Aggregated Micro Power Holdings Ltd

Lindhurst Lodge, Biomass Boiler, Barnsley, S71 3DD

Air Quality Assessment

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Non-Technical Summary

The report presents the findings of an air quality assessment undertaken to support a planning application for the operation of two biomass boilers at Lindhurst Lodge, Lindhurst Road, Barnsley, S71 3DD..

The objective of the Air Quality Assessment is to determine whether off-site impacts from the boiler operations meet the required air quality standards (AQSs) or air quality Environmental Assessment Limits (EALs) for the protection of human health, vegetation and habitats.

A flue height of 8.5 m above the ground level has been determined by a stack height analysis.

The long-term and short term predicted environmental concentrations of NO_2 from the boiler operations are all below the relevant air quality objectives. The significance of effects on the receptors, in respect to long-term NO_2 exposure from the boiler operations is determined to be 'negligible' to 'slight'.

The long-term and short term predicted environmental concentrations of PM_{10} and $PM_{2.5}$ from the boiler operations are all below the relevant air quality objectives. The significance of effects on the emissions on the ground level receptors from the facility operations with respect to long-term PM_{10} is determined to be 'negligible'.

The contributions to the effects from the releases of NO_2 from the boiler operations on the ecological receptor location are insignificant and negligible.

Therefore, the predicted concentrations of the modelled pollutants from the boiler operations are considered acceptable for the protection of human health, vegetation and habitats.

1.0 Introduction

WYG Environment has been commissioned by Aggregated Micro Power Holdings Ltd to prepare an Air Quality Assessment in support of a part retrospective planning application for the continued operation of two biomass boilers at Lindhurst Lodge, Lindhurst Road, Barnsley, S71 3DD.

It is understood that two biomass boilers (and building which was constructed circa 2-3 years ago) serves the Lindhurst Lodge care home in Barnsley. Forest Fuels, an Aggregated Micro Power Holdings Ltd company, would provide the wood chip fuel supply.

It is understood that planning permission was granted for a redevelopment of the care home site to provide a much larger and modern development a few years ago. This consent appears not to have been implemented. A new boiler plant did not form part of the new care home scheme and the current plant room was built without planning permission prior to it being acquired by the applicant. It has since been operating (not at full output capacity) serving the existing care home for a couple of years. The breach in planning control was not known by the Council and as far as we are aware no local residents complained.

Recently, the applicant has discussed the planning status of the plant room with the Council and the Council has asked for a regularising retrospective planning application to be submitted for the continued operation of the boiler plant together with revised positioning and height of the associated exhaust flues..

1.1 Site Location

The Lindhurst Lodge care home and the boiler plant room are located on Lindhurst Road, Barnsley, S71 3DD. The approximate OS reference for the site is 434890, 409780. The location of the site is shown in Figure 1.

The Site is immediately bounded to the south by Lindhurst Road, with the residential houses beyond, to the north by Radcliffe Road, with the residential houses beyond, to both the east and the west by residential houses and gardens.

1.2 Scope of Air Quality Assessment

The details of the scope of air quality assessment have been discussed through a consultation with Barnsley Metropolitan Borough Council. Telephone discussions between Mr Chris Shields, Technical Officer (Pollution Control), Regulatory Services and WYG took place on the 22nd August 2018. Subsequently, Mr Shields emailed WYG in confirmation of the following agreed scope of the air quality assessment.

1) Baseline air quality evaluation - to review of the existing air quality in the vicinity of the Lindhurst Lodge care home, in order to provide a benchmark against which to assess air quality impacts of the continued operation of the two existing biomass boilers with new flue exhaust arrangements.

For the background information for the receptors, a baseline traffic model using ADMS road/urban has been used to take into account for emissions from local road traffic contributions. The traffic model has been calibrated using the local monitoring data from both the council's diffusion tubes and the continuous stations.

2) Undertaking dispersion modelling - the air quality impacts on the local air quality have been assessed using the third generation Breeze AERMOD dispersion model. AERMOD is a development from the ISC3 dispersion model and incorporates improved dispersion algorithms and pre-processors to integrate the impact of meteorology and topography within the modelling output.
3) The nearby building, including the houses and carehome building itself, have been used in AERMOD to take into account of building downwash effect.
4) Meteorological data from Doncaster Met Station for 2015, 2016 and 2017 has been used using surface roughness of 1.0 m to produce a worst case assessment;
5) A flue height analysis has been undertaken to determine the required flue height; and
6) An Assessment of the significance of the effects from the boiler operations has been undertaken using "the impact descriptors for individual receptors" published on the latest guidance by EPUK and IAQM in January 2017.

The objective of the air quality assessment is to determine whether the impacts from boiler emissions meet the required air quality standards (AQSs), air quality Environmental Assessment Limits (EALs), or exposure benchmarks for the protection of human health, vegetation and habitats.

2.0 Extant Policy, Legislation and Relevant Agencies

2.1 Documents Consulted

The following documents were consulted during the undertaking of this assessment:

Legislation and Best Practice Guidance

- National Planning Policy Framework, Department for Communities and Local Government, July 2018;
- Planning Practice Guidance: Air Quality, March 2014;
- The Air Quality Standards Regulations, 2010;
- The Air Quality Strategy for England, Scotland, Wales and Northern Ireland, 2007;
- The Environment Act, 1995;
- Local Air Quality Management Technical Guidance LAQM.TG16, Defra, February 2018;
- Design Manual for Roads and Bridges, Volume 11, Section 3, Part 1, HA 207/07 - Air Quality, Highways Agency, 2007;
- Defra Local Air Quality Management Note on Projecting NO_2 concentrations (April 2012); and,
- Guidance on Air Emissions Risk Assessment for your Environmental Permit, Defra and Environment Agency, 2 August 2016.
- Land-Use Planning & Development Control: Planning for Air Quality, EPUK & IAQM, 2017; and,
- Guidance on the Assessment of Dust from Demolition and Construction, IAQM, 2014.

Websites Consulted

- Google maps (maps.google.co.uk);
- The UK National Air Quality Archive (www.airquality.co.uk);
- emapsite.com;
- MAGIC (http://magic.defra.gov.uk/);
- Planning Practice Guidance (http://planningguidance.planningportal.gov.uk/); and,
- Doncaster Metropolitan Borough Council website (http://www.doncaster.gov.uk/)

Site Specific Reference Documents

- 2018 Air Quality Annual Status Report (ASR), Barnsley Metropolitan Borough Council, June 2018
- Doncaster Metropolitan Borough Core Strategy (Adopted September 2011).

2.2 Air Quality Legislative Framework

European Legislation

European air quality legislation is consolidated under Directive 2008/50/EC, which came into force on 11th June 2008. This Directive consolidates previous legislation which was designed to deal with specific pollutants in a consistent manner and provides new air quality objectives for fine particulates. The consolidated Directives include:

- **Directive 1999/30/EC** – the First Air Quality "Daughter" Directive – sets ambient air limit values for nitrogen dioxide and oxides of nitrogen, sulphur dioxide, lead and particulate matter;
- **Directive 2000/69/EC** – the Second Air Quality "Daughter" Directive – sets ambient air limit values 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.

UK Legislation

The Air Quality Standards Regulations (Amendment 2016) seek to simplify air quality regulation and provide a new transposition of the Air Quality Framework Directive, First, Second and Third Daughter Directives and also transpose the Fourth Daughter Directive within the UK. The Air Quality Limit Values are transposed into the updated Regulations as Air Quality Standards, with attainment dates in line with the European Directives. SI 2010 No. 1001, Part 7 Regulation 31 extends powers, under Section 85(5) of the Environment Act (1995), for the Secretary of State to give directions to Local Authorities (LAs) for the implementation of these Directives.

The UK Air Quality Strategy is the method for implementation of the air quality limit values in England, Scotland, Wales and Northern Ireland and provides a framework for improving air quality and protecting human health from the effects of pollution.

For each nominated pollutant, the Air Quality Strategy sets clear, measurable, outdoor air quality standards and target dates by which these must be achieved; the combined standard and target date is referred to as the Air Quality Objective (AQO) for that pollutant. Adopted national standards are based on the recommendations of the Expert Panel on Air Quality Standards (EPAQS) and have been translated into a set of Statutory Objectives within the Air Quality (England) Regulations (2000) SI 928, and subsequent amendments.

The AQOs for pollutants included within the Air Quality Strategy and assessed as part of the scope of this report are presented in Table 2.1 along with European Commission (EC) Directive Limits and World Health Organisation (WHO) Guidelines.

Table 2.1 Air Quality Standards, Objectives, Limit and Target Values

Pollutant	Applies	Objective	Concentration Measured as[10]	Date to be achieved and maintained thereafter	European Obligations	Date to be achieved and maintained thereafter	New or existing
PM_{10}	UK	50µg/m^3 by end of 2004 (max 35 exceedances a year)	24-hour mean	1st January 2005	50µg/m^3 by end of 2004 (max 35 exceedances a year)	1st January 2005	Retain Existing
	UK	40µg/m^3 by end of 2004	Annual mean	1st January 2005	40µg/m^3	1st January 2005	
$PM_{2.5}$	UK	25µg/m^3	Annual Mean	31st December 2010	25µg/m^3	1st January 2010	Retain Existing
Nitrogen Dioxide	UK	200µg/m^3 not to be exceeded more than 18 times a year	1 Hour Mean	31st December 2005	200µg/m^3 not to be exceeded more than 18 times a year	1st January 2010	Retain Existing
	UK	40µg/m^3	Annual Mean	31st December 2005	40µg/m^3	1st January 2010	

Within the context of this assessment, the annual mean objectives are those against which facades of residential receptors will be assessed and the short-term objectives apply to all other receptor locations, where people may be exposed over a short duration, both residential and non-residential such as using gardens, balconies, walking along streets, using playgrounds, footpaths or external areas of employment uses.

Dust is a generic term covering particles of different compositions, shapes and sizes; these can have different impacts and effects:

- Those particles up to 10 µm (micrometres) in diameter (known as PM_{10}) remain suspended in air for long periods and because they are fine enough to be breathed in and can, potentially, cause health effects; and
- The particles that are larger (and maybe visible to the naked eye) are not thought to cause health effects to the same extent but can cause disamenity through soiling and staining when they deposit onto window ledges, cars, laundry and plants.

Statutory standards exist for concentrations of suspended particulate matter (both PM_{10} and the $PM_{2.5}$ fine fraction), set under The Air Quality Standards Regulations 2010 which implement limit values prescribed by the European Directive 2008/50/EC. The limit values are legally binding and the Secretary of State, on behalf of the UK Government, is responsible for their compliance. In contrast to suspended particulate matter (PM), there are no UK or European statutory standards that define the point when deposited dust causes annoyance or disamenity.

Local Air Quality Management

Under Section 82 of the Environment Act (1995) (Part IV) LAs are required to periodically review and assess air quality within their area of jurisdiction under the system of LAQM. This review and assessment of air quality involves assessing present and likely future air quality against the AQOs. If it is predicted that levels at the façade of buildings where members of the public are regularly present (normally residential properties) are likely to be exceeded, the LA is required to declare an Air Quality Management Area (AQMA). For each AQMA the LA is required to produce an Air Quality Action Plan (AQAP), the objective of which is to reduce pollutant concentrations in pursuit of the AQOs.

2.3 Planning and Policy Guidance

National Policy

The National Planning Policy Framework (NPPF), revised July 2018, principally brings together and summarises the suite of Planning Policy Statements (PPS) and Planning Policy Guidance (PPG), which previously guided planning policy making. The NPPF states that:

> *'Planning policies and decision should sustain and contribute towards compliance with relevant limit values or national objectives for pollutant, taking into account the presence of Air Quality Management Areas or Clean Air Zones, and the cumulative impacts from individual sites in local areas. Opportunities to improve air quality or mitigate impacts should be identified, such as through traffic or travel management, and green infrastructure provision and enhancement. So far as possible these opportunities should be considered at the plan-making stage, to ensure a strategic approach and limit the need for issues to be reconsidered when determining individual applications. Planning decisions should ensure that any new development in Air Quality Management Areas and Clean Air Zones is consistent with the local air quality action plan'*

The Planning Practice Guidance (PPG) web-based resource was launched by the Department for Communities and Local Government (DCLG) on 6 March 2014 to support the National Planning Policy Framework and make it more accessible. A review of PPG: Air Quality identified the following guidance:

> *'When deciding whether air quality is relevant to a planning application, local planning authorities should consider whether the development would:*
>
> *Significantly affect traffic in the immediate vicinity of the proposed development site or further afield. This could be by generating or increasing traffic congestion; significantly changing traffic volumes, vehicle speed or both; or significantly altering the traffic composition on local roads. Other matters to consider include whether the proposal involves the development of a bus station, coach or lorry park; adds to turnover in a large car park; or result in construction sites that would generate large Heavy Goods Vehicle flows over a period of a year or more.*
>
> *Introduce new point sources of air pollution. This could include furnaces which require prior notification to local authorities; or extraction systems (including chimneys) which require approval under pollution control legislation or biomass boilers or biomass-fuelled CHP plant; centralised boilers or CHP plant burning other fuels within or close to an air quality management area or introduce relevant combustion within a Smoke Control Area.*
>
> *Expose people to existing sources of air pollutants. This could be by building new homes, workplaces or other development in places with poor air quality.*

Give rise to potentially significant impact (such as dust) during construction for nearby sensitive locations.

Affect biodiversity. In particular, is it likely to result in deposition or concentration of pollutants that significantly affect a European-designated wildlife site and is not directly connected with or necessary to the management of the site, or does it otherwise affect biodiversity, particularly designated wildlife sites.'

Local Policy

Barnsley Metropolitan Borough Council's Local Development Framework contains the Core Strategy. This document provides a spatial strategy for the future development of Barnsley up to the year 2026. The Core Strategy sets out the key elements of the planning framework for Barnsley, and the approach to its long term physical development to achieve the Council's vision of what sort of place Barnsley wants to become. The document reflects the Council's hopes and aims for the people who live, work, run businesses and enjoy leisure in Barnsley. It is the spatial expression of the Sustainable Community Strategy. The strategy was adopted in September 2011.

Currently, the council is producing a Local Plan for Barnsley, which will replace the Core Strategy and the Unitary Development Plan. Once adopted, this document, together with the Joint Waste Plan prepared with Doncaster and Rotherham and adopted in March 2012, will be council's Statutory Development Plan.

The Plan has been reviewed for the saved policies contained and the following was deemed relevant:

CSP 28 Reducing the Impact of Road Travel

We will reduce the impact of road travel by:

1. *developing and implementing robust, evidence based air quality action plans to improve air quality*
2. *working with our sub regional partners, fleet and freight operators to improve the efficiency of vehicles and goods delivery, and reduce exhaust emissions*
3. *implementing measures to ensure the current road system is used efficiently.*

CSP 41 Developments in Air Quality Management Areas

Development in air quality management areas will be expected to demonstrate that it will not have a harmful effect on the health or living conditions of any future users of the development in terms of air quality (including residents, employees, visitors and customers), or that any such harmful effects can be mitigated against.

We will only allow residential development in air quality management areas, where the developer provides an assessment that shows living conditions will be acceptable for future residents.

We will only allow development in air quality management areas which could cause more air pollution, where the developer provides an assessment that shows there will not be a significantly harmful effect on air quality.

3.0 Assessment of Potential Environmental Effect

The potential environmental effects of the operational phase of the proposed development are identified as far as current knowledge of the site and development is known. The significance of potential environmental effects is assessed according to the latest guidance produced by EPUK and IAQM in January 2017.

The methodology used to determine the potential air quality effects of the construction phase of the proposed development has been derived from the IAQM 'Guidance on the Assessment of the Impacts of Dust from Demolition and Construction' document.

3.1 Determining Significance of the Air Quality Effects

The significance of the effects during the operational phase of the development is based on the latest guidance produced by EPUK and IAQM in January 2017 and the West Yorkshire Low Emissions Strategy (WYLES) published in December 2016. The EPUK/IAQM guidance provides a basis for a consistent approach that could be used by all parties associated with the planning process to professionally judge the overall significance of the air quality effects based on severity of air quality impacts.

The following rationale is used in determining the severity of the air quality effects at individual receptors:

1. The change in concentration of air pollutants, air quality effects, are quantified and evaluated in the context of AQOs. The effects are provided as a percentage of the Air Quality Assessment Level (AQAL), which may be an AQO, EU limit or target value, or an Environment Agency 'Environmental Assessment Level (EAL)';
2. The absolute concentrations are also considered in terms of the AQAL and are divided into categories for long term concentration. The categories are based on the sensitivity of the individual receptor in terms of harm potential. The degree of harm potential to change increases as absolute concentrations are close to or above the AQAL;
3. Severity of the effect is described as qualitative descriptors; negligible, slight, moderate or substantial, by taking into account in combination the harm potential and air quality effect. This means that a small increase at a receptor which is already close to or above the AQAL will have higher severity compared to a relatively large change at a receptor which is significantly below the AQAL;
4. The effects can be adverse when pollutant concentrations increase or beneficial when concentrations decrease as a result of development;
5. The judgement of overall significance of the effects is then based on severity of effects on all the individual receptors considered; and,

6. Where a development is not resulting in any change in emissions itself, the significance of effect is based on the effect of surrounding sources on new residents or users of the development, i.e., will they be exposed to levels above the AQAL.

Table 3.1 Significance of Effects Matrix

Long term average concentration at receptor in assessment year	% Change in concentration relative to AQAL			
	1	2-5	6-10	>10
≤75% of AQAL	Negligible	Negligible	Slight	Moderate
76-94% of AQAL	Negligible	Slight	Moderate	Moderate
95-102% of AQAL	Slight	Moderate	Moderate	Substantial
103-109 of AQAL	Moderate	Moderate	Substantial	Substantial
≥110 of AQAL	Moderate	Substantial	Substantial	Substantial

In accordance with *explanation note 2 of Table 6.3 of the EPUK & IAQM guidance*. The Table is intended to be used by rounding the change in percentage pollutant concentration to whole numbers, which then makes it clearer which cell the impact falls within. The user is encouraged to treat the numbers with recognition of their likely accuracy and not assume a false level of precision. Changes of 0%, i.e. less than 0.5%, will be described as 'Negligible'.

4.0 Baseline Conditions

This section provides a review of the existing baseline air quality in the vicinity of the proposed facility in order to provide a benchmark against which to assess potential air quality impacts of the proposed operations. Baseline air quality in the vicinity of the site has been defined from a number of sources, as described in the following sections.

4.1 Air Quality Review and Assessment

Air Quality Review

As required under section 82 of the Environment Act 1995, Barnsley Metropolitan Borough Council (BMBC) has undertaken an on-going exercise to review and assess air quality within its area of jurisdiction. The assessments have indicated that concentrations of NO_2 are above the relevant AQOs at a number of locations of relevant public exposure within the Council. BMBC has designated six Air Quality Management Areas (AQMA) that are described below:

- AQMA No.1: M1 Motorway, 100 metres either side of the central reservation within the Barnsley Borough;
- AQMA No.2A: A628 Dodworth Road;
- AQMA No.4: A61 Harborough Hill Road;
- AQMA No.5: Junction of A633 Rotherham Road and Burton Road;
- AQMA No.6: A616 passing through Langsett; and
- AQMA No.7: Junction of A61 Sheffield and A6133 Cemetery Road.

The AQMAs No.4 and No.5 are located closest to the site. The AQMA No.4 is situated approximately 2.8 km south of the site and The AQMA No.4 is situated approximately 2.8 km south-southeast of the site. It is anticipated the boiler operations will have minimal impact on those AQMAs.

Air Quality Monitoring

<u>Continuous Monitoring</u>

Barnsley MBC undertook automatic (continuous) monitoring at three sites during 2017. They are located between 3.2km and 4.2 km south/south west of the site.

The automatic monitoring data of 2017 are presented in Table 4.1.

Table 4.1 Monitored Annual Mean NO_2 Concentrations

Site ID	X	Y	Location	Site Type	Distance to Kerb (m)	Inlet Height (m)	Annual Mean Concentration 2017 (µg/m³)
CM1	436298	405691	Barnsley A635 Roadside	Roadside	5	1.45	17 for PM_{10}
CM2	432680	406174	Barnsley A628 Roadside	Roadside	3.5	1.7	35 for NO_2
CM3	432525	407475	Barnsley Gawber	Urban background	n/a	n/a	16 for NO_2

Non-Continuous Monitoring

Barnsley MBC undertook non- automatic (passive) monitoring of NO_2 at fifty five sites during 2017.

Doncaster Council undertook non- automatic (passive) monitoring of NO_2 at 57 sites during 2015 and 2016. Diffusion tubes are used to provide a relatively simple and cost-effective method of monitoring for nitrogen dioxide. It is carried out in several locations where levels are likely to be high, that have been identified by previous reviews and assessments, due to the proximity of significant sources (normally traffic).

The most recently available 2018 data sets for the closest NO_2 diffusion tube monitoring results, to the site, are presented in Table 4.2 below.

Table 4.2 Nitrogen Dioxide Monitoring Locations

Site Name	UK NGR(m)		Site Type	Distance to Kerb of Nearest Road (m)	Distance in (m) to relevant exposure	NO_2 Annual Mean Concentration 2016 (µg/m³)	NO_2 Annual Mean Concentration 2017(µg/m³)
	X	Y					
DT34 – Wakefield Road/Carlton Road	435011	408281	Roadside	2.3	13.3	34.9	35.2
DT35 Wakefield Road/Carlton Road	435027	408190	Roadside	2.0	23.8	40.7	38.7

As Table 4.2 illustrates, the closest diffusion tubes show the 2017 annual average monitored NO_2 concentrations are below the AQO limit of 40.0µg/m³.

4.2 Background Pollutant Mapping

Background pollutant concentration data on a 1km x 1km spatial resolution is provided by the UK National Air Quality Archive[1] and is routinely used to support LAQM and Air Quality Assessments where local pollutant monitoring has not been undertaken.

Background concentrations as used within the prediction calculations were referenced from the UK National Air Quality Information Archive database based on the National Grid Co-ordinates of 1 x 1 km grid squares nearest to the site. Defra issued background maps for NO_X, NO_2, PM_{10} and $PM_{2.5}$ which incorporate updates

[1] www.airquality.co.uk.

to the input data used for modelling. The updated mapped background concentrations adjacent to the site are summarised in Table 4.3 below.

Table 4.3 Predicted Background Concentrations

UK NGR (m)		2018 Predicted Background Concentration (µg/m^3)			
X	Y	NO_2	NO_x	PM_{10}	$PM_{2.5}$
434500	409500	12.40	16.84	11.48	7.57

Table 4.3 indicates that there were no background exceedances of the relevant AQOs within the vicinity of the facility during 2018.

4.3 Background Concentration Used in both Traffic Emission and the Industrial Emission Assessment

The use of background concentrations within the assessment process ensures that all pollutant sources are represented appropriately. Background sources of pollutants include traffic, industrial, domestic, rail and other emissions within the vicinity of the study site.

The background concentrations used within the assessment have been determined with reference to the IAQM Guidance and TG (16).

The IAQM Guidance states:

> "*A matter of judgement should take into account the background and future background air quality and whether it is likely to approach or exceed the value of the AQO.*"

Additionally, TG (16) states:

> "*Typically only the process contributions from local sources are represented within and output by the dispersion model. In these circumstances, it is necessary to add an appropriate background concentration(s) to the modelled source contributions to derive the total pollutant concentrations.*"

Following a review of the LA monitoring, by considering the likely apportionment of traffic vs background contributions at each of the monitoring locations, it is considered that the Defra Background Maps on a 1km grid scale, produce a lower background compared to the non-traffic element from the LA monitoring and is considered to be unrepresentative.

Therefore, traffic air quality modelling assessment has been undertaken to determine representative background concentrations and the LA monitoring has been utilised for the purpose of the traffic modelling verification and assessment models.

Modelled Baseline Inclusive of Traffic Emissions

ADMS Roads has been used to undertake verified baseline modelling to determine pollutant levels at roadside receptor locations to take into account emissions from traffic. Details are provided in Appendix E.

5.0 Detailed Modelling Methodology

5.1 Modelling Methodology

In order to consider the air quality impacts of the facility on the local air quality a quantitative assessment using the third generation Breeze AERMOD dispersion model has been undertaken. AERMOD is a development from the ISC3 dispersion model and incorporates improved dispersion algorithms and pre-processors to integrate the impact of meteorology and topography within the modelling output.

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

5.1.1 Modelling Parameter and Averaging Period

The dispersion modelling has assessed cumulative impact of emissions from the facility taking into consideration of the operation of the proposed installation.

The same averaging period should be used for comparison of emissions against environmental standards. For example, most long-term standards are expressed as an annual mean and many short-term standards as an hourly mean. Note that there are certain exceptions to this which are important when considering compliance with statutory EQS. The averaging period associated with the relevant modelled pollution are detailed in Table 5.2.

Table 5.2 Modelling Parameter and Averaging Period

Parameter	Modelled As	
	Short Term	Long Term
NO_2	99.79th percentile (%ile) 1-hour mean	Annual mean
PM_{10}	90.41th %ile 24-hour mean	Annual mean
$PM_{2.5}$	-	Annual mean

For short term averaging periods the following UK Defra methodology, for example, has been followed:

For 1-hour NO_2 concentrations:

- 99.79th percentile(%ile) 1-hour Process Contribution NO_2 + 2 x (annual mean background contribution NO_2).

5.1.2 Boiler Emission Source

The emissions from the Strebel KSM Multistocker 199 XL boilers have been calculated based on their specifications. There are a total number of 2 boilers installed. The mass emissions used within AERMOD and stack gas parameters for the boilers are presented in Table 5.3.

Table 5.3 Stack Emissions for the Assessment and Stack Parameters

Parameter	The Strebel KSM Multistocker 199 XL Boiler (Each Boiler)	Unit
Boiler Rated Output	199	kW
NO_x Emission rate	150 [a]	g/GJ
PM_{10} Emission rate	30 [a]	g/GJ
Mass NO_x Emission rate	0.02985	g/s
Mass PM_{10} Emission rate	0.00597	g/s
Stack Gas Temperature	150	°C
Stack Volumetric Flow Rate at 10% O_2 and 150 C°	1071	m^3/hr
Modelled stack diameter	0.25	m
Stack velocity	6.06	m/s
Stack Height	To be determined by stack analysis	m

Note:

(a) *The emission limit from Defra Guidance (a AEA Report for Defra) "Conversion of biomass boiler emission concentration data for comparison with renewable heat incentive emission criteria", Ref: AEA/ED46626/AEA/R/3296, May 2012; and*

(b) *Gas volumetric flow rates have been derived from the AEA report of "Conversion of biomass boiler emission concentration data for comparison with renewable heat incentive emission criteria", Ref: AEA/ED46626/AEA/R/3296, May 2012.*

The locations of the modelled boiler emission points are illustrated by Figure 2.

5.1.3 Discrete Receptors for Air Quality Assessment

Following discrete receptors are included in the industrial emission air quality assessment, as presented in Table 5.4 and Figure 3. It should be noted that some of the receptors are same as the identified receptors for the traffic assessment.

Table 5.4 Modelled Existing Sensitive Receptor Locations for Air Quality Assessment

Discrete Sensitive Receptor		Receptor Height (m)	UK NGR (m)	
			X	Y
D1	Lindhurst Lodge 1	1.5	434893	409769
D2	Lindhurst Lodge 2	1.5	434902	409768
D3	Lindhurst Lodge 3	1.5	434906	409775
D4	Lindhurst Lodge 4	1.5	434908	409787
D5	109 Lindhurst Road	1.5	434869	409769
D6	113 Lindhurst Road	1.5	434849	409771
D7	119 Lindhurst Road	1.5	434830	409772
D8	64 Radcliffe Road	1.5	434838	409807

Discrete Sensitive Receptor		Receptor Height (m)	UK NGR (m)	
			X	Y
D9	60 Radcliffe Road	1.5	434854	409805
D10	54 Radcliffe Road	1.5	434874	409802
D11	52 Radcliffe Road	1.5	434937	409793
D12	48 Radcliffe Road	1.5	434952	409792
D13	103 Lindhurst Road	1.5	434942	409761
D14	80 Radcliffe Road	1.5	434935	409708
D15	82 Radcliffe Road	1.5	434891	409712
D16	88 Radcliffe Road	1.5	434869	409716
D17	94 Radcliffe Road	1.5	434835	409720
D18	98 Radcliffe Road	1.5	434809	409721
D19	123 Radcliffe Road	1.5	434797	409773
D20	4 Trowell Way	1.5	434800	409795
D21	8 Trowell Way	1.5	434801	409819
D22	71 Radcliffe Road	1.5	434835	409840
D23	67 Radcliffe Road	1.5	434855	409834
D24	63 Radcliffe Road	1.5	434873	409832
D25	59 Radcliffe Road	1.5	434889	409831
D26	53 Radcliffe Road	1.5	434910	409828
D27	49 Radcliffe Road	1.5	434927	409825
D28	47 Radcliffe Road	1.5	434943	409822
D29/E1	Notton Wood LNR	1.5	434266	411300

5.1.4 Cartesian Grid Receptor

A Cartesian receptor grid was used in the model in order to produce the concentration contour lines. The Cartesian receptor grid consists of receptors identified by their x (east-west) and y (north-south) coordinates. The grid was constructed with grid spacing (x, y) of 50m x 50m over an area covering 1500m by 1500m with south-west corner UK NGR (m) of 434100, 409000.

5.1.5 Ecological Receptors

Guidance contained within "Air Emissions Risk Assessment for your Environmental Permit" (Defra and Environment Agency, 2 August 2016) states that assessments should consider the impact on the conservation areas:

Examining if there are any of the following within 10km of your site (or within 15km for coal or oil fired power stations):

- Special Protection Areas (SPAs);
- Special Areas of Conservation (SACs); and
- Ramsar sites (protected wetlands).

Examining if there are any of the following within 2km of your site:

- Sites of Special Scientific Interest (SSSIs); and
- Local Nature Sites (Ancient Woodlands, Local Wildlife Sites and National and Local Nature Reserves)

Some larger (greater than 50 megawatt) emitters may be required to screen to 15km for European sites and to 10km or 15km for SSSIs. Relevant screening distances should be discussed at pre-application.

Following a review, the following ecological site has been identified.

- Notton Wood (LNR): the local nature Reserves is located approximately 1.6 km north and northwest of site. The LNR site comprises mixed woodland attracting a varied amount of wildlife. A stream and pond add diversity to the site. While a large amount of dead wood provides a home for many insects. Birds include woodpeckers and jays in the wood and kingfishers and herons on the pond and stream. Butterflies include comma and speckled wood.

The above ecological site has been included in the air quality and habitat assessment as ecological receptor.

5.1.6 Meteorological Data

The 3-year meteorological data used in the assessment is derived from Robin Hood Airport weather station, which is considered representative of conditions within the vicinity of the site, with all the complete parameters necessary for the AERMOD model. Reference should be made to Figure 4 for an illustration of the prevalent wind conditions at the Robin Hood Airport weather station.

5.1.7 Surface Characteristics

The land uses surrounding the site are described as residential areas and open field areas. Surface roughness values of 1.0 m to produce a worst-case assessment.

5.1.8 Buildings in the Modelling Assessment

Buildings nearby or immediately adjacent to the stack could potentially cause building downwash effects on emission sources and have therefore been modelled. The locations and dimensions of the buildings used in the model are given in Table 5.5 and illustrated in Figure 2.

Table 5.5 Locations and Heights of Building Used in the Model

Name		UK NGR (m)		Height (m)
		X	Y	
LODGE	Lindhurst Lodge Main	434887	409759	8
EXTENT	Lodge Extension	434906	409768	4
BOILER	Boiler house	434880	409778	3.5
HOUSE1	103 Lindhurst Road	434929	409739	4
HOUSE2	52 Radcliffe Road	434931	409794	8
HOUSE3	48 Radcliffe Road	434947	409793	8
HOUSE4	54 Radcliffe Road	434865	409804	8
HOUSE5	60 Radcliffe Road	434847	409806	8
HOUSE6	109 Lindhurst Road	434860	409762	8
HOUSE7	113 Lindhurst Road	434841	409765	8
HOUSE8	119 Lindhurst Road	434823	409766	8

5.1.9 Treatment of Terrain

The presence of steep terrain can influence the dispersion of emissions and the resulting pollutant concentrations. USEPA guidance indicates that terrain effects should be considered if the gradient exceeds 1:10. A digital terrain file in the UK Ordnance Survey (OS) Landranger format (.NTF) has been used in the assessment.

5.1.10 NO_X to NO_2 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 NO_2. Given the short travel time to the areas of maximum concentration and the rate of reaction to convert NO to NO_2, it is unlikely that more than 30% of the NO_x is present at ground level as NO_2. This conversion factor is based on comparison of ambient NO and NO_2 continuous measurements evaluated over recent years.

Ground level NO_x concentrations have been predicted through dispersion modelling. NO_2 concentrations reported in the results section assume 70% conversion from NO_x to NO_2 for annual means and a 35% conversion for short-term (hourly) concentrations, based upon EA methodology[2].

5.1.11 Modelling Uncertainty

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

- Model uncertainty - due to model limitations;

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2 Conversion Ratios for NO_x and NO_2, Environment Agency, updated.

- Data uncertainty - including emissions estimates, background estimates and meteorology; and,
- Variability - randomness of measurements used.

However, potential uncertainties in model results have been minimised as far as practicable and worst-case inputs considered in order to provide a robust assessment. This included the following:

- Choice of model - AERMOD 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;
- Facility operating parameters - Operational parameters were provided for the facility.
- Emission rates - Emissions were based on 24-hour operation, this is likely to overestimate impacts as periods of shut down have not been considered.
- Background concentrations - Background pollutant concentrations were obtained from a number of recognised sources in order to consider baseline levels in the vicinity of the site, as detailed within the main report text.; and,
- Variability - All model inputs are as accurate as possible and worst-case conditions have been considered where necessary in order to ensure a robust assessment of potential pollutant concentrations.

6.0 Detailed Modelling Assessment Results

The detailed computational modelling assessment of process emissions was undertaken using the input parameters detailed in Section 5.

All predicted concentrations have been compared to the relevant environmental assessment criteria, as detailed in Section 3.

6.1 Existing Baseline Pollutant Levels (from Traffic + Background)

Table 8.1 presents a summary of the baseline NO_2, PM_{10} and $PM_{2.5}$ concentrations at relevant receptor locations from traffic air quality assessment.

Table 8.1 Background Concentrations for Modelled Sensitive Receptors

Receptor		NO_2 (µg/m^3)	PM_{10} (µg/m^3)	$PM_{2.5}$ (µg/m^3)
		From Traffic + Background		
D1	Lindhurst Lodge 1	20.35	11.63	7.70
D2	Lindhurst Lodge 2	20.35	11.63	7.70
D3	Lindhurst Lodge 3	20.34	11.63	7.70
D4	Lindhurst Lodge 4	20.33	11.63	7.69
D5	109 Lindhurst Road	20.35	11.63	7.70
D6	113 Lindhurst Road	20.35	11.63	7.70
D7	119 Lindhurst Road	20.35	11.63	7.70
D8	64 Radcliffe Road	20.33	11.63	7.69
D9	60 Radcliffe Road	20.33	11.63	7.69
D10	54 Radcliffe Road	20.33	11.63	7.69
D11	52 Radcliffe Road	20.33	11.63	7.69
D12	48 Radcliffe Road	20.33	11.63	7.69
D13	103 Lindhurst Road	20.35	11.63	7.70
D14	80 Radcliffe Road	20.39	11.63	7.70
D15	82 Radcliffe Road	20.39	11.63	7.70
D16	88 Radcliffe Road	20.39	11.63	7.70
D17	94 Radcliffe Road	20.39	11.63	7.70
D18	98 Radcliffe Road	20.39	11.63	7.70
D19	123 Radcliffe Road	20.35	11.63	7.70
D20	4 Trowell Way	20.34	11.63	7.70
D21	8 Trowell Way	20.33	11.62	7.69
D22	71 Radcliffe Road	20.31	11.62	7.69
D23	67 Radcliffe Road	20.31	11.62	7.69
D24	63 Radcliffe Road	20.31	11.62	7.69
D25	59 Radcliffe Road	20.31	11.62	7.69
D26	53 Radcliffe Road	20.31	11.62	7.69
D27	49 Radcliffe Road	20.31	11.62	7.69

<table>
<tr><th colspan="2" rowspan="2">Receptor</th><th>NO_2 (µg/m^3)</th><th>PM_{10} (µg/m^3)</th><th>$PM_{2.5}$ (µg/m^3)</th></tr>
<tr><th colspan="3">From Traffic + Background</th></tr>
<tr><td>D28</td><td>47 Radcliffe Road</td><td>20.31</td><td>11.62</td><td>7.69</td></tr>
<tr><td>S29/E1</td><td>Notton Wood (LNR)</td><td>20.13</td><td>12.05</td><td>7.76</td></tr>
</table>

6.2 Boiler Stack Height Analyses/Assessment

A stack height analysis has been undertaken to determine the required stack/flue height in order to meet the air quality standards. The impacts of the long-term emissions of NO_2 at the existing residential receptors and other relevant EA guidance have been used for determining the stack height.

The stack height assessment started with a number of given stack heights of 6.5m, 7.5m, 8.5m, and 9.0m. The long-term emissions of NO_2 from the boilers have been assessed using 3 years of meteorological data. The worst impact year has been identified as 2017.

The maximum PCs and PECs and their significance of changes associated with the operations of the boilers with respect to annual mean NO_2 exposure have been assessed with reference to the criteria in Section 3. The maximum PC location for the existing receptors has been identified at the residential receptor D11 (52 Radcliffe Road). The outcomes of the assessment are summarised in Table 6.1

Table 6.1 The Long-Term (Annual Mean) Concentrations of NO_2 and Significance of Effects at Residential Receptor at Different Stack Heights

<table>
<tr><th rowspan="2">Stack Height (m)</th><th colspan="6">Predicted Annual Mean Concentration (µg/m^3) – 2017 Met Data, and NO_2 Significance Impacts at Receptors</th></tr>
<tr><th>Process Contrib'tn (PC)</th><th>PC as %age of AQO</th><th>PEC[(a)] (PC +Background)</th><th>PEC as %age of AQO</th><th>PEC as %age of AQO</th><th>Significance</th></tr>
<tr><td>6.5</td><td>4.45</td><td>11.14</td><td>24.78</td><td>61.96</td><td><75% of AQAL</td><td>Moderate</td></tr>
<tr><td>7.5</td><td>3.91</td><td>9.77</td><td>24.24</td><td>60.59</td><td><75% of AQAL</td><td>Slight</td></tr>
<tr><td>8.5</td><td>3.41</td><td>8.52</td><td>23.74</td><td>59.34</td><td><75% of AQAL</td><td>Slight</td></tr>
<tr><td>9.0</td><td>3.17</td><td>7.91</td><td>23.50</td><td>58.74</td><td><75% of AQAL</td><td>Slight</td></tr>
<tr><td>AQOs</td><td colspan="6">40</td></tr>
</table>

Note:

(a) *Inclusive of Background concentration of 20.33µg/m^3.*

From Tables 6.1, the percentage change in process concentrations relative to the AQAL as a result of the boiler operations at the maximum residential receptor location, with respect to NO_2 exposure, are determined to be between 7.91% to 11.14%. The significance is determined to be 'slight' or 'moderate'.

The significance will be 'moderate' if the percentage change in the PC is great than 10%. The percentage change in the PC is 9.77% for stack height of 7.5m, resulting in the chance being very close to the 10% value. Therefore, the stack height of 8.5m above the ground level has been determined at be a suitable stack height.

6.3 Nitrogen Dioxide (NO_2)

The modelling results have been presented using the stack height of 8.5m.

Long-Term (annual Mean) NO_2

The long-term emissions of NO_2 from the boiler stacks were assessed for all 3 years of meteorological data. The maximum PCs and PECs among all modelled discrete receptors (at the receptor 52 Radcliffe Road (D11)) are compared against the relevant AQS, in Table 8.2. The maximum PECs of long-term NO_2 for the 3 years of meteorological data assessed do not exceed the relevant AQS, at any location of all discrete receptors. From the meteorological dataset, the year resulting in maximum long-term NO_2 concentration was identified as 2017

The highest long-term PEC of NO_2 when using 2017 meteorological data is 23.74 µg/m^3, which is below the relevant long-term AQS of 40 µg/m^3 for the protection of human health.

Table 8.2 The Maximum Long-Term (Annual Mean) Concentrations of NO_2

Pollutant	Year	Process Contrib'tn (PC) µg/m^3	PC as %age of AQO	Background µg/m^3	PEC[(a)] (PC +Background) µg/m^3	Easting (m)	Northing (m)
NO_2	2015	2.90	7.25	20.33	23.23	434937	409793
NO_2	2016	2.60	6.51	20.33	22.93	434937	409793
NO_2	2017	3.41	8.52	20.33	23.74	434937	409793
AQOs	40						

Note:

(a) *Inclusive of Background concentration of 20.33 µg/m^3.*

Table 8.3 presents a summary of the predicted nitrogen dioxide concentrations, both PCs and PECs, at the modelled receptors locations.

The significance of changes associated with the operations of the facility with respect to annual mean NO_2 exposure has been assessed with reference to the criteria in Section 3. The outcomes of the assessment are summarised in Table 8.3.

Table 8.3 The Long-Term (Annual Mean) Concentrations of NO_2 and Significance of Effects at Receptors

Receptor	Predicted Annual Mean Concentration (µg/m^3) – 2017Met Data, and NO_2 Significance Impacts at Receptors						
	Process Contrib'tn (PC)	PC as %age of AQO	Background	PEC[(a)] (PC +Background)	PEC as %age of AQO	PEC as %age of AQO	Significance
D1	1.06	2.66	20.35	21.41	53.5%	<75% of AQAL	Negligible
D2	2.69	6.73	20.35	23.04	57.6%	<75% of AQAL	Slight
D3	2.67	6.66	20.34	23.01	57.5%	<75% of AQAL	Slight
D4	2.49	6.22	20.33	22.82	57.0%	<75% of AQAL	Slight

Receptor	Predicted Annual Mean Concentration (µg/m³) – 2017Met Data, and NO_2 Significance Impacts at Receptors						
	Process Contrib'tn (PC)	PC as %age of AQO	Background	PEC[(a)] (PC +Background)	PEC as %age of AQO	PEC as %age of AQO	Significance
D5	0.57	1.42	20.35	20.92	52.3%	<75% of AQAL	Negligible
D6	1.58	3.96	20.35	21.93	54.8%	<75% of AQAL	Negligible
D7	1.21	3.02	20.35	21.56	53.9%	<75% of AQAL	Negligible
D8	1.37	3.43	20.33	21.70	54.3%	<75% of AQAL	Negligible
D9	1.89	4.72	20.33	22.22	55.5%	<75% of AQAL	Negligible
D10	1.38	3.44	20.33	21.71	54.3%	<75% of AQAL	Negligible
D11	3.41	8.52	20.33	23.74	59.3%	<75% of AQAL	Slight
D12	1.95	4.86	20.33	22.28	55.7%	<75% of AQAL	Negligible
D13	2.75	6.87	20.35	23.10	57.7%	<75% of AQAL	Slight
D14	1.33	3.33	20.39	21.72	54.3%	<75% of AQAL	Negligible
D15	1.11	2.77	20.39	21.50	53.7%	<75% of AQAL	Negligible
D16	0.89	2.23	20.39	21.28	53.2%	<75% of AQAL	Negligible
D17	0.73	1.82	20.39	21.12	52.8%	<75% of AQAL	Negligible
D18	0.56	1.41	20.39	20.95	52.4%	<75% of AQAL	Negligible
D19	0.55	1.37	20.35	20.90	52.2%	<75% of AQAL	Negligible
D20	0.55	1.38	20.34	20.89	52.2%	<75% of AQAL	Negligible
D21	0.65	1.63	20.33	20.98	52.5%	<75% of AQAL	Negligible
D22	1.26	3.15	20.31	21.57	53.9%	<75% of AQAL	Negligible
D23	1.81	4.51	20.31	22.12	55.3%	<75% of AQAL	Negligible
D24	2.31	5.77	20.31	22.62	56.5%	<75% of AQAL	Negligible
D25	2.41	6.03	20.31	22.72	56.8%	<75% of AQAL	Slight
D26	2.18	5.44	20.31	22.49	56.2%	<75% of AQAL	Negligible
D27	1.79	4.47	20.31	22.10	55.2%	<75% of AQAL	Negligible
D28	1.45	3.61	20.31	21.76	54.4%	<75% of AQAL	Negligible
D29	0.02	0.04	20.13	20.15	50.4%	<75% of AQAL	Negligible
AQOs	40						

The percentage change in process concentrations relative to the AQAL as a result of the facility operations at all receptor locations, with respect to NO_2 exposure, are determined to be 8.52% or less. The significance is determined to be 'negligible' to 'slight', based on the methodology outlined in Section 3.

Therefore, the predicted long-term NO_2 concentrations from the Site are considered acceptable for the protection of human health.

Short-Term (Annual Mean) NO_2

The short-term emissions of NO_2 from the boiler stacks were assessed for all 3 years of meteorological data. The maximum PCs at the receptor 52 Radcliffe Road (D11) are compared against the relevant AQS, in Table 8.4.

Table 8.4 The Maximum Short-Term (1-Hour Mean, 99.79th Percentile) Concentrations of NO_2

Pollutant	Year	Process Contrib'tn (PC)	PC as %age of AQO	PEC[(a)] (PC +Background)	Easting (m)	Northing (m)
NO_2	2015	16.270	8.14	56.89	434937	409793
NO_2	2016	17.439	8.72	58.06	434937	409793

Pollutant	Year	Process Contrib'tn (PC)	PC as %age of AQO	PEC[(a)] (PC +Background)	Easting (m)	Northing (m)
NO_2	2017	17.169	8.58	57.79	434937	409793
AQOs	200					

Note:

(a) *Inclusive of Background concentration of 40.62µg/m³.*

The maximum PECs of short-term NO_2 for the 3 years of meteorological data assessed do not exceed the relevant AQS, at any location within the model domain (including all discrete receptors). From the meteorological dataset, the year resulting in maximum short-term NO_2 concentration was identified as 2017.

The short-term NO_2 PEC concentrations have been calculated at each of the discrete receptors listed for the worst meteorological year of 2010 and these results are detailed in Table 8.5.

Table 8.5 Summary of the Predicted NO_2 Concentrations at Discrete Receptors

Receptor	Predicted 1-hour Mean (99.79th Percentile) Concentration (µg/m³)– 2017 Met Data			
	Process Contrib'tn (PC)	PC as %age of AQO	Background	PEC[(a)] (PC +Background)
D1	3.801	1.901	40.70	44.50
D2	8.162	4.081	40.78	48.94
D3	**11.246**	**5.623**	**40.78**	**52.03**
D4	9.981	4.990	40.78	50.76
D5	2.802	1.401	40.78	43.58
D6	9.784	4.892	40.70	50.48
D7	10.464	5.232	40.68	51.14
D8	6.159	3.079	40.66	46.82
D9	6.418	3.209	40.62	47.04
D10	4.372	2.186	40.62	44.99
D11	17.169	8.584	40.62	57.79
D12	8.555	4.278	40.62	49.18
D13	14.376	7.188	40.62	55.00
D14	14.429	7.214	40.62	55.05
D15	9.522	4.761	40.62	50.14
D16	7.553	3.777	40.78	48.33
D17	8.551	4.275	40.78	49.33
D18	11.524	5.762	40.78	52.30
D19	6.549	3.275	40.70	47.25
D20	3.752	1.876	40.68	44.43
D21	4.907	2.453	40.66	45.57
D22	8.382	4.191	40.62	49.00
D23	7.410	3.705	40.62	48.03
D24	7.962	3.981	40.62	48.58
D25	6.474	3.237	40.62	47.09

Receptor	Predicted 1-hour Mean (99.79th Percentile) Concentration (µg/m³)– 2017 Met Data			
	Process Contrib'tn (PC)	PC as %age of AQO	Background	PEC(a) (PC +Background)
D26	6.532	3.266	40.62	47.15
D27	6.204	3.102	40.62	46.82
D28	5.487	2.743	40.62	46.11
D29	0.673	0.337	40.26	40.93
AQOs	200			

From Table 8.5, it can be seen that there are no exceedances of the short-term NO_2 AQS at any of the identified discrete receptors; indeed the predicted impacts are significantly below the AQS of 200 µg/m³.

Therefore, the predicted short-term NO_2 concentrations from the Site are considered acceptable for the protection of human health.

The contour plots of the predicted long-term and short-term ground level PCs of NO_2 for all receptors, including discrete, boundary and grid receptors are presented in Figures B1 and B2 in Appendix B. The contour plots show that the predicted maximum concentrations occur adjacent to the emission source, with a predicted decrease in concentration with the increased distance from the stack.

6.4 Particulate Matter (PM_{10})

Both long and short-term PM_{10} PEC concentrations have been calculated at each of the discrete receptors listed for the worst meteorological year and these results are detailed in Table 8.6.

Table 8.6 Summary of Predicted PM_{10} Concentrations

Receptor	Predicted Annual Mean Concentration (µg/m³) – 2017 Met Data			Predicted 24-hour Mean (90.41th Percentile) Concentration (µg/m³) – 2017 Met Data		
	Process Contrib'tn (PC)	PC as %age of AQO	PEC(a) (PC +Background)	Process Contrib'tn (PC)	PC as %age of AQO	PEC(b) (PC +Background)
D1	0.30	0.76	11.93	0.714	1.43	12.34
D2	0.77	1.92	12.40	1.655	3.31	13.29
D3	0.76	1.90	12.39	1.703	3.41	13.33
D4	0.71	1.78	12.34	1.470	2.94	13.10
D5	0.16	0.41	11.79	0.299	0.60	11.93
D6	0.45	1.13	12.08	0.782	1.56	12.41
D7	0.35	0.86	11.98	0.659	1.32	12.29
D8	0.39	0.98	12.02	0.738	1.48	12.37
D9	0.54	1.35	12.17	0.917	1.83	12.55
D10	0.39	0.98	12.02	0.743	1.49	12.37
D11	0.97	2.43	12.60	2.043	4.09	13.67
D12	0.56	1.39	12.19	1.038	2.08	12.67
D13	0.79	1.96	12.42	1.778	3.56	13.41
D14	0.38	0.95	12.01	1.022	2.04	12.65

Receptor	Predicted Annual Mean Concentration (μg/m³) – 2017 Met Data			Predicted 24-hour Mean (90.41th Percentile) Concentration (μg/m³) – 2017 Met Data		
	Process Contrib'tn (PC)	PC as %age of AQO	PEC[(a)] (PC +Background)	Process Contrib'tn (PC)	PC as %age of AQO	PEC[(b)] (PC +Background)
D15	0.32	0.79	11.95	0.738	1.48	12.37
D16	0.26	0.64	11.89	0.514	1.03	12.14
D17	0.21	0.52	11.84	0.464	0.93	12.09
D18	0.16	0.40	11.79	0.396	0.79	12.03
D19	0.16	0.39	11.79	0.277	0.55	11.91
D20	0.16	0.39	11.79	0.330	0.66	11.96
D21	0.19	0.46	11.81	0.398	0.80	12.02
D22	0.36	0.90	11.98	0.732	1.46	12.35
D23	0.52	1.29	12.14	1.013	2.03	12.63
D24	0.66	1.65	12.28	1.162	2.32	12.78
D25	0.69	1.72	12.31	1.197	2.39	12.82
D26	0.62	1.55	12.24	1.023	2.05	12.64
D27	0.51	1.28	12.13	0.801	1.60	12.42
D28	0.41	1.03	12.03	0.675	1.35	12.29
D29	0.005	0.01	12.05	0.014	0.03	12.06
AQOs	40			50		

As indicated in Table 8.6 predicted long-term PCs of PM_{10} at discrete receptors range from 0.005 to 0.97 μg/m³. The maximum PEC of long-term PM_{10} emissions for all discrete receptors is 12.60μg/m³, which does not exceed the relevant long-term AQS of 40 μg/m³. Therefore, the long-term PECs of PM_{10} at all discrete receptors are below the relevant long-term AQS for the protection of human health.

The predicted short-term PCs of PM_{10} (24-hour mean) at discrete receptors range from 0.01 to 2.04μg/m³. The maximum PEC of short-term PM_{10} emissions for all discrete receptors is 13.67μg/m³, which does not exceed the relevant short-term AQS of 50 μg/m³. Therefore, the short-term PECs of PM_{10} at all discrete receptors are below the relevant short-term AQS for the protection of human health.

The significance of changes associated with the operations of the plant with respect to annual mean PM_{10} exposure has been assessed with reference to the criteria in Section 3. The outcomes of the assessment are summarised in Table 8.7.

Table 8.7 The Long-Term (Annual Mean) Concentrations of PM_{10} and Significance of Effects at Receptors

Receptor	Predicted Annual Mean Concentration (μg/m³) – 2017 Met Data, and PM_{10} Significance Impacts at Receptors						
	Process Contrib'tn (PC)	PC as %age of AQO	Background	PEC[(a)] (PC +Background)	PEC as %age of AQO	PEC as %age of AQO	Significance
D1	0.30	0.76	11.63	11.93	29.8%	<75% of AQAL	Negligible
D2	0.77	1.92	11.63	12.40	31.0%	<75% of AQAL	Negligible
D3	0.76	1.90	11.63	12.39	31.0%	<75% of AQAL	Negligible

Receptor	Predicted Annual Mean Concentration (µg/m³) – 2017 Met Data, and PM_{10} Significance Impacts at Receptors						
	Process Contrib'tn (PC)	PC as %age of AQO	Background	PEC[(a)] (PC +Background)	PEC as %age of AQO	PEC as %age of AQO	Significance
D4	0.71	1.78	11.63	12.34	30.9%	<75% of AQAL	Negligible
D5	0.16	0.41	11.63	11.79	29.5%	<75% of AQAL	Negligible
D6	0.45	1.13	11.63	12.08	30.2%	<75% of AQAL	Negligible
D7	0.35	0.86	11.63	11.98	29.9%	<75% of AQAL	Negligible
D8	0.39	0.98	11.63	12.02	30.1%	<75% of AQAL	Negligible
D9	0.54	1.35	11.63	12.17	30.4%	<75% of AQAL	Negligible
D10	0.39	0.98	11.63	12.02	30.1%	<75% of AQAL	Negligible
D11	0.97	2.43	11.63	12.60	31.5%	<75% of AQAL	Negligible
D12	0.56	1.39	11.63	12.19	30.5%	<75% of AQAL	Negligible
D13	0.79	1.96	11.63	12.42	31.0%	<75% of AQAL	Negligible
D14	0.38	0.95	11.63	12.01	30.0%	<75% of AQAL	Negligible
D15	0.32	0.79	11.63	11.95	29.9%	<75% of AQAL	Negligible
D16	0.26	0.64	11.63	11.89	29.7%	<75% of AQAL	Negligible
D17	0.21	0.52	11.63	11.84	29.6%	<75% of AQAL	Negligible
D18	0.16	0.40	11.63	11.79	29.5%	<75% of AQAL	Negligible
D19	0.16	0.39	11.63	11.79	29.5%	<75% of AQAL	Negligible
D20	0.16	0.39	11.63	11.79	29.5%	<75% of AQAL	Negligible
D21	0.19	0.46	11.62	11.81	29.5%	<75% of AQAL	Negligible
D22	0.36	0.90	11.62	11.98	29.9%	<75% of AQAL	Negligible
D23	0.52	1.29	11.62	12.14	30.3%	<75% of AQAL	Negligible
D24	0.66	1.65	11.62	12.28	30.7%	<75% of AQAL	Negligible
D25	0.69	1.72	11.62	12.31	30.8%	<75% of AQAL	Negligible
D26	0.62	1.55	11.62	12.24	30.6%	<75% of AQAL	Negligible
D27	0.51	1.28	11.62	12.13	30.3%	<75% of AQAL	Negligible
D28	0.41	1.03	11.62	12.03	30.1%	<75% of AQAL	Negligible
D29	0.005	0.01	12.05	12.05	30.1%	<75% of AQAL	Negligible
AQOs	40						

The % change in process concentrations relative to the AQAL as a result of the plant operations at all receptor locations, with respect to PM_{10} exposure, are determined to be 2.43% or less. The significance is determined to be 'negligible', based on the methodology outlined in section 3.

Therefore, the predicted long-term PM_{10} concentrations from the Site are considered acceptable for the protection of human health.

6.5 Particulate Matter ($PM_{2.5}$)

A worst-case scenario assumption of 100% of PM_{10} to be $PM_{2.5}$ has been made in the assessment. The predicted long-term PCs of $PM_{2.5}$ and the significance of changes associated with the operations of the plant with respect to annual mean $PM_{2.5}$ exposure has been presented and assessed in Table 8.8.

Table 8.8 The Long-Term (Annual Mean) Concentrations of $PM_{2.5}$ and Significance of Effects at Key Receptors

Receptor	Predicted Annual Mean Concentration (µg/m³) – 2017 Met Data, and $PM_{2.5}$ Significance Impacts at Receptors						
	Process Contrib'tn (PC)	PC as %age of AQO	Background	PEC[a] (PC +Background)	PEC as %age of AQO	PEC as %age of AQO	Significance
D1	0.304	1.22	7.70	8.00	32.02%	<75% of AQAL	Negligible
D2	0.769	3.08	7.70	8.47	33.88%	<75% of AQAL	Negligible
D3	0.762	3.05	7.70	8.46	33.85%	<75% of AQAL	Negligible
D4	0.711	2.85	7.69	8.40	33.61%	<75% of AQAL	Negligible
D5	0.162	0.65	7.70	7.86	31.45%	<75% of AQAL	Negligible
D6	0.453	1.81	7.70	8.15	32.61%	<75% of AQAL	Negligible
D7	0.346	1.38	7.70	8.05	32.18%	<75% of AQAL	Negligible
D8	0.393	1.57	7.69	8.08	32.33%	<75% of AQAL	Negligible
D9	0.540	2.16	7.69	8.23	32.92%	<75% of AQAL	Negligible
D10	0.394	1.57	7.69	8.08	32.33%	<75% of AQAL	Negligible
D11	0.973	3.89	7.69	8.66	34.65%	<75% of AQAL	Negligible
D12	0.556	2.22	7.69	8.25	32.98%	<75% of AQAL	Negligible
D13	0.785	3.14	7.70	8.49	33.94%	<75% of AQAL	Negligible
D14	0.380	1.52	7.70	8.08	32.32%	<75% of AQAL	Negligible
D15	0.317	1.27	7.70	8.02	32.07%	<75% of AQAL	Negligible
D16	0.255	1.02	7.70	7.96	31.82%	<75% of AQAL	Negligible
D17	0.208	0.83	7.70	7.91	31.63%	<75% of AQAL	Negligible
D18	0.161	0.64	7.70	7.86	31.44%	<75% of AQAL	Negligible
D19	0.157	0.63	7.70	7.86	31.43%	<75% of AQAL	Negligible
D20	0.158	0.63	7.70	7.86	31.43%	<75% of AQAL	Negligible
D21	0.186	0.74	7.69	7.88	31.50%	<75% of AQAL	Negligible
D22	0.360	1.44	7.69	8.05	32.20%	<75% of AQAL	Negligible
D23	0.516	2.06	7.69	8.21	32.82%	<75% of AQAL	Negligible
D24	0.660	2.64	7.69	8.35	33.40%	<75% of AQAL	Negligible
D25	0.689	2.75	7.69	8.38	33.51%	<75% of AQAL	Negligible
D26	0.622	2.49	7.69	8.31	33.25%	<75% of AQAL	Negligible
D27	0.510	2.04	7.69	8.20	32.80%	<75% of AQAL	Negligible
D28	0.413	1.65	7.69	8.10	32.41%	<75% of AQAL	Negligible
D29	0.005	0.02	7.76	7.76	31.06%	<75% of AQAL	Negligible
D30	0.304	1.22	7.70	8.00	32.02%	<75% of AQAL	Negligible
D31	0.769	3.08	7.70	8.47	33.88%	<75% of AQAL	Negligible
D32	0.762	3.05	7.70	8.46	33.85%	<75% of AQAL	Negligible
D33	0.711	2.85	7.69	8.40	33.61%	<75% of AQAL	Negligible
D34	0.162	0.65	7.70	7.86	31.45%	<75% of AQAL	Negligible
D35	0.453	1.81	7.70	8.15	32.61%	<75% of AQAL	Negligible
AQOs	25						

The percentage change in process concentrations relative to the AQAL as a result of the plant operations at all receptor locations, with respect to $PM_{2.5}$ exposure, are determined to be 3.89% or less. The significance is determined to be 'negligible', based on the methodology outlined in Section 3.

Therefore, the predicted long-term $PM_{2.5}$ concentrations from the Site are considered acceptable for the protection of human health.

7.0 Habitat Assessment

The habitat assessment has been undertaken for the following identified nature conservation site.

- Notton Wood (LNR): the local nature Reserves is located approximately 1.6km north and northwest of site. The LNR site comprises mixed woodland attracting a varied amount of wildlife. A stream and pond add diversity to the site. While a large amount of dead wood provides a home for many insects. Birds include woodpeckers and jays in the wood and kingfishers and herons on the pond and stream. Butterflies include comma and speckled wood.

The long-term and short-term concentrations among this ecological site have been calculated for habitat assessment against relevant critical loads, using 2017 met data (the year resulting in maximum long-term and short-term PC concentrations).

7.1 Predicted Nitrogen Oxide Concentrations

The nitrogen depositions have been calculated using the predicted contribution in nitrogen oxide concentrations at the ecological receptor location.

Table 9.1 presents a summary of the predicted nitrogen oxide concentrations using 2017 met data (the year resulting in maximum long-term and short-term PC concentrations.

Critical Level of Long-Term and Short-Term NO_x (as NO_2)

Table 9.1 Summary of Predicted NOx Concentrations for Protection of Vegetation and Ecosystems

Ecological Receptor	Predicted Maximum Annual Mean Concentration ($\mu g/m^3$)				Predicted 24-hour Mean Concentration ($\mu g/m^3$)			
	Process Contrib'tn (PC)	PC as %age of AQO	Back-ground	PEC[(a)] (PC +Background)	Process Contrib'tn (PC)	PC as %age of AQO	Back-ground	PEC[(b)] (PC +Background)
Notton Wood LNR	0.017	0.06	22.63	22.65	0.32	0.42	26.70	27.02
AQO/Critical Level (CL)	30[(c)]				75[(d)]			

Note:

(a) Inclusive of Background concentration and the Background concentration was taken from http://www.apis.ac.uk/.
(b) The Inclusive of Background concentration and the Background concentration was taken from http://www.apis.ac.uk/.
(c) The AQO of 30 $\mu g/m^3$ is the annual standard for the protection of vegetation and ecosystems;
(d) The AQO of 75 $\mu g/m^3$ is the daily standard for the protection of vegetation and ecosystems.

The annual mean NO_x PEC at the ecological receptor is below the annual mean critical level of 30 $\mu g/m^3$ for the protection of vegetation and Ecosystems, with exception at Back Wood Ancient Woodland due to high existing background concentration.

The NO_x daily (24 hour) predicted environmental concentrations at all ecological receptors are well below the daily mean critical levels of 75 $\mu g/m^3$ for the protection of vegetation and Ecosystems.

The significance of changes associated with the operations of the facility with respect to annual mean NO_2 exposure ecological receptors has been assessed with reference to the criteria in Section 3. The outcomes of the assessment are summarised in Table 9.2.

Table 9.2 The Long-Term (Annual Mean) Concentrations of NO_2 and Significance of Effects at Ecological Receptors

Receptor	Predicted Annual Mean Concentration (µg/m^3) – 2010 Met Data, and NO_2 Significance Impacts at Ecological Receptors						
	Process Contrib'tn (PC)	PC as %age of AQO	Back-ground	PEC[(a)] (PC +Background)	PEC as %age of AQO	PEC as %age of AQO	Significance
Notton Wood LNR	0.017	0.06	22.63	22.65	75.5	≤75% AQAL	Negligible

The percentage change in process concentrations relative to the AQAL as a result of the boiler operations at the ecological receptor location, with respect to NO_2 exposure, are determined to be 0.06%. The significance is to be 'Negligible'.

Screen out insignificant emissions

Because the predicted maximum annual mean process concentration and the predicted maximum 24 hour mean process concentration of NO_2 are well below the 1% of long-term critical level and 10% of short-term critical level respectively, the contributions to the effects from the releases of NO_2 from the boiler operations on the ecological receptor location will be considered insignificant and negligible. Therefore, now further assessment is required.

8.0 Summary and Conclusions

WYG Environment has been commissioned by Aggregated Micro Power Holdings Ltd to prepare an Air Quality Assessment in support of a part retrospective planning application for the continued operation of two biomass boilers at Lindhurst Lodge, Lindhurst Road,, Barnsley, S71 3DD together with revised positioning and heights of the associated plant room exhaust flues..

The objective of the Air Quality Assessment has been to determine whether off-site impacts from the continued boiler operations meet the required air quality standards (AQSs) or air quality Environmental Assessment Limits (EALs) for the protection of human health, vegetation and habitats.

For the background information for the receptors, a baseline traffic model using ADMS road/urban has been used to take into account for emissions from local road traffic contributions. The traffic model has been calibrated using the local monitoring data from both the council's diffusion tubes and the continuous stations.

A flue height of 8.5m above the ground level have been determined by a stack height analysis

The long-term and short term predicted environmental concentrations of NO_2 from the boiler operations are all below the relevant air quality objectives. The significance of effects on the ground level receptors, in respect to long-term NO_2 exposure from the boiler operations is determined to be 'negligible' to 'slight'.

The long-term and short term predicted environmental concentrations of PM_{10} and $PM_{2.5}$ from the boiler operations are all below the relevant air quality objectives. The significance of effects on the emissions on the ground level receptors from the facility operations with respect to long-term PM_{10} is determined to be 'negligible'.

The predicted maximum annual mean process concentration and the predicted maximum 24 hour mean process concentration of NO_2 at the ecological receptor locations are well below the 1% of long-term critical level and 10% of short-term critical level respectively, the contributions to the effects from the releases of NO_2 from the boiler operations on the ecological receptor location are insignificant and negligible.

Therefore, the predicted concentrations of the modelled pollutants from the boiler operations are considered acceptable for the protection of human health, vegetation and habitats.

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Units and Abbreviations Used

AQO	Air Quality Objectives
Defra	Department for Environment, Food and Rural Affairs
EA	Environment Agency
EAL	Environmental Assessment Level
EPAQS	Expert Panel on Air Quality Standards
g/s	Gram per second
C	Temperature (in Celsius)
kPa	Pressure (in kilopascals)
LA	Local Authority
LAPC	Local Authority Pollution Control
LAQM	Local Air Quality Management
m/s	Velocity (in metres per second)
$\mu g/m^3$	Concentration (in micrograms per cubic metre)
$m^{3/}s$	Volumetric flow rate (in cubic meters of air per second)
mg/Nm^3	Concentration (in milligrams per cubic metre at standard conditions)
mg/s	Emission rate (in milligrams per second)
UK NGR	UK National Grid Reference
N	Nitrogen
NO_2	Nitrogen dioxide
NO	Nitric oxide
NO_X	Total oxides of nitrogen
PM_{10}	Particulate matter with a mean hydraulic diameter less then 10µm
STP	Standard temperature and pressure
WYG	WYG Environment Planning Transport
%ile	Percentile
%(v/v)	Percentage (volume per volume)

Appendix A Figures

Figure 1 Site Location

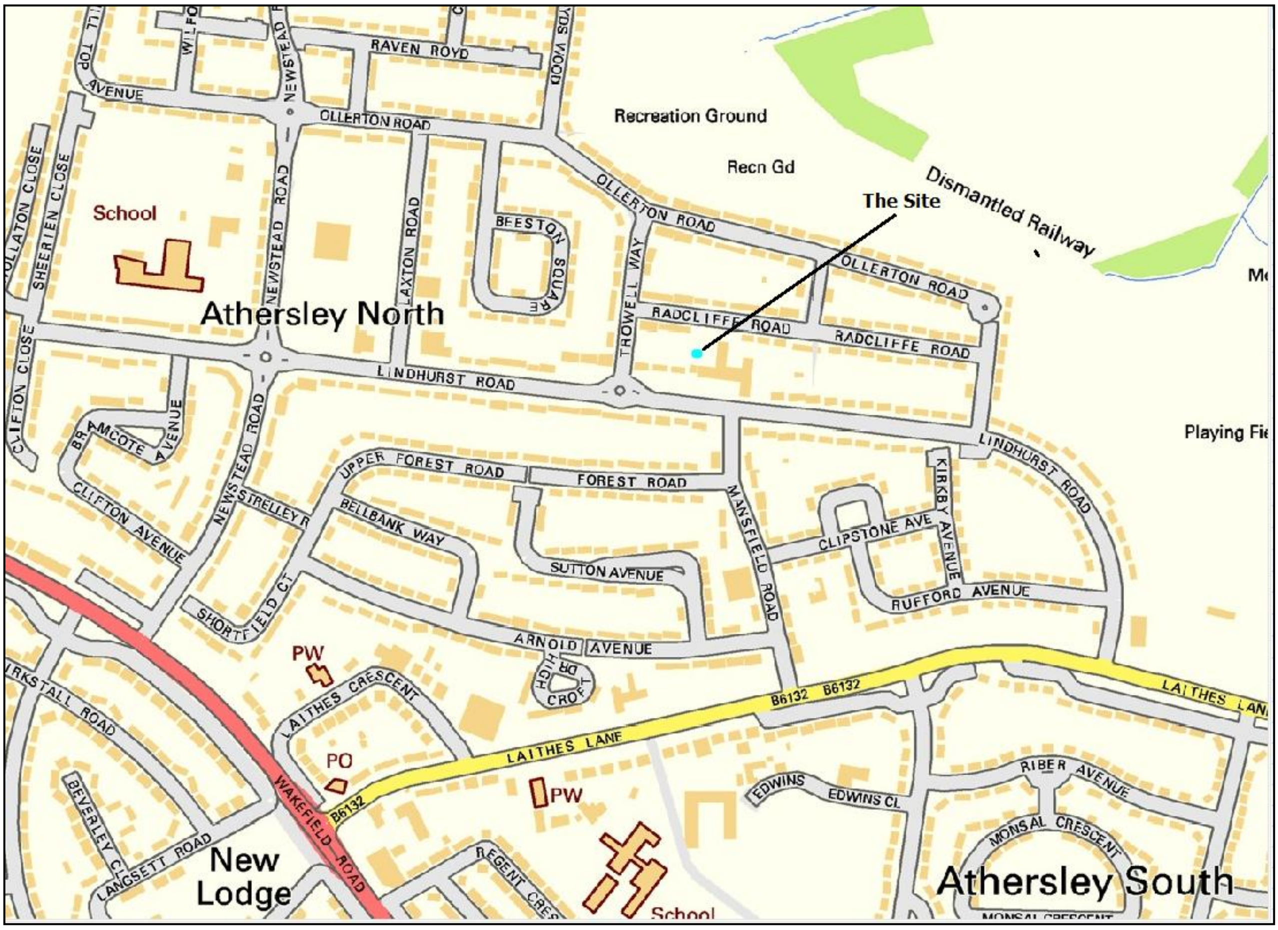


Figure 2 Boiler Flue Locations and Buildings

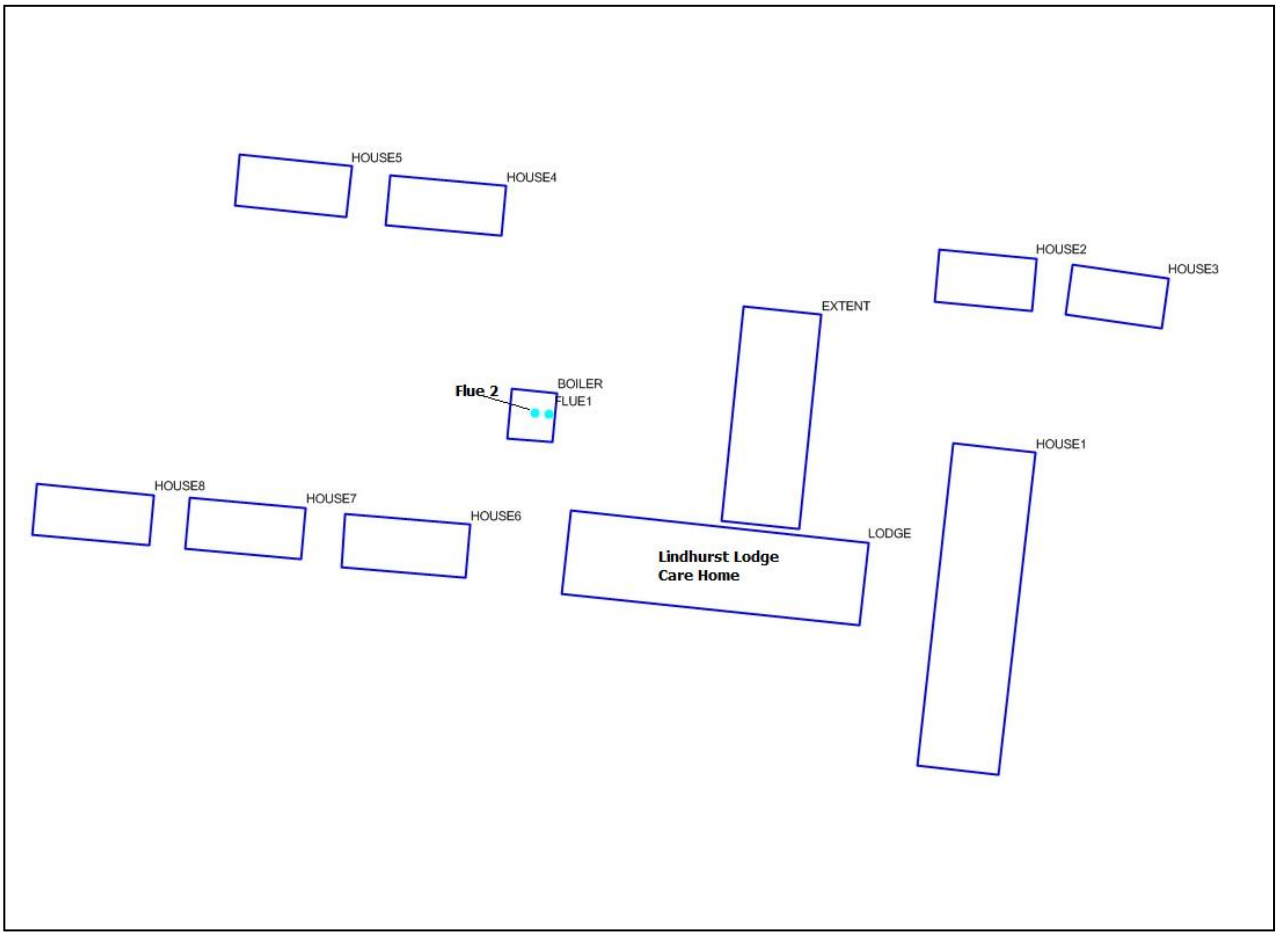


Figure 3 Sensitive Receptor and Ecological Receptors

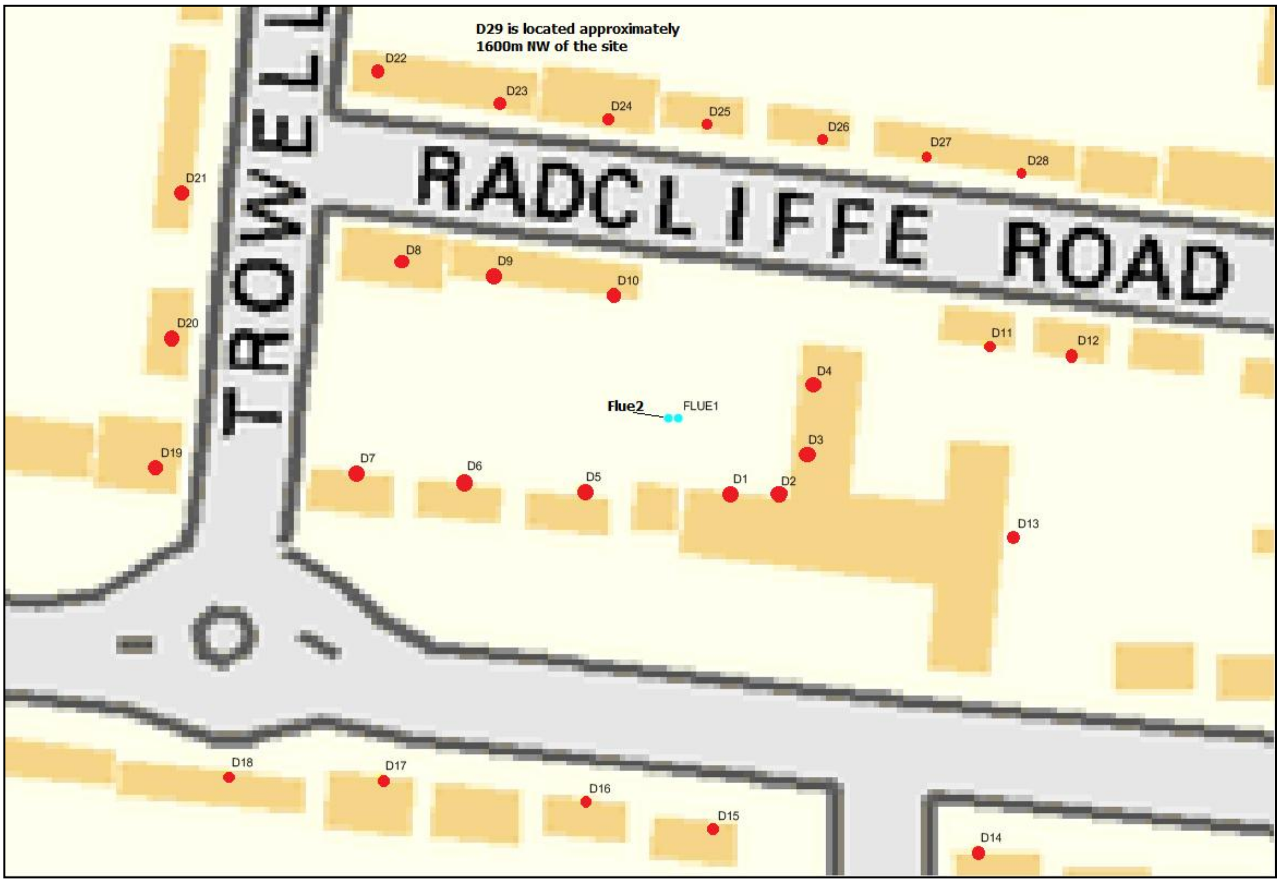
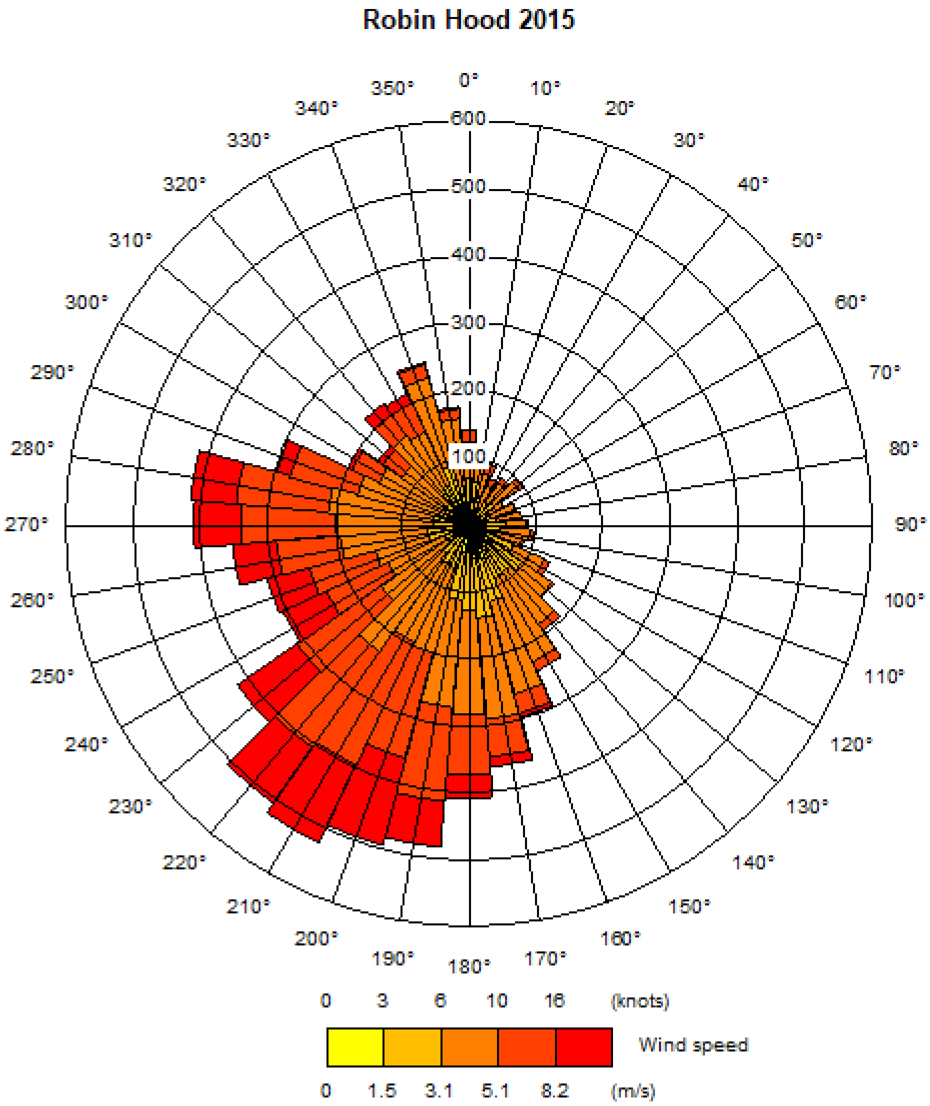
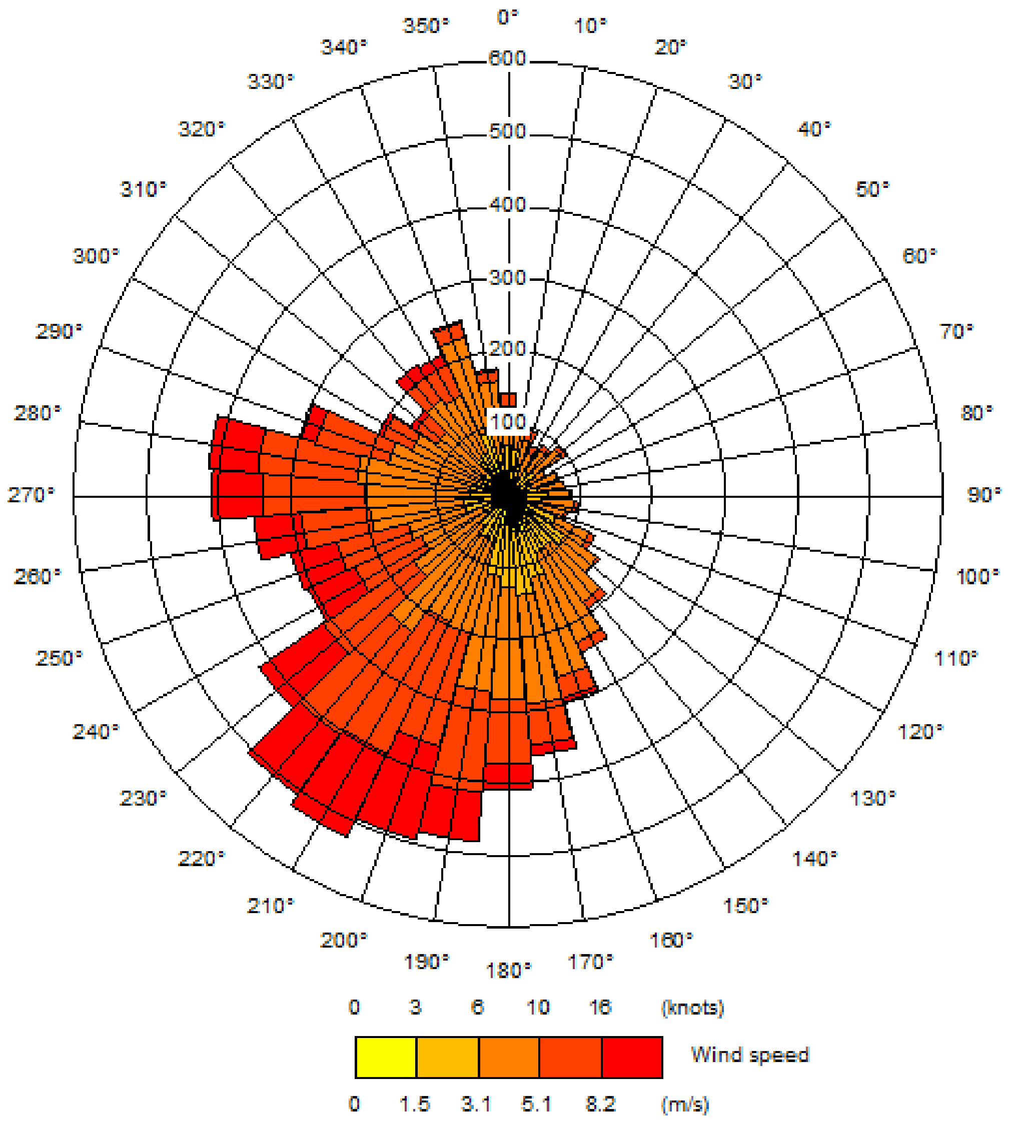


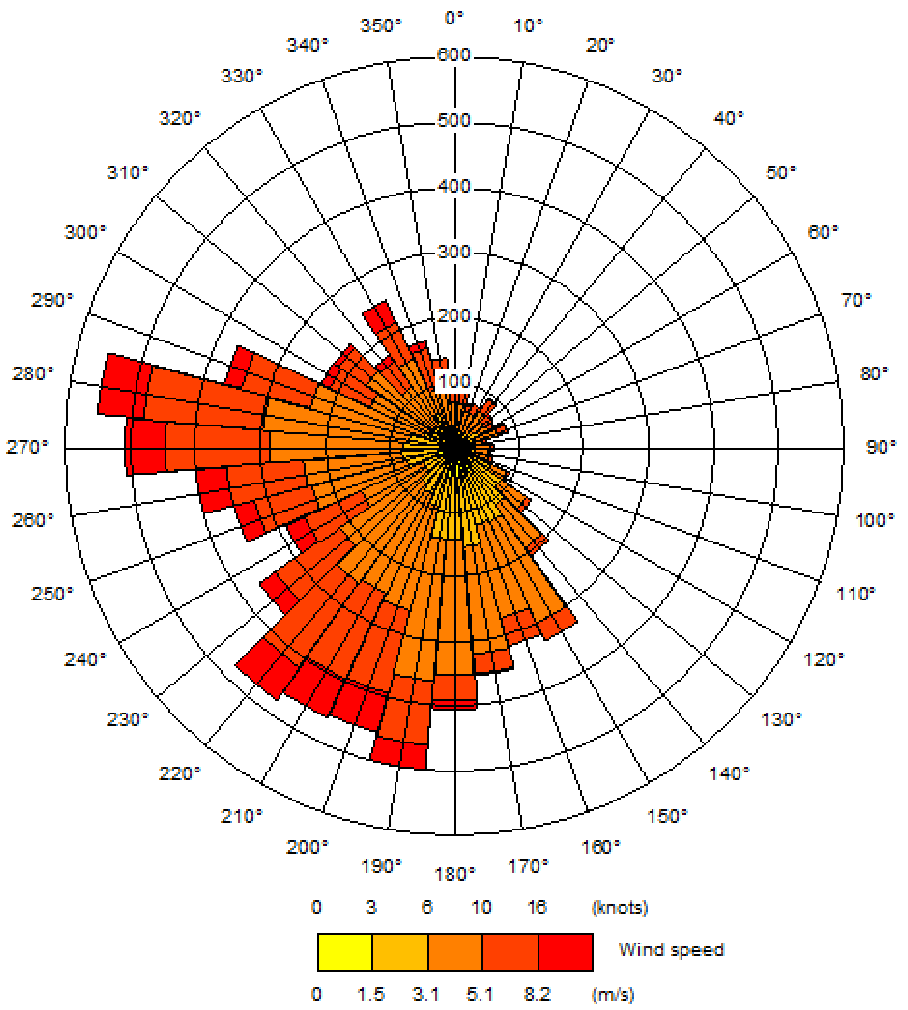
Figure 4 Robin Hood Airport Meteorological Station Wind Rose



Robin Hood 2015



Robin Hood 2017



Appendix B Detailed Dispersion Modelling Contour-Plot

Figure B1 Long-Term NO_2 PC – 2017 Met Data

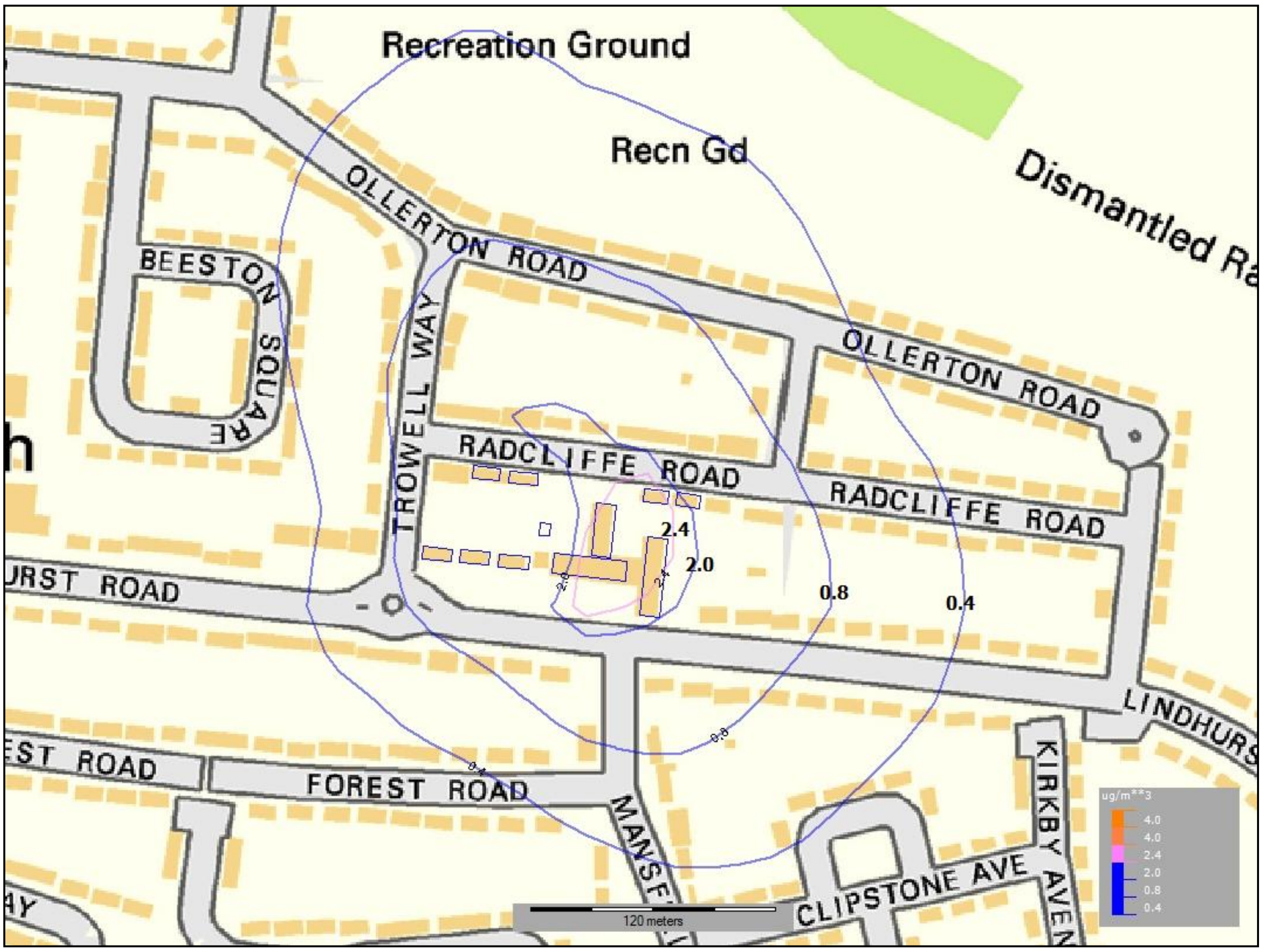


Figure B2 Short-Term NO_2 PC – 2017 Met Data

Appendix C Traffic Assessment For Baseline inclusive of Traffic Emissions

Traffic Model Inputs

This appendix outlines the assessment of baseline air quality with emissions from current traffic movements within the area. The assessment has utilised;

- ADMS Roads 4.1;
- DEFRA 2015 published pollutant concentration background maps (for 2017);
- 2017 Robin Hood Meteorological Data;
- Emissions Factor Toolkit (v8.0.1, December 2017);
- NOx to NO2 calculator (v6.1, November 2017);
- 2017 AADT Traffic Data downloaded from the Department for Transport.

The inputs for the traffic model are as follows in Tables C1 and C2.

Table C1 Traffic Data

Link	2017 Baseline		
	AADT	HGV %	Speed (km/h)
Blacker Road/Barr Lane	7164	1.84	48
Wakefield Road North of B6428	11023	3.38	64
A61 Wakefield Road South of B6428	12114	3.39	48
A633 Rotherham Road	8534	3.52	48
A61 Wakefield Road south of Roundabout to Old Mill Lane	16594	2.54	48
A61 Harborough Hill Road	22535	2.36	64
Laithes Lane	7738	1.85	48
Burton Road East of Rotherham Road	4460	1.02	48

Table C2 ADMS Roads Model Inputs

Parameter	Description	Input Value
Chemistry	A facility within ADMS-Roads to calculate the chemical reactions in the atmosphere between Nitric Oxide (NO), NO2, Ozone (O3) and Volatile organic compounds (VOCs).	**No atmospheric chemistry parameters included**
Meteorology	Representative meteorological data from a local source	**Robin Hood Airport 2017 Meteorological Station, hourly sequential data**
Surface Roughness	A setting to define the surface roughness of the model area based upon its location.	**1m representing a typical surface roughness for Cities and Woodlands.**
Latitude	Allows the location of the model area to be set	**United Kingdom = 53.5**
Monin-Obukhov	This allows a measure of the stability of the atmosphere within the model area to be specified depending upon its	**Cities and large towns = 30m.**

Length	character.	
Elevation of Road	Allows the height of the road link above ground level to be specified.	**All road links were set at ground level = 0m.**
Road Width	Allows the width of the road link to be specified.	**Road width used depended on data obtained from OS map data for the specific road link**
Topography	This enables complex terrain data to be included within the model in order to account for turbulence and plume spread effects of topography	**No topographical information used**
Time Varied Emissions	This enables daily, weekly or monthly variations in emissions to be applied to road sources	**No time varied emissions used**
Road Type	Allows the effect of different types of roads to be assessed.	**Urban (Not London) settings were used for the relevant links**
Road Speeds	Enables individual road speeds to be added for each road link	**Based on national speed limits**
Canyon Height	Allows the model to take account turbulent flow patterns occurring inside a street with relatively tall buildings on both sides, known as a "street canyon".	**No canyons used within the model**
Road Source Emissions	Road source emission rates are calculated from traffic flow data using the in-built EfT database of traffic emission factors.	**The EFT Version 8.0.1 (2017) dataset was used.**
Year	Predicted EfT emissions rates depend on the year of emission.	**2017 data for verification and baseline assessment.**

This traffic data has been utilised to assess the corresponding receptors within the assessment. These are outlined in Table C3.

Table C3 Modelled Existing Sensitive Receptor Locations

Discrete Sensitive Receptor		Receptor Height (m)	UK NGR (m)	
			X	Y
D1	Lindhurst Lodge 1	1.5	434893	409769
D2	Lindhurst Lodge 2	1.5	434902	409768
D3	Lindhurst Lodge 3	1.5	434906	409775
D4	Lindhurst Lodge 4	1.5	434908	409787
D5	109 Lindhurst Road	1.5	434869	409769
D6	113 Lindhurst Road	1.5	434849	409771
D7	119 Lindhurst Road	1.5	434830	409772
D8	64 Radcliffe Road	1.5	434838	409807
D9	60 Radcliffe Road	1.5	434854	409805
D10	54 Radcliffe Road	1.5	434874	409802
D11	52 Radcliffe Road	1.5	434937	409793
D12	48 Radcliffe Road	1.5	434952	409792
D13	103 Lindhurst Road	1.5	434942	409761
D14	80 Radcliffe Road	1.5	434935	409708
D15	82 Radcliffe Road	1.5	434891	409712
D16	88 Radcliffe Road	1.5	434869	409716
D17	94 Radcliffe Road	1.5	434835	409720
D18	98 Radcliffe Road	1.5	434809	409721
D19	123 Radcliffe Road	1.5	434797	409773
D20	4 Trowell Way	1.5	434800	409795
D21	8 Trowell Way	1.5	434801	409819
D22	71 Radcliffe Road	1.5	434835	409840
D23	67 Radcliffe Road	1.5	434855	409834
D24	63 Radcliffe Road	1.5	434873	409832
D25	59 Radcliffe Road	1.5	434889	409831

Discrete Sensitive Receptor		Receptor Height (m)	UK NGR (m)	
			X	Y
D26	53 Radcliffe Road	1.5	434910	409828
D27	49 Radcliffe Road	1.5	434927	409825
D28	47 Radcliffe Road	1.5	434943	409822
R1	6 Hornes Lane (residential)	1.5	433502	410491
R2	2 Bar Lane (residential)	1.5	434027	409621
R3	Mapplewell Primary School (residential)	1.5	433250	410107
R4	303 Wakefield Road (residential)	1.5	434510	409354
R5	Athersley South Primary School (residential)	1.5	434873	409006
R6	215 Wakefield Road (residential)	1.5	434871	408897
R7	257 Rotherham Road (residential)	1.5	435733	407899
R8	128 Burton Road (residential)	1.5	436063	407323
R9	167 Wakefield Road (residential)	1.5	435025	408241
R10	Burton Road Primary School (residential)	1.5	435266	407467
R11	107 Harborough Hill Road (residential)	1.5	434979	406817
R12	Queens Road Academy (residential)	1.5	434950	406582
R13	183 Laithes Lane (residential)	1.5	435492	409382
D29/E1	Notton Wood (LNR)	1.5	434266	411300

This data has been input into the ADMS Roads 4.1 model, and verified to local monitoring data at diffusion tubes DT34, DT35, DT36, DT37, DT39, DT41, DT43. DT44, BU4 as outlined in Table C4.

Table C4 Comparison of Roadside Modelling & Monitoring Results for NO_2

Tube location	NO_2 µg/m^3		
	Monitored NO_2	Modelled NO_2	Difference (%)
DT34	35.20	37.97	7.86
DT35	38.60	40.57	5.10
DT36	43.50	39.66	-8.83
DT37	33.40	33.77	1.12
DT39	45.00	44.17	-1.85
DT41	68.80	66.89	-2.78
DT43	65.80	66.71	1.38
DT44	42.70	42.86	0.37
BU4	41.90	42.92	2.44

The final model produced data at the monitoring locations to within 10% of the monitoring results, as the requirement by TG16 guidance.

The final verification model correlation coefficient (representing the model uncertainty) is 0.989[3]. This figure demonstrates that the model predictions were in line with the road traffic emissions at the monitoring locations.

The 'ideal value' correlation coefficient recommended in Box 7.17 of TG16 is 1.00. The model is therefore considered to be verified and suitably representative of local emissions and exposures.

The modelled Baseline concentrations of NO_2, PM_{10} and $PM_{2.5}$ are outlined in Table C5 below.

Table C5 Predicted 2015 Annual Average Concentrations of NO_2 and PM_{10}

Receptor		Modelled Baseline (2017) Pollutant Concentrations (µg/m³)		
		NO_2	PM_{10}	$PM_{2.5}$
D1	Lindhurst Lodge 1	20.35	11.63	7.70
D2	Lindhurst Lodge 2	20.35	11.63	7.70
D3	Lindhurst Lodge 3	20.34	11.63	7.70
D4	Lindhurst Lodge 4	20.33	11.63	7.69
D5	109 Lindhurst Road	20.35	11.63	7.70
D6	113 Lindhurst Road	20.35	11.63	7.70
D7	119 Lindhurst Road	20.35	11.63	7.70
D8	64 Radcliffe Road	20.33	11.63	7.69
D9	60 Radcliffe Road	20.33	11.63	7.69
D10	54 Radcliffe Road	20.33	11.63	7.69
D11	52 Radcliffe Road	20.33	11.63	7.69
D12	48 Radcliffe Road	20.33	11.63	7.69
D13	103 Lindhurst Road	20.35	11.63	7.70
D14	80 Radcliffe Road	20.39	11.63	7.70
D15	82 Radcliffe Road	20.39	11.63	7.70
D16	88 Radcliffe Road	20.39	11.63	7.70
D17	94 Radcliffe Road	20.39	11.63	7.70
D18	98 Radcliffe Road	20.39	11.63	7.70
D19	123 Radcliffe Road	20.35	11.63	7.70
D20	4 Trowell Way	20.34	11.63	7.70
D21	8 Trowell Way	20.33	11.62	7.69
D22	71 Radcliffe Road	20.31	11.62	7.69
D23	67 Radcliffe Road	20.31	11.62	7.69
D24	63 Radcliffe Road	20.31	11.62	7.69
D25	59 Radcliffe Road	20.31	11.62	7.69
D26	53 Radcliffe Road	20.31	11.62	7.69
D27	49 Radcliffe Road	20.31	11.62	7.69
D28	47 Radcliffe Road	20.31	11.62	7.69
R1	6 Hornes Lane (residential)	31.57	11.99	7.80
R2	2 Bar Lane (residential)	31.99	11.73	7.76
R3	Mapplewell Primary School (residential)	31.16	11.93	7.77
R4	303 Wakefield Road (residential)	34.24	11.98	7.92

[3] This was achieved by applying a model correction factor of 1.45 to roadside predicted NO_X concentrations before converting to NO_2

Receptor		Modelled Baseline (2017) Pollutant Concentrations (µg/m^3)		
		NO_2	PM_{10}	$PM_{2.5}$
R5	Athersley South Primary School (residential)	33.06	11.85	7.84
R6	215 Wakefield Road (residential)	36.75	12.67	8.24
R7	257 Rotherham Road (residential)	33.46	12.60	8.33
R8	128 Burton Road (residential)	45.59	12.40	8.20
R9	167 Wakefield Road (residential)	40.79	12.62	8.36
R10	Burton Road Primary School (residential)	29.50	12.34	8.17
R11	107 Harborough Hill Road (residential)	66.38	13.79	9.13
R12	Queens Road Academy (residential)	62.51	13.15	8.73
R13	183 Laithes Lane (residential)	31.40	11.73	7.78
E1	Notton Wood (LNR)	20.13	12.05	7.76
Annual Mean AQO not to be exceeded		**40 µg/m^3**		

All modelled existing receptors are predicted to be below their respective AQOs for NO_2, PM_{10} and $PM_{2.5}$, other than R7, R8 R11 and R12 for NO_2 (257 Rotherham Road, 128 Burton Road, 107 Harborough Hill and Queens Road Academy). These are based on current traffic flows from 2017 and all receptors are within AQMA's.

Appendix D Report Terms and Conditions

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End of Report