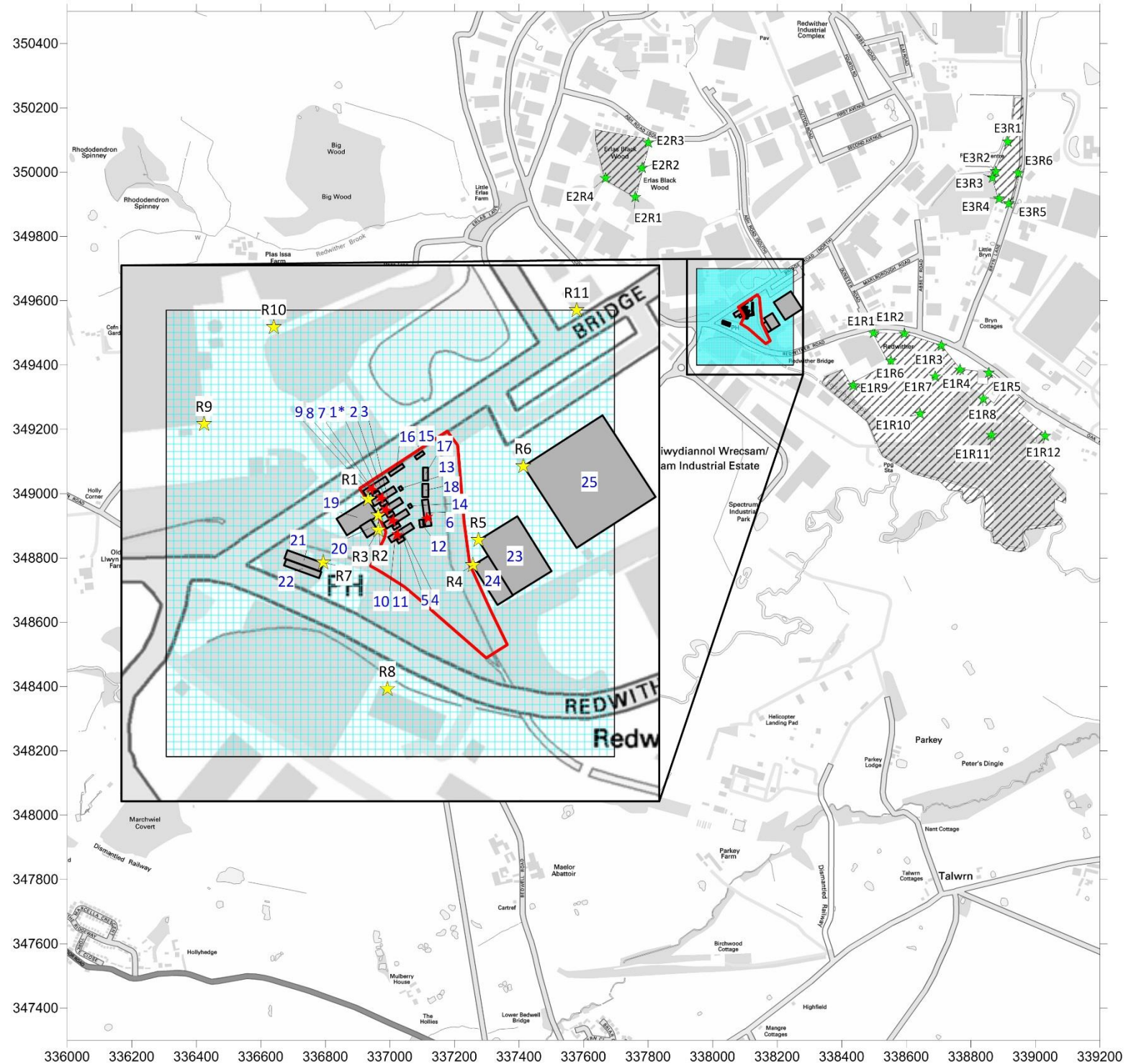
Impacts were predicted based on a maximum concentration of all meteorological years assessed. As such, predicted results are considered to be a robust estimate.

Based on the assessment results, air quality issues are not considered a constraint to planning consent for the development.

7 ABBREVIATIONS

%ile	Percentile
ADM	Atmospheric Dispersion Modelling
APIS	Air Pollution Information System
AQLV	Air Quality Limit Value
AQMA	Air Quality Management Area
AQO	Air Quality Objective
AQS	Air Quality Strategy
CERC	Cambridge Environmental Research Consultants
CO	Carbon monoxide
DEFRA	Department for Environment, Food and Rural Affairs
EQS	Environmental Quality Standard
EU	European Union
LA	Local Authority
LAQM	Local Air Quality Management
LNR	Local Nature Reserve
MAGIC	Multi-Agency Geographic Information for the Countryside
MWth	Megawatt Thermal
NGR	National Grid Reference
NO	Nitric oxide
NO ₂	Nitrogen dioxide
NO _x	Oxides of nitrogen
PM _{2.5}	Particulate matter with an aerodynamic diameter of less than 2.5µm
PM ₁₀	Particulate matter with an aerodynamic diameter of less than 10µm
PC	Process Contribution
PEC	Predicted Environmental Concentration
SAC	Special Areas of Conservation
STOR	Short-term Operation Reserve
WCBC	Wrexham County Borough Council
z ₀	Roughness Length

APPENDIX I FIGURES



Legend

- Site Boundary
- Stack Location
- Cartesian Grid
- Sensitive Human Receptor Location
- Sensitive Ecological Receptor Location
- Ecological Locations
- Building Locations

Title

Figure 1
Site Location

Project

Air Quality Assessment
Bridge Road, Wrexham

Project Number

AQ109191

Client

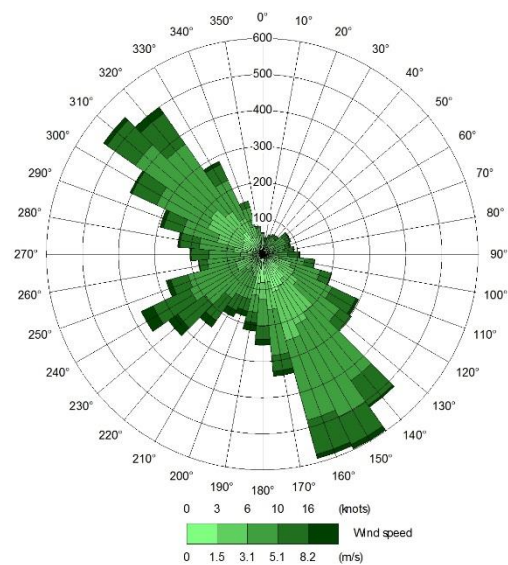
Caelus Limited

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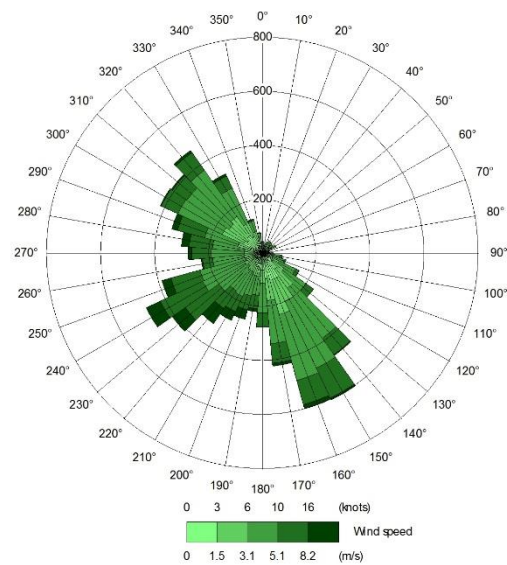


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Osprey House, Broadway, Manchester M50 2UE

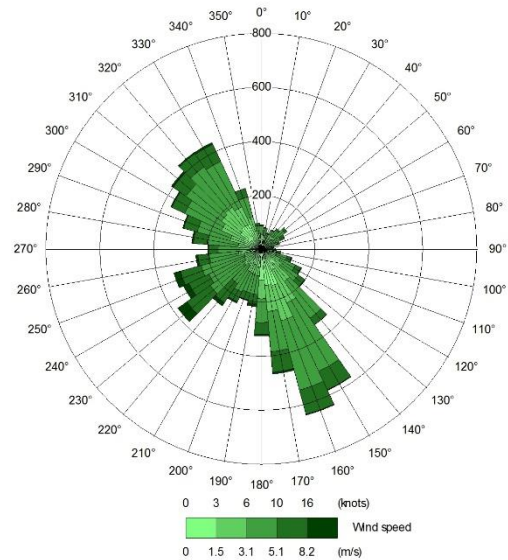
Tel – 0161 868 1300
www.ensafe.co.uk



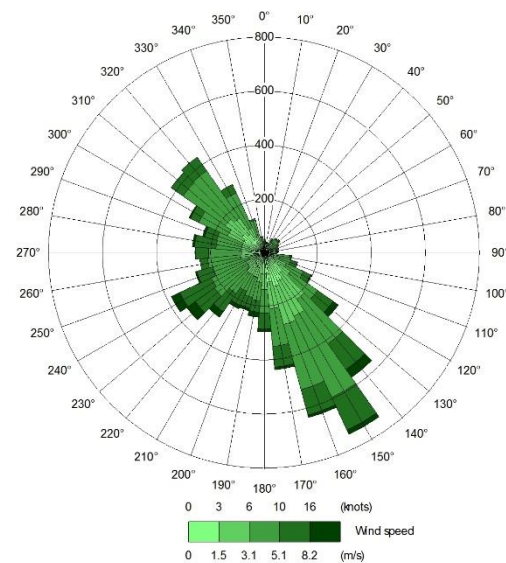
2013



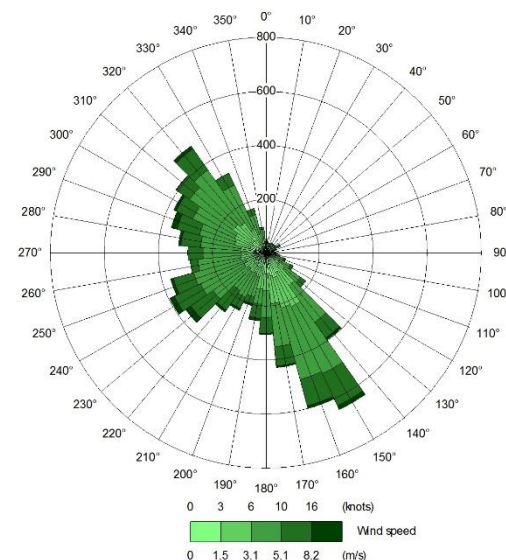
2015



2016



2014



2017

Title

Figure 2
Wind Rose
Howarden Meteorological Station
2013 to 2017

Project

Air Quality Assessment
Bridge Road, Wrexham

Project Number

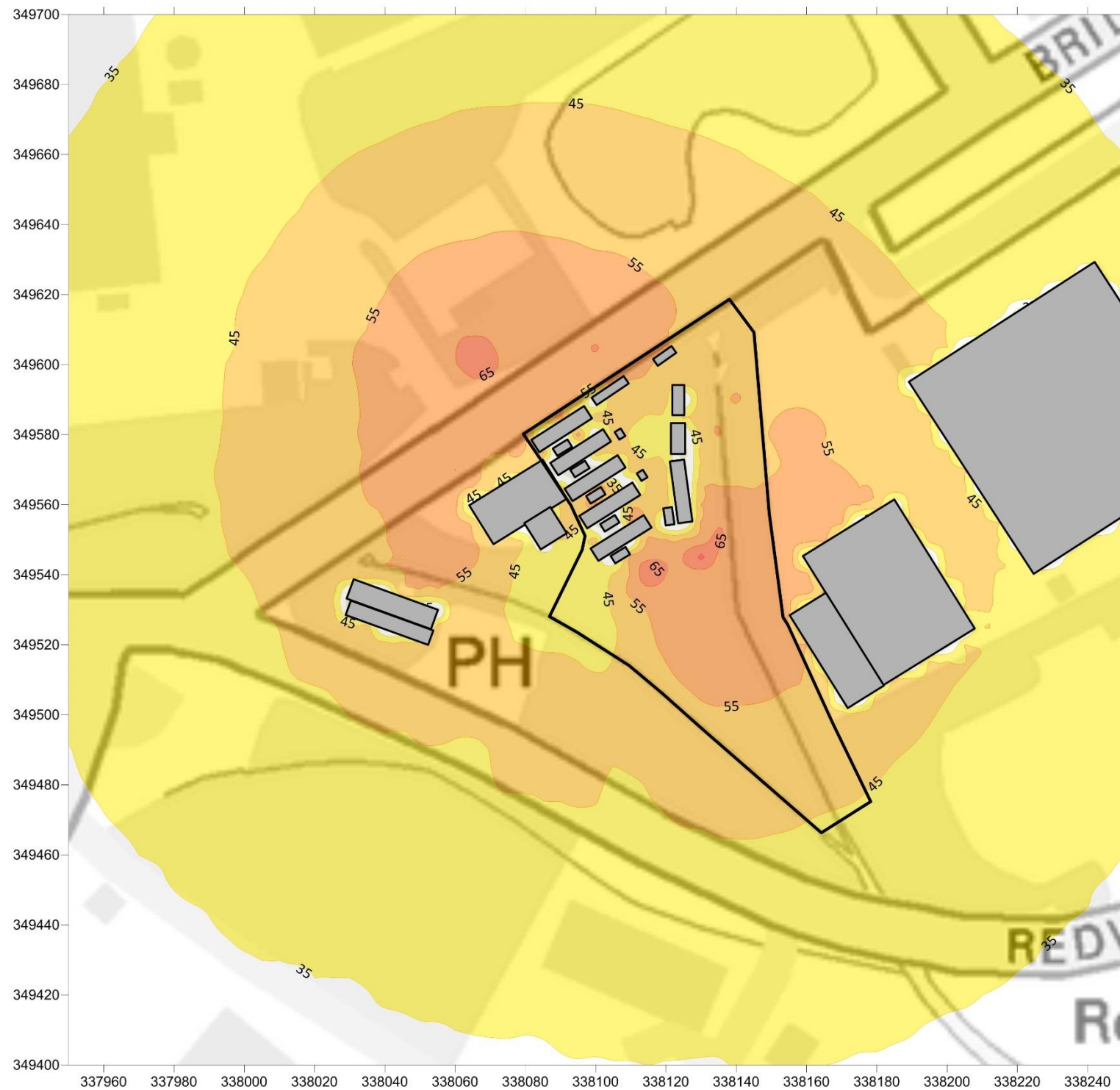
AQ109191

Client

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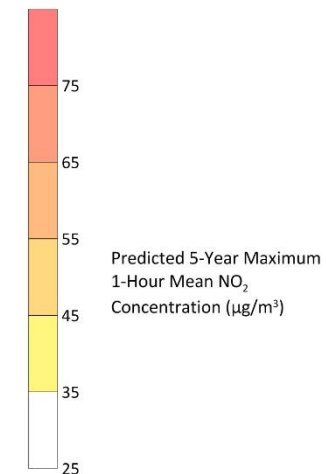


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Legend

Site Boundary



Title

Figure 3
Predicted 5-Year Maximum 1-Hour Mean NO₂
Concentrations (µg/m³)

Project

Air Quality Assessment
Bridge Road, Wrexham

Project Number

AQ109191

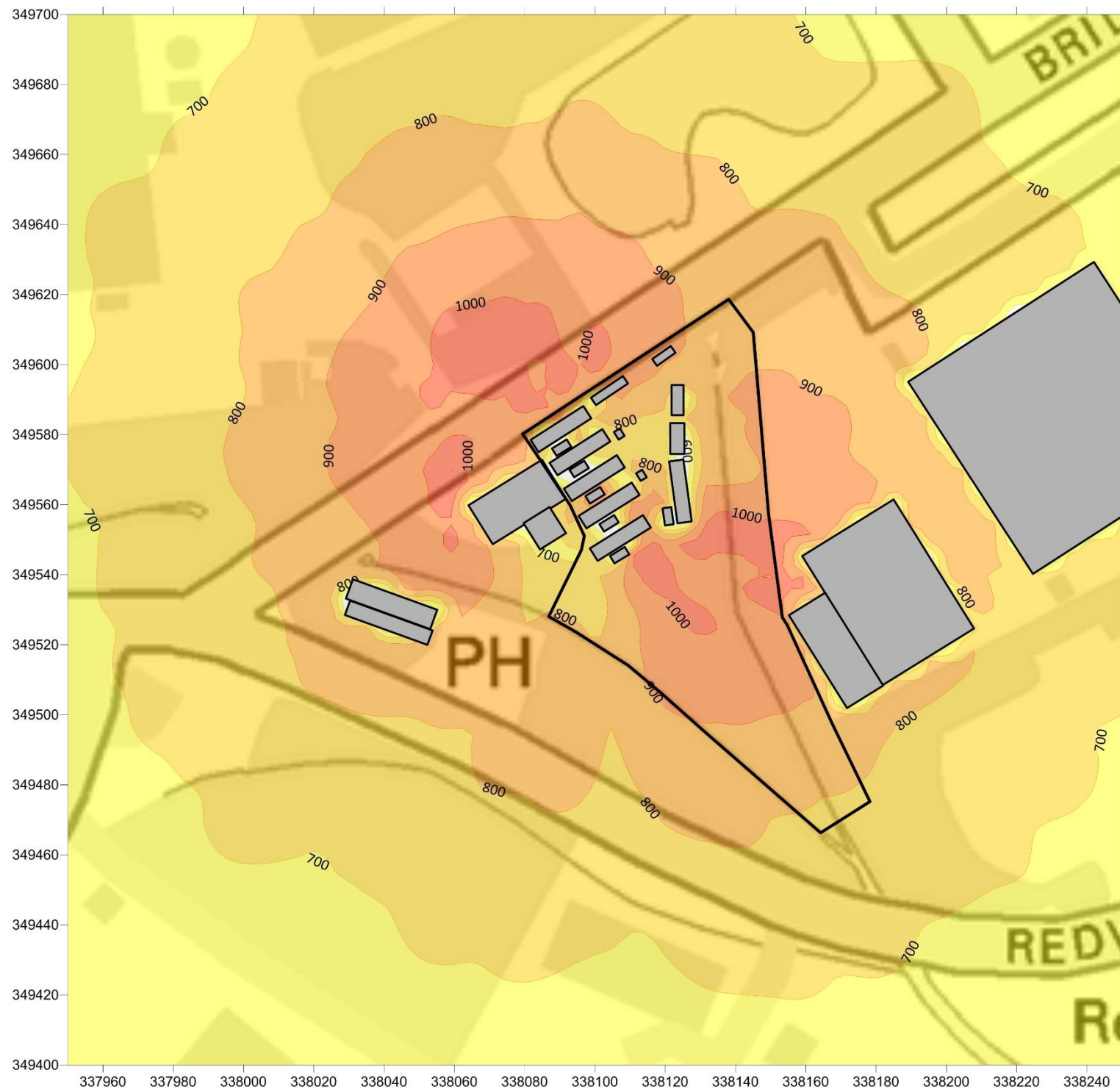
Client

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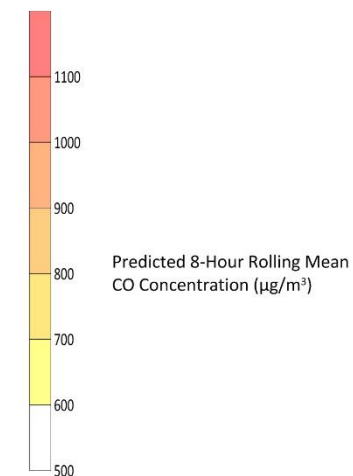


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Legend

 Site Boundary



Title

Figure 4

Predicted 5-Year Maximum Average 8-Hour Rolling Mean CO Concentrations ($\mu\text{g}/\text{m}^3$)

Project

Air Quality Assessment
Bridge Road, Wrexham

Project Number

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Client

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Dispersion Modelling Assessment
Bridge Road, Wrexham Industrial Estate
July 2020
AQ109191

APPENDIX II ASSESSOR'S CURRICULUM VITAE

CONAL KEARNEY

Associate Director

BEng(Hons), MSc, MIAQM, MEnvSc

KEY EXPERIENCE:

Conal is an Associate Director with specialist experience in the air quality and odour sector. His key capabilities include:

- ▶ Advanced atmospheric air dispersion modelling of road vehicle and industrial emissions using ADMS-ROADS and AIRVIO.
- ▶ Preparation of factual and interpretative Air Quality Assessment reports and Air Quality Environmental Statement chapters in the vicinity of proposed schemes and developments in accordance with DEFRA, Environment Agency and Environmental Protection UK (EPUK) and Institute of Air Quality Management (IAQM) methodologies.
- ▶ Management and delivery of project work on key, land development and urban regeneration projects.
- ▶ Assessment of road vehicle exhaust emissions using the Design Manual for Roads and Bridges (DMRB) calculation spreadsheet.
- ▶ Assessment of dust impacts from construction sites to the Institute of Air Quality Management (IAQM) methodology.
- ▶ Dust and Odour impact assessments from minerals and waste sites
- ▶ Representing clients at public inquiries and planning hearings as an expert witness.

QUALIFICATIONS:

- ▶ Bachelor of Engineering
- ▶ Master of Science
- ▶ Member of Institute of Air Quality Management
- ▶ Member of the Institute of Environmental Science (IES)

SELECT PROJECTS SUMMARY:

Industrial Developments

Land at Mossdown Road, Oldham – energy from waste incinerator. Industrial and road impacts on air quality dust and odour.

Buck Park, Denholme - AQA and dust assessment for proposed mineral extraction and site restoration project.

Messingham Quarry, North Lincolnshire - AQA and dust impacts for proposed new sand extraction site.

Arden Quarry, Derbyshire - AQA for proposed mineral extraction and site restoration

Granta Park, Oxfordshire. Assessment of VOC fume emissions.

University of Birmingham. Permit application for CHP scheme.

Arbroath Road, Carnoustie. Odour and AQA for biogas CHP scheme.

Brenda Road, Hartlepool – Dispersion modelling to inform stack design for biogas AD facility environmental permit.

Highways Developments

Alderley Edge Bypass, Cheshire - AQA for major new road scheme.

South Heywood – EIA for new link road and mixed use joint development

Residential /Mixed-Use Developments

Orchard Close, Knaresborough. AQA and public inquiry evidence.

Friars School, Southwark, London. School development for mixed use education and residential building in AQMA.

Fairoaks Garden Village – ES chapter and input for major mixed use development

Westcraig, Edinburgh - EIA chapter and input for major residential development

Queensway, Lytham St Annes. Dust and odour assessment for development. Public Inquiry expert witness

Manor Place, London. Road and energy generation dispersion emissions assessment

Craven Park, London. Mitigation statement and planning hearing expert opinion

Public Sector

Technical advisor on Manchester Airport Consultative Committee - advise members on environmental technical matters in relation to the airport's operations.

Cheshire County Council - compile AQ chapters for Local Transport Plan

Cheshire East Council - specialist AQ advice on highways, minerals and waste projects

Local Air Quality Management

Broughton Gyratory, Chester - dispersion model for City Centre detailed assessment report

Congleton town centre - dispersion modelling assessment for detailed and further assessment reports.

Disley - dispersion modelling assessment for detailed and further assessments

Holmes Chapel - dispersion modelling assessment for detailed and further assessment reports for road and rail sources.

Crewe - town centre dispersion modelling for detailed and further assessment reports.

Commercial Developments

Granta Park Daycare Centre, Oxfordshire. AQA for new build daycare centre adjacent to major road.

Curzon Cinema, Colchester. Air quality assessment for town centre new build cinema.

Newfoundland Circus, Bristol - AQA for hotel development in city centre

Salesians School, Chertsey - AQA for school extension near M25.

Cathedral Street and Thistle Street, Glasgow. University energy generation emission assessments.

LEWIS ELLISON

Air Quality Consultant

MOcean.Geo (Hons)

KEY EXPERIENCE:

Lewis is an Environmental Consultant with specialist experience in the air quality sector. His key capabilities include:

- ▶ Production of Air Quality Assessments to the Department for Environment, Food and Rural Affairs (DEFRA), Environment Agency and Environmental Protection UK (EPUK) methodologies for clients from the residential, retail and commercial sectors.
- ▶ Detailed dispersion modelling of road vehicle emissions using ADMS-Roads. Studies have included impact assessment of pollutant concentrations at various floor levels and assessment of suitability of development sites for proposed end-use.
- ▶ Assessment of road vehicle exhaust emissions using the Design Manual for Roads and Bridges (DMRB) calculation spreadsheet.
- ▶ Assessment of dust impacts from construction sites to the Institute of Air Quality Management (IAQM) methodology.
- ▶ Production of air quality mitigation strategies for developments throughout the UK.
- ▶ Defining baseline air quality conditions and identification of sensitive areas.

QUALIFICATIONS:

- ▶ Master of Science

SELECT PROJECTS SUMMARY:

Residential Development:

AGFA Works, Seagate – Air Quality Assessment using ADMS-Roads in support of an 83 residential unit development with the potential to cause air quality impacts at sensitive locations.

Andrew Avenue, Breahead – Air Quality Assessment using ADMS-Roads in support of a 77 residential unit development in close proximity to the M8.

Clothorn Road, Didsbury – Air Quality assessment for a residential development consisting of 12 units in close proximity to an AQMA declared by Manchester city council.

Downend Road, Portchester – Air Quality Assessment in support of a 350 residential unit development in close proximity to the M27.

Great Leighs, Chelmsford- Baseline scoping report in support of several proposed large scale residential developments totalling 1300 residential units, with the potential to impact on nearby sensitive locations.

Parkview, Lofthouse Gate – Air Quality Assessment in support of a proposed 160 residential unit development in close proximity to two AQMA declared by Wakefield Metropolitan District Council.

Shields Road, Walkergate - Air Quality Assessment using ADMS-Roads in support of a 40 residential unit development in close proximity to the Shields Road.

Environmental impact assessment:

Bower Farm, Bridgewater – Production of an Air Quality Assessment with relevant mitigation measures for inclusion in an EIA report for part of the east Sedgemoor development.

Commercial Development:

ALDI, Hertford – Air Quality Assessment for the Proposed Aldi Superstore at Hertfordshire using ADMS-Roads.

Hortonwood West, Telford – Construction Environmental Management Plan (CEMP) for the expansion of the current factory on site.

Inverness Airport Business Park – Air Quality Scoping Report for a proposed hotel and commercial office space.

Odour assessment:

Wren Park Care Home, Shefford – Qualitative Odour Assessment of industrial units in the vicinity of a proposed extension to the current care home.

Marsh Farm, Basildon – Qualitative Odour Assessment of an anaerobic digesting unit in support of a follow up assessment for the unit.

Mixed-Use Development:

Coldharbour Land, Lambeth – Air Quality Assessment for a proposed mixed use development with the implementation of mitigation measures.

Old Fire Station, Newham, London- Air Quality Assessment using ADMS-Roads for a proposed mixed use development with the implementation of mitigation measures, in support of a redevelopment of the previous fire station.

Ordsall Lane, Salford – Air Quality Assessment in support of a mixed use development using ADMS-Roads.