Air Quality Assessment for Environmental Permit: I'Anson Bros Feed Mill, Dalton Industrial Estate

April 2022

Experts in air quality management & assessment

Document Control

Client	I'Anson Bros Ltd	Principal Contact	Andy Vincent (AV Consultants)

Job Number	J13056

Report Prepared By:	Adam Dawson and Anna McMahon

Document Status and Review Schedule

Report No.	Date	Status	Reviewed by
J13056/1/F2	27 April 2022	Final	Adam Clegg (Associate Director)

Air Quality Consultants Ltd
23 Coldharbour Road, Bristol BS6 7JT Tel: 0117 974 1086
24 Greville Street, Farringdon, London, EC1N 8SS Tel: 020 3873 4780
aqc@aqconsultants.co.uk

Registered Office: 23 Coldharbour Road, Bristol BS6 7JT
Companies House Registration No: 2814570

Contents

1 Introduction

1.1 This report describes the air quality assessment for a proposed feed mill within the northern section of the Dalton Industrial estate, near Dalton, Thirsk. The assessment has been prepared to support the Environmental Permit application for the facility, which is made in accordance with the Environmental Permitting (England and Wales) Regulations 2016 (EPR), as amended (2018). The assessment has been carried out by Air Quality Consultants Ltd on behalf of I'Anson Bros Ltd.

1.2 Once operational, the proposed feed mill will generate emissions to air from the use of steam boilers (fuelled by natural gas) and stack outlets from four pellet cooler and two grinder filters.

1.3 Nitrogen dioxide (NO_2) is the principal pollutant of concern with respect to emissions from the natural gas fired steam boilers, whereas particulate matter (PM) emissions will be emitted via the pellet cooler and grinder filter stacks. The pellet cooler and grinder filter stacks will emit directly from the feed production process and therefore also have the potential to emit odours.

1.4 This assessment has considered the impacts of the site on human health effects, as well as the impact on amenity of residents due to odour emissions. A search of ecological sites has identified no local or national designated sites within 2 km of the application site and no internationally designated sites within 10 km. These are the screening distances recommended within Environment Agency (EA) guidance (EA, 2020).

1.5 Table 1 provides the site location, whilst Table 2 summarises the modelled scenarios and sensitivity tests that have been carried out.

Table 1: Site Location

Parameter	Entry
Site Name	I'Anson Bros Feed Mill
Site Address	Waterloo House, Wellington Way, Dalton Airfield Industrial Estate, Dalton, Thirsk, YO7 3SS
Grid Reference of Facility (O.S. X,Y)	441838,476318

Table 2: Summary of Model Scenarios and Sensitivity Tests

Parameter	Entry
Year for Baseline Conditions	Last available representative year (2019[a]) – no improvement assumed into the future (see Section 5)
Operating Hours	The plant is proposed to operate for 90% of the year, accounting for maintenance, cleaning and breakdowns. As a conservative approach, the model has been run assuming 8,760 hours of operation per year. The dispersion model has been run assuming continuous operation. Short-term outputs have assumed constant operation and are thus worst-case (see Paragraphs 6.29 and 6.30)
Meteorological Conditions	Five years of meteorological data used. Each modelled separately. Receptor-specific maxima out of the five years are reported (see Section 6)
Building Wake Effects	Model run with and without nearby buildings. Receptor-specific maxima from the two tests are reported (see Section 6)
Terrain Effects	Model run with and without nearby terrain. Receptor-specific maxima from the two tests are reported (see Section 6)

[a] Due to the impacts of the Covid-19 pandemic on both road and industrial activities, 2019 is deemed the most appropriate baseline.

2 Site Description

Nearby Sensitive Features

2.1 The facility is 1 km to the west of Dalton, a village near Thirsk (see Figure 1). There are no locally or nationally designated ecological sites within 2 km of the application site and no internationally designated ecological sites within 10 km.

2.2 The nearest Air Quality Management Area (AQMA) is 12 km to the south-west in Ripon.

2.3 The proposed feed mill will be operating within Dalton Industrial Estate, which already houses several activities that contribute to both the air quality and odour baseline in the study area. These activities include an existing feedmill (Cargill Provimi), a pet food manufacturing mill (IPN/Wagg), a flavours and fragrance business (Firmenich), an animal feed additive and chemicals blender (Cod Beck Blenders), a tannery (Colomer Munmany Europe Company Ltd), logistics companies and steel beams manufacturing. A number of these sites already hold EA permits.

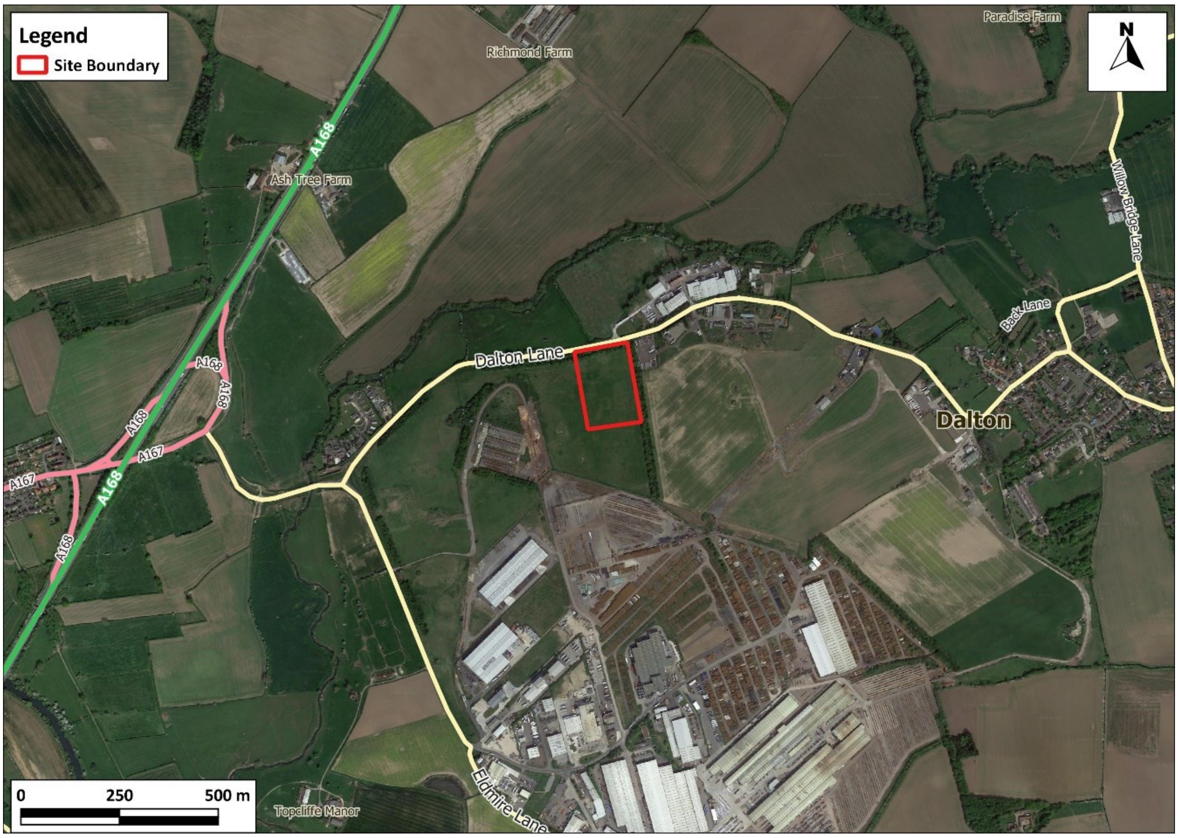


Figure 1: Site Layout

Imagery ©2022 Imagery ©2022 Getmapping plc, Infoterra Ltd & Bluesky, Maxar Technologies, The GeoInformation Group, Map data ©2022. Contains Ordnance Survey data © Crown copyright and database right 2021. Ordnance Survey licence number 100046099. Additional data sourced from third parties, including public sector information licensed under the Open Government Licence v1.0.

Table 3: Summary of Nearby Sensitive Features

Feature	Description	Distance from Stack
Nearest roadside human receptor	Residential property on Dalton Lane	370 m
Nearest non-roadside human receptor	Residential property in Dalton	900 m
Nearest SAC, SPA, Ramsar site or SSSI	Pilmoor SSSI	5 km [a]
Receptors within the downwash cavity length from the nearest edge/side of the building?	There are receptors downwind of the building within the region of potential downwash effects	363 m
Sensitive receptor setting	Rural	n/a

[a] Not within EA screening distance.

3 Description of Process

Overview of Plant Requiring Permit

3.1 The proposed facility will produce animal feed within the main buildings of the site. This will involve the use of four pellet cooler lines and two grinding lines. The pellet cooler lines are abated by purpose designed high efficiency cyclones by an internationally renowned specialist supplier. The grinders are abated by reverse jet bag filters sized by the specialist suppliers. This is to ensure the required performance is delivered. Each of these will have an exhaust stack, emitting 3 m above roof level of the tallest building (37 m above ground level), where they will expel waste heat/air from the process. To comply with the Best Available Technique Achievable Emissions Levels (BAT-AELs) within the food and drink BAT Reference document (BREF) (European Union, 2019), the exhausts from the pellet coolers lines will meet a total particulate matter exhaust concentration of 20 mg/m^3. Emissions from the two grinder exhausts are also designed to meet a total particulate matter exhaust concentration of 5 mg/m^3.

3.2 There is also the potential for odours to be released from the four pellet lines and two grinding lines as they release air from the animal feed manufacturing process.

3.3 The proposed facility will incorporate two Yorkshireman Low NOx steam boilers fuelled by natural gas. The steam boilers will each have a net thermal rated input capacity of ~2,003 kW_{th} (~2,218 kW_{th} gross thermal input), resulting in a total site capacity of approximately 4 MW_{th}. The combustion gases will be exhausted from two individual vertical flues, terminating 3 m above roof level, at 16 m above ground level (see Figure 5).

4 Environmental Standards for Air

Human Health

4.1 The relevant Air Quality Standards (AQS) for human health impacts based on the emissions from the processes described in Section 3 are set out in Table 4 (EA, 2020).

Table 4: AQS for Human Health

Pollutant	Averaging Period	AQS (µg/m^3)	Acceptable Exceedance Criteria
NO_2	Annual Mean	40	Zero exceedances
	1-hour	200	Not to be exceeded more than 18 times a year
PM_{10}	Annual Mean	40	Zero exceedances
	24-hour	50	Not to be exceeded more than 35 times a year
$PM_{2.5}$	Annual Mean	25	Zero exceedances

4.2 The AQS for NO_2 are defined as UK objectives within the Air Quality (England) Regulations (2000) and the Air Quality (England) (Amendment) Regulations (2002). The same numerical values are also set as European Limit values (The European Parliament and the Council of the European Union, 2008).

4.3 The objectives apply at locations where members of the public are likely to be regularly present and are likely to be exposed over the averaging period of the objective. Defra explains where these objectives will apply in its Local Air Quality Management Technical Guidance (Defra, 2018). The annual mean objectives are considered to apply at the façades of residential properties, schools, hospitals etc.; they do not apply at hotels. The 24-hour mean objective for PM_{10} is considered to apply at the same locations as the annual mean objective, as well as in gardens of residential properties and at hotels. The 1-hour mean objective for NO_2 applies wherever members of the public might regularly spend 1-hour or more, including outdoor eating locations and pavements of busy shopping streets. Further details on relevant locations for members of the public can be found in the note published by Air Quality Consultants (AQC, 2016).

4.4 Schedule 1, Part 1(2) of the Air Quality Standards Regulations 2010 clarifies that the AQS do not apply where members of the public do not have access and there is no fixed habitation; on factory premises or at industrial locations; and on the carriageway of roads and on central reservations where there is not normally pedestrian access.

Odour

Environment Agency

4.5 The EA has produced a horizontal guidance note (H4) on odour assessment and management (Environment Agency, 2011), which is designed for operators of EA-regulated processes (i.e., those which classify as Part A(1) processes under the EPR regime). Within this document, a set of suggested odour modelling benchmarks are set out. Depending on the offensiveness of the odour, the predicted 98th percentile of 1-hour odour concentrations are compared to one of the below benchmarks:

- 1.5 OU_E/m^3 for most offensive odours;
- 3 OU_E/m^3 for moderately offensive odours; and
- 6 OU_E/m^3 for less offensive odours.

4.6 The guidance also suggests which benchmarks should be used for a range of industrial processes. It is judged that the manufacturing of animal feed is a moderately offensive odour, as it is most similar to intensive livestock rearing or fat frying (food processing), which H4 suggests should be assessed against the benchmark for moderately offensive odours. It is not judged to be as offensive as the processing of decaying animal or sludge, which is classed in the most offensive odour category. Therefore, modelling outputs will be compared against the 3 OU_E/m^3 concentration benchmark.

Institute of Air Quality Management Guidance

4.7 The latest UK guidance on odour was published by the IAQM in 2018 (IAQM, 2018). The IAQM guidance sets out assessment methods which may be utilised in the assessment of odours for planning applications. It is the only UK odour guidance document which contains a method for estimating the significance of potential odour impacts. The IAQM guidance provides descriptors for odour effects for "*moderately offensive*" odours. These have been set out in Table 5 below.

Table 5: Odour Effect Descriptors for Impacts Predicted by Modelling – "Moderately Offensive" Odours

Risk of Odour Impact	Receptor Sensitivity		
	Low	Medium	High
≥10	Moderate	Substantial	Substantial
5-<10	Slight	Moderate	Moderate
3-<5	Negligible	Slight	Moderate
1.5-<3	Negligible	Negligible	Slight
0.5-<1.5	Negligible	Negligible	Negligible
<0.5	Negligible	Negligible	Negligible

5 Baseline Conditions

5.1 Baseline conditions have been sourced from a combination of Defra's published background maps (Defra, 2021a) and measurements made by Hambleton District Council.

Local Air Quality Management

5.2 Under Part IV of the Environment Act 1995, Hambleton District Council is required to periodically review and assess air quality within its area of jurisdiction. This process of Local Air Quality Management (LAQM) is an integral process for achieving national air quality objectives (AQOs).

5.3 Review and assessment of local air quality aims to identify areas where national policies to reduce vehicle and industrial emissions are unlikely to result in air quality meeting the Government's air quality objectives by the required dates.

5.4 Where the assessment indicates that some or all of the objectives may be potentially exceeded, the Local Authority has a duty to declare an Air Quality Management Area (AQMA). The declaration of an AQMA requires the Local Authority to implement an Air Quality Action Plan (AQAP) to reduce air pollution concentrations so that the required AQOs are met. The closest AQMA to the site is an AQMA declared by neighbouring district, Harrogate District Council, 12 km to the south-west of the proposed facility. The site is therefore not located within or near to an AQMA.

Monitoring of LAQM Pollutants

5.5 Monitoring data of pollutants covered by the LAQM regime and reported by Hambleton are contained in Table 6, with monitoring locations shown in Figure 2. These include selected suburban and roadside sites. Data have been taken from Hambleton District Council latest ASR (Hambleton District Council, 2020).

5.6 These sites are over 5 km away from the receptors within the study area and located within a more urbanised area then the receptors affected by the development. As a result, they give a conservative estimate of baseline concentrations at receptors near the proposed facility.

Table 6: Summary of Nitrogen Dioxide (NO_2) Monitoring (2015-2019) [a]

Site No.	Site Type	Location	2015	2016	2017	2018	2019
HDC5	Suburban	Admirals' Court, Thirsk	12.9	11.6	14.9	12.9	11.4
HDC33	Roadside	Westgate (A61), Thirsk	-	-	**40.1**	34.1	29.4
HDC35	Roadside	Westgate (A61), Thirsk	-	-	35.5	30.2	25.4
Objective			**40**				

[a] Exceedances of the objectives are shown in bold.

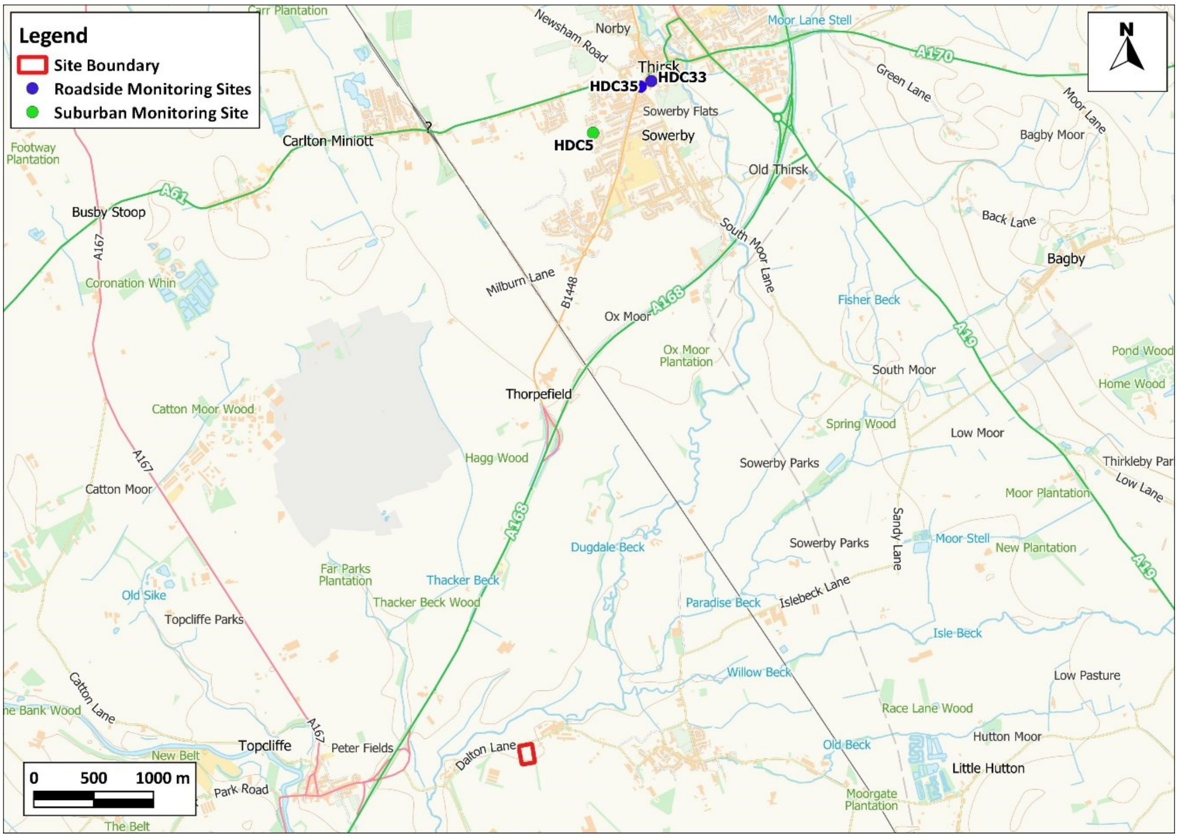


Figure 2: Hambleton District Council NO_2 Monitoring Locations.

5.7 The only monitored exceedance in Thirsk between 2015-2019 was at the kerbside monitoring site HDC33 on Westgate (A61) in 2017. In 2019, monitored concentrations at the locations presented were all well below the AQO. From analysis of the data in Table 6, there is a general downward trend of NO_2 concentrations in the local area between 2015-2019.

5.8 Neither Hambleton nor nearby Harrogate District Councils currently monitor PM_{10} or $PM_{2.5}$ concentrations. Hambleton District Council previously monitored roadside PM_{10} in Northallerton (18 km to the north of the proposed facility) until 2016, when its sensor malfunctioned and was not replaced. The measured 2015 concentration from Hambleton District Council's 2016 ASR (Hambleton District Council , 2016) was 16 µg/m^3. This is well below the AQO of 40 µg/m^3.

Background Concentrations

5.9 Defra, through its contractor, Ricardo, maintains a nationwide model (the Pollution Climate Mapping (PCM) model) of existing and future background concentrations at a 1 km grid square resolution. The PCM model is semi-empirical in nature; it uses data from the national atmospheric emissions inventory (NAEI) to model the concentrations of pollutants at the centroid of each 1 km grid square but then calibrates these concentrations in relation to actual monitoring data. Estimated background concentrations in the study area are set out in Table 7 and are all well below the objectives. A range of values is presented as the study area covers multiple 1x1 km grid squares.

Table 7: Estimated Annual Mean Background Pollutant Concentrations in 2019 and 2022 (ug/m³)

Year	NO_2	PM_{10}	$PM_{2.5}$
2019	6.4 – 8.3	12.5 - 15.6	7.1 - 8.3
2022	6.0 - 7.1	12.0 - 15.1	6.8 - 7.9
Objective	**40**	**40**	**25**

Summary of Baseline Concentrations

5.10 Table 8 sets out the baseline concentrations used in this assessment.

Table 8: Baseline NO_2 and Particulate Matter Concentrations used in the Assessment

Location	Value (µg/m³)	Derivation
Annual Mean Concentrations		
All Receptors (NO_2)	29.4	Highest NO_2 concentration in 2019 from the two roadside monitoring locations within Thirsk
All Receptors (PM_{10})	15.6	Defra's highest 2019 background PM_{10} concentration across all of the grid squares within the area of the facility. Roadside PM_{10} monitoring in nearby Northallerton is not considered representative of receptors near the facility.
All Receptors ($PM_{2.5}$)	8.3	Defra's highest 2019 background $PM_{2.5}$ concentration across all of the grid squares within the area of the facility. Roadside $PM_{2.5}$ monitoring is not undertaken in the local area.
1-hour / 24-hour Mean Concentrations		
All Receptors (NO_2)	58.8	2 x the annual background mean concentrations
All Receptors (PM_{10})	31.2	

6 Modelling Methodology

6.1 Modelling has been carried out in line with EA documents: *"Air emissions risk assessment for your environmental permit"* (EA, 2020) and *"Environmental permitting: air dispersion modelling reports"* (EA, 2019).

Dispersion Model

6.2 There are two primary dispersion models which are used extensively throughout the UK for assessments of this nature and accepted as appropriate air quality modelling tools by the Regulators and local planning authorities alike:

- The ADMS model, developed in the UK by Cambridge Environmental Research Consultants (CERC) in collaboration with the Met Office, National Power and the University of Surrey; and
- The AERMOD model, developed in the United States by the American Meteorological Society (AMS)/United States Environmental Protection Agency (EPA) Regulatory Model Improvement Committee (AERMIC).

6.3 Both models are termed 'new generation' Gaussian plume models, parameterising stability and turbulence in the planetary boundary layer (PBL) by the Monin-Obukhov length and the boundary layer depth. This approach allows the vertical structure of the PBL to be more accurately defined than by the stability classification methods of earlier dispersion models. Like these earlier models, ADMS and AERMOD adopt a symmetrical Gaussian profile of the concentration distribution in the vertical and crosswind directions in neutral and stable conditions. However, unlike earlier models, the ADMS and AERMOD vertical concentration profile in convective conditions adopts a skewed Gaussian distribution to take account of the heterogeneous nature of the vertical velocity distribution in the Convective Boundary Layer (CBL).

6.4 Numerous model inter-comparison studies have demonstrated little difference between the output of ADMS and AERMOD, except in certain scenarios, such as in areas of complex terrain (Carruthers and Seaton, 2011). For the purposes of this particular study, the use of the ADMS model (version 5.2) is adopted. ADMS is widely used for assessments of this type and has been extensively validated[1]. Consequently, it is considered suitable for the current assessment.

Operational Scenarios

6.5 A single model scenario has been developed to assess the impact of the site's operations. It assumes that the operations are running at 100% load/capacity for 8760 hours of the year (i.e. operating continuously). As discussed in Table 1, the plant is only likely to operate for 90% of the

1 https://www.cerc.co.uk/environmental-software/model-validation.html

year, accounting for maintenance, cleaning and breakdowns. The modelling scenario is, therefore, conservative.

Emission Parameters

Steam Boilers

6.6 As new Medium Combustion Plant (MCP), the two steam boilers will be required to meet the Medium Combustion Plant Directive (MCPD) emission limits from their first operation. Although the steam boilers are described as low NOx, they have been modelled using design data and assuming emissions are at the MCPD emission limits for new plant under 5 MW_{th}.

6.7 The steam boilers have been assumed to operate at 100% load for 8,760 hours per year (see Paragraph 6.5). Full stack parameter and emission parameters are detailed in Appendix A3.

Pellet Coolers and Grinders

6.8 The four pellet cooler lines and the two grinding lines are involved in the physical making of the feed, therefore may produce dust emissions. To comply with the BAT-AELs within the food and drink BREF (European Union, 2019), the four pellet cooler exhausts are abated by high efficiency cyclones as described in para 3.1 above. This is to meet a total particulate matter exhaust concentration of 20 mg/m³. Emissions from the two grinder exhausts are abated by reverse jet bag filters, also as described in para 3.1 above. This will ensure compliance with the required total particulate matter exhaust concentration of 5 mg/m³. As the precise size fractions of the dust are unknown, all dust emissions will be assumed to emit as both PM_{10} and $PM_{2.5}$ simultaneously; this is likely to be a very conservative approach as the dust will contain a wide range of particle sizes.

6.9 The pellet coolers and grinders have been assumed to operate at 100% load for 8,760 hours per year (see Paragraph 6.5). Full stack parameter and emission parameters are detailed in Appendix A3.

6.10 As the site is not yet operational, it is not possible to precisely quantify the potential odour emission rates from this specific location. Consequently, odour emissions from the pellet coolers and grinders have been calculated based on the design volumetric flow rates of the proposed stacks and surrogate odour emission concentrations from odour sampling at a similar animal feed facility. The same odour emission concentration has been assumed for all four pellet cooler and grinder stacks.

6.11 The surrogate facility, where the odour concentrations were monitored, manufactures animal feed for chickens and cattle, which are also catered for by the I'Anson Bros facility being assessed. As it is likely that a mixture of feeds will be produced at the site, the average concentrations from four different product types has been used within this assessment (with the maximum sample from each product was used to derive the average[2]). The results of this odour sampling can be views in Appendix A5.

Receptors and Study Area

6.12 Human health impacts have been predicted over a 10 km x 10 km model domain, with the proposed facility at the centre. Concentrations have been predicted over this area using nested Cartesian grids. These grids have a spacing of 5 m x 5 m within 200 m of the facility, 25 m x 25 m within 400 m of the facility, 50 m x 50 m within 1,000 m of the facility, 250 m x 250 m within 2,000 m of the facility and 500 m x 500 m within 5,000 m of the facility. This grid is considered to provide a sufficiently high resolution to enable the identification of worst-case impacts throughout the study area. The receptor grid has been modelled at a height of 1.5 m above ground level. Additional specific receptors have been included in order to assess the concentrations at the nearest human receptors; these locations are shown in Figure 3 and described in Table 9.

Table 9: Details of Modelled Specific Receptor Points

Receptor ID	Description	X Coordinate (m)	Y Coordinate (m)	Height (m)	Approx. Distance to Site boundary (m)
1	Residential Dwelling	442250	476476	1.5	385
2	Residential Dwelling	442205	476547	1.5	363
3	Residential Dwelling	442467	476443	1.5	600
4	Residential Dwelling	441232	476208	1.5	536
5	Residential Dwelling	442769	476331	1.5	893
6	Residential Dwelling	442776	476039	1.5	903
7	Residential Dwelling	441625	477143	1.5	934
8	Residential Dwelling	442810	476237	1.5	105

[2] The maximum sampled odour emission rate (excluding contaminated samples) is 9682 OU_E/m^3, with the average concentration used being 8161 OU_E/m^3.

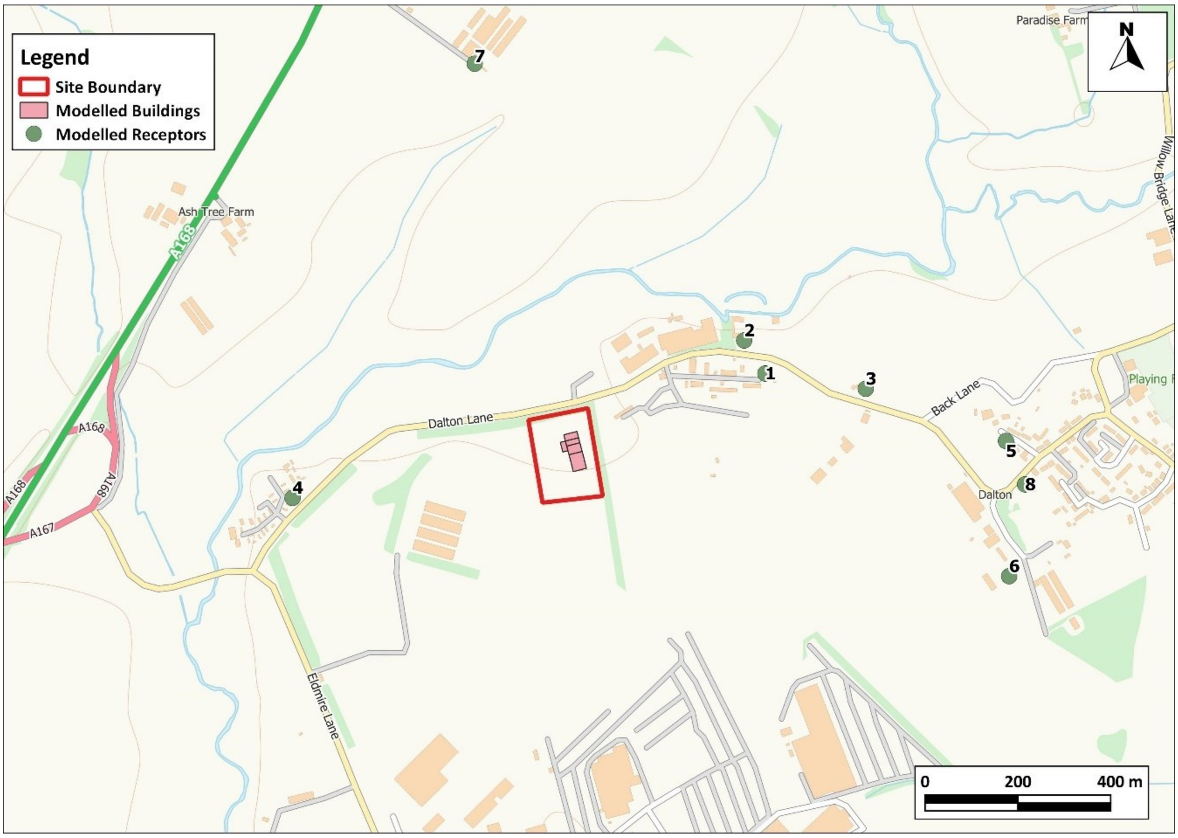


Figure 3: Modelled Receptors (Discrete)

Contains Ordnance Survey data © Crown copyright and database right 2022. Ordnance Survey licence number 100046099. Additional data sourced from third parties, including public sector information licensed under the Open Government Licence v1.0.

Meteorological Data

6.13 In order to account for uncertainties in local and future-year conditions, the dispersion model has been run five times, with each run using a different year of hour-by-hour meteorological data from a representative meteorological monitoring site. For each individual receptor point on the nested Cartesian grids, and for the specific receptor points, the maximum predicted concentration across any of the five meteorological datasets has then been determined. It is these maxima which are presented within the contour plots and results tables in section 8.

6.14 For the odour assessment, the receptor results for all five meteorological years have been presented, as well as the maximum on the grid. The contour for the worst-case meteorological year (2017), based on the highest predicted odour concentration at a residential receptor, has been presented in section 8. The contour plots for the other meteorological years are presented in Appendix A5.

6.15 Hourly sequential meteorological data obtained from the Met Office for Topcliffe airfield have been used in this assessment, covering the years 2016-2020 inclusive. The Topcliffe airfield meteorological monitoring station is located approximately 3 km to the north of the site. It is considered to be the nearest monitoring station providing representative meteorological conditions for the site.

6.16 The site-specific data entered into the model which are used to calculate the various boundary later parameters from the meteorological data are shown in Table 10. Wind roses for each year are presented in Appendix A1.

Table 10: Meteorological Parameters Entered into the ADMS Model

Parameter	Modelled Receptors (including Cartesian Grids)	Meteorological Site
Surface Roughness	Variable Surface Roughness File	0.2 m
Minimum MO length	1 m	1 m
Surface Albedo	0.23[a]	0.23[a]
Priestly-Taylor Parameter	1[a]	1[a]

[a] Model default value

Variable Surface Roughness File

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

6.18 The surface roughness length is related to the height of surface elements; typically, the surface roughness length is approximately 10% of the height of the main surface features. Consequently, it follows that surface roughness is greater in urban, congested areas than in rural, open areas.

6.19 Cambridge Environmental Research Consultants (CERC, 2016) and a paper on micrometeorology (Oke, 1987) suggest typical roughness lengths for various land use categories (Table 11).

Table 11: Typical Surface Roughness Lengths of Different Land Use Types

Type of Surface	Surface Roughness Length (m)
Ice	0.00001
Smooth snow	0.00005
Smooth sea	0.0001 - 0.0002
Lawn grass	0.01
Pasture	0.2
Isolated settlement (farms, trees, hedges)	0.4
Parkland, woodlands, villages, open suburbia	0.5-1.0
Forests/cities/industrialised areas	1.0-1.5
Heavily industrialised areas	1.5-2.0

6.20 The study area encompasses a range of land types. Consequently, a variable surface roughness file has been used to represent the spatial variation of the surface roughness over each land type as shown in Figure 4 (only area presented in the results sections has been shown for clarity). The following parameters have been used to define the surface roughness length based on land type:

- forest – 1 m;
- built-up area/suburbia – 0.5 m;
- grassland – 0.2 m; and
- water – 0.0001 m.

6.21 The variable surface roughness file was generated for a 50 m resolution gridded area covering the model domain by assigning appropriate representative surface roughness values based on the underlying land use categories. The land use categories were derived by combining those defined in the Meridian 2 and VectorMap District datasets available from Ordnance Survey.

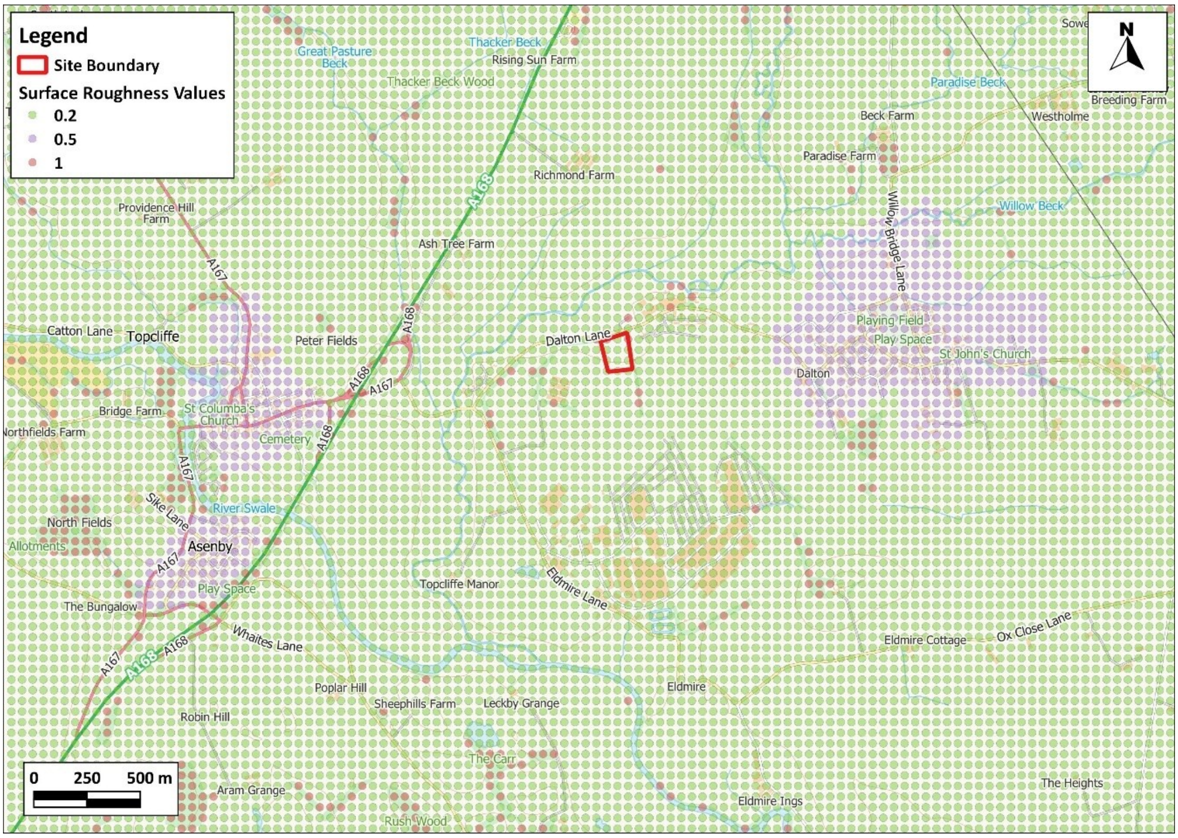


Figure 4: Surface Roughness across Modelled Area

Contains Ordnance Survey data © Crown copyright and database right 2022. Ordnance Survey licence number 100046099. Additional data sourced from third parties, including public sector information licensed under the Open Government Licence v1.0.

Buildings

6.22 Atmospheric flow is disrupted by aerodynamic forces in the immediate vicinity of structures. These disruptions generate an area of stagnation behind the structure known as the cavity region. The flow within this region is highly turbulent and can be visualised as circulating eddies of air. The area beyond the cavity region is known as the building wake, where turbulence generated by the structure gradually decays to background levels. The entire area covered by the cavity region and turbulent wake is known as the 'building envelope'.

6.23 The above phenomena can cause a plume to be drawn downwards towards the ground in the building envelope, resulting in elevated ground level concentrations; this effect is known as building induced downwash. The building envelope is generally regarded as extending to a height of three times the height of the structure in the vertical plane, and a distance of 5L (where L is the lesser of the building width or height) from the foot of the building in the horizontal plane. Consequently, stacks within these extents should be identified and the corresponding building included in the dispersion model. The location of the modelled buildings relative to the stacks are shown in Figure 5 and detailed in Table 12 . Building heights have been derived using data provided by I'Anson Bros Ltd.

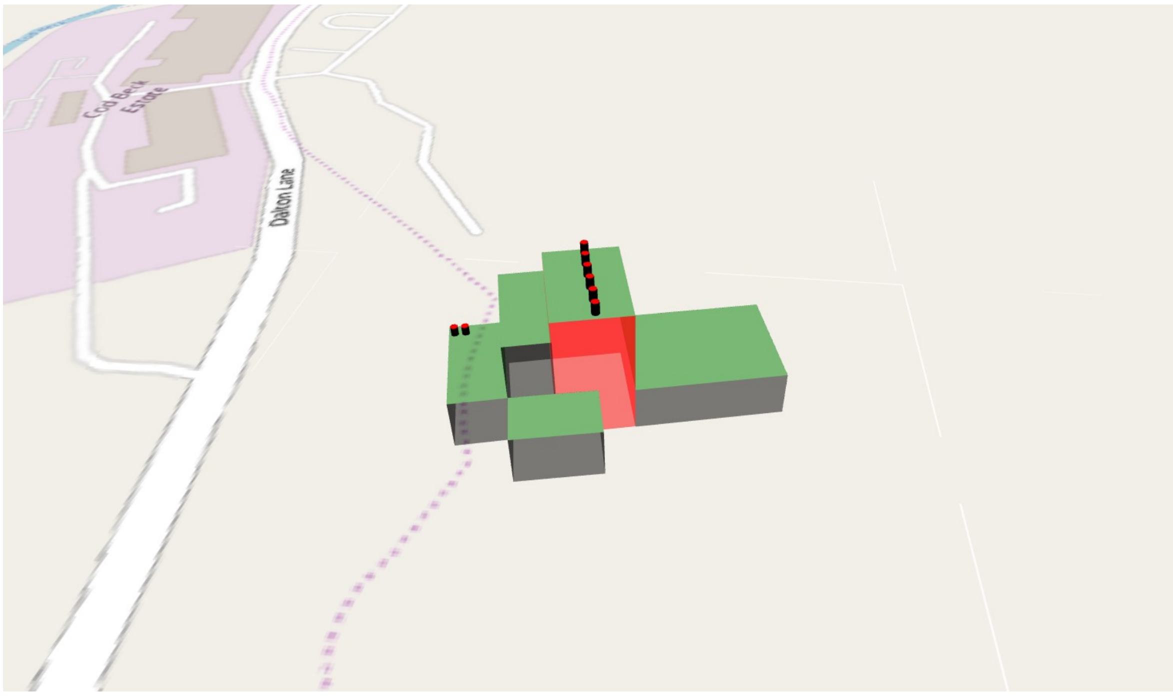


Figure 5: Buildings Included in the Model (Green-topped Objects) and Modelled Flues (Red-topped Cylinders). Red Building Signifies the Chosen Main Building.

Table 12: Modelled Building Dimensions

Building	Height (m)	Length / Diameter (m)	Width (m)	Rotation (º)
Building 1	12.3	37.4	29.3	345.4
Building 2 (Main Building)	34.5	28.9	19.2	75.5
Building 3	29	28.9	11.2	75
Building 4	13.7	13.8	21.2	75.9
Building 5	13.7	29.4	14.0	74.9

Terrain Effects

6.24 Local terrain has not been included within the model as, based on OS Terrain 50 data, the gradient in the surrounding area is less then 1:10. Terrain has, however, been included within the sensitivity modelling runs (see Paragraph 8.9)

NO_x to NO_2 conversion

6.25 NOx emissions will be in the form of nitric oxide (NO) and primary NO_2. The primary NO_2 from natural gas-fuelled generators is likely to be in the region of 5-12% of the total NOx. Over time, the NO emissions will react with available ozone (O_3) to form NO_2. In close proximity to the source, the ratio will be similar to the primary NO_2 proportion; with increasing distance from the source the ratio will increase, depending on the availability of O_3.

6.26 The EA (2020) recommends that, as a conservative approach:

- 70% of the NOx emitted from the generators converts to NO_2 for the annual mean average concentrations; and
- 35% of the 1-hour mean NOx emitted from the generators converts to NO_2 for the 1-hour mean average concentrations.

6.27 The EA Guidance on dispersion modelling for oxides of nitrogen assessment from specified generators Version 1 (EA, 2018) states: "*For primary NO_2 to NOx ratios of 10% or less, worst case NOx to NO_2 conversion ratios of 35% for short term assessment and 70% for long term assessment can be used as a conservative approach in the modelling study*."

6.28 Given the nature of the boiler plant and its fuel, it is likely that the primary NO_2:NOx ratio will be 10% or less; therefore, the 70% (long-term) and 35% (short-term) conversion ratios used represent a conservative approach.

Model Post-Processing

Annual Mean PCs

6.29 The model has been run assuming constant operation. Annual mean Process Contributions (PCs) have therefore not been reduced to account for any periods of shutdown.

Short-term PCs

6.30 The short term AQSs (1-hour NO_2 and 24-hour PM_{10} means) are based on a number of hours (18 and 35 respectively) that a threshold concentration (200 µg/m^3 and 50 µg/m^3 respectively) cannot be exceeded in a year. The short term AQSs have been assessed assuming constant operation and considering the 99.79th percentile of 1-hour NO_2 mean concentrations and 90.41st percentile of 24-hour PM_{10} mean concentrations. This provides a worst-case assessment.

6.31 For comparison against the short-term standards (1-hour and 24-hour means), the annual mean backgrounds presented in section 5 have been doubled before being added to the short-term process contributions to derive the predicted environmental concentration.

Uncertainty

6.32 The point source dispersion model used in the assessment is dependent upon emission rates, flow rates, exhaust temperatures and other parameters for each source, all of which are both variable and uncertain. There are then additional uncertainties, as models are required to simplify real-world conditions into a series of algorithms. These uncertainties cannot be easily quantified, and it is not possible to verify the point-source model outputs. Consequently, to account for the potential uncertainty of model predictions, the approach has been to use reasonable worst-case assumptions.

6.33 On balance, when taking into account the assumed number of operating hours, the approach taken to meteorological conditions, the assumption that all sources in the normal operation scenario will operate at 100% load continuously throughout the year, the use of the EA NO_x to NO_2 conversion factors, and modelling certain emission sources at emission limits, the assessment can be expected to over-predict the impacts of the facility. The approach has been designed to provide a robust and conservative assessment.

6.34 The implications of modelling uncertainty have been discussed further in the sensitivity analysis in Paragraph 8.9.

7 Assessment Approach

7.1 EA guidance (EA, 2020) states that, following detailed modelling, PCs are insignificant where they are less than:

- 10% of a short-term environmental standard; or
- 1% of a long-term environmental standard.

7.2 This is the case regardless of the total concentration (i.e. the PC + the local baseline, or the Predicted Environmental Concentration 'PEC').

7.3 Where these criteria are not met following detailed modelling, the EA does not provide any specific assessment criteria but instead requires a judgement of significance based on the site-specific circumstances, taking into account the PCs and PECs. EA guidance (EA, 2020) does, however, provide a further screening criterion for long-term PECs, suggesting that where the long-term PEC is less than 70% of the long-term environmental standard then no further assessment is required.

8 Results

Human Health

8.1 Table 13 presents the maximum modelled PC and PEC for the facility for all pollutants at any specified human receptor. The PEC has further been compared against the AQS for each pollutant. Impacts at other human receptors would be lower than those predicted within this table.

8.2 Contour plots for each applicable pollutant and averaging period are presented in Figures 6 to 8. No contour plot has been presented for the 90.41st percentile of 24-hour Mean PM_{10} PC; the contour is too small and provides no meaningful value.

Table 13: Maximum PCs and PECs at Relevant Human Health Receptors

Receptor ID	PC (µg/m³)	PC (% of AQS) [a]	PEC (µg/m³) [b]	PEC (% of AQS)	AQS
Annual Mean NO_2 AQS (40 µg/m³)					
2	0.14	0.4%	29.54	73.9%	**40**
1-hour Mean NO_2 AQS (200 µg/m³) [c]					
7	2.79	1.4%	61.59	30.8%	**200**
Annual Mean PM_{10}					
2	0.38	0.9%	15.98	39.9%	**40**
90.41th %ile of 24-hourly Mean PM_{10}					
2	1.21	2.4%	32.41	64.8%	**50**
Annual Mean $PM_{2.5}$					
2	0.38	1.5%	8.68	34.7%	**25**

a Calculated by adding the short-term process contributions to two times the predicted annual mean baseline concentration which is common practice.

b The 25 µg/m³ $PM_{2.5}$ objective, which was to be met by 2020, is not in Regulations and there is no requirement for local authorities to meet it.

c 100th percentile of 1-hour mean concentrations are provided in Appendix A2.

8.3 Table 13 shows the annual mean NO_2 PC from the new boilers does not exceed 1% of the long-term NO_2 AQS at the worst-case receptor. Table 13 further shows that the 1-hourly NO_2 PC from the new boilers does not exceed 10% of the 1-hour short-term AQS at the worst-case receptor location. In accordance with EA guidance, the impacts from the boilers can be classed as insignificant, with no further assessment required. For completeness, the maximum NO_2 PECs are also below their AQS's; thus, there is no risk that the AQS's will be exceeded as a result of boiler emissions from the facility.

8.4 Table 13 shows the annual mean PM_{10} PC from the new grinder/cooler stacks does not exceed 1% of the long-term PM_{10} AQS at the worst-case receptor. Table 13 further shows that the 24-hour PM_{10} PCs from the new grinder/cooler stacks do not exceed 10% of the 24-hour short-term AQS at the worst-case receptor location. In accordance with EA guidance, the impacts from the grinder/cooler stacks can be classed as insignificant, with no further assessment required. For completeness, the maximum PM_{10} PECs are also below their AQS's; thus, there is no risk that the AQS's will be exceeded as a result of grinder and cooler stack emissions from the facility.

8.5 Table 13 shows the annual mean $PM_{2.5}$ PC from the grinder/cooler stacks exceeds 1% of the long-term $PM_{2.5}$ AQS at the worst-case receptor. The maximum annual mean $PM_{2.5}$ PEC is well below the AQS at the worst-case location; thus, there is no risk that the annual $PM_{2.5}$ AQS will be exceeded as a result of the grinders/coolers emissions from the facility. Considering all PM_{10} emissions have been considered to be $PM_{2.5}$ and taking account of the low annual mean PEC (35% of the AQS), the impact of the facilities $PM_{2.5}$ emissions have been judged to be not significant.

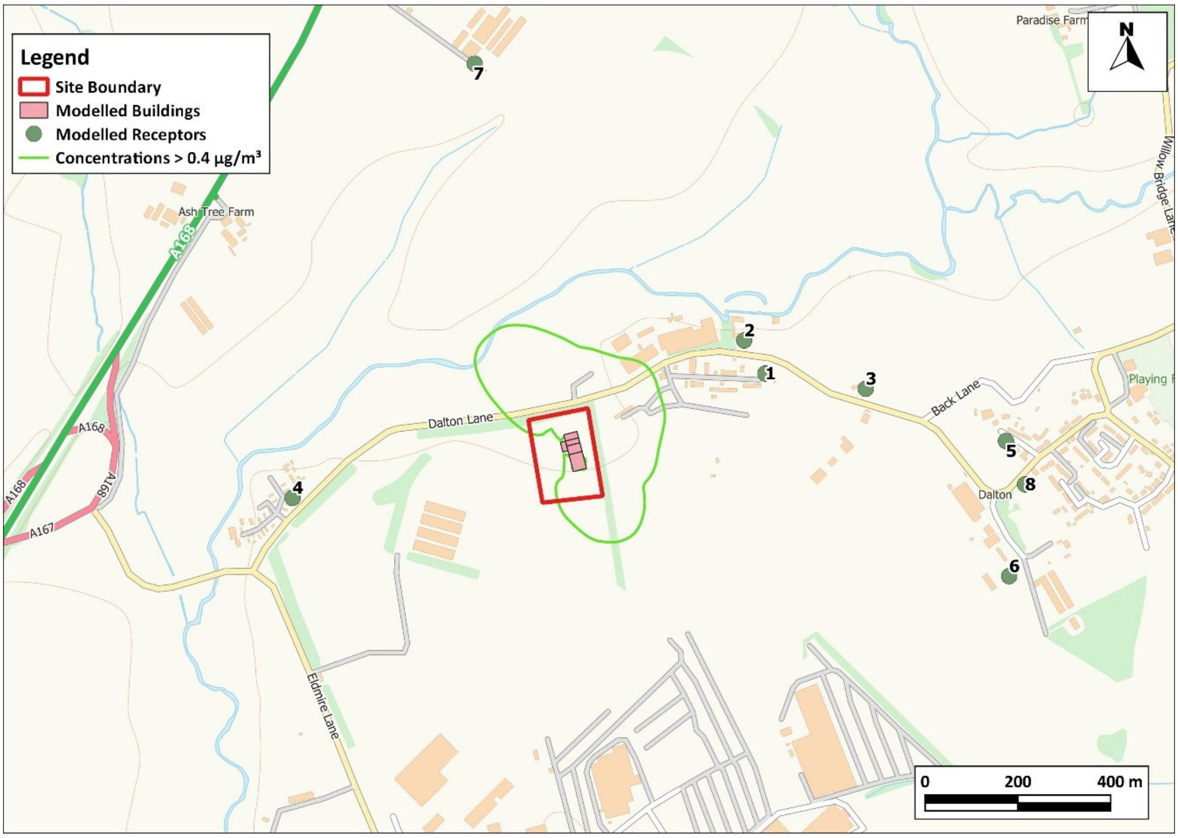


Figure 6: Contour Plot of Annual Mean NO_2 PCs

Contains Ordnance Survey data © Crown copyright and database right 2022. Ordnance Survey licence number 100046099. Additional data sourced from third parties, including public sector information licensed under the Open Government Licence v1.0.

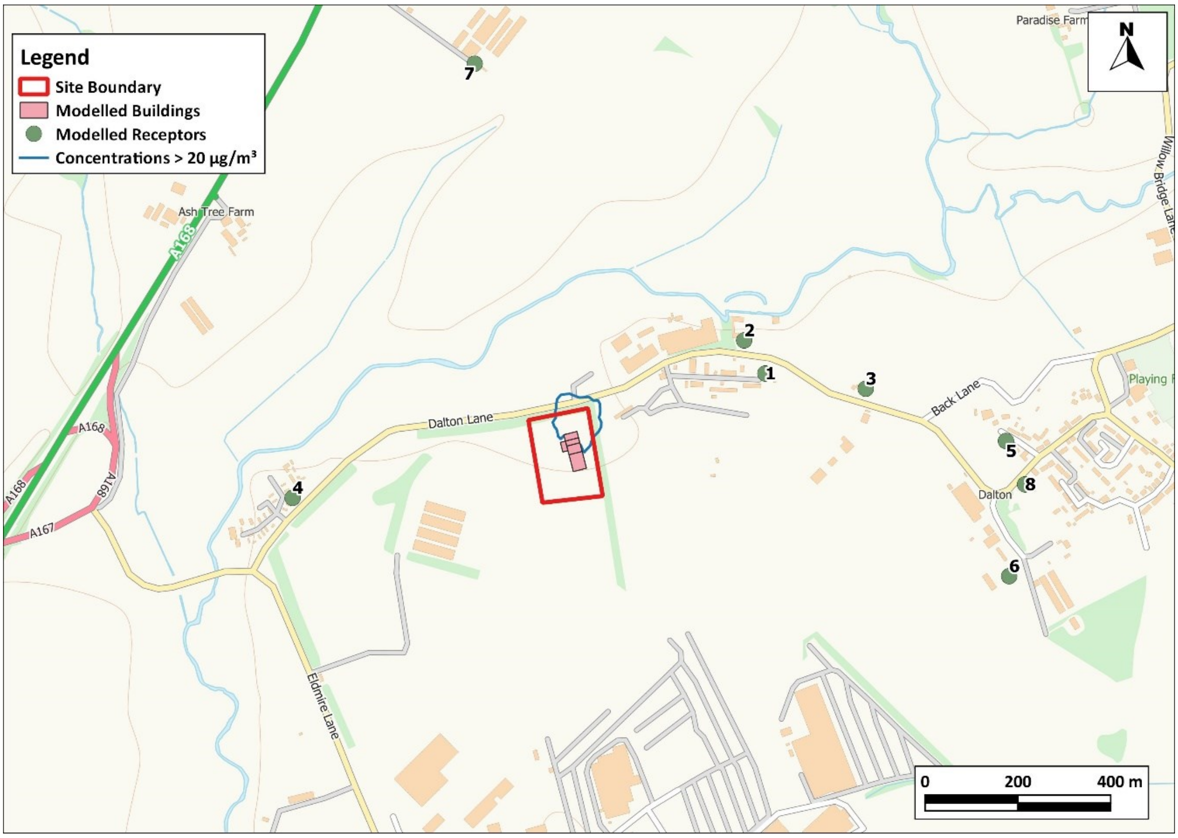


Figure 7: Contour Plot of the 99.79th Percentile of 1-hour Mean NO_2 PCs

Contains Ordnance Survey data © Crown copyright and database right 2022. Ordnance Survey licence number 100046099. Additional data sourced from third parties, including public sector information licensed under the Open Government Licence v1.0.

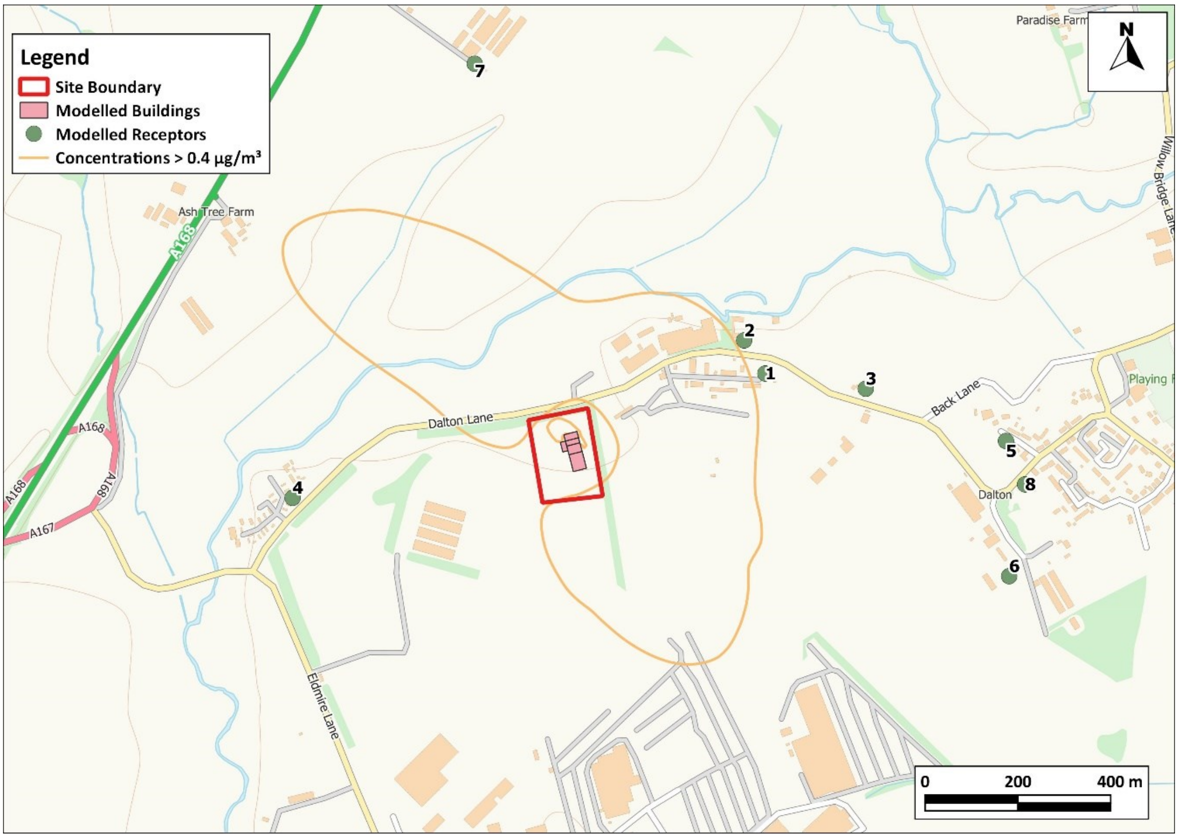


Figure 8: Contour Plot of Annual Mean PM_{10}/$PM_{2.5}$ PCs

Odour

8.6 Table 14 presents the modelled odour concentrations from the site at all nearby residential receptors for all modelled years. An odour contour plot for the worst-case meteorological year (2017) is presented in Figure 9, with the other years presented in Appendix A4.

8.7 As there are predicted to be no exceedances of the moderately offensive odour benchmark (3 OUE/m^3), based on surrogate odour emissions, it is judged that odour effects from the facility are unlikely to be significant at nearby residential receptors.

8.8 There are also several other receptor types close to the proposed development. Based on their use (storage, manufacturing etc), their sensitivity to odours will be lower than nearby residential receptors. There are also several activities that may generate odours in the area, further altering the sensitivity of local receptors. On balance, low sensitivity receptors within an area of other industrial odours are likely to be less sensitive than residential receptors that expect high amenity levels. The moderately offensive odour benchmark (3 OU_E/m^3) is therefore likely to be too stringent for this type of receptor. As there is no methodology in H4 to account for low sensitivity receptors[3], the slight adverse benchmark (<10 OU_E/m^3) for low sensitive receptors for moderately offensive odours from IAQM guidance for planning on odours (see Table 5) has been used. As there are no predicted exceedances anywhere on the grid of the 10 OU_E/m^3 benchmark (see Table 14), based on surrogate odour emissions, it is judged that odour effects from the facility are unlikely to be considered significant at the nearby industrial receptors.

Table 14: Modelled Odour Concentrations at Nearby Residential Receptors

Building	Modelled 98th Percentile 1-Hour Odour Concentrations (OU_E/m^3)				
	2016	2017	2018	2019	2020
Receptor 1	2.0	2.3	2.1	2.1	2.2
Receptor 2	2.3	2.4	2.2	2.2	2.3
Receptor 3	1.1	1.4	1.2	1.2	1.3
Receptor 4	0.4	0.2	0.7	0.6	0.5
Receptor 5	0.6	0.8	0.7	0.7	0.8
Receptor 6	0.7	0.8	0.7	0.6	0.6
Receptor 7	0.9	0.9	1.0	1.0	0.9
Receptor 8	0.6	0.7	0.7	0.6	0.7
Max on the Grid	7.4	7.8	7.4	7.6	7.4

[3] The H4 guidance regarding changing the benchmark by 0.5 OU_E/m^3 deals with already sensitised local populations, not lower sensitivity types.

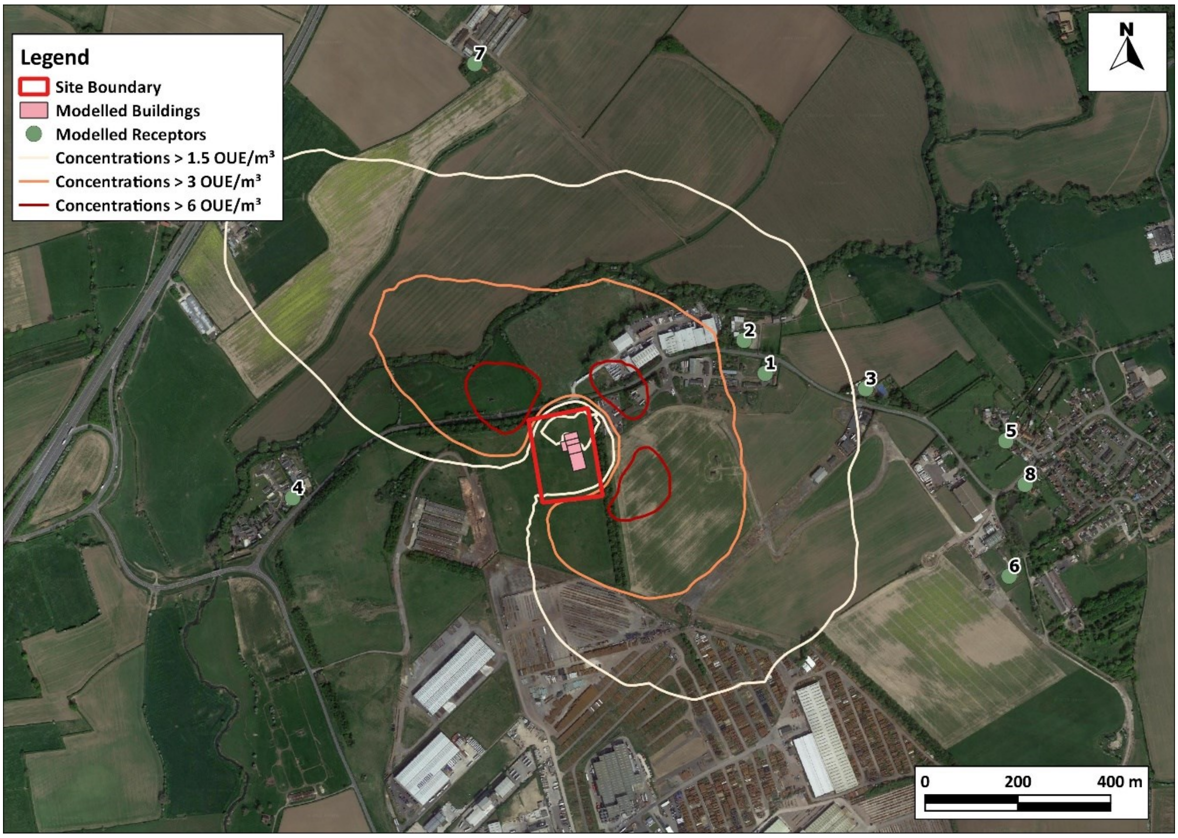


Figure 9: Contour Plot of the 2017 98th Percentile of 1-hour Mean Odour Concentrations

Sensitivity Analysis

8.9 As discussed in Paragraph 6.32, the point source dispersion model used in this assessment is required to simplify real-world conditions into a series of algorithms. This is because atmospheric turbulence is a stochastic (random) process which cannot be completely resolved by deterministic methods. These simplifications introduce uncertainties that cannot be easily quantified, whilst it is generally not possible to verify point-source model outputs. Acknowledging this fact, a number of sensitivity tests have been undertaken to investigate some of the key modelling uncertainties associated with the model created for this assessment. Based on this particular model setup, it is deemed appropriate to run sensitivity tests of the following parameters:

- Buildings; and
- Terrain.

8.10 It is important to emphasise that the aim of the sensitivity analysis is not to find a model setup that obtains the maximum possible prediction from the model, but to provide greater understanding of how assumptions on key input variables may affect the assessment, so that these factors can be considered when evaluating the significance of potential effects.

8.11 Sensitivity has been undertaken by running the model, with and without the above parameters, in order to quantify the impact these model options may have on predicted concentrations. As the worst-case results across five meteorological years have been presented in the main results section, and a variable surface roughness file has been used across the whole modelling domain, it is not deemed necessary to perform sensitivity tests on meteorological year or surface roughness. Furthermore, as nested Cartesian grids have been used with a grid resolution of 5 m x 5 m for the finest resolution grid, it is also not considered necessary to perform sensitivity analysis on grid resolution.

8.12 The results of the sensitivity test at the worst-case receptor have been compared and presented as a ratio to the base model (assuming the base model is that described in section 6). For example, a value of 0.8 in the table indicates the maximum result from the sensitivity test is 20% smaller than the base model, whilst a value of 1.2 indicates the maximum result from the sensitivity test in 20% greater than the base model.

8.13 Table 15 presents the sensitivity tests for the annual mean and 99.79th percentile of hourly means at the worst-case residential receptors. The analysis indicates the model is relatively insensitive to terrain, especially for the annual mean results, which is the consequence of the predominantly flat terrain within the model domain. The model appears to be very sensitive to buildings configuration, especially for the short-term impacts, increasing the predicted 1-hour impacts by up to 78%. The below analysis is based on the NO_2 results, with NO_2 emitted from the 16 m boiler stacks. The results for PM_{10}/odour are much less sensitive to model configuration due to being expelled from taller stacks (37 m) only.

Table 15: Model Sensitivity results

Model Sensitivity Test	Annual Mean	1-hour 99.79 %ile
	Ratio	
Buildings Only (Base Model)	**1**	**1**
No Buildings or Terrain	**1.02**	**0.22**
Building and Terrain	**1.11**	**0.7**

9 Conclusions

9.1 It is concluded that the air quality and odour impact of the proposed facility will not be significant based on the following:

- The new boilers contributions to the annual mean and 1-hour NO_2 AQSs are predicted to be less than the 1%/10% respective criteria at the worst-case locations;
- The grinder and cooler stacks contribution to the annual and 24-hour mean PM_{10} AQSs are predicted to be less than the 1%/10% respective criteria at the worst-case locations;
- There is negligible risk that the annual mean or 1-hour NO_2 AQSs will be exceeded at any nearby sensitive locations as a result of the whole sites operation;
- There is negligible risk that the annual mean or 24-hour PM_{10} AQSs will be exceeded at any nearby sensitive locations as a result of the whole sites operation;
- There is negligible risk that the annual mean $PM_{2.5}$ AQS will be exceeded at any nearby sensitive locations as a result of the whole sites operation;
- Using surrogate odour emissions data, there is not predicted to be any exceedances of the moderately offensive odour benchmark (3 OU_E/m^3) at any residential receptor location. There are, however, predicted to be exceedances of this benchmark at industrial receptors in the local area. However, these locations are normally less sensitive to odours, with other odorous industry in the area potentially reducing their sensitivity further. Based on the surrogate odour emissions data used, as there are no exceedances of the IAQMs slight adverse benchmark (<10 OU_E/m^3) for low sensitivity receptors from moderately offensive odours, it is judged that odour effects from the facility are not likely to be significant.
- The assessment is based on operation for 8,760 hours per year (see Paragraph 6.5) at 100% load and includes a number of conservative assumptions . It also takes account of the maximum predicted impacts across several sensitivity tests. In particular:
  - the assessment of short-term impacts assumes constant operation of the plant;
  - the results presented are the maxima from modelling with five separate years of meteorological data;
  - the results presented are the maxima from modelling both with and without including surrounding buildings within the dispersion model;
  - a conservative approach has been taken to calculating NO_2 concentrations from modelled NOx concentrations; and
  - No exceedances of the 1-hour NO_2 AQS when considering the 100^{th} percentile.

10 References

AQC (2016) *Relationship between the UK Air Quality Objectives and Occupational Air Quality Standards*, Available: http://www.aqconsultants.co.uk/AQC/media/Reports/Relationship-between-the-UK-Air-Quality-Objectives-and-Occupational-Air-Quality-Standards.pdf.

Carruthers, D.J. and Seaton, M.D..M.C.A..S.X..S.E.a.V.E. (2011) 'Comparison of the complex terrain algorithms incorporated into two commonly used local-scale air pollution dispersion models (ADMS and AERMOD) using a hybrid model', *Journal of Air and Waste Management Association*, pp. 61(11): 1227-1235.

CERC (2016) *ADMS User Guide*.

Defra (2018) *Review & Assessment: Technical Guidance LAQM.TG16 February 2018 Version*, Defra, Available: https://laqm.defra.gov.uk/documents/LAQM-TG16-February-18-v1.pdf.

Defra (2021a) *Background Mapping data for local authorities*, Available: https://uk-air.defra.gov.uk/data/laqm-background-home.

EA (2018) *Guidance on dispersion modelling for oxides of nitrogen assessment from specified generators*, Available: https://consult.environment-agency.gov.uk/psc/mcp-and-sg-regulations/supporting_documents/Specified%20Generators%20Modelling%20GuidanceINTERIM%20FINAL.pdf.

EA (2019) *Environmental permitting: air dispersion modelling reports*, Available: https://www.gov.uk/guidance/environmental-permitting-air-dispersion-modelling-reports?utm_source=4101c1a1-65a0-4299-99f3-d50dc8cd5823&utm_medium=email&utm_campaign=govuk-notifications&utm_content=immediate.

EA (2020) *Air emissions risk assessment for your environmental permit*, Available: https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit.

Environment Agency (2011) *H4 Odour Management. How to comply with your environmental permit*.

European Union (2019) *Best Available Techniques (BAT) Reference Document for the Food, Drink and Milk Industries*.

Hambleton District Council (2016) *2016 Air Quality Annual Status Report* .

Hambleton District Council (2020) *2020 Air Quality Annual Status Report (ASR)*.

IAQM (2018) *Guidance on the assessment of odours for planning v1.1*.

Oke (1987) *Boundary Layer Climates*.

The Air Quality (England) (Amendment) Regulations 2002, Statutory Instrument 3043 (2002), HMSO, Available: https://www.legislation.gov.uk/uksi/2002/3043/contents/made.

The Air Quality (England) Regulations 2000 Statutory Instrument 928 (2000), HMSO, Available: http://www.legislation.gov.uk/uksi/2000/928/contents/made.

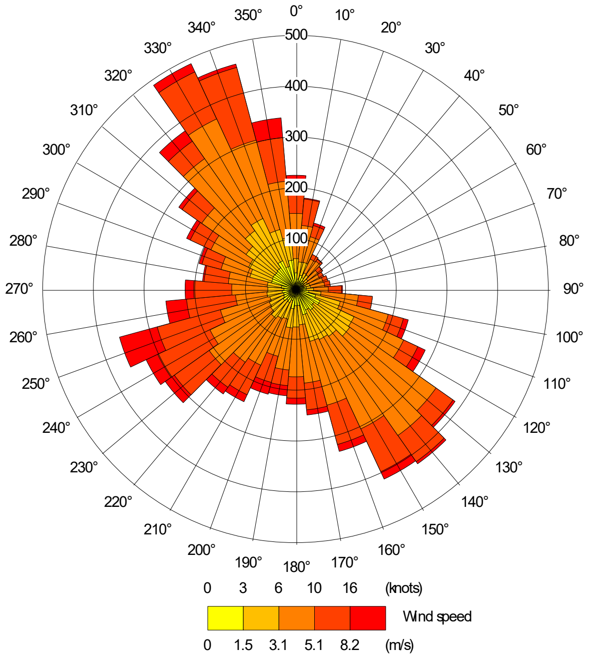
The Environmental Permitting (England and Wales) (Amendment) Regulations 2018 Statutory Instrument 2018 No.110 (2018), Available: http://www.legislation.gov.uk/uksi/2018/110/contents/made.

The European Parliament and the Council of the European Union (2008) *Directive 2008/50/EC of the European Parliament and of the Council*, Available: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32008L0050.

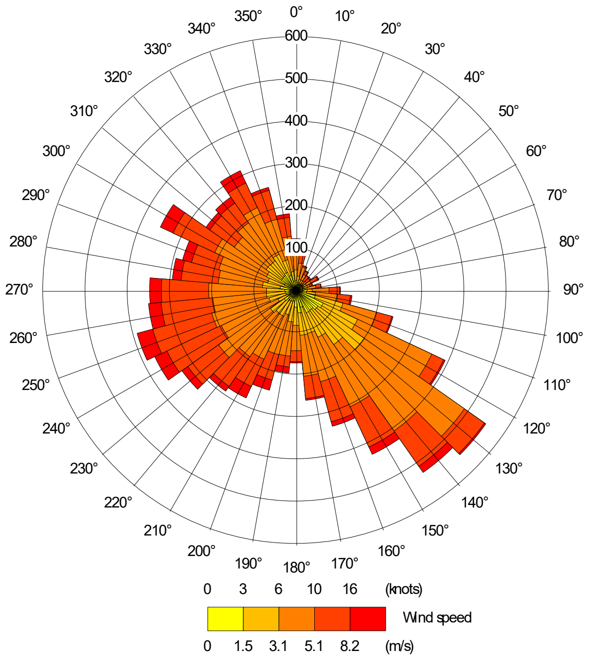
11 Appendices

A1 Wind Roses for Topcliffe

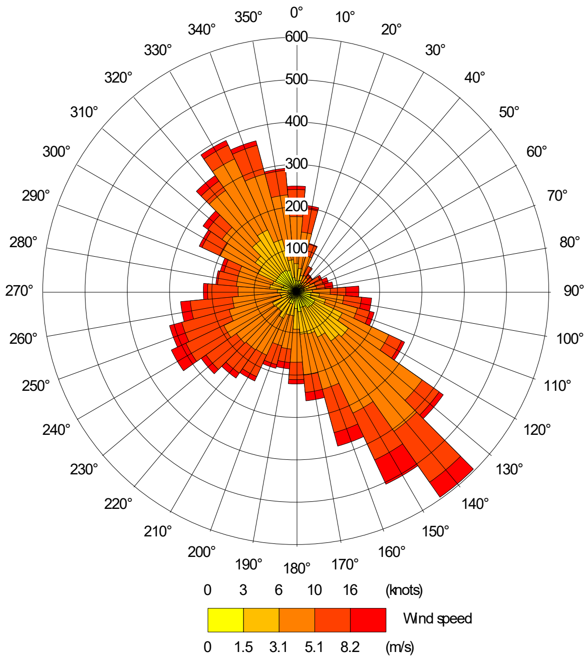
2016



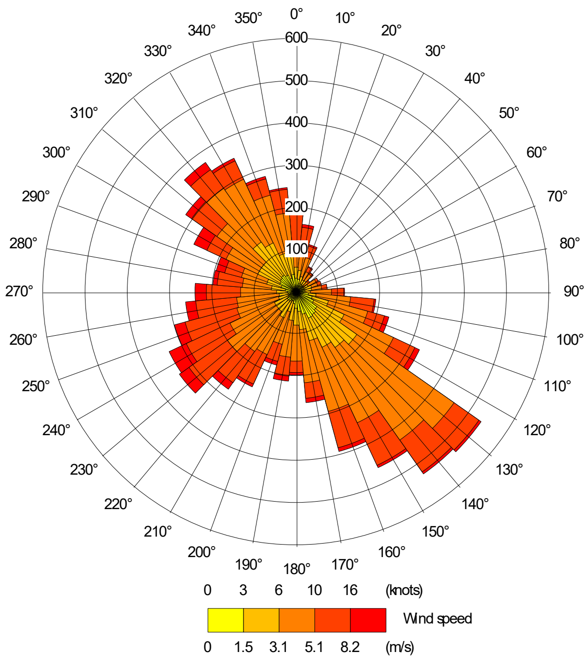
2017



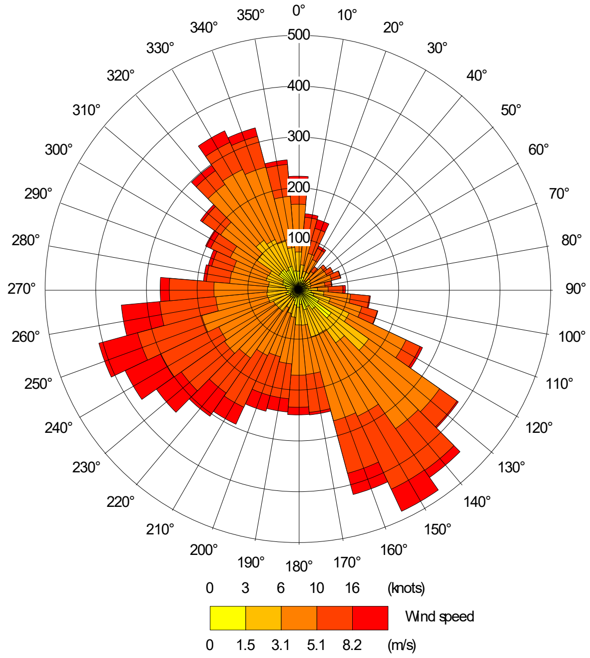
2018


0°
10°
20°
30°
40°
50°
60°
70°
80°
90°
100°
110°
120°
130°
140°
150°
160°
170°
180°
190°
200°
210°
220°
230°
240°
250°
260°
270°
280°
290°
300°
310°
320°
330°
340°
350°
600
500
400
300
200
100
0 3 6 10 16 (knots)
Wind speed
0 1.5 3.1 5.1 8.2 (m/s)

2019


0°
10°
20°
30°
40°
50°
60°
70°
80°
90°
100°
110°
120°
130°
140°
150°
160°
170°
180°
190°
200°
210°
220°
230°
240°
250°
260°
270°
280°
290°
300°
310°
320°
330°
340°
350°
600
500
400
300
200
100
0 3 6 10 16 (knots)
Wind speed
0 1.5 3.1 5.1 8.2 (m/s)

2020


0°
10°
20°
30°
40°
50°
60°
70°
80°
90°
100°
110°
120°
130°
140°
150°
160°
170°
180°
190°
200°
210°
220°
230°
240°
250°
260°
270°
280°
290°
300°
310°
320°
330°
340°
350°
500
400
300
200
100
0 3 6 10 16 (knots)
Wind speed
0 1.5 3.1 5.1 8.2 (m/s)

A2 100th Percentile of 1-hour Mean PCs

A2.1 Table A2.1 presents the 100th percentile of 1-hour mean NO_2 PCs (across 5 meteorological years) at the worst case receptor, while Figure A2.1 presents a contour plot of these PCs. The AQS for 1-hour mean NO_2 concentrations allows 18 exceedances of 200 µg/m³ in each calendar year. The 100th percentile of 1-hour means (i.e. the maximum in any hour of the year) is thus not directly comparable with the AQS. Results are provided here for information only.

Table A2.1: Maximum 100th Percentile of 1-hour Mean NO_2 PCs

Receptor ID	X Coordinate	Y Coordinate	PC (µg/m³)	PC (% of AQS)
2	442030.5	476472.9	2.58	1.3

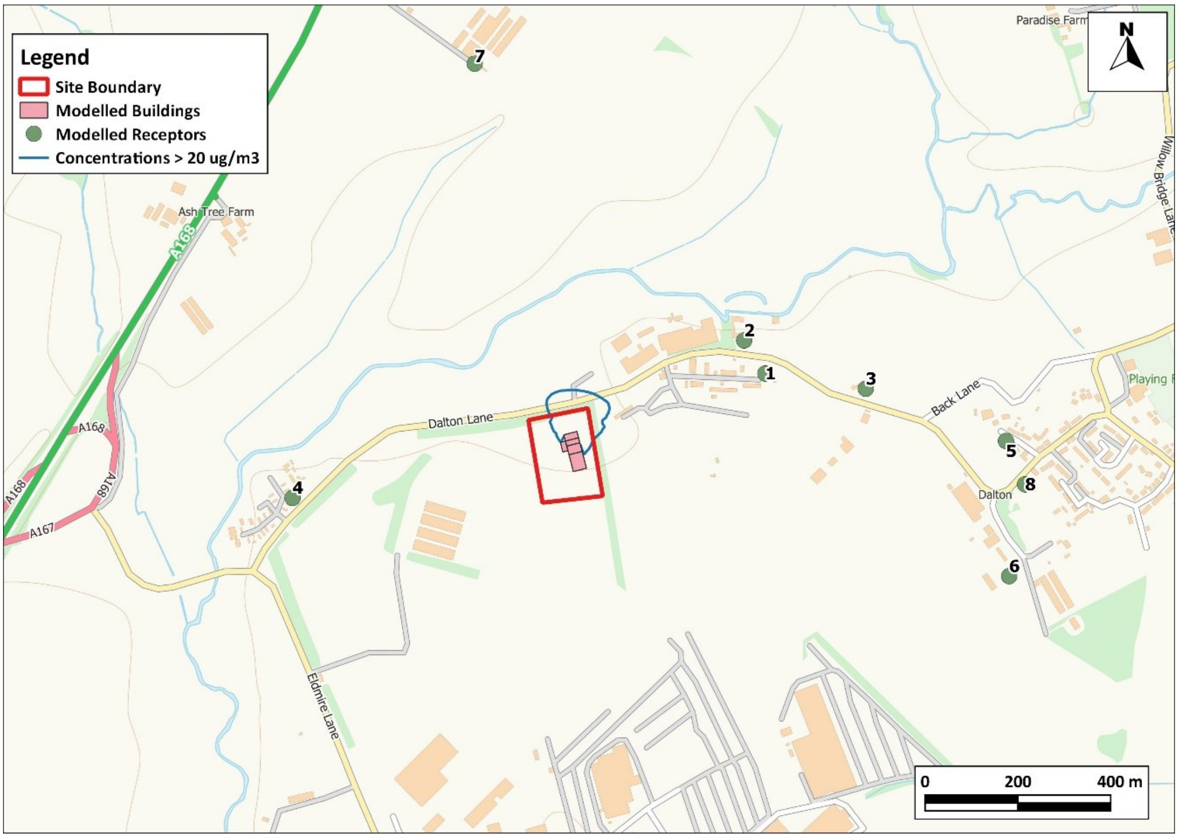


Figure A2.1: Contour Plot of 100 %ile 1-hour Mean NO_2 PC (µg/m³)

A3 Stack Parameters

A3.1 Figure A3.1 presents the locations of all stack sources modelled. The associated stack parameters and emission rates for each modelled stack are presented in Table A3.1 and Table A3.2.

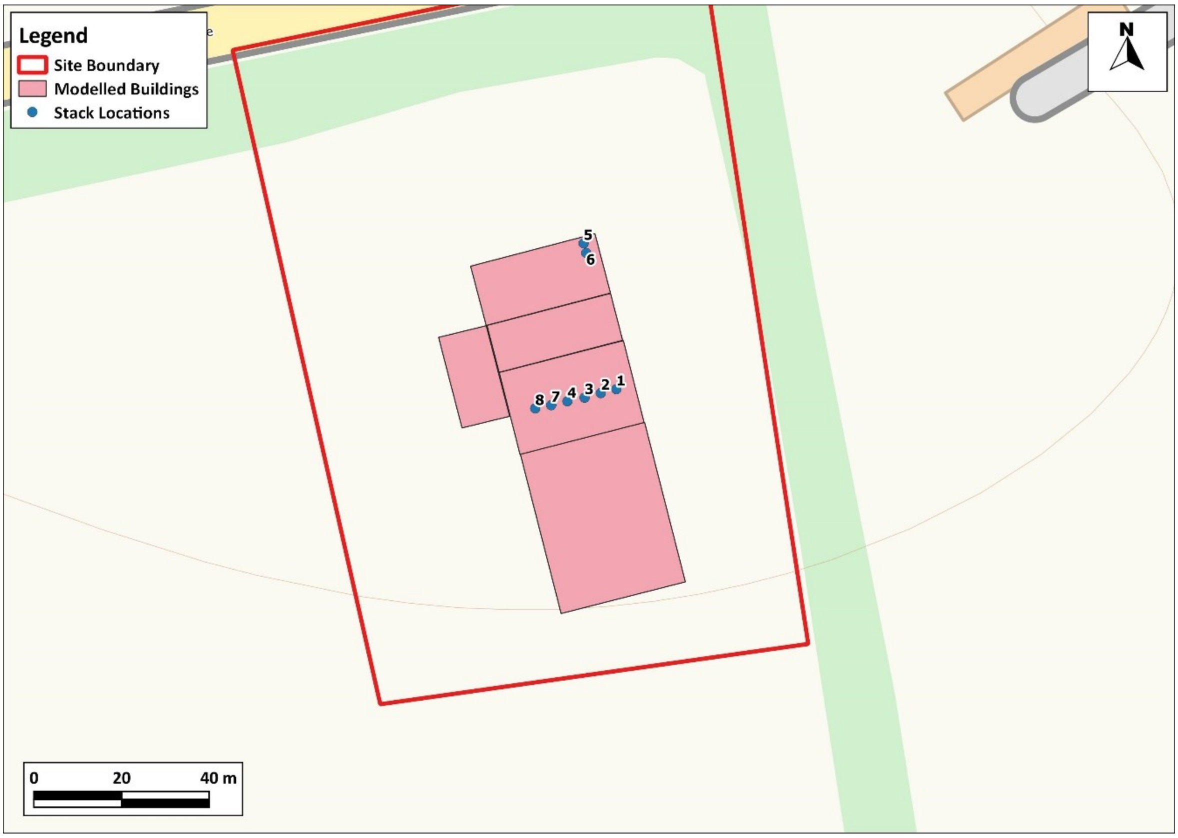


Figure A3.1: Location of Stack Emission Points (numbers correspond to stack IDs in Table A3.1)

Imagery ©2022 Getmapping plc, Infoterra Ltd & Bluesky, Maxar Technologies, The Geoinformation Group, Map Data ©2021

Table A3.1: Emission Parameters

Parameter	Unit	Pellet Cooler	Pellet Cooler	Pellet Cooler	Pellet Cooler	Steam Boiler	Steam Boiler	Pellet Grinder	Pellet Grinder
Stack ID		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Stack Coordinated (X, Y)	m	441851, 476316	441846, 476315	441841, 476313	441837, 476312	441842, 476349	441842, 476346	441832, 476311	441827, 476309
Stack Height	m	37.5	37.5	37.5	37.5	16.5	16.5	37.5	37.5
Net Fuel Input	kW_{th}	n/a	n/a	n/a	n/a	2030	2030	n/a	n/a
NOx Emissions	mg/Nm^3 [a]	n/a	n/a	n/a	n/a	100	100	n/a	n/a
	g/s	n/a	n/a	n/a	n/a	0.05679	0.05679	n/a	n/a
PM_{10} Emissions	mg/Nm^3 [b]	20	20	20	20	n/a	n/a	5	5
	g/s	0.0976	0.0976	0.0976	0.0976	n/a	n/a	0.0136	0.0136
Odour Emissions	OU_E/m^3	8161	8161	8161	8161	n/a	n/a	8161	8161
	OU_E/s	47115	47115	47115	47115	n/a	n/a	23365	23365
Exit Diameter	m	0.7	0.7	0.7	0.7	0.3	0.3	0.45	0.45
Efflux Temperature	°C	50	50	50	50	134	134	14.3	14.3
Volumetric Flow Rate	Nm^3/s	4.88 [b]	4.88 [b]	4.88 [b]	4.88 [b]	0.568 [a]	0.568 [a]	2.72 [b]	2.72 [b]
	Am^3/s	5.77	5.77	5.77	5.77	0.956	0.956	2.86	2.86
Efflux Velocity	m/s	15	15	15	15	13.5	13.5	18	18
Oxygen	%vol	n/a	n/a	n/a	n/a	1.2	1.2	n/a	n/a
Moisture	%vol	n/a	n/a	n/a	n/a	18.2	18.2	n/a	n/a
Operational Hours per Annum	Hours	8,760	8,760	8,760	8,760	8,760	8,760	8,760	8,760

[a] Reference is 3.0% vol O_2, 273K, 101.325 kPa, 0% vol H_2O

[b] Reference is 273K, 101.325 kPa.

[c] Derived by multiplying odour emission concentrations by actual flow rate. Odour sampling has been assumed to have been undertaken under similar conditions to how the proposed plant will operate.

Table A3.2: Plant Specifications, Emissions and Release Conditions [e]

Parameter	Steam Boiler 1	Steam Boiler 2
Electrical Power Output (kW_{out})	-	-
Net Input Fuel Rate (kW_{in})	2,030	2,030
Gross Input Fuel Rate (kW_{in})	2,248	2,248
Gross Fuel Consumption (kg/hr)	157	157
Combustion Air_{in} (kg/h dry)	2,689	2,689
Excess Air (%)	7	7
Exhaust Mass Flow (kg/h) for Actual Flow	2,862	2,862
Molar Flow Rate (mol/s) for Actual Flow	28.6	28.6
Molecular Mass (g/mol) for Actual Flow	27.8	27.8
Exhaust Flow (Am^3/s) [a, b] for Actual Flow	0.956	0.956
Flue Internal Diameter (m)	0.3	0.3
Exhaust Velocity (Am/s) for Actual Flow	13.51	13.51
Exhaust Temperature (ºC)	134	134
Actual Exhaust O_2 Content (%)	1.2	1.2
Actual Exhaust H_2O Content (%)	18.2	18.2
Molar Flow Rate (mol/s) for Normalised Flow	25.34	25.34
Exhaust Flow (Nm^3/s) [c,d] for Normalised Flow	0.568	0.568
NOx Emission Concentration (mg/Nm^3) [d]	100	100
NOx Emission Rate (g/s)	0.05679	0.05679

[a] Actual flow conditions in the exhaust at the stated exhaust O_2 and H_2O contents.

[b] Calculated from molar flow rate x 8.3145 x (T+273.13) / 101,325, where T is the temperature in ºC.

[c] Calculated from normalised molar flow rate x 8.3145 x (273.13) / 101325.

[d] At 0 ºC, 101.325 kPa, 3% oxygen, dry.

[e] Cells in orange inputted into model.

A4 Odour Contours

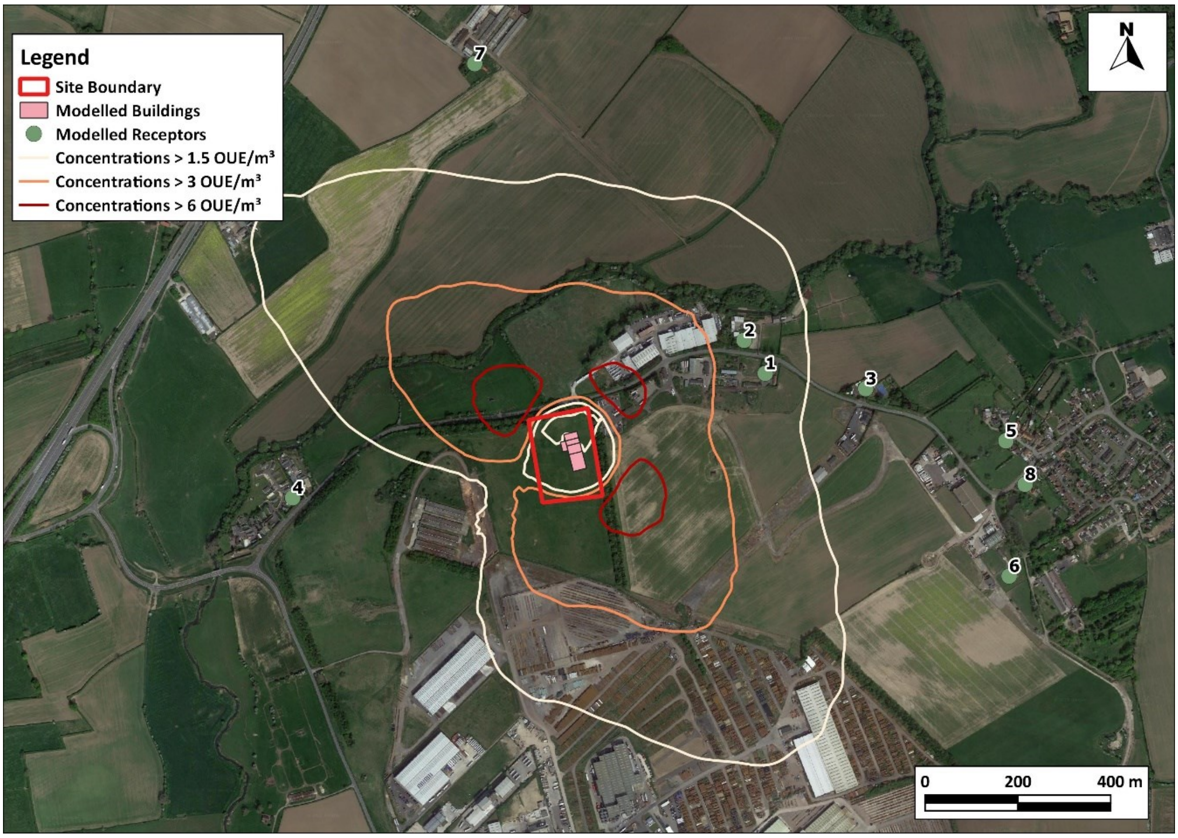


Figure A4.1: Contour Plot of the 2016 98th Percentile of 1-hour Mean Odour Concentrations

Imagery ©2022 Imagery ©2022 Getmapping plc, Infoterra Ltd & Bluesky, Maxar Technologies, The GeoInformation Group, Map data ©2022.

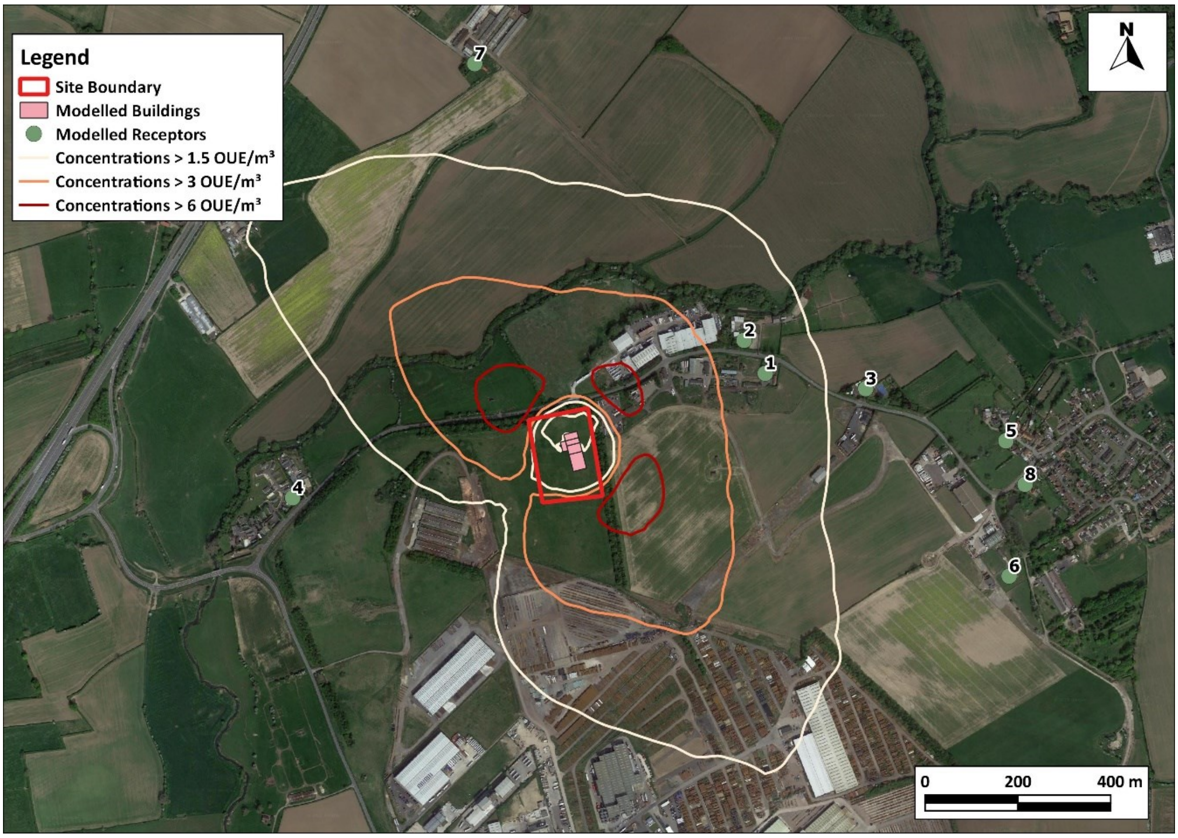


Figure A4.2: Contour Plot of the 2018 98th Percentile of 1-hour Mean Odour Concentrations

Imagery ©2022 Imagery ©2022 Getmapping plc, Infoterra Ltd & Bluesky, Maxar Technologies, The GeoInformation Group, Map data ©2022.

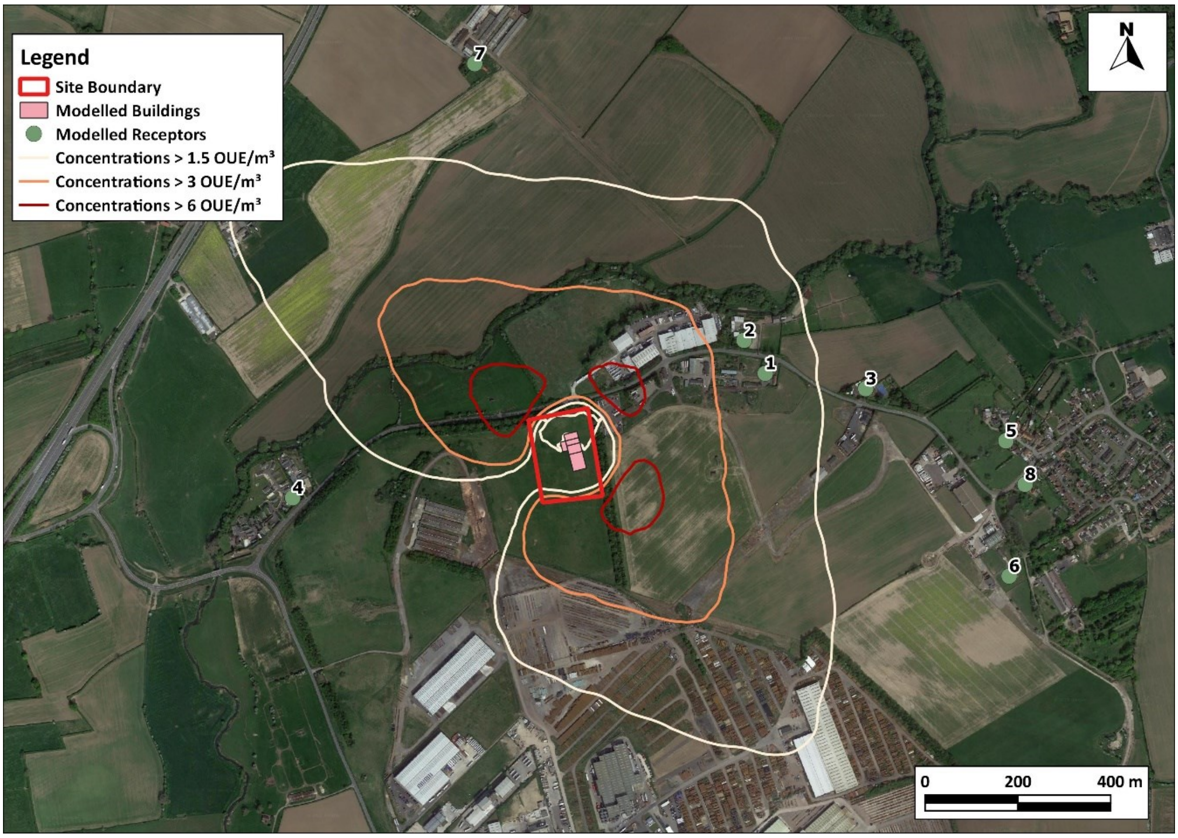


Figure A4.3: Contour Plot of the 2019 98th Percentile of 1-hour Mean Odour Concentrations

Imagery ©2022 Imagery ©2022 Getmapping plc, Infoterra Ltd & Bluesky, Maxar Technologies, The GeoInformation Group, Map data ©2022.

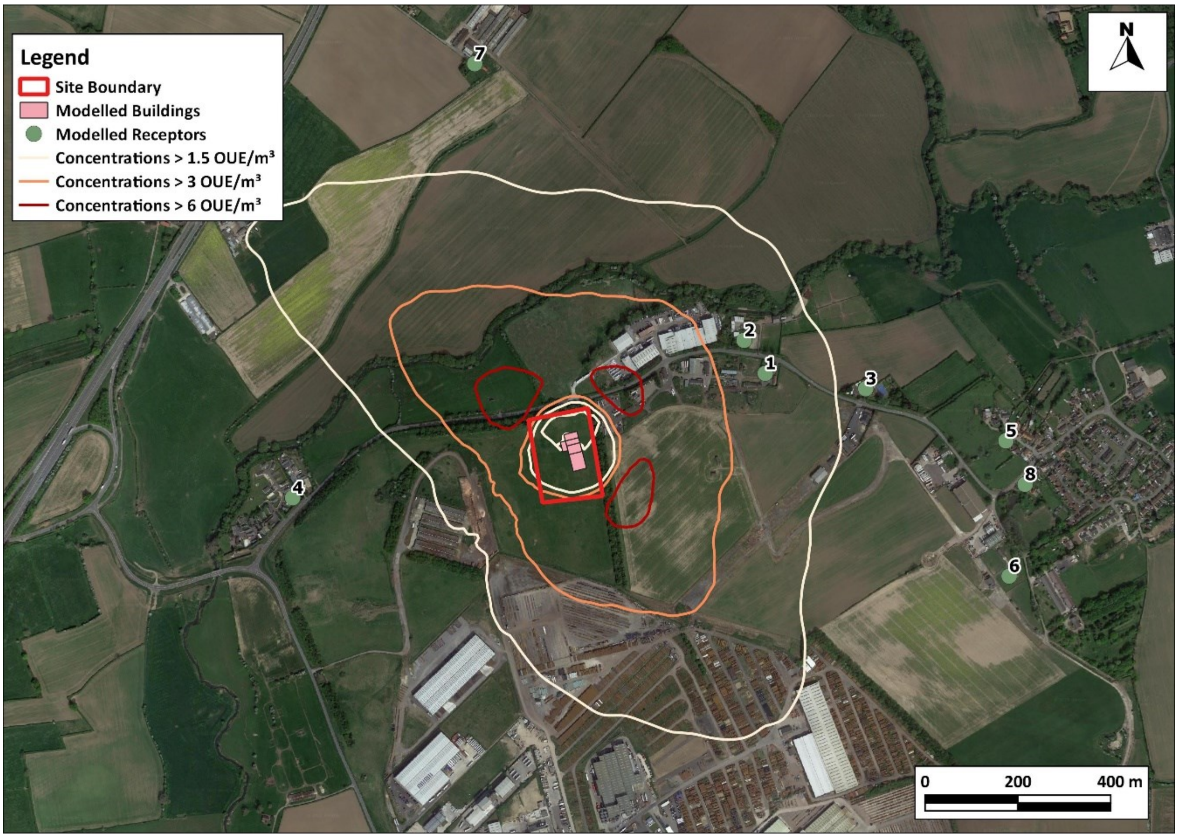


Figure A4.4: Contour Plot of the 2020 98th Percentile of 1-hour Mean Odour Concentrations

Imagery ©2022 Imagery ©2022 Getmapping plc, Infoterra Ltd & Bluesky, Maxar Technologies, The GeoInformation Group, Map data ©2022.

A5 Odour Sampling Data

Table A5.1: Sampling Data used within this Assessment [a]

Process Description	Odour Concentration (OU_E/m^3)
Broiler Finisher Stack	64288 [b]
Broiler Finisher Stack	5162
Broiler Finisher Stack	9682
Broiler Withdrawal Stack	21501 [b]
Broiler Withdrawal Stack	8078
Dairy Graze Nuts	4117
Dairy Graze Nuts	6350
Sterilized Wheat	8533

[a] Taken from Odour Monitoring and odour modelling report for McLarnon Feeds (AV Consultants). See Olfactometry Certificate in Appendix A6.

[b] These samples were contaminated with moisture carryover from the stack, and hence resulted in higher olfactometry analysis results. These results have therefore been discarded.

A6 Model Checklist

Table A6.1: EA Checklist for Dispersion Modelling Report for Installations

Item	Included	Comment
Location map	✓	See Figure 1
Site plan	✓	See Figure 1 and Section 3
List of emissions modelled	✓	See Paragraph 1.3 and Table 4
Details of modelled scenarios	✓	See Paragraph 6.5
Details of relevant ambient concentrations used	✓	See Section 5
Model description and justification	✓	See Paragraph 6.2
Special model treatments used	✓	See Section 6
Table of emission parameters used	✓	Table A3.1 and Table A3.2
Details of modelled domain receptors	✓	See Paragraph 6.12
Details of meteorological data used (including origin) and justification	✓	See Paragraphs 6.13 to 6.14
Details of terrain treatment	✓	See Paragraph 6.24
Details of building treatment	✓	See Paragraphs 6.22
Sensitivity analysis	✓	See Table 2 and Section 8
Assessment of impacts	✓	See Sections 8
Model input files	✓	Sent electronically

A7 Odour Sampling Olfactometry Certificate

ODOURNET
air quality and odour research consultants

Odournet UK Ltd
5 St. Margaret's Street
Bradford on Avon
Wiltshire BA15 1DA
Phone 01225 868869
uk@odournet.com
Companies House Cardiff 2900894

CERTIFICATE

Certificate number ENEN14B_140702 / 14-07-03 15:15 DM

Client	Organisation	Envest Environmental Ltd
	Contact	M. Keegan
	Address	Innovation in Business Centre GMIT, Westport Road Castlebar Co. Mayo
	Telephone	**+353 (0)87 9136491**
Project		
	Project number	**ENEN14B_140702**
	Lead technician	**F. Santilli**

Investigated item Odour concentration ou_E/m^3, determined by sensory measurement of odour concentration of an odour sample supplied in a sampling bag.

Identification The odour sample bags were labelled individually. The label showed the identification of the bag. This identification is referenced within the results.

Method The odour concentration measurements were performed according to the European Standard EN13725:2003 '*Air quality – Determination of odour concentration by dynamic olfactometry*', and according to those parts as described in the internal procedure QD01: ' *Procedure for olfactometry based on EN13725:2003*'. The odour perception characteristic of the panel within the presentation series for the samples was analogous to that for the butanol calibration. The forced-choice method of presentation was used and at least two rounds are presented to determine the panel threshold. Sample bags are manufactured from PET, Nalophane and are not re-used.

Measuring range The measuring range of the olfactometer is $2^6 \leq x \leq 2^{14}$ ou_E/m^3. When the sample concentration is outside the measuring range the odour sample may have been pre-diluted. If samples are pre-diluted in the laboratory this is specified under the column *Pre-dilution factor Z* in Table 1.

Environment The measurements were performed in an air- and odour conditioned room, at a temperature of T ≤25 °C and with a fluctuation of less than ±3 °C. The CO_2 concentration is ≤0.15 %. The laboratory is stationary and permanent.

Measurement dates and times The measuring dates and times are specified together with the results in Table 1.

Results The measurement results are presented in Table 1 of this certificate.

Uncertainty The confidence limits for a value x for one measurement according to EN13725, with a cover factor *k* = 2 are: $x \cdot 2.21^{-1} \leq x \leq x \cdot 2.21$. Based on repeated measurements of n-butanol reference gas the actual confidence limits at the Olfactolab UK are more favourable: for one measurement, including pre-dilution, the confidence limits are: x·1.80-1 ≤ x ≤ x·1.80 (*k* = 2). It is assumed that this uncertainty, based on verification with reference gases, is transferable to environmental samples. The most recent interlaboratory comparison result is A = 0.185.

Traceability The measurements have been performed using standards for which the traceability to (inter)national standards has been demonstrated. The assessors are individually selected to comply with fixed criteria and are monitored in time to keep within the limits set. The results from the assessors are traceable to primary standards (PSM's) of n-butanol in nitrogen.

Bradford on Avon, 3 July, 2014,

Deborah McCollum

Head of Olfactometry

UKAS TESTING
2430

www.odournet.com

Odournet UK Ltd
5 St. Margaret's Street
Bradford on Avon
Wiltshire BA15 1DA
Phone 01225 868869
uk@odournet.com
Companies House Cardiff 2900894

CERTIFICATE

Certificate number ENEN14B_140702 / 14-07-03 15:15 DM

Table 1 Measurement results

Analysis file	Sample ID	Client reference	Analysis result [$ou_E.m^{-3}$]	Pre-dilution factor Z	Odour concentration [$ou_E.m^{-3}$]	Date and time of sampling	Date and time of analysis	Number of valid panel members	Number of valid ITE values	Remarks
140701AHK	14070217_01	ENV - 1339/01	951	67.60	64288	01-07-2014 08:45	02-07-2014 12:39	6	12	The sample has been pre-diluted using PreNose.
140701BHK	14070218_01	ENV - 1399/02	4778	4.50	21501	01-07-2014 09:03	02-07-2014 14:32	6	10	The sample has been pre-diluted using PreNose.
140701CHK	14070219	ENV - 1399/03	4117	-	4117	01-07-2014 10:08	02-07-2014 15:14	6	10	
140701DHK	14070220	ENV - 1399/04	8078	-	8078	01-07-2014 10:58	02-07-2014 15:30	6	12	
140701EHK	14070221	ENV - 1399/05	6350	-	6350	01-07-2014 11:25	02-07-2014 17:10	6	8	
140701FHK	14070222	ENV - 1399/06	5162	-	5162	01-07-2014 11:55	02-07-2014 17:26	6	10	
140701GHK	14070223	ENV - 1399/07	8533	-	8533	01-07-2014 12:14	02-07-2014 17:41	6	10	
140701HHK	14070224	ENV - 1399/08	9682	-	9682	01-07-2014 12:44	02-07-2014 17:55	5	8	

UKAS TESTING 2430

www.odournet.com