



Environmental Visage

**DETAILED AIR QUALITY ASSESSMENT FOR
THE PROPOSED INSTALLATION OF FOUR
NEW BIOMASS BOILERS AT**

**THE WOODYARD, CHEADLE
UK RENEWABLE ENERGY LIMITED**

**Report Issue No: 1
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Executive Summary

UK Renewable Energy Limited proposes to install four biomass boilers at The Woodyard, off Draycott Cross Road, Brook Houses, Cheadle, Staffordshire, ST10 2NR.

In order to provide Staffordshire Moorlands District Council with the information it requires to consider and approve the planning application for the new boilers, UK Renewable Energy Limited has commissioned Environmental Visage Limited (Envisage) to prepare an assessment of the potential air quality impacts of the proposed boilers. Envisage has therefore undertaken a detailed dispersion modelling exercise and presents the results in this Air Quality Assessment of the predicted impact of emissions to air from the boilers, when operating in various combinations.

The modelling incorporated a series of conservative assumptions, and therefore results in a highly conservative assessment.

Despite this, the overall conclusion from detailed modelling of emissions from the existing and proposed new biomass boilers at The Woodyard site is that the potential impact on local air quality is likely to be small, generally being screened as either insignificant or not otherwise significant at local receptor locations and will not therefore have any significant impact on the health of people living and working nearby, or on the surrounding environment.

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Issue and Revision Record

Issue	Date	Author	Review / Authorise	Description
DRAFT	12/11/2024	A. Owen	ENVISAGE	Initial draft for Client comment
1	13/11/2024	A. Owen	ENVISAGE	Issue 1

1. Introduction

UK Renewable Energy Limited proposes to install four biomass boilers at The Woodyard, off Draycott Cross Road, Brook Houses, Cheadle, Staffordshire, ST10 2NR.

During the consultation of their planning application, the Environmental Health Department of Staffordshire Moorlands District Council noted that:

“The above application is for the installation of 4 no. biomass boilers. It is understood that a single biomass boiler already operates at the site.

At this time there is insufficient information to determine if the proposal will have a significant adverse impact.

The combined use of the boilers has the potential to impact on nearby residential receptors. Therefore, an assessment of the impact of both existing and proposed boilers and to determine that the stacks heights for the proposed boilers are adequate for the dispersion of pollutants will need to be undertaken.”

As a result of this request, UK Renewable Energy Limited, commissioned Environmental Visage Limited (Envisage) to prepare an assessment of the potential air quality impacts of the proposed boilers. This was initially done using both the Bureau Veritas Industrial Emissions Screening Tool (Version 3), and the SCAIL Combustion (Simple Calculation of Atmospheric Impact Limits) tool to determine whether more detailed atmospheric dispersion modelling may be required to consider the impact of the proposed boilers.

Despite the results of the two assessment methodologies confirming that the impact of the proposed boilers would not be significant when assessed against the Air Quality Standards (AQS) for Nitrogen Dioxide (NO₂) and particulate matter (PM₁₀), further, more detailed dispersion modelling has been requested in order to give the Environmental Health Department of Staffordshire Moorlands District Council the information it requires to fully remove its objection to the scheme.

The objective of the modelling exercise was to assess the potential impact of the process emissions to atmosphere on local air quality, in terms of ground level concentrations of pollutants designated by air quality standard objective values and other relevant environmental assessment levels recommended by the Environment Agency. Modelling was based upon emissions and process data, and site drawings supplied by UK Renewable Energy Limited and Andrew Martin Associates (planning consultants).

This report describes the data used, the methodology adopted, assumptions made, and the results generated by the model.

1.1 ADMS Model

The main modelling software used was ADMS Version 6, one of a range of atmospheric dispersion models available for assessing the impact on local air quality of pollutant emissions to atmosphere. The ADMS model uses two parameters to describe the atmospheric boundary layer, namely the boundary layer height (h) and the Monin-Obukhov Length (L_{MO}), and a skewed Gaussian concentration distribution to calculate dispersion under convective conditions. Models used routinely in the UK for this sort of application include United States Environmental Protection Agency (US-EPA) models such as AERMOD, and the ADMS models developed in the UK by Cambridge Environmental Research Consultants (CERC)¹.

The ADMS model can be used to assess ambient pollutant concentrations arising from a wide variety of emissions sources associated with an industrial process. It can be used for initial screening or more refined determination of ground level pollutant concentrations on either a short-term basis (up to 24-hour averages) or longer term (monthly, quarterly or annual averages).

1.2 Modelling Uncertainty

Atmospheric dispersion modelling is not a precise science and results can be impacted by a variety of factors such as:

- Model uncertainty - due to limitations in the dispersion algorithms incorporated into the model and their ability to replicate “real-life” situations;
- Data uncertainty - due to potential errors associated with emission estimates, discharge characteristics, land use characteristics and the relevance of the meteorological data to a particular location; and
- Variability - randomness of measurements used.

CERC models are continually validated against available measured data obtained from real world situations, field campaigns and wind tunnel experiments. Validation of the ADMS dispersion models has been performed using many experimental datasets that test different aspects of the models, for instance: ground / high level sources, passive and buoyant releases, buildings, complex terrain, chemistry, deposition and plume visibility. These studies are both short-term as well as annual, and involve tracer gases or specific pollutants of interest.

Potential uncertainties in model results derived from the current study have been minimised as far as practicable, and a series of worst-case assumptions have been applied to the input data in order to provide a robust assessment. This included the following:

- Selection of the dispersion model - ADMS 6 is a commonly used atmospheric dispersion model and results have been verified through a number of inter-comparison studies to ensure that model predictions are as accurate as possible;
- Meteorological data - Modelling was undertaken using hourly average Numerical Weather Prediction (NWP) meteorological data;
- Plant operating conditions – Data on the likely discharge conditions from the installation were provided by UK Renewable Energy Limited and Andrew Martin Associates. As no monitoring has been undertaken on the one existing biomass boiler at the site and the four proposed boilers are not yet installed, all information regarding the discharge conditions is naturally theoretical;
- Receptor locations - A 2 km x 2 km Cartesian Grid (with 20-metre grid spacing) was utilised in the model in order to calculate the maximum predicted concentrations in the vicinity of The Woodyard. Specific receptor locations were also included in the model to provide detailed assessment at these sensitive locations; 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.

The application of the above measures to reduce uncertainty and the use of a series of worst-case assumptions relating to the operational performance of the process should result in model accuracy of an acceptable level.

1.3 Air Quality Standards and Environmental Assessment Levels

In the UK, limit values, targets, and air quality standards (AQS) and objectives for major pollutants are described in The Air Quality Strategy. In addition, the Environment Agency provides environmental assessment levels (EALs) for other pollutants. The results of the modelling were considered in the context of these limits, targets, objectives and assessment levels, as summarised in Table 1 over page.

Table 1 Relevant Air Quality Standards and Environmental Assessment Levels

Substance	Assessment Level	Averaging time	Specific Receptors	Regulatory Source
Nitrogen Dioxide	200 $\mu\text{g m}^{-3}$ with up to 18 exceedances (99.79 th %)	1 hour mean	Human health / AQ	AQ and AQS Regulations (L)
Nitrogen Dioxide	40 $\mu\text{g m}^{-3}$	Annual mean	Human health / AQ	AQ and AQS Regulations (L)
Oxides of Nitrogen (expressed as Nitrogen Dioxide)	75 $\mu\text{g m}^{-3}$	Daily mean	Conservation / Habitats	Critical Level
Oxides of Nitrogen (expressed as Nitrogen Dioxide)	30 $\mu\text{g m}^{-3}$	Annual mean	Conservation / Habitats	Critical Level
Particulates (PM₁₀)	50 $\mu\text{g m}^{-3}$ with up to 35 exceedances (90.41 st %)	24 hour mean	Human health / AQ	AQ and AQS Regulations (L)
Particulates (PM₁₀)	40 $\mu\text{g m}^{-3}$	Annual mean	Human health / AQ	AQ and AQS Regulations (L)
Particulates (PM_{2.5})	20 $\mu\text{g m}^{-3}$	Annual	Human health / AQ	AQS Regulations (L)
Particulates (PM_{2.5})	10 $\mu\text{g m}^{-3}$	Annual from 2040	Human health / AQ	Env. Target 2040

Key to Table 1:

AQ Regulations	Air Quality (England) Regulations 2000 (as amended) ²
AQS Regulations	Air Quality Standards Regulations 2010 Limit or Target Values and UK Air Quality Strategy Objectives ³
Critical Level	Not habitat specific but cover broad vegetation types
Env. Target 2040	The Environmental Targets (Fine Particulate Matter) (England) Regulations 2023 ⁴
(L)	Limit Value

2.2 Emissions Data

The site already operates a single biomass boiler, with a capacity of 195 kW_{th}. Four new boilers are to be installed, two with capacities of 210 kW_{th} and two with 295 kW_{th} capacities. All of the boilers are manufactured by Glen Farrow, and the future site capacity will total 1.205 MW_{th}. However, the small size of each of the individual boilers provides the ultimate flexibility for operational needs and it is unlikely that all five boilers will ever be required to operate together.

Although the boilers have slightly different capacities, the discharge conditions of each of the Glen Farrow units are similar. Each is understood to discharge through a 5.5 m high stack of 0.2 m inner diameter, and the RHI certificate confirms the emissions of each unit as being the same. The RHI certificate is included as Appendix A for information.

The modelled source and emissions data applied to the model were provided by UK Renewable Energy Limited or were calculated from the RHI certificate and are summarised in Tables 2 and 3 respectively.

Table 2 Emission Source Parameters

Parameter	Value
Stack Height (m)	5.5
Stack Diameter (m)	0.2
Efflux Temperature (° C)	Range of 105 – 110: 105 modelled as a worst case
Oxygen Content (% dry)	No information but no correction required
Moisture Content (%)	No information but no correction required
Flue-gas Volumetric Flowrate (Am ³ /s)	0.282743
Efflux Velocity (m s ⁻¹)	9
Locations (x, y)	Existing: 398968.40, 342238.11 New 1: 398922.00, 342263.01 New 2: 398923.70, 342262.00 New 3: 398923.00, 342260.80 New 4: 398920.70, 342260.20

Table 3 Modelled Emissions Data

Substance	195 kW _{th} Boiler	210 kW _{th} Boiler	295 kW _{th} Boiler
Capacity in GJ (kW x 0.0036)	0.702	0.756	1.062
Oxides of Nitrogen: NO _x as NO ₂ (g GJ ⁻¹)	60		
NO _x as NO ₂ Annual Emission (T)	0.3689	0.3974	0.5582
NO _x as NO ₂ mass release (g s ⁻¹)	0.0117	0.0126	0.0177
Total particulate matter: TPM (g GJ ⁻¹)	27.6		
TPM Annual Emission (T)	0.1697	0.1828	0.2568
TPM mass release (g s ⁻¹)	0.0054	0.0058	0.0081

2.3 Atmospheric Chemistry

Emissions of NO_x will comprise contributions of Nitric Oxide (NO) and Nitrogen Dioxide (NO₂). Air quality assessments are made against the concentration of NO₂, although assessments for the impact on vegetation are made against the concentrations of NO_x as NO₂. As emissions of NO₂ are only ever a proportion of the total emissions of NO_x, an allowance for the quantity of NO₂ in NO_x has to be made. The following procedure recommended by the Environment Agency⁵ was used to calculate annual average and hourly average NO₂ ground-level concentrations from the reported annual average NO_x concentrations.

Emissions of Oxides of Nitrogen should be recorded as Nitrogen Dioxide because Nitrogen Oxide converts to Nitrogen Dioxide over time:

- For short-term process contributions (PC) and predicted environmental concentrations (PEC), assume only 50 % of emissions of Oxides of Nitrogen convert to Nitrogen Dioxide in the environment;
- For long-term PCs and PECs, assume all Oxides of Nitrogen convert to Nitrogen Dioxide.

Further guidance⁶ from the Air Quality Modelling and Assessment Unit (AQMAU) regarding the preparation of dispersion models for Environmental Permitting, goes on to clarify that:

For combustion processes where no more than 10 % of Nitrogen Oxides are emitted as Nitrogen Dioxide, you can assume worst case conversion ratios to Nitrogen Dioxide of:

- 35 % for short-term average concentrations
- 70 % for long-term average concentrations

This assessment will follow a step-wise approach to the modelling of Nitrogen Dioxide.

Predicted environmental concentrations for NO₂ are calculated using the following formulae:

Equation 1 Calculation of Annual Average NO₂ PEC:

$$= (\text{Annual NO}_x \text{ Modelled} \times 0.7) + \text{Annual NO}_2 \text{ Monitored}$$

Equation 2 Calculation of Hourly Average NO₂ PEC:

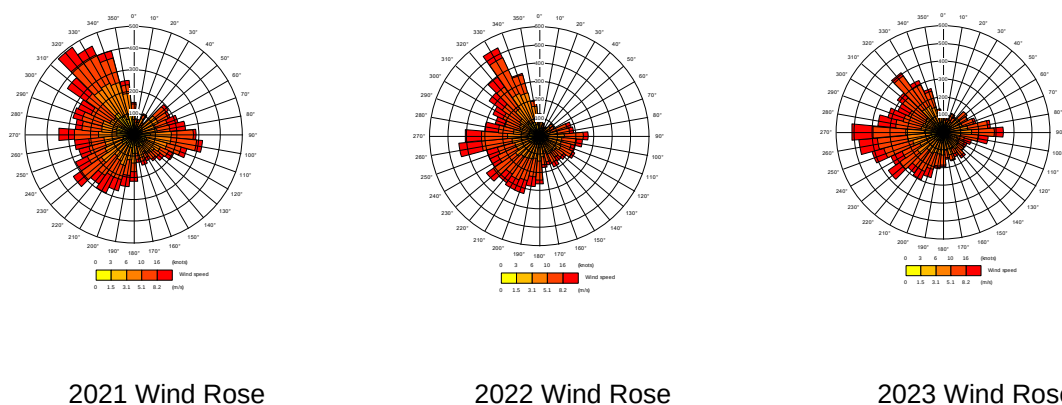
$$= (\text{Hourly NO}_x \text{ Modelled} \times 0.35) + (\text{Annual NO}_2 \text{ Monitored} \times 2)$$

Despite the recognition that only a portion of the discharge comprises NO₂, this method may still overestimate concentrations of NO₂ in close proximity to the site as the conversion of NO_x to NO₂ is unlikely to be instantaneous, requiring the mixing of the plume with ambient air and its associated oxidant species such as Ozone (O₃) etc.

2.4 Meteorological Data

Three years' worth of hourly average Numerical Weather Prediction (NWP) meteorological data was applied to the modelling assessment. NWP modelling allows meteorological data to be interpolated to create a dataset for any desired location and is useful where there are no local or representative monitoring stations in the vicinity of the assessment site. The wind roses from the data applied are shown in Figure 2.

Figure 2 Wind Roses for the Local Area



All meteorological data used in the assessment were provided by Atmospheric Dispersion Modelling (ADM) Limited, which is an accredited distributor of meteorological data within the UK. The data indicate the prevailing wind in the area is from the western side of the site, although can also come from the east. The wind roses show that the wind in the area is least likely to come from a north-easterly direction. The application of multiple years' worth of data enables the effects of inter-annual variations to be taken into account.

The meteorological data included within the model incorporated the nine parameters defined below:

Parameter	Description
YEAR	Year of observation
TDAY	Julian Day (1 to 366) of observation
THOUR	Hour of Observation
T0C	Temperature (° C)
U	Wind speed (m s ⁻¹)
PHI	Wind Direction (nearest 10 degrees)
P	Precipitation (mm)
CL	Cloud cover (Oktas)
RHUM	Relative Humidity (%)

2.5 Local Environmental Conditions

Local environmental conditions describe the factors that might influence the dispersion process (such as nearby structures, sharply rising terrain, etc.) and also describe the locations at which pollutant concentrations are to be predicted. These include:

Surface Roughness

Surface roughness defines the amount of near-ground turbulence that occurs as a consequence of surface features, such as land use (i.e. agriculture, water bodies, urbanisation, open parkland, woodland, etc.). Agricultural areas may have a surface roughness of approximately 0.2m to 0.3m whereas large cities and woodlands may have a roughness of 1 to 1.5m.

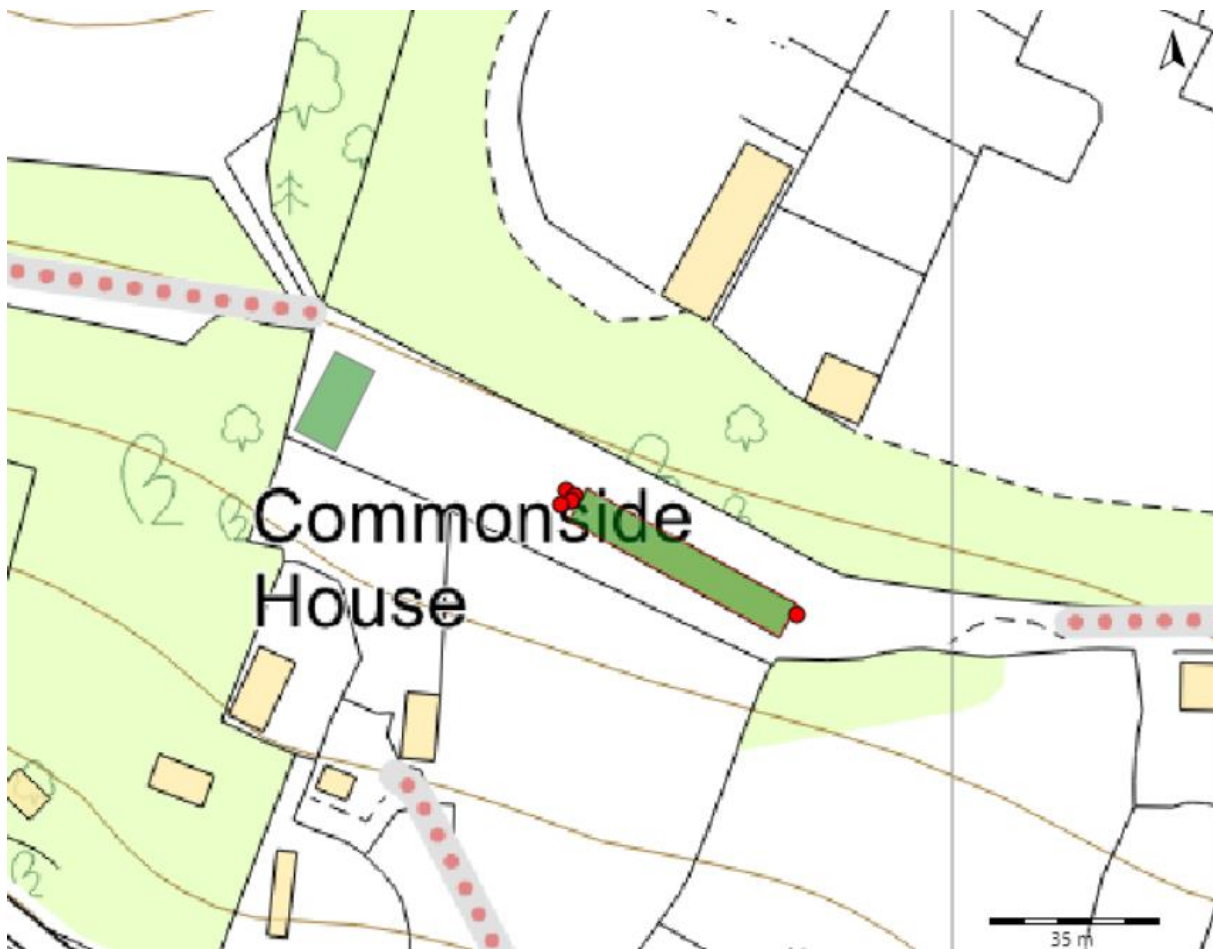
Land use in the immediate vicinity of the site is largely rural with woodland and open fields, especially to the south of the site. Commercial and industrial businesses are present to the north and the north-east of the site, extending from the western reaches of Cheadle town, with residential areas within Cheadle, but also with individual or small groups of dwellings located across the area, and the hamlet of Boundary to the west. The mixed land use across the area prompted the use of a spatially variable surface roughness file to accurately detail the surface roughness across the modelled grid. Where it was not appropriate to apply the variable roughness file to model runs, such as when considering more distant receptors, a surface roughness factor of 0.5 metres was considered appropriate to provide a generic description woodland and open suburbia.

Nearby Buildings and Structures

The proximity of solid structures, such as buildings, to an emission source can affect the dispersion of a plume emitted from an adjacent stack, particularly in the vicinity of that structure. The effects of this were included into the model based on the data presented in Table 4, and graphically in Figure 3.

Table 4 Modelled Building Data

Building	Height (m)	Length (m)	Width (m)	Angle (Degrees)
Main (existing) building	4.625	48.75	7.3	118.5
New building (woodstore)	6.5	18	9	207

Figure 3 Site Layout as Modelled

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Local Terrain

Local terrain can affect wind flow patterns and, consequently, can affect the dispersion of atmospheric pollutants. The effects of terrain are not normally noticeable where the gradient is less than 10 % (otherwise described as a 1:10 slope). Ordnance Survey mapping for the area generally shows the absence of significant terrain in the vicinity of the site and as such, terrain data was not incorporated into the modelling exercise.

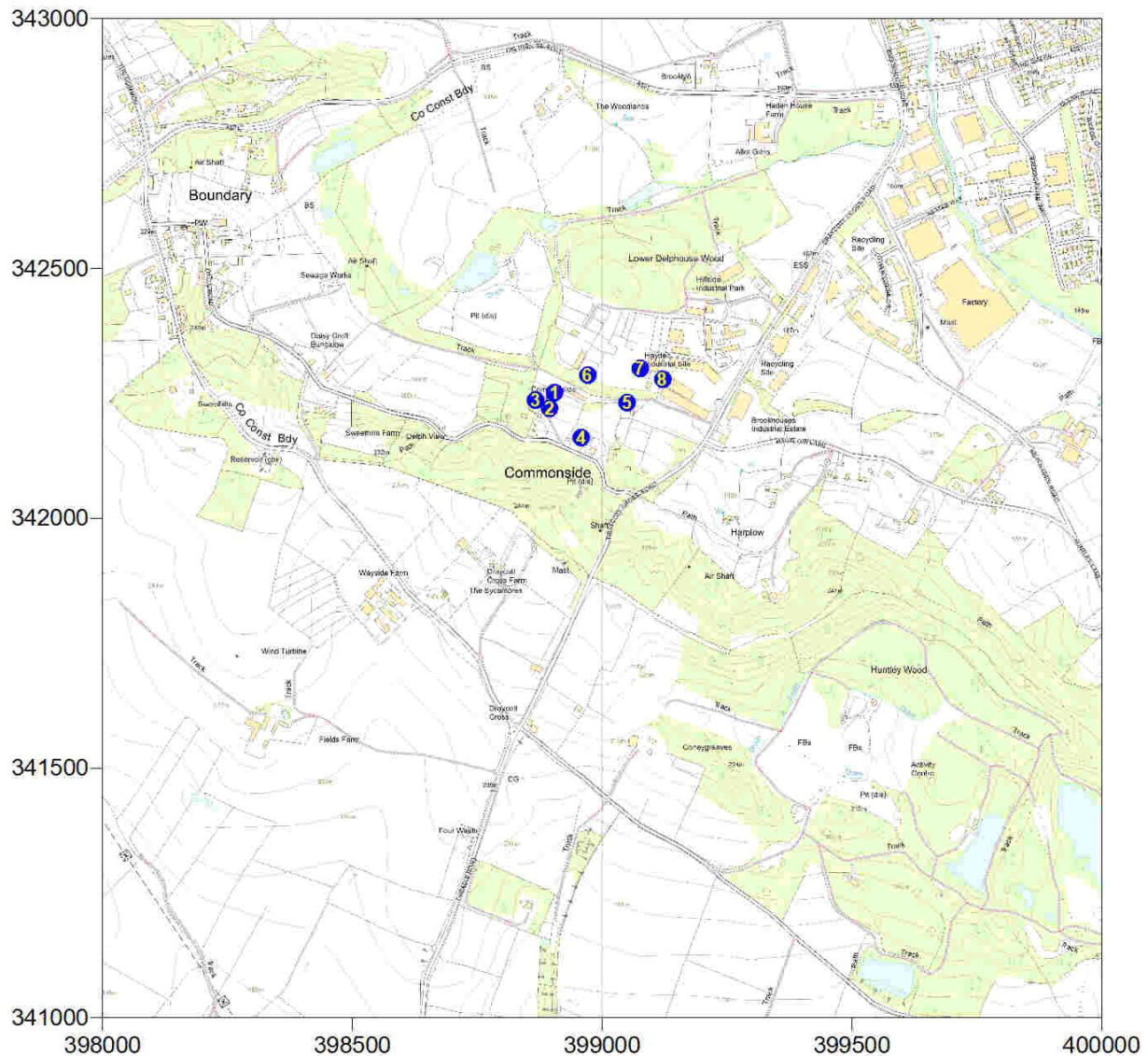
Output Grid

When setting up a receptor grid it is important to ensure that there are sufficient receptor points to be able to accurately predict the magnitude and location of the maximum process contribution. If the grid of receptor points is too widely spaced, the maximum concentration may be missed. Modelling of the Facility was undertaken using a 2 km x 2 km grid with 20-metre grid spacing.

Eight specific receptors, representing nearby residential properties and business premises were entered into the model, as were four sensitive ecological receptors representing Sites of Special Scientific Interest (SSSIs), each of which is located between 5 and 6 km from the site. Details of the sensitive receptor locations are presented in the following table.

Table 5 Specific Receptors Included in Detailed Modelling

Number	X	Y	Distance from Site (m)	Receptor Name
1	398905	342252	21	Field / Garden of neighbouring residence: SW
2	398895	342220	51	Nearest residence: SSW
3	398867	342236	62	Residence: SW
4	398958	342161	107	Residence: S
5	399050	342232	130	Residence: E
6	398971	342286	53	Business premises / offices: N
7	399076	342300	157	Business premises / offices: NE
8	399121	342278	198	Business premises / offices: ENE
9	398904	347340	5,078	Churnet Valley – SSSI
10	402557	346532	5,607	Froghall Meadow and Pastures – SSSI
11	404406	343522	5,625	Dimmings Dale and The Ranger – SSSI
12	403517	345994	5,918	Whiston Eaves - SSSI

Figure 4 Receptor Locations

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Background Air Quality

Estimates of background concentrations for NO₂, PM₁₀ and PM_{2.5} are provided on the UK-AIR⁷ website hosted by DEFRA at a resolution of 1 km x 1 km grid spacing. The development site is located within an area under the jurisdiction of Staffordshire Moorlands District Council, and data were obtained for 2025 for the locality around the site, representing the earliest date for the operation of the new boilers.

The data show that future estimates of background concentrations for the pollutants included within the model and without any process contribution from the Facility, are well below their respective air quality standards.

Table 6 Background Air Quality Data in the Vicinity of the Facility (2025)

Pollutant	Annual Average Concentration (µg m ⁻³)
Nitrogen Dioxide (NO ₂)	8.8116
Particulate Matter as PM ₁₀	11.041
Particulate Matter as PM _{2.5}	7.4878
Estimated concentrations at grid reference 399500, 342500 – the nearest downwind data point	

2.6 Model Default Values Applied

The following values were retained as the default inputs defined by the model, in the absence of any site-specific data for the site location or the meteorological measurement station:

Surface Albedo; 0.23 representing an area of non-snow covered land.

Priestley-Taylor Parameter; 1 representing moist grassland.

Minimum Monin-Obukhov Length; 1 m.

3. Results and Discussion

3.1 Modelled Parameters

Detailed atmospheric dispersion modelling of emissions from the existing and proposed boilers was undertaken on the basis of:

Release height: 5.5 metres
 Building downwash module: active
 Terrain effects: not active
 Surface roughness (grid): spatially variable surface roughness file or 0.5 metre beyond the grid
 Meteorological data: Numerical Weather Prediction data for the local area: 2021 - 2023

Emissions of NO_x and particulate matter were assessed in line with the air quality standards and their objective values (where applicable), or against specific pollutant EALs detailed in EA guidance⁵.

The modelled emissions data were as summarised in Tables 2 and 3. The results from detailed modelling of the possible operational scenarios are discussed in Sections 3.3 to 3.5. Results are presented in terms of the maximum process contribution and, where the PC cannot immediately be screened as insignificant are also reported as the predicted environmental concentration taking into account the PC and the estimated background concentration for the area.

The modelled scenarios were as follows:

1. One existing and four new biomass boilers discharging continually throughout the course of the year. The four new boilers which are located to the west of the existing building are not combined in the assessment, with all boilers modelled as individual units. This will have the effect of presenting an absolute worst-case assessment as:
 - a) it is unlikely that all five boilers will ever be run together;
 - b) the new boilers are also highly unlikely to be run for more than approximately 60 % of the year, while the existing boiler is expected only to run for approximately 28 % of the year; and
 - c) where more than one of the new boilers are run together at any one time, the positioning of the discharge points in close proximity to one another would aid the dispersion from each of the individual units. This can be reflected by 'combining' the releases within the model.
2. One existing and four new biomass boilers discharging continually throughout the course of the year. The four new boilers which are located to the west of the existing building are combined. While this will have a positive impact, reducing the process contributions reported for the local area, the assumption that all five boilers operate, continuously throughout the year, still presents a conservative assessment of the impact of the site operations.
3. Finally, one single 210 kW_{th} boiler and one 295 kW_{th} boiler have each been modelled to ensure that no unusual effects are predicted when modelling the operation of any one of the new units individually. The assessment continues to assume that the boilers run throughout the entire year.

3.2 Determining Significance

This report details the assessment of comprehensive modelling undertaken for the discharges. The significance or otherwise of the results regarding the potential impact on human health or national ecological sites are assessed using a two-stage approach, aligned with the Environment Agency (EA) requirements.

The EA provides guidance⁵ for screening the significance of air quality impacts associated with the operation of industrial processes. For long-term impacts, the guidance recommends a 1 % insignificance threshold of process contributions relative to a long-term AQS or EAL, with a corresponding 10 % insignificance threshold for the assessment of short-term PCs.

Where the long-term PC is greater than 1 % but the PEC remains within 70 % of the long-term assessment level, the emissions do not screen as insignificant, but are not considered to be significant. Similarly, where the short-term PC is more than 10 % of the assessment level, but is less than 20 % of the assessment level minus twice the long-term background concentration, emissions are confirmed as not significant.

When considering local nature sites in the area, the requirement is different, and the guidance specifies that no further assessment is required where the short-term and / or long-term PC is less than 100 % of relevant environmental standard.

Contour plots are provided for pollutants assessed against air quality objectives, and where the process contribution cannot be screened as insignificant.

3.3 Nitrogen Dioxide (NO₂)

The results of modelling NO_x as NO₂ when assuming the worst-case conditions specified under Scenario 1 are presented in Table 7. The data presented are for both the maximum process contribution (PC) and the predicted environmental concentration (PEC) for NO₂ and are based upon the maximum values reported from the 2021 to 2023 meteorological data. The PEC values take into account the background concentration of NO₂ in the local area in 2025, estimated to be 8.8116 µg m⁻³ and conversion of the NO_x released from the process, based upon empirical formulae recommended by the Environment Agency; 50 % conversion for short-term assessments and 100 % conversion for long-term assessments.

Where contributions cannot be screened, they are presented in bold type.

Table 7 Results from Detailed Assessment for Nitrogen Dioxide and Oxides of Nitrogen

Statistic	Assessment Level	Averaging Period	Process Contribution (µg m ⁻³)	Percentage of the AQS
Annual PC	40	Annual	16.52	41 %
Annual PEC			25.34	63 %
Short-term 99.79% PC	200	1hr	47.36	24 %
Short-term 99.79% PEC			64.98	32 %
Revised ST Assessment Level (AQS – background x 2)	182.38		47.36	26 %

The maximum reported values (annual and hourly average process contributions respectively) are predicted by the modelling to occur at locations approximately 20 and 40 metres from the new boilers, in a generally easterly direction. These locations are both within the UK Renewable Energy site boundary, and reduce significantly with distance from the site.

The results from modelling predict that the PC from the continuous operation of five biomass boilers at the site will equate to approximately 41 % of the annual average for the protection of human health at the point of maximum process contribution. This contribution cannot immediately be screened as insignificant although this point of maximum impact is not located at a specific human health receptor, instead being within the site boundary where long periods of access by the general public do not occur.

Receptors of annual average duration exposure would usually include locations where members of the public might be regularly exposed, such as building façades of residential properties, schools, hospitals, care homes etc. The air quality objectives do not usually apply at the building façades of offices or other places of work where members of the public do not have regular access, and thus annual average contributions will not generally be of concern at such locations.

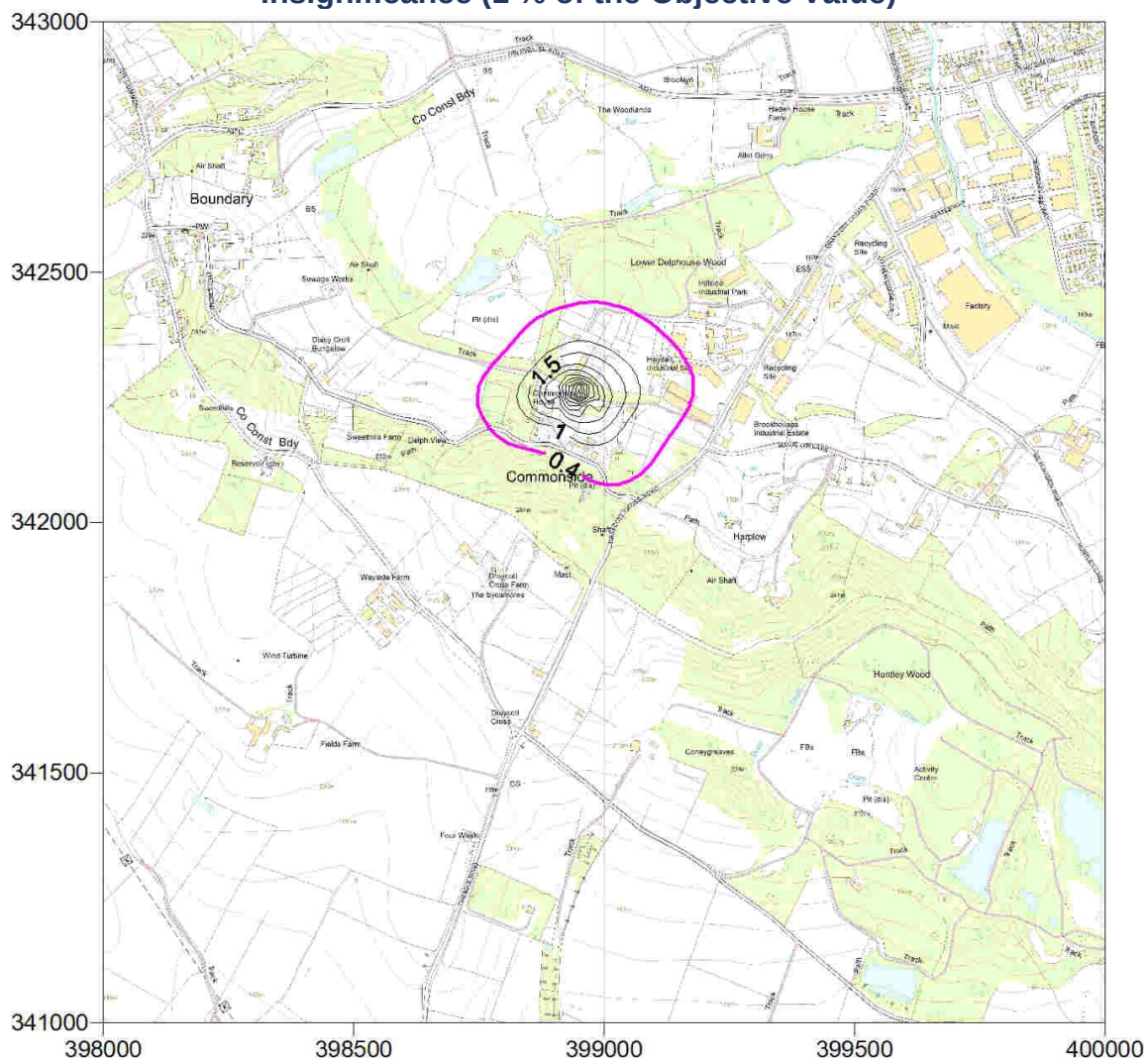
The assessment was made assuming that 100 % of the long-term NO_x converts fully to Nitrogen Dioxide (NO₂) which is a worst-case estimate. Following the Environment Agency's AQMAU guideline⁶ as confirmed in Section 2.3, that only 70 % of the NO_x will actually convert to NO₂ in the long-term, results in a process contribution of 11.57 µg m⁻³, or approximately 29 % of the annual average Air Quality Standard (AQS).

Applying the estimated local background concentration of NO₂ for 2025 ($8.8116 \mu\text{g m}^{-3}$) in order to calculate the predicted environmental concentration (PEC) results in a PEC of $25.34 \mu\text{g m}^{-3}$ (when modelling 100 % NO_x as NO₂) or 63 % of the AQS, reducing to approximately 51 % when the process contribution of NO₂ is assumed to be 70 % of the total NO_x.

Therefore, although the annual average PC does not screen as insignificant at the initial assessment stage, the maximum PEC remains within 70 % of the AQS, whether NO₂ is assumed to comprise 100 % or 70 % of the NO_x contribution, and will therefore not have any significant effect on air quality.

The annual average process contribution plot for Nitrogen Dioxide, where the long-term process contribution of NO₂ is 100 % of total NO_x, is presented in Figure 5. Assuming that only 70 % of the long-term NO_x contributions convert to Nitrogen Dioxide over the course of the year would reduce the area where the PC does not immediately screen as insignificant.

Figure 5 Annual Average Process Contribution of NO_x as NO₂ ($\mu\text{g m}^{-3}$); 2023 Meteorological Conditions. Magenta Isopleth Denotes the Point of Insignificance (1 % of the Objective Value)



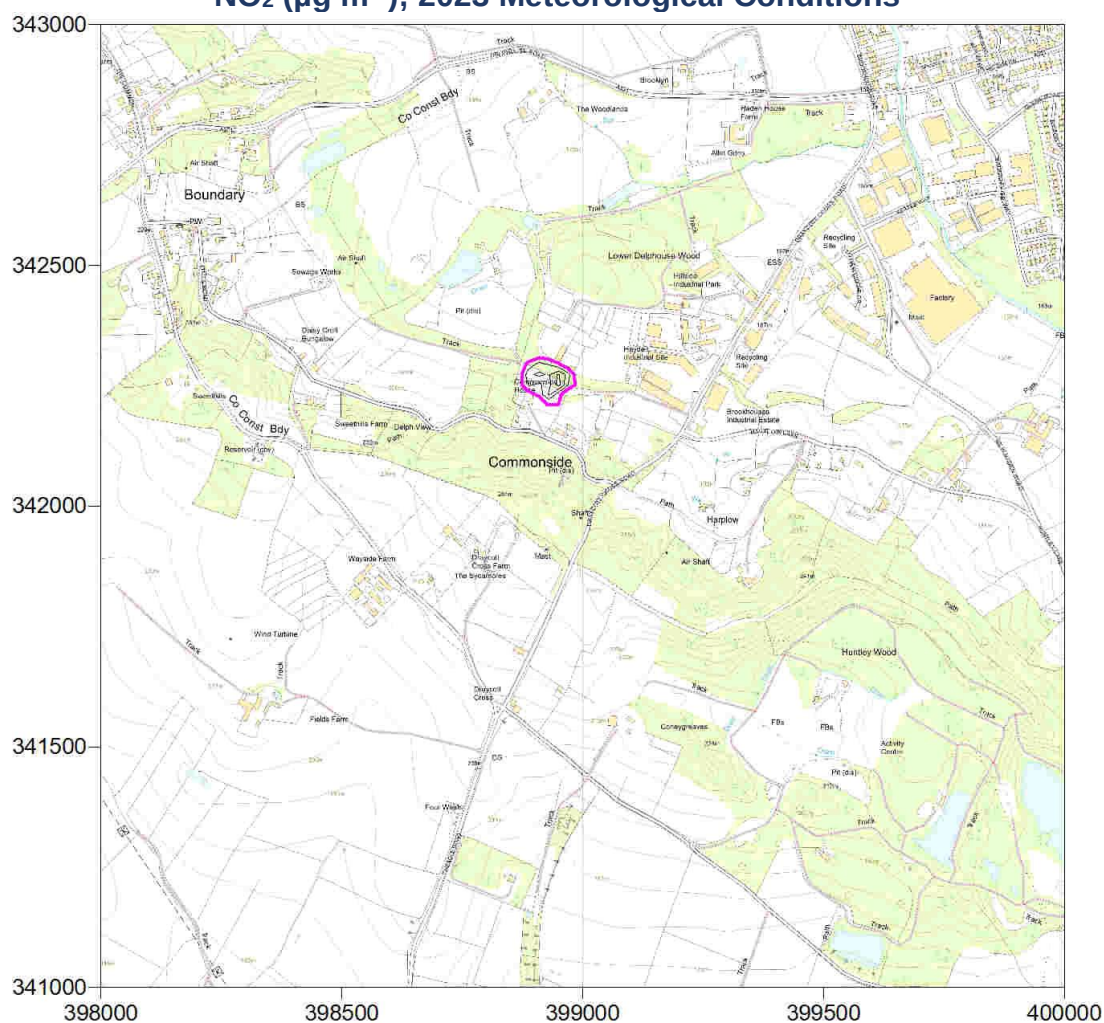
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The maximum hourly average NO₂ PC was predicted to be approximately 47.36 µg m⁻³, expressed as the 99.79th percentile value, equating to approximately 24 % of the 200 µg m⁻³ objective value. However, this assumes that up to 50 % of the NO_x released converts to NO₂ in the short-term, whereas the Environment Agency confirms that, for combustion processes where no more than 10 % of Nitrogen Oxides are emitted as Nitrogen Dioxide, a conservative conversion ratio of 35 % can be applied to the short-term averaging period.

Assuming that only 35 % of the NO_x converts to NO₂ in the short-term, the resultant maximum 99.79th percentile hourly average process contribution equates to 33.15 µg m⁻³ or approximately 17 % of the short-term air quality objective. Neither of these levels of process contribution can be immediately screened as insignificant, and nor can the contributions be considered to be not significant when comparing a 50 % contribution of NO_x as NO₂ against the AQS objective value minus twice the background concentration, giving a new assessment level of 182.38 µg m⁻³. However, when assuming 35 % of the NO_x converts to NO₂ in the short term, the process contribution equates to approximately 18 % of this revised assessment level and therefore, not only remains well within the air quality standard which is unlikely to be breached even at this point of maximum contribution but would also be considered not to be significant.

Figure 6 plots the short-term NO₂ PC and shows the small local area where the PC is not screened as insignificant when modelling NO₂ at 50 % of total NO_x. Assuming that only 35 % of the NO_x contributions convert to NO₂ in the short-term, in line with the guidance from AQMAU⁶, would further reduce the area where the PC does not immediately screen as insignificant.

Figure 6 99.79th Percentile Hourly Average Process Contribution of NO_x as NO₂ (µg m⁻³); 2023 Meteorological Conditions



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It should be remembered that the maximum PC reported here occurs within the site boundary and hence is not an area that is classified as a sensitive human health or ecological receptor, and that the assessment under Scenario 1 provides for an overly conservative, worst-case approach. In reality, if the four new boilers were to be operated simultaneously, the discharges from each boiler would benefit from the buoyant discharges of the other boilers, thereby increasing lift and improving dispersion. Additionally, the model assumes that the boilers are operational continuously throughout the course of the year. This is highly unlikely to be the case. However, the results show that, even if they were to operate continually, the highest process contributions occurring during the few hours over the course of the three years modelled, where the meteorological conditions result in elevated process contributions at this point of maximum impact, remain well within the AQS and therefore are acceptable.

When modelling the four new boilers as a combined discharge to recognise the improvement in buoyance of the discharge from the co-located flues (Scenario 2), the following reductions in process contributions are reported.

Table 8 Comparison of Results Modelling All Stacks as Individual Releases and Modelling the Four New Stacks Combined, with the Existing Stack Individually

Assessment	All Stacks - not combined	All Stacks (new stacks combined)	Reduction	Two new stacks (505 kW) – combined, plus existing	Two new stacks (505 kW) - combined
Annual Average (NO₂ = 100 % NO_x)					
Maximum PC	16.52	14.63	1.89	8.36	6.27
Percentage of the AQS	41.3 %	36.6 %	4.7 %	21 %	16 %
PEC	25.34	23.44	1.89	17.17	15.08
Percentage of the AQS	63.3 %	58.6 %	4.7 %	43 %	38 %
99.79th Percentile Hourly Average (NO₂ = 50 % NO_x)					
Maximum PC	47.36	38.30	9.06	19.37	18.84
Percentage of the AQS	23.7 %	19.2 %	4.5 %	10 %	9 %
PEC	64.98	55.93	9.06	37.00	36.46
Percentage of the AQS	32.5 %	28.0 %	4.5 %	18.5 %	18.2 %
PC Percentage of Revised ST Assessment Level (AQS – background x 2)	26 %	21 %	5%	11 %	10 %

Despite the notable improvement in dispersion and the resultant predicted impact on local air quality of combining the emissions from the new stacks when all boilers are in operation, the fundamental conclusion of the assessment does not change when considering emissions of Nitrogen Dioxide, with annual average concentrations not being significant, although not screening as insignificant, and short-term contributions at the point of maximum impact being neither insignificant nor not significant when assuming 50 % conversion of NO₂, but remaining well within the AQS.

When smaller combinations of boiler operations are considered, the annual average contributions remain as not being significant, and the short-term hourly average contributions (as the 99.79th percentile), immediately screen as insignificant whether two new boilers are operating alone, or in combination with the existing boiler. This will generally be the most likely operational schedule for the site processes, with the operation of five boilers at any one time being highly unlikely.

3.4 Particulates (PM₁₀)

The results from detailed modelling of total particulate matter, assumed to be discharged as PM₁₀ under Scenario 1 are provided in Table 9 and are presented in the context of the process contribution and the resultant predicted environmental concentration, taking into account the DEFRA estimated annual average background concentration for 2025 of 11.04 µg m⁻³.

Table 9 Maximum Process Contribution for Particulates (PM₁₀)

Statistic	Assessment Level	Averaging Period	Process Contribution (µg m ⁻³)	Percentage of the AQS
Annual PC	40	Annual	7.6	19 %
Annual PEC			18.64	47 %
Short-term PC 90.41%	50	24hr	18.95	38 %
Short-term PEC 90.41%			41.03	82 %
Revised ST Assessment Level (AQS – background x 2)	27.92		27.92	68 %

Detailed modelling predicted that the maximum annual average PC for particulates (assumed to be PM₁₀) due to emissions from the biomass boilers was likely to be less than 7.6 µg m⁻³, or approximately 19 % of the AQS objective value, and cannot therefore immediately be screened as insignificant. However, with an existing estimated background concentration of 11.04 µg m⁻³, a PEC of 18.64 µg m⁻³ equates to approximately 47 % of the AQS objective value and, being within 70 % of the total annual average limit, will therefore not have any significant effect on air quality.

The maximum daily average PC under normal operating conditions was predicted to be 18.95 µg m⁻³, expressed as the 90.41 percentile value, equivalent to approximately 38 % of the 50 µg m⁻³ daily average objective value, and which does not therefore screen at either the initial or secondary assessment stage.

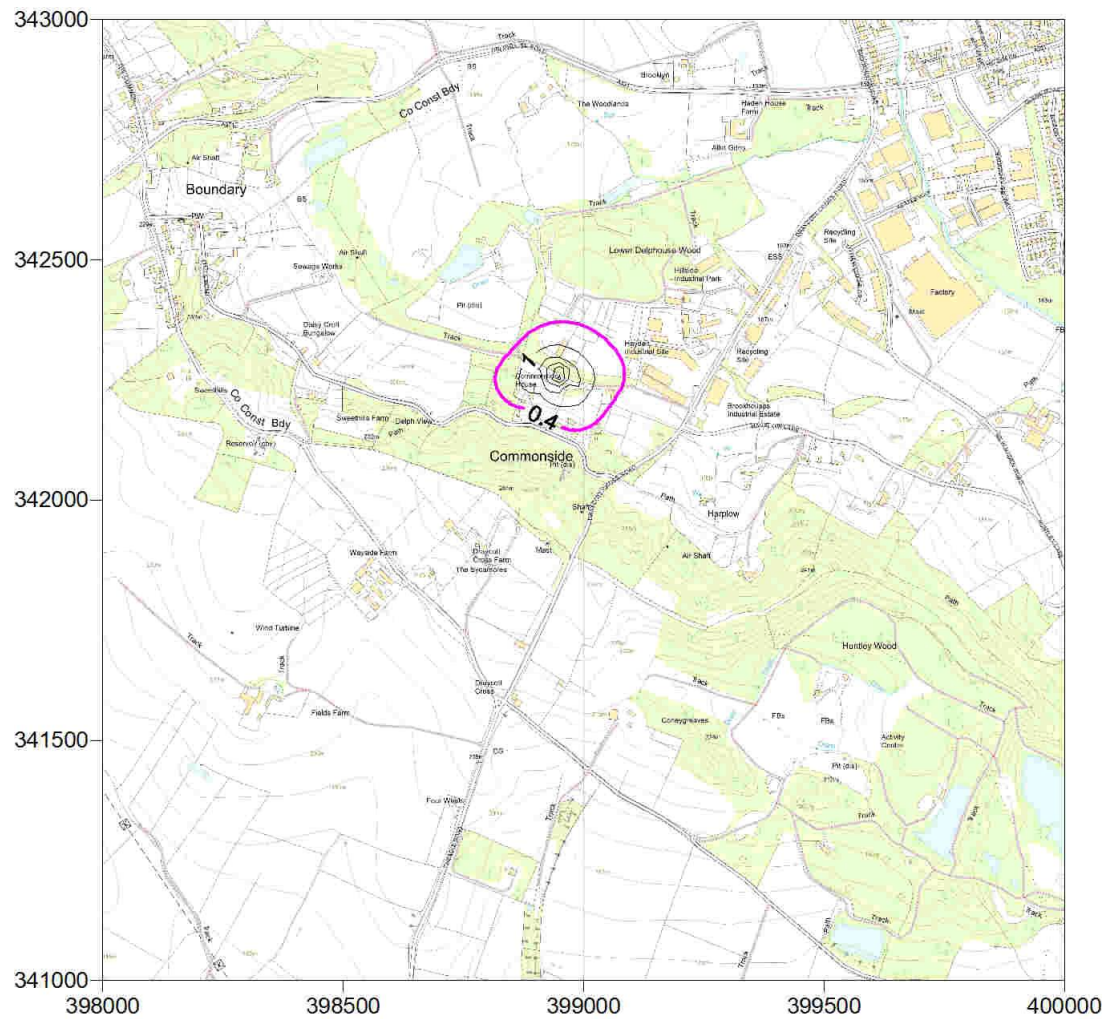
Plots of the long and short-term process contribution isopleths are presented in Figures 7 and 8.

The point of maximum process contribution occurs approximately 20 metres from the new boilers, in a generally easterly direction, and is located within the site boundary. As such, the potential impact at sensitive human health or ecological receptors will be lower than reported here.

It is also important to note that the modelling has assumed that the release of total particulate matter, which will include the PM₁₀ and PM_{2.5} portions, as well as larger particulate fractions, is all emitted as PM₁₀. This will result in an over-estimate of the impact of the emissions, as emissions of larger particulate fractions are not considered as part of the Air Quality Standard.

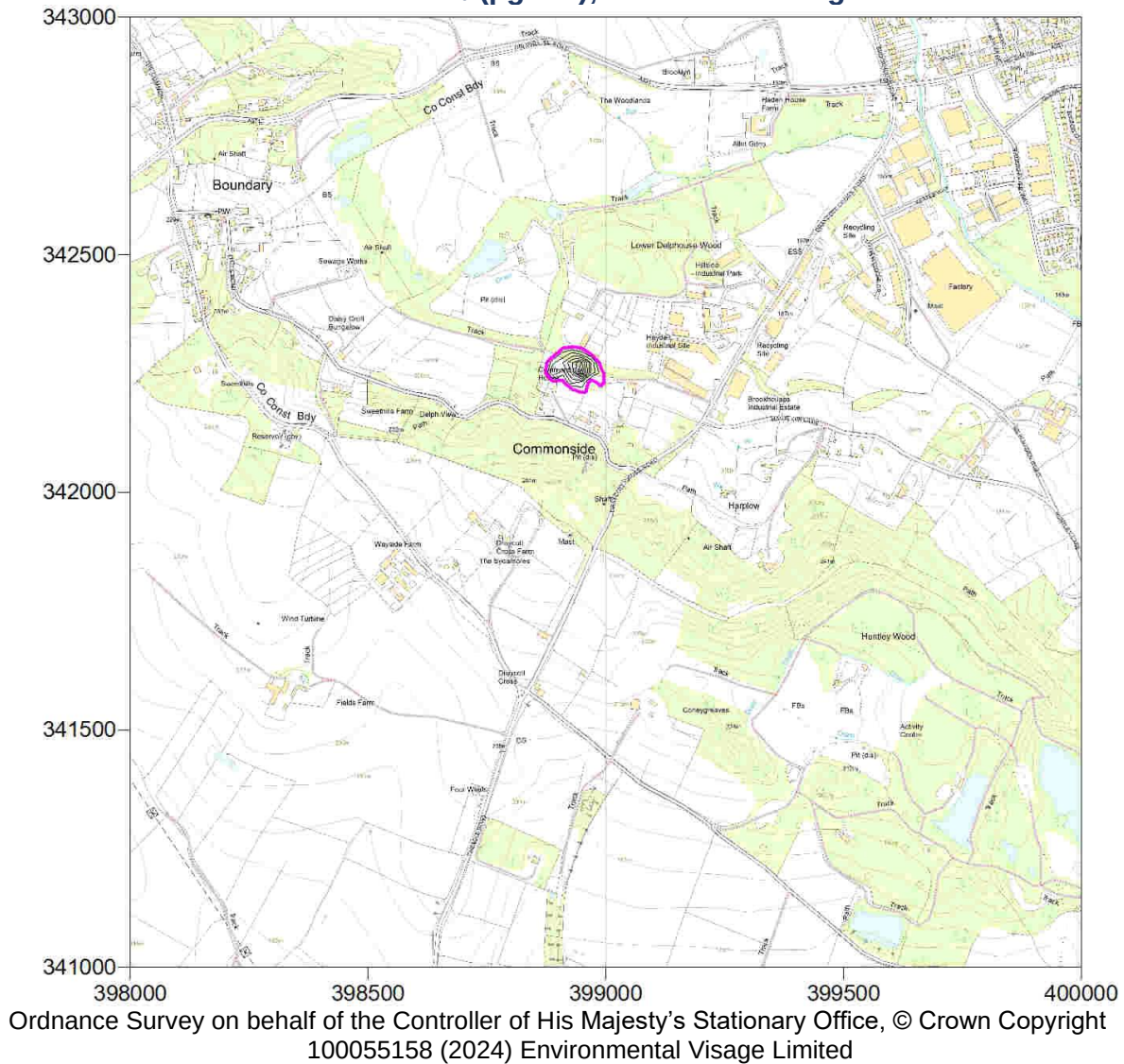
Similarly to the assessment of NO_x emissions, combining the new flues when all four are operational results in a reduction in the predicted impact, with a PC equating to approximately 34 % of the short-term AQS. However, this result is still not screened either as insignificant or not otherwise significant, at the point of maximum contribution, within the site boundary.

Figure 7 Annual Average Process Contribution of Particulate Matter as PM₁₀ ($\mu\text{g m}^{-3}$); 2023 Meteorological Conditions



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Figure 8 90.41st Percentile Daily Average Process Contribution of Particulate Matter as PM₁₀ ($\mu\text{g m}^{-3}$); 2023 Meteorological Conditions



3.5 Particulates (PM_{2.5})

The Air Quality Standards Regulations 2010 (as amended) set a target of $20 \mu\text{g m}^{-3}$ PM_{2.5} to be met by 2020. A new target⁴ has recently been issued and ultimately requires a background level of $10 \mu\text{g m}^{-3}$ PM_{2.5} to be met by 2040. Hence, both assessment levels, current and future are considered here, and assume that the release of total particulate matter from the biomass boilers is all PM_{2.5}.

Assuming that the results of total particulate modelling represent emissions of PM_{2.5} an assessment against the relevant AQS and Environmental Target is presented in Table 10 in the context of the annual average PC and PEC, taking into account DEFRA's estimated annual average background concentration for 2025 of $7.488 \mu\text{g m}^{-3}$.

Table 10 Modelling Predictions for Particulates (as PM_{2.5})

Statistic	Assessment Level	Averaging Period	Process Contribution ($\mu\text{g m}^{-3}$)	Percentage of the AQS
Annual PC	20 (current)	Annual	7.6	38 %
Annual PEC			15.09	75 %
Annual PC	10 (by 2040)	Annual	7.6	76 %
Annual PEC			15.09	151 %

The results from modelling particulates, assuming that the total particulate emission is of PM_{2.5}, predicted that the maximum annual average PC associated with emissions from the biomass boilers is unlikely to screen as insignificant or otherwise as not significant, at the point of maximum impact within the site boundary, assuming that all five boilers run continually. That said, all contributions remain within the assessment levels, with the exception of the PEC when considered against the 2040 Environmental Target.

The PM_{2.5} Environmental Target also includes a population exposure reduction target, stated as a 35 % reduction in population exposure by 2040 (compared to a base year of 2018). The PM_{2.5} concentration in the local area was estimated to be approximately 6.99 µg m⁻³ in 2018, and a 35 % reduction should therefore see the background concentration at approximately 4.54 µg m⁻³ in 2040. Applying this background concentration to the PEC, and considering both the operation of all five boilers concurrently but not combined and the most likely, although still conservative operational scenario of the existing boiler plus two new boilers, combined, operating at the same time throughout the course of the year, results in the following predicted environmental concentrations at the point of maximum impact, when projecting to 2040 for comparison with the future target:

Table 11 Further Assessment of the Impact on the 2040 Annual Average Environmental Target

Statistic	Assessment Level	Process Contribution (µg m ⁻³)	Percentage of the AQS
Annual PC (five boilers)	10 (by 2040)	7.6	76 %
Annual PEC (background = 4.54)		12.14	121 %
Annual PC (three boilers)		3.84	38 %
Annual PEC (background = 4.54)		8.39	84 %

Although the results at the point of maximum impact, located within the site boundary and therefore not at a specified receptor, are still not screened as either insignificant or not otherwise significant, applying the likely future background concentration with the emissions from the more likely, although still overly conservative operation of three site boilers, continually throughout the year predicts that, even when assuming that the release of total particulate matter comprises only the very fine PM_{2.5} fraction of the emission, the 2040 Environmental Target will not be exceeded. The assumptions made in this prediction are significant and all err on the side of caution. It is therefore considered highly unlikely that, even at the point of maximum contribution of particulate emissions from the biomass boilers, the future Environmental Target would be exceeded due to their operation.

The annual average distribution of PM_{2.5} dispersion would be similar to that of PM₁₀, as depicted in Figure 7.

4. Air Quality Impact at Specific Receptors

The ADMS model was set up to calculate the impact of emissions at eight specific human health receptors in the vicinity of The Woodyard. The locations of these receptors were shown in Figure 4 and represent locations where members of the general public may be present for extended periods of time, either through residence in a particular area, or as a result of their employment. The results have been assessed and the maximum process contributions from three years' worth of modelled data are summarised in the tables over page.

The background concentrations applied to the PEC are as detailed in Section 2 and applied in Section 3 of this report.

The results in Tables 12 and 13 demonstrate that, with the exception of the short-term contribution of particulate matter at receptor number 1, when the total particulate emission is assumed to comprise only particles within the PM₁₀ fraction, the process contributions and predicted environmental concentrations of NO₂ and PM₁₀ can be screened either as insignificant, or otherwise as not significant.

Receptor number 1 represents a location in the field or garden of the neighbouring property, directly adjacent The Woodyard site. Although not able to be screened as not significant, the process contribution at this point, when considering the 90.41st percentile 24-hour average from three years' worth of data, modelling five boilers operating continually with no combination of the discharges, equates to approximately 48 % of the short-term AQS minus twice the long-term background. Therefore, although not insignificant or otherwise not significant, the additional potential contribution from the operation of the biomass boilers remains within 50 % of, and does not threaten, the AQS. It is therefore considered to be acceptable.

Table 12 Results from Detailed Assessment of Nitrogen Dioxide Contributions at Specific Human Health Receptors

Receptor Number	Annual Average PC NO ₂ (µg m ⁻³)	Percentage of the AQS	PEC (µg m ⁻³)	Percentage of the AQS	Short-term 99.79% PC	Percentage of the AQS	Percentage of Revised ST Assessment Level (AQS – background x 2)
1	7.076	18 %	15.887	40 %	33.732	17 %	18 %
2	1.876	5 %	10.687	27 %	15.448	8 %	17 %
3	1.985	5 %	10.796	27 %	14.240	7 %	16 %
4	1.504	4 %	10.315	26 %	9.0674	5 %	10 %
5	1.209	3 %	10.021	25 %	9.1021	5 %	10 %
6	4.261	11 %	13.073	33 %	18.506	9 %	20 %
7	0.859	2 %	9.671	24 %	5.4236	3 %	6 %
8	0.610	2 %	9.421	24 %	4.2191	2 %	5 %

The revised short term assessment level is: $200 - (8.811613 \times 2) = 182.38 \mu\text{g m}^{-3}$

Table 13 Results from Detailed Assessment of Particulate Matter Contributions (as PM₁₀) at Specific Human Health Receptors

Receptor Number	Annual Average PC PM ₁₀ (µg m ⁻³)	Percentage of the AQS	PEC (µg m ⁻³)	Percentage of the AQS	Short-term 90.41% PM ₁₀ PC	Percentage of the AQS	Percentage of Revised ST Assessment Level (AQS – background x 2)
1	3.255	8 %	14.296	36 %	13.465	27 %	48 %
2	0.863	2 %	11.904	30 %	3.675	7 %	13 %
3	0.913	2 %	11.954	30 %	3.669	7 %	13 %
4	0.692	2 %	11.733	29 %	2.536	5 %	9 %
5	0.556	1.4 %	11.598	29 %	1.627	3 %	6 %
6	1.960	5 %	13.001	33 %	4.931	10 %	18 %
7	0.395	1.0 %	11.436	29 %	1.080	2 %	4 %
8	0.281	0.7 %	11.322	28 %	0.843	2 %	3 %

The revised short term assessment level is: $50 - (11.04121 \times 2) = 27.92 \mu\text{g m}^{-3}$

Applying the worst-case predicted particulate concentrations to the Air Quality Standard for PM_{2.5} (currently $20 \mu\text{g m}^{-3}$), an annual average PC of $3.255 \mu\text{g m}^{-3}$ equates to 16 % of the AQS, and a predicted environmental concentration of $10.743 \mu\text{g m}^{-3}$, or approximately 54 % of the AQS, assuming that the total particulate concentration is emitted as PM_{2.5}. Therefore, although not screened as insignificant, and accepting the overly conservative nature of this assessment, the biomass boilers are considered not to have a significant effect on the levels of PM_{2.5} in air at any of the local human health receptors.

5. Impact of Emissions on Nearby Ecological Receptors

Four ecological receptor locations were also incorporated into the ADMS model representing designated ecological habitats within a 10 km radius of the development site. The ecological habitats comprised four Sites of Special Scientific Interest (SSSIs), each located between 5 and 6 km from The Woodyard, as listed in Table 5.

5.1 Assessment Relative to Critical Level Values

Annual average process contributions of NO_x were calculated for each of the ecological receptors using the ADMS model, and the predicted increases were compared against their respective critical level values as specified by the Environment Agency⁵. As detailed in Table 1, the critical levels for NO_x at designated habitat sites are 30 µg m⁻³ as an annual mean, and 75 µg m⁻³ as a daily mean, unless more stringent levels are required due to the sensitivities of the site.

The results from the critical levels assessment, assuming Scenario 1, are presented in the table below. As the environmental assessment level for ecological receptors considers NO_x as NO₂, the results provided are of total NO_x for both long and short-term assessment periods

Table 14 Critical Levels Assessment for NO_x at Sensitive Ecological Receptors

Ecological Receptor	Annual NO _x PC (µg m ⁻³)	Percentage of Critical Level	Daily NO _x PC (µg m ⁻³)	Percentage of Critical Level
1. Churnet Valley: a river valley that includes semi-natural and ancient woodland	0.002827	0.009%	0.08411	0.11%
2. Froghall Meadow and Pastures: Grassland	0.002637	0.009%	0.14076	0.19%
3. Dimmings Dale and The Ranger: Hill pasture	0.002979	0.010%	0.06726	0.09%
4. Whiston Eaves: Grassland	0.00245	0.008%	0.12074	0.16%

As can be seen in the above table the annual average process contributions of NO_x (as NO₂) at each of the receptors considered are a fraction 1 % of the 30 µg m⁻³ CL for NO_x. The daily process contributions of NO_x (as NO₂) are also within 1 % of the CL and hence, the process contributions screen as insignificant at all reported receptors.

5.2 Assessment Relative to Site-Specific Critical Load Values

Sensitive ecological receptors may also be sensitive to nutrient Nitrogen and acid deposition, and where relevant, an assessment has been made of the potential for deposition to occur. Information on site specific critical loads and background levels of nutrient Nitrogen and acid deposition were obtained from the APIS website.⁸ Critical load values are generally expressed as a range and, in order to provide a worst-case assessment, the most stringent load in each range has been applied here. The hill pasture of Dimmings Dale and the Ranger has no critical loads specified for nutrient Nitrogen nor acid deposition on the APIS website and as such, is not considered in this assessment.

The following dry deposition velocities were applied to the study to calculate the levels of deposition from the release point:

Dry deposition of:	Grassland Velocity (m s⁻¹)	Forest Velocity (m s⁻¹)
NO ₂	0.0015	0.003

The model was run to include outputs for dry deposition based on the relevant deposition factors specified above, for each site, whereby only the Churnet Valley was considered to be a forest receptor, and all others were modelled as grassland receptors.

The following methods were applied when calculating total nutrient Nitrogen and acid deposition rates.

Calculating the Loading from Nitrogen Based Species

Levels of NO_x dry deposition were multiplied by 0.7 in order to represent the deposited level of NO₂, as NO does not deposit in any significant quantity. The resultant $\mu\text{g m}^{-2} \text{s}^{-1}$ figures were multiplied by 95.9 to calculate the contributions to nutrient Nitrogen deposition.

When calculating the Nitrogen based component of acid deposition, NO_x dry deposition ($\mu\text{g m}^{-2} \text{s}^{-1}$) at each site was multiplied by 0.7 as above, before being multiplied by 6.84 to calculate the contribution of Nitrogen based species to acid deposition, in $\text{keq ha}^{-1} \text{year}^{-1}$.

As no other Nitrogen or acid-based species have been modelled, the critical load assessment is based solely on emissions of NO_x. The results of the assessment follow.

Table 16 Results from Detailed Modelling of Nitrogen Deposition in Relation to the Site-Specific Critical Load

Ecological Receptor	Critical Load Range	N Deposition (kgN/ha/yr)	% Lower Critical Load
1. Churnet Valley: a river valley that includes semi-natural and ancient woodland	5 – 15	0.000569	0.011%
2. Froghall Meadow and Pastures: Grassland	6 – 10	0.000266	0.004%
4. Whiston Eaves: Grassland	10 - 20	0.000246	0.002%

The results in Table 16 confirm that contributions of nutrient Nitrogen to the local sensitive ecological receptors constitute a fraction of 1 % of the most stringent critical load, and hence are immediately screened as insignificant.

Table 17 Results from Detailed Modelling of Acid Deposition in Relation to the Site-Specific Critical Load: Assessment of PEC

Ecological Receptor	Existing Background (keq/ha/yr)	Acid Deposition (keq/ha/yr)	PEC (keq/ha/yr)	Critical Load (CLminN)	CL < CLminN?
1. Churnet Valley: a river valley that includes semi-natural and ancient woodland	2.65	0.000041	2.650041	0.357	No
2. Froghall Meadow and Pastures: Grassland	1.53	0.000019	1.530019	0.856	No
4. Whiston Eaves: Grassland	1.53	0.000018	1.530018	0.856	No

Guidance provided on the APIS website⁸, notes that the first stage in the method for calculating exceedances of the acidity critical load considers the contribution of the predicted environmental concentration of Nitrogen based acid deposition to the CLminN assessment level as, only if the PEC is greater than CLminN will the additional Nitrogen deposition from the source contribute to acidity. However, the background levels of acid deposition at each of the modelled sites already exceed the very low CLminN levels and hence, if SO₂ were anticipated from the boilers, the sulphur-based acid deposition should also be included at this point of the assessment. However, none is anticipated, and hence there is no additional acid loading to include.

With no additional acid loading to include, the assessment reverts to consideration of the PC against the critical level. In this case, with only Nitrogen-based acid available, the assessment applies the most stringent critical level (CLminN) and considers the percentage contribution from the boiler emissions, to each sensitive receptor.

Table 18 Results from Detailed Modelling of Acid Deposition in Relation to the Site-Specific Critical Load: Assessment of PC

Ecological Receptor	Acid Deposition (keq/ha/yr)	Critical Load (CLminN)	% of CLminN
1. Churnet Valley: a river valley that includes semi-natural and ancient woodland	0.000041	0.357	0.011%
2. Froghall Meadow and Pastures: Grassland	0.000019	0.856	0.002%
4. Whiston Eaves: Grassland	0.000018	0.856	0.002 %

With no Sulphur-based acid contributions and with Nitrogen-based acid contributions equating to a fraction of 1 % of the most stringent critical load values, the contribution to acid deposition from the operation of the proposed boilers will be negligible.

It is noted that critical loads are defined as: *"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"*. As such, even an exceedance of the critical load would not guarantee any direct adverse effects on receptors, and the very small contributions from the operations at The Woodyard are predicted to have no measurable effect on the SSSI habitats.

6. Conclusions

Detailed atmospheric dispersion modelling has been undertaken of emissions to atmosphere from five biomass boilers, located or proposed to be located at The Woodyard, off Draycott Cross Road, Brook Houses, Cheadle, Staffordshire, ST10 2NR.

UK Renewable Energy Limited has applied for planning to erect a new building, and to install four new biomass boilers at the site, which already includes a single existing building and one small biomass boiler. In order to provide Staffordshire Moorlands District Council with the information it requires to consider and approve the planning application for the new boilers, UK Renewable Energy Limited has commissioned Environmental Visage Limited (Envisage) to prepare an assessment of the potential air quality impacts of the proposed boilers. Envisage has therefore undertaken a detailed dispersion modelling exercise and presents the results in this Air Quality Assessment of the predicted impact of emissions to air from the boilers, when operating in various combinations.

The modelling was undertaken using ADMS Version 6 and considered various scenarios in order to ensure that the model presented a reasonable worst-case assessment. Hourly average meteorological data for the local area was prepared in the form of Numerical Weather Prediction data for 2021 – 2023 and were used to determine maximum process contributions across a 2 km x 2 km receptor grid with 20-metre grid spacing, as well as at specified nearby receptor locations.

The model predicted that process contributions for all modelled pollutants would be well below the objective limits defined within the UK Air Quality Standards Regulations, or relevant environmental assessment levels recommended by the Environment Agency, with the majority of impacts either screening as insignificant or being deemed to not be significant at the secondary assessment stage.

Some shorter-term assessment periods predict results that cannot be screened either as insignificant, or otherwise not significant. However, even when considering the highly conservative scenario that models all five boilers operating continually throughout the course of the year, including during weather conditions that restrict dispersion from the flues, and with no added buoyancy considered from the multiple new flue discharges that will naturally benefit from their grouped positioning, the predicted environmental concentrations that are reported around the facility, remain well within the Air Quality Standards and therefore remain acceptable.

Some additional analysis was made when considering the future (2040) Environmental Target for PM_{2.5} as, when assuming that the total particulate matter release consists of the very fine PM_{2.5} fraction, the contributions cannot readily be screened against the future target when considering the worst-case scenario. However, the Environmental Target also includes a requirement to reduce the background levels of PM_{2.5} and, when modelling assumes that three of the five boilers operate continually throughout the course of the year, which is still an overly conservative assumption, the overall PEC remains within the AQS specified by the 2040 target. This is despite the fact that the modelling has assumed that the total particulate release, which will include particulate matter within the 2.5 micron fraction but also the PM₁₀ fraction and larger particles, all discharges as PM_{2.5}.

When considering the potential impacts at local human health receptors, the process contributions and predicted environmental concentrations of NO₂ and PM₁₀ can be screened either as insignificant, or otherwise as not significant at all points, with the exception of the short-term (24-hour) contribution of particulate matter at receptor number 1. Again, this assumes that the total particulate emission comprises particles within the PM₁₀ fraction and is predicted when modelling the most conservative of the scenarios considered. However, the process contribution remains within 50 % of the revised (short-term) AQS and is therefore considered to be acceptable.

Contributions to critical levels and critical loads at each of the sensitive ecological receptors remain well within 1 % of the assessment levels and can therefore be screened as insignificant.

The overall conclusion from detailed modelling of emissions from the existing and proposed new biomass boilers at The Woodyard site is that the potential impact on local air quality is likely to be small, generally being screened as either insignificant or not otherwise significant at local receptor locations and will not therefore have any significant impact on the health of people living and working nearby, or on the surrounding environment.

7. References

¹ <https://www.cerc.co.uk/environmental-software/ADMS-model/data.html>

² The Air Quality (England) Regulations 2000 SI 2000 No. 928 (as amended)

³ Air Quality Standards (England) Regulations 2010 SI 2010 No. 1001 (as amended)

⁴ The Environmental Targets (Fine Particulate Matter) (England) Regulations 2023

⁵ <https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit>

⁶ <https://www.gov.uk/guidance/environmental-permitting-air-dispersion-modelling-reports>

⁷ <https://uk-air.defra.gov.uk/data/laqm-background-home>

⁸ <http://www.apis.ac.uk/>

APPENDIX A

RHI Certificate for Glen Farrow Boilers

Renewable Heat Incentive

Non-domestic Renewable Heat Incentive Emissions Certificate

This certificate provides evidence that the tested boiler meets the air quality requirements of the non-domestic Renewable Heat Incentive (RHI) – Reg 5A(3) and Schedule A1. It must be issued by a testing laboratory. Applicants applying for the RHI with biomass boilers must submit a certificate with their application, or alternatively, an environmental permit.

1. TEST HOUSE	
a) name and address of testing laboratory	Environmental Scientifics Group Limited Unit 5 Crown Industrial Estate Kenwood Road Stockport SK5 6PH Tel: 00 44 161 443 0980
b) name and signature of the person authorised by the testing laboratory to issue the certificate	Name: Dave Armitage
	Signature: 
c) date of issue of this certificate together with certificate reference number *Please see Note A	Date: 10 th December 2018
	Ref: LNO 11741/v7b
d) if testing laboratory is accredited to BS EN ISO/IEC 17025:2005, date of accreditation and accreditation number (note: if testing conducted after 24 September 2013, the testing laboratory must be BS EN ISO/IEC 17025:2005 accredited)	Date: 11/12/1992
	Accreditation number: 1015

2. PLANT Please see Note B	
a) name of the plant tested	Glen Farrow GF175
b) model of the plant tested	GF175
c) manufacturer of the plant tested	Glen Farrow
d) installation capacity* of the tested plant in kilowatts (kW) *defined in the RHI Regulations as the total installed peak heat output capacity of the plant	175kW

e) is the plant a <u>manually stoked, natural draught</u> plant? (that is, without a fan providing forced or induced draught)	No
f) (i) the date the plant was tested* (ii) please confirm that NOx and PM have been tested on the same occasion *This is in reference to the emissions testing for PM and NOx, not any wider range of tests. A specific date is required.	11/03/2014 - 13/03/2014 Yes, NOx and PM tested on the same occasion
g) list of all the plants in the type-testing range* of plants to which the certificate applies, if any ¹ Please include the installation capacity of each model. <i>*This must follow the ratio rules: If the smallest plant in the range is 500kW or less, the largest plant in the range can't be more than double the smallest. If the smallest plant in the range is over 500kW, the largest plant in the range can't be more than 500kW greater than the smallest.</i>	Glen Farrow GF195 Glen Farrow GF210 Glen Farrow GF295

3. FUELS	
a) types of fuels used when testing	Mixed logs with moisture content of 17 – 23 % based on category A1 classification according to EN14961-5
b) based on the testing, list the range of fuels that can be used in compliance with the emission limits of 30 grams per gigajoule (g/GJ) net heat input for particulate matter (PM), and 150 g/GJ net heat input for oxides of nitrogen (NOx) (based if relevant on classifications from EN14961 or EN303-5)	Mixed Logs with moisture content of 17-23% based on category A1 classification according to EN14961-5
c) moisture content of the fuel used during testing	Wood Logs 14-23% - EN 14961-5
d) maximum moisture content* of the fuel which can be used with the certified plant(s) so as to ensure that the RHI emission limits are not exceeded. *This value may be obtained from ranges specified in EN 303-5 based on the fuel type(s) tested	Wood Logs - 23% - EN 14961-5

4. TESTS	
Confirm which requirements the emissions of NOx and PM have been tested in accordance with. Either 4a or 4b should be confirmed, the other should be 'not applicable'	

¹ The type-testing approach enables testing laboratories to provide assurance that all boilers in a given range meet the air quality requirements, without needing to specifically test each boiler.

