



# AIR QUALITY ASSESSMENT

Cleveland Bridge Facility

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# AIR QUALITY ASSESSMENT

## Cleveland Bridge Facility

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## NON-TECHNICAL SUMMARY

Sol Environment Ltd has been commissioned by Endolys Ltd to undertake an air quality assessment for a plastic waste recycling facility on land to the southeast of Darlington, County Durham. The facility will utilise advanced thermal treatment (pyrolysis) to manufacture pyrolysis oil (PyOil) from around 120,000 tonnes of waste plastic film per annum. The project will be undertaken in two distinct phases; six modular pyrolysis units will be installed in Phase 1, with a further six modular pyrolysis units in Phase 2. By project completion there will be a total of twelve pyrolysis units, each with a capacity of 1.3 tonnes per hour. Allowing for maintenance and downtime and assuming 90% availability the plant will process approximately 330 tonnes per day and produce approximately 81,000 tonnes per annum of PyOil. The assessment is provided to support the Environmental Permit application for the waste recycling facility.

Detailed dispersion modelling has been undertaken to determine potential impacts arising from various emissions to air from the facility. Maximum predicted concentrations are compared with the relevant Air Quality Objectives (AQO) and Environmental Assessment Levels (EALs) for the protection of human health. The significance of the air quality impacts has been assessed using criteria provided by the Environment Agency's Risk Assessment Guidance. The assessment has considered the impact of emissions on human receptors and sensitive habitat sites.

There are no European habitat sites within 10 km of the facility but there are four locally designated sites within 2 km. Therefore, the impact of airborne emissions on habitat sites has been assessed.

For human health, the maximum impact of pollutant emissions from the site is considered 'not significant' or 'it is unlikely that the AQO/EAL would be exceeded' on the basis of the Environment Agency's Risk Assessment Guidance and professional judgement.

The impact of emissions from the facility on the identified habitat sites was also determined and assessed as 'not significant' compared with existing background conditions and relevant critical levels and critical loads.

## 1. INTRODUCTION

### 1.1 Proposed Facility

Sol Environment Ltd has been commissioned by Endolys Ltd to undertake an air quality assessment for a proposed plastic waste recycling facility on land to the southeast of Darlington, County Durham. The facility will utilise advanced thermal treatment (pyrolysis) to manufacture pyrolysis oil (PyOil) from around 120,000 tonnes of waste plastic film per annum. The project will be undertaken in two distinct phases; six modular pyrolysis units will be installed in Phase 1, with a further six modular pyrolysis units in Phase 2. By project completion there will be a total of twelve pyrolysis units, each with a capacity of 1.3 tonnes per hour. Allowing for maintenance and downtime and assuming 90% availability the plant will process approximately 330 tonnes per day and produce approximately 81,000 tonnes per annum of PyOil. The assessment is provided to support the Environmental Permit application for the waste recycling facility.

There are numerous emissions to air from the proposed facility including the following:

- Pyrolysis heating;
- Excess syngas combustion;
- Reception, feedstock handling and pyrolysis building ventilation;
- Natural gas fired combined heat and power (CHP) plant;
- Flare; and
- Emergency diesel generator.

The proposed facility site is located to the southeast of Darlington, County Durham. The location of the facility is presented in **Figure 1.1**. The area surrounding the site is a mix of light industrial use but land use to the east and south is rural. The nearest residential (hotel) receptor is located to the north of the site to the north of Yarm Road.

The site is located within the administrative area of Darlington Borough Council (DBC). DBC does not currently have any Air Quality Management Areas (AQMA) within their administrative area. The nearest AQMA to the facility is 28 km to the north in Durham. Therefore, the facility site is not located within or close to an AQMA.

### 1.2 Scope of the Assessment

The potential air quality impacts arising from the facility are as follows:

- the generation of odours and off-site odour annoyance; and
- emissions to air from the various on-site activities.

All storage, sorting and processing of waste will be carried out within the existing building on site, and all accepted waste will be dry clean waste with a low odour potential. Any waste brought to site with odour potential will be immediately sent off site for external processing. Furthermore, an Odour Management Plan (OMP) will be implemented at the site. Therefore, the potential odour impacts are considered low and are not considered further.

Operational impacts associated with emissions to air from the on-site activities have been assessed using a dispersion model to predict the impact at ground level utilising five years of meteorological data from the Durham Tees Valley Airport (2018 to 2022) meteorological observing station. This assessment has considered the impact on human health and sensitive habitat sites.

As the proposed facility involves the thermal treatment of waste, emissions to air from the waste combustion units will be governed by the Industrial Emissions Directive (IED)<sup>1</sup>, which requires adherence to emission limits for the following pollutants:

- nitrogen oxides (NO<sub>x</sub> as NO<sub>2</sub>);
- carbon monoxide (CO);
- total dust (as PM<sub>10</sub> and PM<sub>2.5</sub>);
- gaseous and vaporous organic substances, expressed as total organic carbon;
- sulphur dioxide (SO<sub>2</sub>);
- hydrogen chloride (HCl);
- hydrogen fluoride (HF);
- twelve trace metals; and
- dioxins and furans.

The assessment has also considered emissions of polycyclic aromatic hydrocarbons (PAH, as benzo[a]pyrene) and polychlorinated biphenyls (PCBs). NO<sub>x</sub> emissions control will be required for the waste treatment processes and Selective Catalytic Reduction (SCR) is proposed with the addition of ammonia or urea. Therefore, there is the potential for ammonia slip and emissions of ammonia (NH<sub>3</sub>) have also been included.

A glossary of common air quality terminology is provided in **Appendix A**.

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<sup>1</sup> The Industrial Emissions Directive, 2010/75/EU

## 2. LEGISLATION AND POLICY

### 2.1 The European Directive on Ambient Air and Cleaner Air for Europe

European Directive 2008/50/EC of the European Parliament and of the Council of 21st May 2008, sets legally binding Europe-wide limit values for the protection of public health and sensitive habitats. The Directive streamlines the European Union's air quality legislation by replacing four of the five existing Air Quality Directives within a single, integrated instrument.

The pollutants included are sulphur dioxide (SO<sub>2</sub>), nitrogen dioxide (NO<sub>2</sub>), particulate matter of less than 10 micrometres (µm) in aerodynamic diameter (PM<sub>10</sub>), particulate matter of less than 2.5 µm in aerodynamic diameter (PM<sub>2.5</sub>), lead (Pb), carbon monoxide (CO), benzene, ozone (O<sub>3</sub>), polycyclic aromatic hydrocarbons (PAHs), cadmium (Cd), arsenic (As), nickel (Ni) and mercury (Hg).

### 2.2 Environment Act 2021

The Environment Act 2021<sup>2</sup> establishes a legally binding duty on the government to bring forward new air quality targets by 31 October 2022 for PM<sub>2.5</sub>.

The proposed air quality targets currently under consultation (consultation closed on 27<sup>th</sup> June 2022) are:

- An Annual Mean Concentration Target - a maximum concentration of µg/m<sup>3</sup> to be met across England by 2040; and
- A Population Exposure Reduction Target ('exposure target') - a 35% reduction in population exposure by 2040 (compared to a base year of 2018).

These have been adopted into the first revision of Defra's Environmental Improvement Plan 2023 for England published in February 2023.

Schedule 11 of the Environment Act 2021 also strengthens the Local Air Quality Management (LAQM) framework which was introduced by the Environment Act 1995. Schedule 11 requires the LAQM framework to be reviewed and where appropriate modified within 12 months of the Environment Act coming into force and every 5 years following the initial review. Schedule 11 also places a duty on the local authority to have regard to the LAQM framework when exercising a function which could affect air quality (i.e. determining a planning application with air quality implications).

### 2.3 Air Quality Strategy 2023

The Air Quality Strategy<sup>3</sup> is the government's strategic framework for local authorities and other partners. It sets out their powers, responsibilities, and further actions the government expects them to take. It sets out a framework to enable local authorities to deliver for their communities and contribute to the government's long-term air quality goals, including ambitious new targets for fine particulate matter (PM<sub>2.5</sub>).

It fulfils the statutory requirement of the Environment Act 1995 as amended by the Environment Act 2021 to publish an Air Quality Strategy setting out air quality standards, objectives, and measures for improving ambient air quality every 5 years. It does not replicate or replace other air quality guidance documents relevant to local authorities.

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<sup>2</sup> Environment Act 2021, 2021 Chapter 30

<sup>3</sup> Air Quality Strategy, Framework for Local Authority Delivery, Department for Environment, Food and Rural Affairs (2023)

The government's national-level air quality regulations for concentrations consist of the Air Quality Standards Regulations 2010, which set limits for several pollutants, including nitrogen oxides, particulate matter, and others. In addition, under the Environment Act 2021, the government has set two new legally-binding long-term targets to reduce concentrations of fine particulate matter, PM<sub>2.5</sub>.

The two new targets are an annual mean concentration of 10 µg/m<sup>3</sup> and a reduction in average population exposure by 35% by 2040, compared to a 2018 baseline. These targets are designed to help drive reductions in the worst PM<sub>2.5</sub> hotspots across the country, whilst ensuring nationwide action to improve air quality for everyone.

There are also interim targets for each long-term target in the Environmental Improvement Plan which will promote early action and improvement. These are an annual mean PM<sub>2.5</sub> concentration of 12 µg/m<sup>3</sup> by January 2028 and a 22% reduction in average population exposure by January 2028 compared to a 2018 baseline.

## 2.4 Air Quality (England) Regulations

Many of the objectives in the former Air Quality Strategy were made statutory in England with the Air Quality (England) Regulations 2000<sup>4</sup> and the Air Quality (England) (Amendment) Regulations 2002<sup>5</sup> (the Regulations) for the purpose of Local Air Quality Management (LAQM).

The Air Quality Standards (England) Regulations 2010<sup>6</sup> have adopted into UK law the limit values required by EU Directive 2008/50/EC<sup>7</sup> and came into force on the 10<sup>th</sup> June 2010. These regulations prescribe the 'relevant period' (referred to in Part 12V of the Environment Act 1995) that local authorities must consider in their review of the future quality of air within their area. The regulations also set out the air quality objectives to be achieved by the end of the 'relevant period'.

Ozone is not included in the Regulations as, due to its transboundary nature, mitigation measures must be implemented at a national level rather than at a local authority level.

The environmental assessment levels (EALs), air quality objectives (AQOs) for the pollutants considered in the assessment are presented in **Appendix B**.

## 2.5 The Environmental Targets (Fine Particulate Matter) (England) Regulations 2023

The Environmental Targets (Fine Particulate Matter) (England) Regulations 2023 sets two legally binding environmental targets for air quality relating to the reduction of levels of fine particulate matter (PM<sub>2.5</sub>) in ambient air: one with the purpose of reducing PM<sub>2.5</sub> in locations where concentrations are highest, the annual mean concentration target ("AMCT"); and a second with the purpose of reducing average exposure across the country, the population exposure reduction target ("PERT"). This instrument establishes for each target the level to be achieved and the date for its achievement, as well as making provision about monitoring, measurement, and calculation to assess whether the targets are met.

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4 The Air Quality (England) Regulations 2000 - Statutory Instrument 2000 No.928

5 The Air Quality (England) (Amendment) Regulations 2002 - Statutory Instrument 2002 No.3043

6 The Air Quality Standards Regulations 2010 – Statutory Instrument 2010 No. 1001

7 Directive 2008/50/EC of the European Parliament and of the Council of 21st May 2008, on ambient air quality and cleaner air for Europe

This instrument satisfies the requirement in section 1(2) of the Environment Act 2021 (“the Environment Act”) for government to set at least one target in the priority area of air quality and section 2 of the Environment Act to set a target in respect of the annual mean level of PM<sub>2.5</sub> in ambient air.

## 2.6 Industrial Emissions Directive

The Industrial Emissions Directive (2010/75/EU) came into force on the 6<sup>th</sup> January 2011, replacing the seven existing Directives, including the Waste Incineration Directive (WID) and Large Combustion Plant Directive (LCPD), implemented through the Environmental Permitting Regulations (EPR).

The aim of the Directive is to simplify the existing legislation and reduce administrative costs, whilst maintaining a high level of protection for the environment and human health. Permits will still be issued under EPR; however existing and new sites will be required to comply with the requirements of the IED, which places greater emphasis on new plant best available technology (BAT).

The IED has been transposed into UK law via the Environmental Permitting (England and Wales) (Amendment) Regulations 2013 (SI 2013 No, 390), which came into force on 27 February 2013.

The design and operation of all new waste incineration facilities must ensure compliance with emission limit values (ELVs) set out in the IED; these ELVs are summarised in **Table 2.1**.

**Table 2.1: IED Emission Limits (mg/Nm<sup>3</sup>)**

Pollutant	ELV (Referenced to 11% O <sub>2</sub> )
<b>Daily Average</b>	
Total dust	10
Total organic carbon (TOC)	10
Hydrogen chloride (HCl)	10
Hydrogen fluoride (HF)	1
Sulphur dioxide (SO <sub>2</sub> )	50
Oxides of nitrogen (NO <sub>x</sub> )	200
Carbon monoxide (CO)	50
<b>Half-Hourly Average</b>	
Total dust	30
Total organic carbon (TOC)	20
Hydrogen chloride (HCl)	60
Hydrogen fluoride (HF)	4
Sulphur dioxide (SO <sub>2</sub> )	200
Oxides of nitrogen (NO <sub>x</sub> )	400
Carbon monoxide (CO)	100
<b>Average over a sample period between 30-Minutes and 8-Hours</b>	
Group 1 metals (a)	0.05
Group 2 metals (b)	0.05
Group 3 metals (c)	0.5
<b>Average over a sample period between 6-Hours and 8-Hours</b>	
Dioxins and furans (d)	0.1 x 10 <sup>-6</sup>

- (a) Cadmium (Cd) and Thallium (Tl)
- (b) Mercury (Hg)
- (c) Antimony (Sb), arsenic (As), lead (Pb), chromium (Cr), cobalt (Co), copper (Cu), manganese (Mn), nickel (Ni) and vanadium (V)
- (d) I-TEQ

The European Union Best Available Techniques (BAT) Reference Document (BREF) for Waste Incineration was adopted in December 2019. The proposed facility does not currently have an Environmental Permit. Therefore, it will be classed as a new plant.

The BREF provides BAT Associated Emission Limits (AEL) for new plants and existing plants. For the purposes of this assessment, it is assumed that the plant will need to comply with the requirements for new plant. These ELVs are provided as a range of concentrations for each pollutant. Therefore, for the purposes of this assessment it is assumed that the plant will comply with the upper range of emissions as provided in **Table 2.2**.

**Table 2.2: BAT Associated Emission Limits (mg/Nm<sup>3</sup>)**

Pollutant	Emission Limit (a)
Total Dust	5
Gaseous and vaporous organic substances, expressed as total organic carbon (TOC)	10
Sulphur Dioxide	30
Nitrogen monoxide (NO) and nitrogen dioxide (NO <sub>2</sub> ), expressed as NO <sub>2</sub>	120
Carbon Monoxide	50
Hydrogen Chloride	6
Hydrogen Fluoride	1
Ammonia (NH <sub>3</sub> )	10
Group I Metals (Cd, Tl)	0.02 (group total)
Group II Metals (Hg)	0.02
Group III Metals (Sb, As, Pb, Cr, Co, Cu, Mn, Ni, V)	0.3 (group total)
Dioxins and furans (PCDD/Fs)	0.06 x 10 <sup>-6</sup>

(a) Dry gas at 273.15K, 101.3 kPa and 11% O<sub>2</sub>

## 2.7 Medium Combustion Plant Directive (MCPD)

The Medium Combustion Plant Directive (2015/2193) came into force on 18<sup>th</sup> December 2015 and regulates pollutant emissions from the combustion of fuels in plants with a rated thermal input equal to or greater than 1 megawatt (MWth) and less than 50 MWth.

It regulates emissions of SO<sub>2</sub>, NO<sub>x</sub> and dust into the air with the aim of reducing those emissions and the risks to human health and the environment they may cause. It also lays down rules to monitor emissions of carbon monoxide (CO).

It fills the regulatory gap at EU level between large combustion plants (> 50 MWth), covered under the Industrial Emissions Directive (IED) and smaller appliances (heaters and boilers <1 MWth) covered by the Ecodesign Directive.

The Medium Combustion Plant is implemented through the Environmental Permitting Regulations (EPR). The design and operation of all new Medium Combustion Plants must ensure compliance with emission limit values (ELVs) set out in the MCPD; these ELVs are summarised in Table 2.3 and 2.4.

**Table 2.3: MCPD Emission Limits for MCP other than Engines and Gas Turbines (mg/Nm<sup>3</sup>)**

Pollutant	Emission Limit (Dry gas at 273.15K, 101.3mb and 3% O <sub>2</sub> )					
	Solid Biomass	Other Solid Fuels	Gas Oil	Liquid Fuels Other Than Gas Oil	Natural Gas	Gaseous Fuels Other Than Natural Gas
SO <sub>2</sub>	200 <sup>(1)</sup>	400	-	350 <sup>(2)</sup>	-	35 <sup>(3)(4)</sup>
NO <sub>x</sub>	300 <sup>(5)</sup>	300 <sup>(5)</sup>	200	300 <sup>(6)</sup>	100	200
Dust	20 <sup>(7)</sup>	20 <sup>(7)</sup>	-	20 <sup>(8)</sup>	-	

(1) The value does not apply in the case of plants firing exclusively woody solid biomass.

(2) Until 1 January 2025, 1 700 mg/Nm<sup>3</sup> in the case of plants which are part of SIS or MIS.

(3) 400 mg/Nm<sup>3</sup> in the case of low calorific gases from coke ovens, and 200 mg/Nm<sup>3</sup> in the case of low calorific gases from blast furnaces, in the iron and steel industry.

(4) 100 mg/Nm<sup>3</sup> in the case of biogas.

(5) 500 mg/Nm<sup>3</sup> in the case of plants with a total rated thermal input equal to or greater than 1 MW and less than or equal to 5 MW.

(6) Until 1 January 2025, 450 mg/Nm<sup>3</sup> when firing heavy fuel oil containing between 0,2 % and 0,3 % N and 360 mg/Nm<sup>3</sup> when firing heavy fuel oil containing less than 0,2 % N in the case of plants which are part of SIS or MIS.

(7) 50 mg/Nm<sup>3</sup> in the case of plants with a total rated thermal input equal to or greater than 1 MW and less than or equal to 5 MW; 30 mg/Nm<sup>3</sup> in the case of plants with a total rated thermal input greater than 5 MW and less than or equal to 20 MW.

(8) 50 mg/Nm<sup>3</sup> in the case of plants with a total rated thermal input equal to or greater than 1 MW and less than or equal to 5

**Table 2.4: MCPD Emission Limits for MCP for Engines and Gas Turbines (mg/Nm<sup>3</sup>)**

Pollutant	Emission Limit (Dry gas at 273.15K, 101.3mb and 15% O <sub>2</sub> )				
	Generator Type	Gas Oil	Liquid Fuels Other Than Gas Oil	Natural Gas	Gaseous Fuels Other Than Natural Gas
SO <sub>2</sub>	Engines and gas turbines	-	120 <sup>(9)</sup>	-	15 <sup>(10)</sup>
NO <sub>x</sub>	Engines	190 <sup>(11)</sup>	190 <sup>(11)(12)</sup>	95 <sup>(13)</sup>	190
	Gas turbines	75	75 <sup>(14)</sup>	50	75
Dust	Engines and gas turbines	-	10 <sup>(15)(16)</sup>	-	-

(9) Until 1 January 2025, 590 mg/Nm<sup>3</sup> for diesel engines which are part of SIS or MIS

(10) 40 mg/Nm<sup>3</sup> in the case of biogas

(11) 225 mg/Nm<sup>3</sup> for dual fuel engines in liquid mode.

(12) 225 mg/Nm<sup>3</sup> for diesel engines with a total rated thermal input less than or equal to 20 MW with ≤ 1 200 rpm

(13) 190 mg/Nm<sup>3</sup> for dual fuel engines in gas mode.

(14) Until 1 January 2025, 550 mg/Nm<sup>3</sup> for plants which are part of SIS or MIS.

(15) Until 1 January 2025, 75 mg/Nm<sup>3</sup> for diesel engines which are part of SIS or MIS

(16) 20 mg/Nm<sup>3</sup> in the case of plants with a total rated thermal input equal to or greater than 1 MW and less than or equal to 5 MW

### 3. METHODOLOGY

#### 3.1 Scope of the Assessment

The scope of the assessment has been determined in the following way:

- review of air quality data for the area surrounding the site, including data from the Defra Air Quality Information Resource (UK-AIR);
- desk study to confirm the location of nearby areas that may be sensitive to changes in local air quality; and
- review and modelling of emissions data which have been used as input to the UK Atmospheric Dispersion Modelling System (ADMS).

The assessment for the facility comprises a review of emission parameters for the various emission sources and dispersion modelling to predict ground-level concentrations of pollutants at sensitive human and habitat receptor locations.

Predicted ground level concentrations are compared with relevant air quality objectives for the protection of health and critical levels / loads for the protection of sensitive ecosystems and vegetation.

#### 3.2 Methodology

##### 3.2.1 Dispersion Modelling Parameters

The predicted impact of the facility emissions on local air quality has been undertaken using the UK ADMS (Version 6.0).

As a waste treatment process, emissions (refer to **Table 2.2**) have been assumed based on the requirements of the IED and the BREF for the thermal treatment of waste. For the purposes of the modelling assessment, the majority of plant is assumed to be operating at full load, continually throughout the year, ensuring that a worst-case assessment of impacts is presented. Stack emission parameters for the various sources (flow rate, temperature etc.) have been provided by Endolys or derived from similar plant.

For the Group III trace metal predictions, it has been assumed in accordance with the Environment Agency's metals guidance<sup>8</sup>, that each of the metals is emitted at the maximum ELV (assumed to be 0.3 mg/Nm<sup>3</sup>) as a worst case. The same approach has also been adopted for the Group I and II metals.

Where the screening criteria set out in the guidance are not met, typical emission concentrations for energy from waste plants have been used, as specified in the guidance. The waste treatment plant will be equipped with air pollution control equipment specifically designed to control emissions from energy from waste facilities. Therefore, it is not unreasonable to assume that emissions from the facility will be no worse than the maximum measured at municipal waste incinerators.

An emission limit of  $9 \times 10^{-5}$  mg/Nm<sup>3</sup> has been assumed for PAH (benzo(a)pyrene) based on the Defra (WR0608) report on emissions from waste management facilities. Information on PCB emissions has been obtained from the Waste Incineration BREF document which provides a range of PCB emissions from the

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<sup>8</sup> Releases from waste incinerators, Guidance on assessing group 3 metal stack emissions from incinerators – Version 4

incineration of municipal waste. This states that the annual average PCB emission is less than 0.005 mg/Nm<sup>3</sup>. Therefore, the PCB emission is assumed to be 0.005 mg/Nm<sup>3</sup> in the absence of an ELV.

A summary of the input parameters used in the assessment are identified in **Appendix C**.

### 3.2.2 Emissions Sources

Details of the various emissions associated with the proposed waste recycling facility are summarised in **Table 3.1**.

**Table 3.1: Emission Sources**

Source	Description
A1a and A1b, pyrolysis heating	Two separate emissions points, pollutant emissions based on IED/BREF for incineration. Likely to operate for 7,200 hours per annum but assumed to operate continuously.
A2a and A2b, excess syngas combustion	Two separate emissions points, pollutant emissions based on IED/BREF for incineration. Likely to operate for 7,200 hours per annum but assumed to operate continuously.
A3a and A3b, reception, feedstock handling and pyrolysis building ventilation	Two separate emissions points, pollutant emission of dust at 10 mg/Nm <sup>3</sup> . Likely to operate for 7,200 hours per annum but assumed to operate continuously.
A5 Natural gas fired CHP	Single emission point, pollutant emission based on MCPD. Likely to operate for 7,500 hours per annum but assumed to operate continuously.
A6a and A6b, flares	Two separate emission points, pollutant emissions based on landfill gas flare guidance. Three operational scenarios proposed. Scenario 1 (flaring of 2,084 kg/h of syngas) which would operate for only three hours, twice per year. Scenario 2 (flaring of 930 kg/h of syngas) which would operate for 24 hours, once per year. Scenario 3 (flaring of 400 kg/h of syngas) which could operate for up to 10% of the time.
A7, emergency diesel generator	Single emission point, would only operate in the event of a power failure. Estimate that it would only operate once a year for five hours and for testing (30 minutes per month). As a worst-case, assumed to operate for 50 hours per year.

There are other small emissions sources such as emergency relief valves and emissions from tank purging which operate very infrequently or have small emissions. These include the following:

- Vent 1 is an emergency release valve for syngas and could run for up to two hours, with each reactor releasing up to 150kg. These would only release during an emergency event and would occur very infrequently.
- Vent 2 is a breather vent on the oil collection tank. This is a continuous fugitive emission during normal operation, as the tank fills the tank headspace is released via the vent. Likely emissions would be VOCs and the feasibility of abatement via a carbon filter should be considered.
- Vent 3 is a maintenance vent from a number of tanks. Releases would be intermittent and infrequent during a nitrogen purge of the syngas within the tanks during maintenance.
- Vent 4 is also a small volume nitrogen purge and would also occur intermittently and infrequently during maintenance.
- Vent 5 is an oil tank breather vent and would be a continuous fugitive emission during normal operation. Therefore, as for Vent 2, the feasibility of abatement via a carbon filter should be considered.

### 3.2.3 Meteorological Data

Dispersion modelling has been undertaken using five years (2018 to 2022) of hourly sequential meteorological data in order to take account of inter-annual variability and reduce the effect of any atypical conditions. For each receptor (including gridded receptors) and each averaging period, the maximum predicted impact for the five year data set is presented. Therefore, predicted impacts would be representative of the worst-case for the five year period for each receptor.

Data from a meteorological observing station at Durham Tees Valley Airport (approximately 5.1 km east of the facility site) have been used for the assessment. This is the most representative data currently available for the area. Wind roses for each year of meteorological data are presented in **Appendix D**.

### 3.2.4 Building Downwash / Entrainment

The presence of buildings close to emission sources can significantly affect the dispersion of pollutants by leading to a phenomenon called building downwash. This occurs when a building distorts the wind flow, creating zones of increased turbulence. Increased turbulence causes the plume to come to ground earlier than otherwise would be the case and results in higher ground level concentrations closer to the stack.

For buildings that have a width that is greater than their height, downwash effects are only significant where building heights are greater than one third of the emission release height<sup>9</sup>. The downwash structures also need to be sufficiently close for their influence to be significant. All potential downwash structures have been included in the model as detailed in **Table 3.2**.

**Table 3.2: Building Downwash Structures**

Building	Easting	Northing	Height (m)	Length (m)	Width (m)	Angle
East Section	432115	513502	18.4	29	150	93
North Section	432080	513625	13.5	112	92	93
Mid Section	432059	513504	16.2	84	150	93
West Section	432008	513506	10	13	150	93
NW Building	431987	513627	10.2	18	41	93
Gas Buffer	431955	513515	10.2	Diameter = 10 m		
Tanks	431964	513568	11	26	48	93
Flue Gas Treatment	431971	513466	10.5	14	28	93

There are other buildings within the site that are smaller (both in height and width) than the buildings included in **Table 3.2** and located further from the source. Guidance provided by the Environment Agency for detailed modelling of specified generators<sup>10</sup> states that buildings should be considered:

- where the stack height is less than 2.5 times the height of a building;
- the distance of a building from the stack is less than 5L (where L is the lesser dimension of the building height and maximum projected width).

<sup>9</sup> ADMS 6 User Guide (Section 4.9.6)

<sup>10</sup> Specified generators: dispersion modelling assessment - GOV.UK ([www.gov.uk](http://www.gov.uk))

Given the numerous emission sources and buildings included within the model, the main building has been automatically selected for each source.

### 3.2.5 Topography

The presence of elevated terrain can significantly affect the dispersion of pollutants by increasing turbulence and reducing the distance between the plume centre line and the ground level.

A terrain data set has been included in the model to ensure that the impact of terrain features on the dispersion of emissions from the facility is taken into account. Terrain data has been obtained from the OS Landform Panorama data.

### 3.2.6 Nitric Oxide to NO<sub>2</sub> Conversion

Oxides of nitrogen (NO<sub>x</sub>) emitted to atmosphere as a result of combustion will consist largely of nitric oxide (NO), a relatively innocuous substance. Once released into the atmosphere, NO is oxidised to NO<sub>2</sub>. The proportion of NO converted to NO<sub>2</sub> depends on a number of factors including wind speed, distance from the source, solar irradiation and the availability of oxidants, such as ozone (O<sub>3</sub>).

A conversion ratio of 70% NO<sub>x</sub>:NO<sub>2</sub> has been assumed for comparison of predicted concentrations with the long-term objectives for NO<sub>2</sub>. A conversion ratio of 35% has been utilised for the assessment of short-term impacts, as recommended by the Environment Agency's Risk Assessment Guidance<sup>11</sup>.

### 3.2.7 Sensitive Human Receptors

LAQM.TG(22) describes in detail typical locations where consideration should be given to pollutants defined in the Regulations. Generally, the guidance suggests that all locations 'where members of the public are regularly present' should be considered. At such locations, members of the public will be exposed to pollution over the time that they are present, and the most suitable averaging period of the pollutant needs to be used for assessment purposes.

For instance, on a footpath, where exposure will be transient (for the duration of passage along that path) comparison with short-term standard (i.e. 15-minute mean or 1-hour mean) may be relevant. In a school, or adjacent to a private dwelling, however; where exposure may be for longer periods, comparison with long-term (such as 24-hour mean or annual mean) standards may be most appropriate. In general terms, concentrations associated with long-term standards are lower than short-term standards owing to the chronic health effects associated with exposure to low level pollution for longer periods of time.

The locations of the discrete sensitive receptors selected for the assessment are presented in **Table 3.3** and **Figure 3.1**.

#### **Table 3.3: Human Health Receptors**

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<sup>11</sup> <https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit>

ID	Receptor	Type	Easting	Northing
R1	Business Park	Commercial	432226	513483
R2	Pioneer Court	Commercial	432231	513620
R3	Morton Park Hotel	Residential/leisure	432236	513823
R4	Offices	Commercial	432041	513849
R5	Driving Test Centre	Commercial	431858	513561
R6	Farmhouse	Residential	432123	513204
R7	Morton Grange Farm	Residential	432908	513668
R8	Aeolian House	Residential	432797	513999
R9	Woodlands Hospital	Hospital	432144	513972
R10	Travelodge	Residential/leisure	431748	513937
R11	Yarm Road	Residential	431286	514092
R12	Recreation Ground	Leisure	431305	513832
R13	Estoril Road	Residential	431132	513958
R14	School	Educational	430787	513874
R15	Warren Close	Residential	431171	513515
R16	Firthmoor Academy	Educational	430966	513417

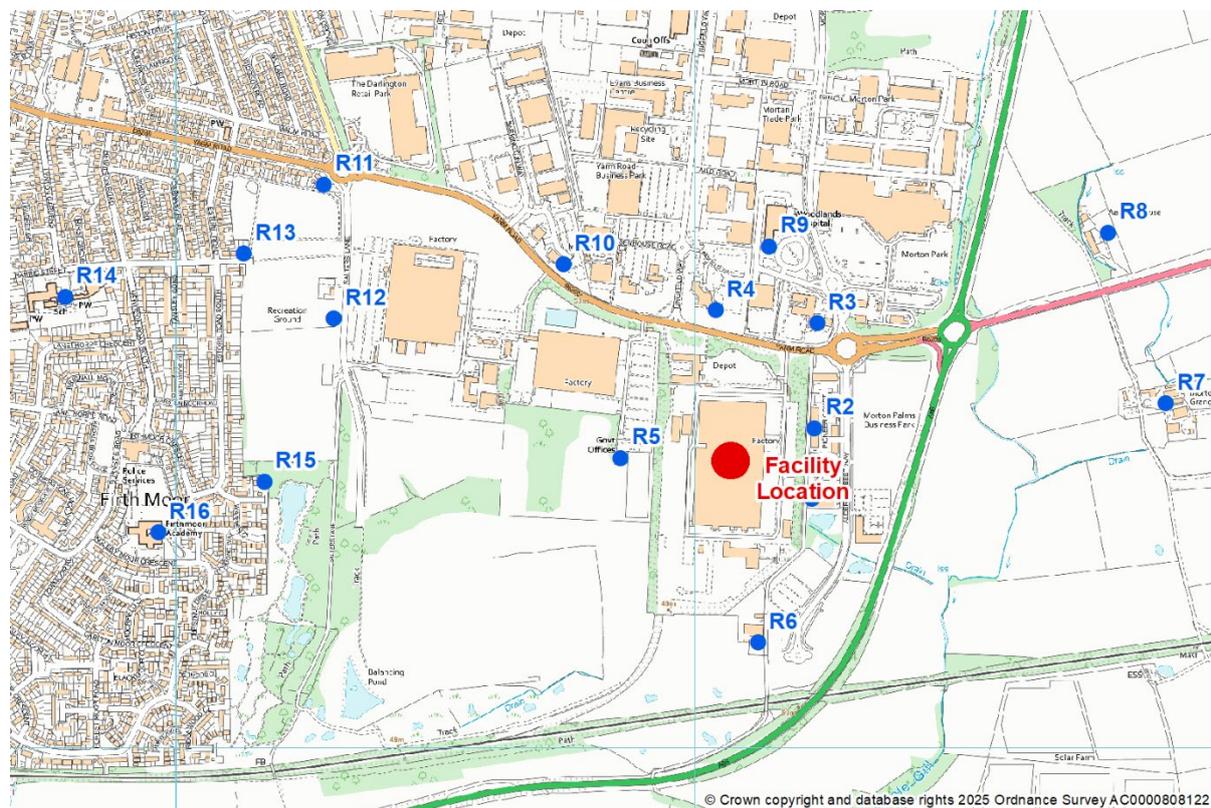


Figure 3.1: Sensitive Human health Receptor Locations

Pollutant concentrations have been predicted at both discrete receptor locations and the maximum predicted concentration over a 3 km by 3 km Cartesian grid of 30 m grid resolution. All receptor locations (discrete and gridded receptors) are assumed to be at a height of 0 m (i.e. at ground level).

### 3.2.8 Sensitive Habitat Receptors

The Environment Agency's Risk Assessment Guidance states that the impact of emissions to air on vegetation and ecosystems should be assessed for the following habitat sites within 10 km of the source:

- Special Areas of Conservation (SACs) and candidate SACs (cSACs) designated under the EC Habitats Directive;
- Special Protection Areas (SPAs) and potential SPAs designated under the EC Birds Directive; and
- Ramsar Sites designated under the Convention on Wetlands of International Importance

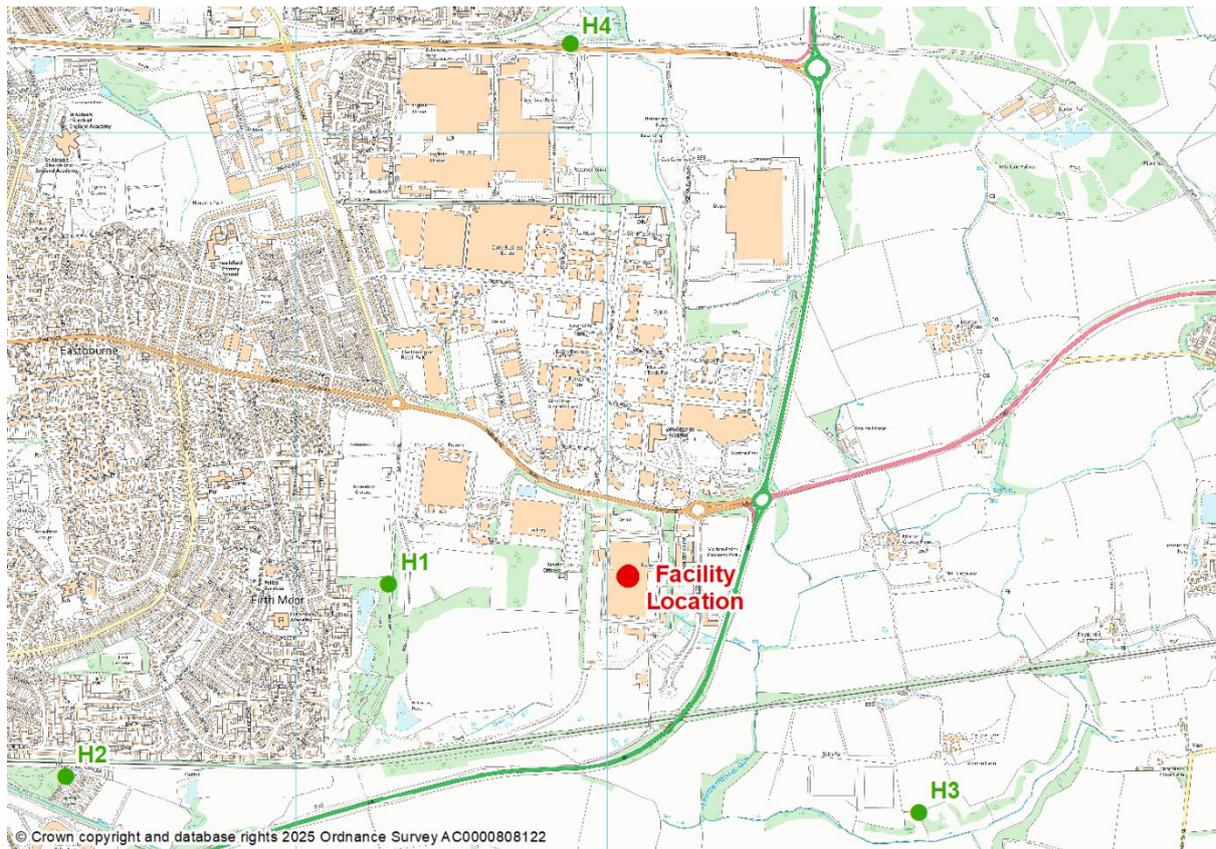
Within 2 km of the source:

- Sites of Special Scientific Interest (SSSI) established by the 1981 Wildlife and Countryside Act;
- National Nature Reserves (NNR);
- Local Nature Reserves (LNR);
- local wildlife sites (Biological Heritage Sites (BHS), Sites of Interest for Nature Conservation, (SINC), Sites of Local Interest for Nature Conservation (SLINC) and County Wildlife Sites (CWS)); and
- Ancient Woodland (AW).

Habitat receptor designations and locations relevant to the assessment are presented in **Table 3.4** and the location of each is presented in **Figure 3.2**.

**Table 3.4: Sensitive Habitat Receptors**

Receptor	Assumed Primary Habitat	Easting	Northing
H1. Maidendale Fishing & Nature Reserve LNR/LWS	Neutral grassland	431299	513532
H2. Brankin Moor LNR/LWS	Woodland	430258	512907
H3. Hunger Hill Farm LWS	Woodland	433006	512789
H4. Red Hall LWS	Neutral grassland	431884	515287



**Figure 3.2: Sensitive Habitat Locations**

Where appropriate, the modelled ground level pollutant concentrations are used to predict deposition rates, using typical deposition velocities. A summary of typical NO<sub>2</sub>, SO<sub>2</sub>, NH<sub>3</sub> and HCl dry deposition velocities is presented in **Table 3.5**.

**Table 3.5: Dry Deposition Velocities (m/s)**

Pollutant	Grassland	Woodland
Nitrogen Dioxide (NO <sub>2</sub> )	0.0015	0.0030
Sulphur Dioxide (SO <sub>2</sub> )	0.012	0.024
Hydrogen Chloride (HCl)	0.025	0.06
Ammonia (NH <sub>3</sub> )	0.02	0.03

The predicted nitrogen deposition rate assumes a 100% NO<sub>x</sub>: NO<sub>2</sub> conversion. This represents a worst-case for the assessment since nitric oxide (NO) has a lower deposition velocity than NO<sub>2</sub> and would consequently result in lower deposition rates.

It is considered that wet deposition of SO<sub>2</sub> and NO<sub>2</sub> is not significant within a short range<sup>12</sup>. However, wet deposition of HCl and HNO<sub>3</sub> should be considered where a process emits these species. Therefore, a wet deposition rate for HCl has been calculated using a dry to wet deposition ratio, as follows:

$$\text{HCl wet deposition rate} = \text{HCl dry deposition rate} \times \text{wet-to-dry deposition ratio}$$

<sup>12</sup> AQTAG06 Technical Guidance on Detailed Modelling Approach for an Appropriate Assessment for Emissions to Air

Within a few kilometres of the source, the wet deposition rate is comparable to the dry deposition rate and with increasing distance, the wet deposition fraction becomes a smaller fraction of the total HCl deposition. As a worst-case, the wet-to-dry deposition ratio is assumed to be at unity at all the identified habitat sites.

Predicted ground level concentrations and acidification/ deposition rates are compared with relevant critical levels and critical loads for the protection of sensitive ecosystems and vegetation (see **Appendix E**).

### 3.3 Significance Criteria

#### 3.3.1 Impacts on Human Health

The Environment Agency has developed criteria for assessing the significance of an impact compared with relevant air quality standards and background air quality<sup>13</sup>. A process contribution (PC) is considered not significant if:

- the long-term PC < 1% of the long-term air quality standard; and/or
- the short-term PC < 10% of the short-term air quality standard.

At 1% of the long-term air quality standard, the impact of a development is unlikely to be significant compared with background air quality. Both the short- and long-term criteria are also designed to ensure that there is a substantial safety margin to protect public health and the environment.

If the screening criteria are not met the process contribution should be considered in combination with relevant ambient background pollutant concentrations. The air quality standards are likely to be met if:

- the long-term PC + background concentration < 70% of the air quality standard; and/or
- the short-term PC < 20% of the air quality standard minus the short-term background concentration, where the short-term background concentration is assumed to be twice the long-term background concentration.

For the Group III metals the significance of emissions is determined following the Environment Agency guidance on releases from waste Incinerators, which recommends a two-step approach to screening group III metal emissions, which is as follows:

- Step One – predict metal concentrations assuming each metal is being emitted at 100% of the group ELV. The results are compared against the following criteria:
  - Where the PC of any metal exceeds 1% of the long-term or 10% of the short-term air quality standard, then the PEC should be compared to the air quality standard.
  - Where the PEC exceeds 100% of the air quality standard, then the assessment should proceed to Step Two.
- Step Two – make predictions for the metals exceeding the criteria in Step One, using emission concentrations provided in the guidance. Where the PC of any metal exceeds 1% of the long-term or 10% of the short-term air quality standard, then the PEC should be compared to the air quality standard. Where the PEC exceeds 100% of the air quality standard, then the impact of the metal can be considered to be significant.

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13 <https://www.gov.uk/guidance/risk-assessments-for-your-environmental-permit>

### 3.3.2 *Impacts on Habitat Sites*

The Environment Agency has developed criteria for assessing at SPAs, SACs, Ramsar sites and SSSIs, compared with the relevant EAL and background air quality. The criteria are designed to ensure that there is a substantial safety margin to protect the environment.

#### *Stage 1*

A process contribution (PC) is considered not significant if:

- The long term PC < 1% of the long-term EAL
- The short term PC < 10% of the short-term EAL

#### *Stage 2*

If the Stage 1 screening criteria are not met, the PC should be considered in combination with relevant ambient background pollutant concentrations. The air quality standards are likely to be met if:

- The long term PC + background concentration < 70% of the EAL
- The short term PC < 20% of the (EAL – short term background concentration)

For local nature sites (SINCs, SLINCs, NNRs, LNRs and ancient woodland), a process contribution (PC) is considered not significant if:

- The long term PC < 100% of the long-term EAL
- The short term PC < 100% of the short-term EAL

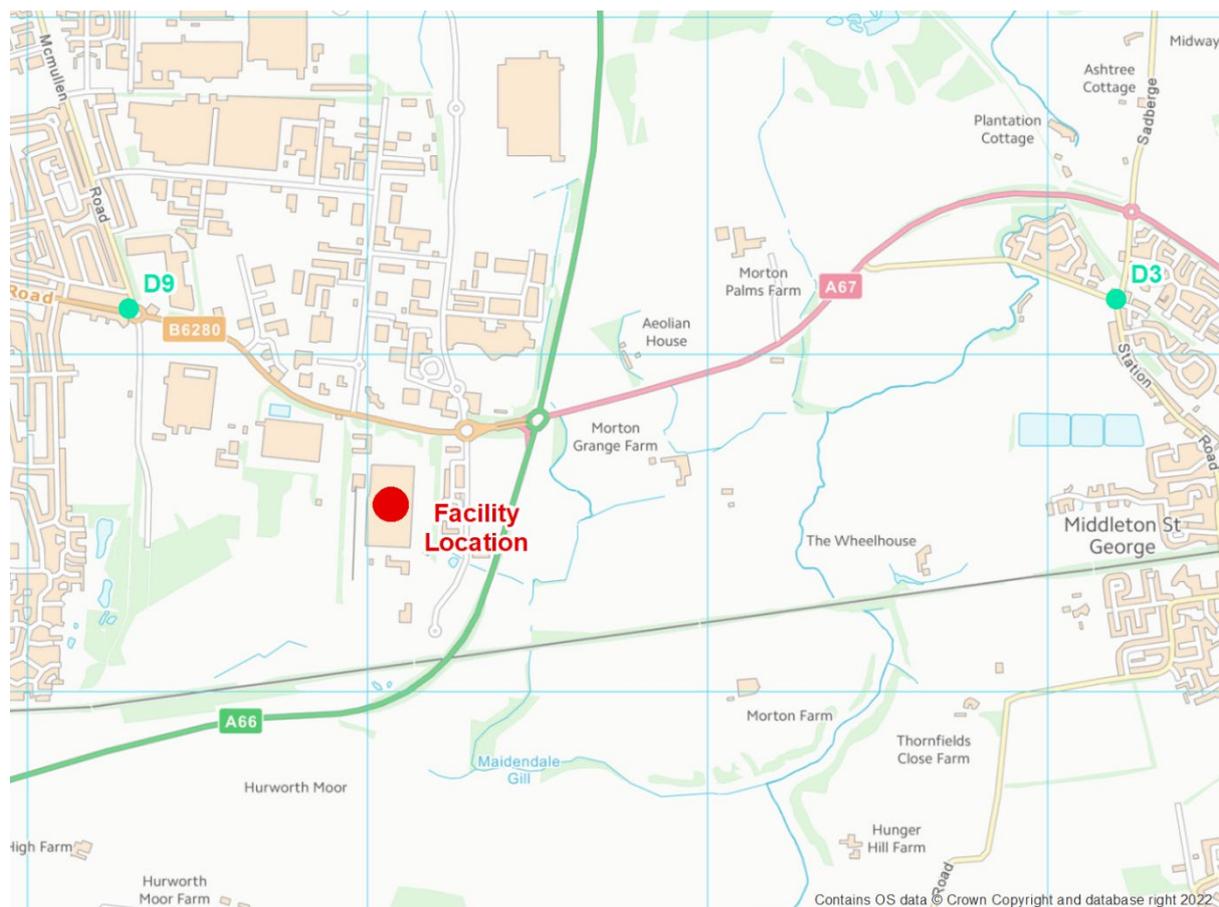
## 4. BASELINE CONDITIONS

### 4.1 Introduction

This section provides an assessment of baseline conditions for the facility site. The assessment of impacts requires an analysis of the change in pollutant concentrations with the relevant air quality standard taking into account background concentrations of the pollutant. Background monitoring data is not always available locally, particularly in areas that have good air quality. However, it is normal practice to obtain data from a comparable location to describe the air quality at the facility site. Therefore, air quality at the facility site has been characterised based on monitoring data and modelled data obtained from national and local sources.

### 4.2 Nitrogen Dioxide (NO<sub>2</sub>)

Darlington Borough Council did not undertake automatic ambient air quality monitoring within their administrative area in 2024. The council has a network of diffusion tube monitoring locations with monitoring of annual mean NO<sub>2</sub> carried out at 16 locations in 2024. Two of these monitoring sites (D3 and D9) are located within 2 km of the facility site, refer **Figure 4.1**. Measured concentrations between 2022 and 2024 are presented in **Table 4.1**.



**Figure 4.1: Diffusion Tube Monitoring Sites within 2 km of the Facility Site**

**Table 4.1: Annual Mean NO<sub>2</sub> Concentrations with 2 km of the Facility Site**

Monitoring Site	Type	2022	2023	2024
D3 Middleton St George	Roadside	10.9	11.2	11.2
D9 Yarm Road	Roadside	19.7	19.1	18.4

Both monitoring sites are roadside locations and will measure higher concentrations than might be experienced at residential locations. However, measured concentrations are well below the annual mean air quality objective for NO<sub>2</sub> of 40 µg/m<sup>3</sup>.

For comparison, annual mean NO<sub>2</sub> background concentrations for 2025 have also been obtained from the Defra UK Background Air Pollution Maps. The latest background maps were issued in November 2024 and are based on 2021 monitoring data. The 2025 mapped annual mean NO<sub>2</sub> background concentration for the facility site and surrounding area is 9.4 µg/m<sup>3</sup>, 24% of the air quality objective. This is the maximum for the twelve 1 km<sup>2</sup> grid squares surrounding the facility.

For the purposes of the assessment a background concentration of 18.4 µg/m<sup>3</sup> has been adopted as the highest concentration measured in 2024. As a roadside location, it is considered that this is representative of the worst-case.

### 4.3 Carbon Monoxide (CO)

Monitoring of background CO concentrations is not currently undertaken by DBC. Therefore, concentrations have been obtained from the Defra background maps. The CO mapping is based on 2001 monitoring data and it is assumed as a worst-case that 2001 concentrations would be representative of future years.

The 2001 maximum annual mean background CO concentration for the twelve 1 km<sup>2</sup> grids surrounding the facility site is 292 µg/m<sup>3</sup>.

### 4.4 Particulate Matter (PM<sub>10</sub> and PM<sub>2.5</sub>)

DBC did not undertake automatic monitoring of PM<sub>10</sub> or PM<sub>2.5</sub> in 2024. The maximum Defra background mapped concentration for 2025 is 11.8 µg/m<sup>3</sup> for PM<sub>10</sub> and 6.1 µg/m<sup>3</sup> for PM<sub>2.5</sub> for the twelve 1 km<sup>2</sup> grids located around the site. These are assumed to be representative of air quality at the facility site.

### 4.5 Sulphur Dioxide (SO<sub>2</sub>)

Automatic monitoring of SO<sub>2</sub> concentrations is not currently undertaken by DBC. The maximum mapped SO<sub>2</sub> concentration for the area surrounding the facility site is 2.9 µg/m<sup>3</sup>. The SO<sub>2</sub> mapping is based on 2001 monitoring data and the 2025 SO<sub>2</sub> concentrations are assumed to be 100% of the published 2001 estimates and represents a worst-case.

### 4.6 Total Organic Carbon (as Benzene)

DBC does not undertake ambient monitoring of benzene. Therefore, concentrations have been obtained from the Defra UK Background Air Pollution Maps. The mapped benzene concentrations are based on 2001 monitoring data, projected to 2010. These are the most recent projections available and are assumed to be representative of concentrations in future years. The maximum estimated 2010 annual mean background benzene concentration for the area surrounding the facility is 0.30 µg/m<sup>3</sup>.

## 4.7 Hydrogen Chloride (HCl)

Ambient monitoring of hydrogen chloride has been carried out as part of the Defra Acid Gases & Aerosol Network at a number of locations around the UK. The closest monitoring site is at High Muffles (rural background site), which is 50 km east-southeast of the site. This is some distance from the development site and in a more remote location and may underestimate measured concentrations at the site.

There are no data beyond 2015 but monthly measured concentrations in 2015 varied between 0.03 and 0.21  $\mu\text{g}/\text{m}^3$ . Therefore, the highest monthly concentration (0.21  $\mu\text{g}/\text{m}^3$ ) is assumed to be representative of annual mean concentration at the facility site.

## 4.8 Hydrogen Fluoride (HF)

It is difficult to identify an appropriate background HF concentration as HF is not routinely measured in the UK, even historically. Furthermore, any measurements that have been made have been obtained from heavily industrialised locations.

Measurements obtained in the UK between 1984 and 1986 in the Marston Vale region of Bedfordshire where there was a high density of brickworks<sup>14</sup>, a known source of HF, revealed monthly mean concentrations of 0.040 to 0.86  $\mu\text{g}/\text{m}^3$ . Daily mean concentrations of up to 2.2  $\mu\text{g}/\text{m}^3$  were also measured. These concentrations would not be characteristic of measured concentrations around the facility as concentrations measured forty years ago would not reflect present day regulatory controls. Data provided by the UK National Atmospheric Emissions Inventory (NAEI) indicates that emissions of HF have reduced from around 8 kilotonnes per annum (kt/a) in 1993 to less than 1 kt/a in 2021 mainly due to the decommissioning of coal fired power stations.

Information provided by the World Health Organization (WHO) in 2002<sup>15</sup> indicated that in areas not in the direct vicinity of emission sources, the mean concentrations of fluoride in ambient air would be generally less than 0.1  $\mu\text{g}/\text{m}^3$ . Therefore, given the reduction in emissions since this time it is concluded that a concentration of 0.1  $\mu\text{g}/\text{m}^3$  as an annual mean would be representative of the worst-case for the installation site.

## 4.9 Trace Metals

Defra has undertaken monitoring of trace elements at a number of locations in the UK since 1976 as part of the UK Urban and Rural Heavy Metals Monitoring Network. The nearest monitoring sites are located in and around Scunthorpe but these are urban industrial sites. Further afield, monitoring is carried out in Eskdalemuir (rural background site), two locations in Sheffield and one location in Chesterfield. The Sheffield and Chesterfield sites are urban background locations. Measured concentrations at the three urban background sites in 2024 are summarised in **Table 4.2**.

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14 EPAQS (February 2006), Guidelines for Halogen and Hydrogen Halides in Ambient Air for Protecting Human Health Against Acute Irritancy Effects.

15 Fluorides, Environmental Health Criteria 227, World Health Organization (2002)

**Table 4.2: Annual Mean Trace Metal Concentrations in 2024 (ng/m<sup>3</sup>)**

Pollutant	Sheffield Tinsley	Sheffield Devonshire Green	Chesterfield Loundsley Green	EAL
Antimony (Sb)	No data available	No data available	No data available	5,000-
Arsenic (As)	0.78	0.62	0.91	6
Cadmium (Cd)	0.24	0.13	0.091	5
Chromium (Cr)	30.5	4.3	2.8	-
Cobalt (Co)	0.56	0.13	0.071	1,000
Copper (Cu)	12.4	7.4	3.5	-
Lead (Pb)	12.5	5.1	4.4	250
Manganese (Mn)	26.8	6.6	3.9	150
Mercury (Hg)	No data available	No data available	No data available	-
Nickel (Ni)	14.6	1.6	1.3	20
Thallium (Tl)	No data available	No data available	No data available	1,000
Vanadium (V)	1.2	0.73	0.50	-

It is considered that concentrations measured in and around Sheffield will be higher than measured at the facility site. Therefore, it is assumed that measured concentrations at the Chesterfield site will be characteristic of concentrations at the site.

There are no measurements of antimony, mercury or thallium. There have been some historical measurements of gaseous mercury at a couple of monitoring locations up to 2018 when monitoring appears to have ceased. Measured concentrations of gaseous mercury were measured at the London Westminster site and the Runcorn Weston Point site between 2015 and 2018. Neither of these sites are characteristic of the facility location as London is heavily trafficked and Runcorn Weston Point is heavily industrial. Maxima annual mean concentrations at these two sites for the four years were 2.7 ng/m<sup>3</sup> and 20.1 ng/m<sup>3</sup> for the London Westminster and Runcorn Weston Point site, respectively. For the purposes of the assessment, it is assumed that measured concentrations at London Westminster (2.7 ng/m<sup>3</sup>) are characteristic of the site and surroundings.

Guidance issued by the Environment Agency<sup>8</sup> for the assessment of Group 3 metals, states that for screening purposes it should be assumed that Cr(VI) comprises 20% of the total background chromium. On this basis the average Cr(VI) concentration at 0.56 ng/m<sup>3</sup> would be more than double the EAL of 0.25 ng/m<sup>3</sup>. All other measured concentrations are well below the respective annual mean EALs where they exist.

#### 4.10 Dioxins and Furans

Monitoring of PCDD/Fs is currently carried out by Defra at six locations in the UK (Hazelrigg, High Muffles, London, Manchester, Auchencorth Moss and Weybourne) as part of the Toxic Organic Micropollutants (TOMPs) Network.

To provide an indication of the range of PCDD/F concentrations that occur in the UK, a summary of the annual mean concentrations measured between 2013 and 2015 is presented in **Table 4.3**.

**Table 4.3: UK PCDD/Fs Concentrations (fg TEQ/m<sup>3</sup>)**

Monitoring Site	Type	2013	2014	2015
London	Urban background	3.5	2.9	4.4
Manchester	Urban background	10.0	17.0	6.0
Auchencorth Moss	Rural background	0.87	0.01	0.01
High Muffles	Rural background	0.6	1.1	0.5
Hazelrigg	Rural background	2.0	2.6	5.3
Weybourne	Rural background	2.3	1.6	1.4

In general, the concentration of dioxins and furans at rural locations is considerably lower than at urban locations. The mean for urban background locations for the three years is 7.3 fg TEQ/m<sup>3</sup>. Whereas for the rural background sites the mean is 1.5 fg TEQ/m<sup>3</sup>.

Therefore, the average concentration measured at the four rural background monitoring sites from 2013 to 2015 (1.5 fg TEQ/m<sup>3</sup>) is assumed to be reasonably representative of the baseline dioxin and furan concentration at the facility site and nearby sensitive receptors.

#### 4.11 Polycyclic Aromatic Hydrocarbons (as benzo[a]pyrene)

Monitoring of benzo(a)pyrene (BaP) is currently carried out by Defra at a number of locations in the UK as part of the TOMPS and PAH monitoring and analysis network. The nearest monitoring location is located at Middlesborough (20 km to the east-northeast of the site) and is an urban background site. The annual average concentrations of BaP between 2022 and 2024 were 0.15 to 0.17 ng/m<sup>3</sup>. It is assumed that a background concentration of 0.17 ng/m<sup>3</sup> is a reasonable estimate of the background concentration in the vicinity of the facility site.

#### 4.12 Polychlorinated Biphenyls

Monitoring of PCBs is currently carried out by Defra at six locations in the UK as part of the TOMPs Network. The average PCB concentration measured at the urban background monitoring sites (London and Manchester) from 2013 to 2015 is 106 pg/m<sup>3</sup> and for the rural background sites (Auchencorth Moss, High Muffles, Hazelrigg and Weybourne) 24 pg/m<sup>3</sup>. Given the more rural nature of the site, the average rural background concentration is assumed to be reasonably representative of the baseline PCB concentration at the facility site and nearby sensitive receptors.

#### 4.13 Summary of Background Concentrations

A summary of the annual mean and short-term background concentrations assumed for the assessment is presented in **Table 4.4**. The current background concentrations are assumed to be representative of future year concentrations. Since pollutant concentrations are expected to decline in the future, this methodology ensures that the worst-case impacts are determined (i.e. future impacts combined with existing air quality).

**Table 4.4: Summary of Background Concentrations**

Pollutant	Annual Mean	Short-Term	
		Concentration	Averaging Period
Particles (PM <sub>10</sub> )	11.8 µg/m <sup>3</sup>	13.9 µg/m <sup>3</sup> (a)(b)	24-hour
Particles (PM <sub>2.5</sub> )	6.1 µg/m <sup>3</sup>	n/a	n/a
Nitrogen Dioxide (NO <sub>2</sub> )	18.4 µg/m <sup>3</sup>	36.8 µg/m <sup>3</sup> (a)	1-hour
Sulphur Dioxide (SO <sub>2</sub> )	2.9 µg/m <sup>3</sup>	3.4 µg/m <sup>3</sup> (a)(b)	24-hour
		5.8 µg/m <sup>3</sup> (a)	1-hour
		7.8 µg/m <sup>3</sup> (a)(d)	15-minute
Carbon Monoxide (CO)	292 µg/m <sup>3</sup>	409 µg/m <sup>3</sup> (a)(c)	8-hour
		584 µg/m <sup>3</sup> (a)	1-hour
Hydrogen Fluoride (HF)	0.1 µg/m <sup>3</sup>	0.2 µg/m <sup>3</sup> (a) 0.2 µg/m <sup>3</sup> (e)	1-hour Monthly/weekly
Hydrogen Chloride (HCl)	0.21 µg/m <sup>3</sup>	0.42 µg/m <sup>3</sup> (a)	1-hour
TOC (as benzene)	0.30 µg/m <sup>3</sup>	0.35 µg/m <sup>3</sup> (a)(b)	24-hour
Ammonia (NH <sub>3</sub> )	2.4 µg/m <sup>3</sup>	4.8 µg/m <sup>3</sup>	1-hour
Dioxins and Furans (PCDD/Fs)	1.5 fg/m <sup>3</sup>	n/a	n/a
Antimony (Sb)	No data available	No data available	n/a
Arsenic (As)	0.91 ng/m <sup>3</sup>	n/a	n/a
Cadmium (Cd)	0.091 ng/m <sup>3</sup>	0.11 ng/m <sup>3</sup> (a)(b)	24-hour
Chromium (Cr)	2.8 ng/m <sup>3</sup>	3.3 ng/m <sup>3</sup> (a)(b)	24-hour
Cobalt (Co)	0.071 ng/m <sup>3</sup>	n/a	n/a
Copper (Cu)	3.5 ng/m <sup>3</sup>	4.1 ng/m <sup>3</sup> (a)(b)	24-hour
Lead (Pb)	4.4 ng/m <sup>3</sup>	n/a	n/a
Manganese (Mn)	3.9 ng/m <sup>3</sup>	7.8 ng/m <sup>3</sup> (a)	1-hour
Mercury (Hg)	2.7 ng/m <sup>3</sup>	3.2 ng/m <sup>3</sup> (a)(b)	24-hour
		5.4 ng/m <sup>3</sup> (a)	1-hour
Nickel (Ni)	1.3 ng/m <sup>3</sup>	2.6 ng/m <sup>3</sup> (a)	1-hour
Thallium (Tl)	No data available	n/a	n/a
Vanadium (V)	0.50 ng/m <sup>3</sup>	0.59 ng/m <sup>3</sup> (a)(b)	24-hour
Polycyclic Aromatic Hydrocarbons (as BaP)	0.17 ng/m <sup>3</sup>	n/a	n/a
Polychlorinated biphenyls (PCBs)	0.024 ng/m <sup>3</sup>	0.048 ng/m <sup>3</sup> (a)	1-hour

- (a) 1-hour mean background concentration estimated by multiplying the annual mean by a factor of 2 in accordance with the EA Guidance.
- (b) 24-hour mean background concentration estimated by multiplying the 1-hour mean by a factor of 0.59 in accordance with the EA Guidance.
- (c) 8-hour mean background concentration estimated by multiplying the 1-hour mean by a factor of 0.70 in accordance with the EA Guidance.
- (d) 15-minute mean background concentration estimated by multiplying the 1-hour mean by a factor of 1.34 in accordance with the EA Guidance.
- (e) In the absence of correction factors for these averaging periods.

## 5. ASSESSMENT OF OPERATIONAL IMPACTS

### 5.1 Human Health Impacts

#### 5.1.1 Introduction

Predicted process contributions (PC) for the five years of meteorological data are presented as the maximum concentration for each of the discrete receptors identified in **Section 3.3**. The worst-case meteorological year for each pollutant, receptor and averaging period is provided.

The maximum PC at any discrete receptor is added to the estimated background concentration for the area (see **Table 3.4**) to give the total predicted environmental concentration (PEC) for comparison with the relevant air quality assessment level (AQAL). The significance of the impacts has been assessed in accordance with the Environment Agency's Risk Assessment Guidance.

#### 5.1.2 Nitrogen Dioxide (NO<sub>2</sub>)

The maximum predicted annual mean and 99.8<sup>th</sup> percentile of 1-hour mean ground level NO<sub>2</sub> concentrations are presented in **Table 5.1** and **Table 5.2**, respectively. Emissions from sources A1a, A1b, A2a, A2b, A5, A6a, A6b and A7 have been included in the dispersion model for NO<sub>2</sub>.

**Table 5.1: Predicted Annual Mean Concentrations of NO<sub>2</sub>**

Receptor	PC (µg/m <sup>3</sup> )	PC (% AQAL)	PEC (µg/m <sup>3</sup> )	PEC (% AQAL)
Maximum Predicted	6.2	15.4%	24.6	61.4%
R1. Business Park	2.3	5.8%	20.7	51.8%
R2. Pioneer Court	2.6	6.5%	21.0	52.5%
R3. Morton Park Hotel	2.0	5.0%	20.4	51.0%
R4. Offices	2.7	6.8%	21.1	52.8%
R5. Driving Test Centre	1.4	3.4%	19.8	49.4%
R6. Farmhouse	1.4	3.5%	19.8	49.5%
R7. Morton Grange Farm	0.49	1.2%	18.9	47.2%
R8. Aeolian House	0.58	1.5%	19.0	47.5%
R9. Woodlands Hospital	1.8	4.4%	20.2	50.4%
R10. Travelodge	1.2	2.9%	19.6	48.9%
R11. Yarm Road	0.26	0.7%	18.7	46.7%
R12. Recreation Ground	0.23	0.6%	18.6	46.6%
R13. Estoril Road	0.18	0.4%	18.6	46.4%
R14. School	0.10	0.2%	18.5	46.2%
R15. Warren Close	0.17	0.4%	18.6	46.4%
R16. Firthmoor Academy	0.14	0.4%	18.5	46.4%
<b>AQAL (µg/m<sup>3</sup>)</b>	<b>40</b>			
<b>Background (µg/m<sup>3</sup>)</b>	<b>18.4</b>			
<b>Maximum PC as %age of AQAL</b>	<b>6.8%</b>			

Maximum PEC as %age of AQAL

52.8%

At sensitive receptors, the PC is 6.8% of the AQAL and at greater than 1% of the AQAL would be assessed as potentially significant. However, the PEC is 52.8% of the AQAL and in accordance with the Environment Agency's Risk Assessment Guidance it is unlikely that the AQAL would be exceeded. Furthermore, there is no relevant public exposure at this location (i.e. residential properties). For the maximum predicted concentration anywhere within the model domain the PC is 15% of the AQAL but the PEC is well below 70% or less of the AQAL. The location of the predicted maximum occurs within the site boundary (refer **Figure 5.1**) where there is no relevant long-term public exposure. Therefore, it is concluded that the long-term impact of the emissions of NO<sub>x</sub> from the facility would be 'not significant' or 'unlikely that the AQAL would be exceeded'.

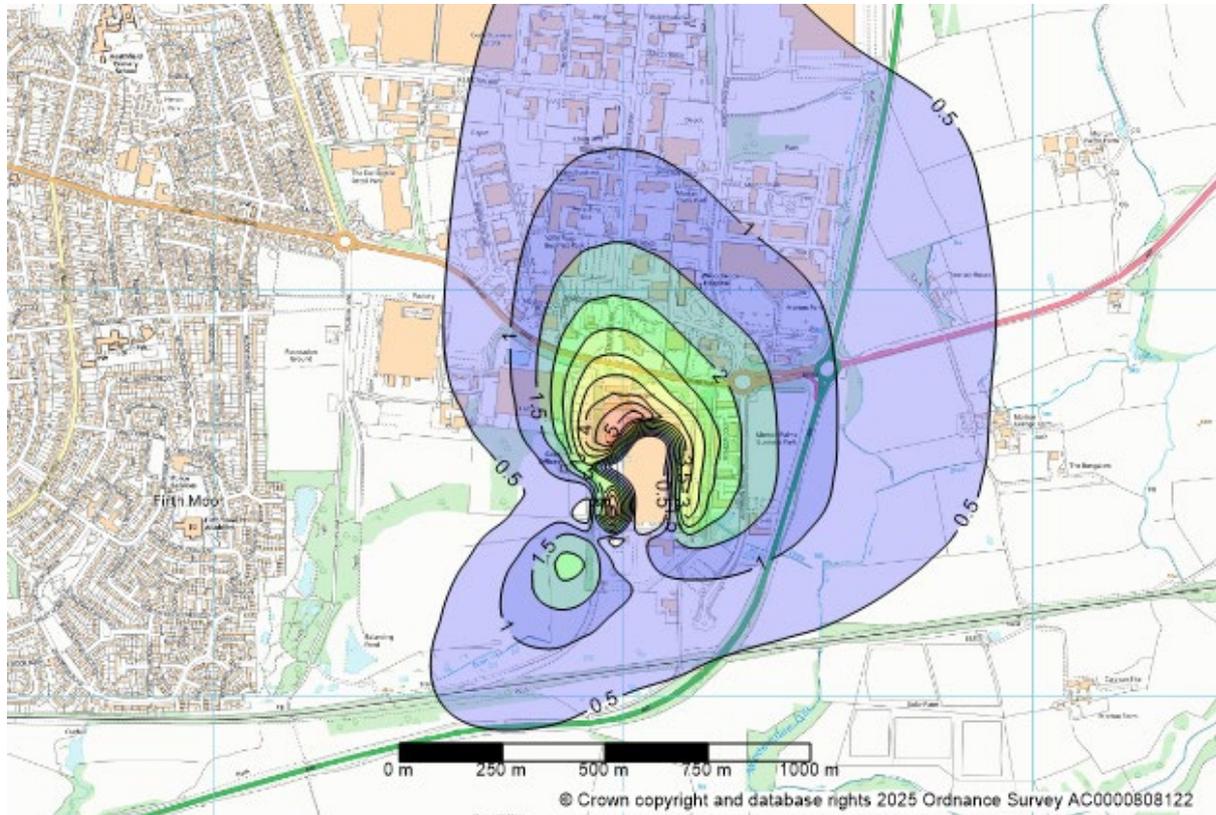
**Table 5.2: Predicted 99.8<sup>th</sup> Percentile of 1-hour Mean Concentrations of NO<sub>2</sub>**

Receptor	PC (µg/m <sup>3</sup> )	PC (% AQAL)	PEC (µg/m <sup>3</sup> )	PEC (% AQAL)
Maximum Predicted	92.3	46.1%	129	64.5%
R1. Business Park	26.2	13.1%	63.0	31.5%
R2. Pioneer Court	27.9	13.9%	64.7	32.3%
R3. Morton Park Hotel	18.7	9.4%	55.5	27.8%
R4. Offices	20.4	10.2%	57.2	28.6%
R5. Driving Test Centre	31.3	15.6%	68.1	34.0%
R6. Farmhouse	20.7	10.4%	57.5	28.8%
R7. Morton Grange Farm	8.4	4.2%	45.2	22.6%
R8. Aeolian House	9.1	4.6%	45.9	23.0%
R9. Woodlands Hospital	15.2	7.6%	52.0	26.0%
R10. Travelodge	12.9	6.5%	49.7	24.9%
R11. Yarm Road	7.8	3.9%	44.6	22.3%
R12. Recreation Ground	8.6	4.3%	45.4	22.7%
R13. Estoril Road	7.2	3.6%	44.0	22.0%
R14. School	5.1	2.5%	41.9	20.9%
R15. Warren Close	7.9	3.9%	44.7	22.3%
R16. Firthmoor Academy	6.3	3.1%	43.1	21.5%
AQAL (µg/m <sup>3</sup> )	200			
Background (µg/m <sup>3</sup> )	36.8			
Maximum PC as %age of AQAL	15.6%			
Maximum PEC as %age of AQAL	34.0%			

The hourly-mean predicted concentrations are 10% or less of the AQAL at the majority of residential receptors and would be described as 'not significant' according to the Environment Agency's Risk Assessment Guidance. At some of the receptors, predicted concentrations would be assessed as potentially significant. However, at these locations, predicted concentrations are less than 20% of the difference

between the AQAL and background concentration ( $32.6 \mu\text{g}/\text{m}^3$ ) and it is unlikely that this would be exceeded. Therefore, it is concluded that the short-term impact of the emissions of  $\text{NO}_x$  from the facility would be 'not significant' or 'unlikely that the AQAL would be exceeded'.

Predicted annual mean and 99.8th percentile of hourly mean  $\text{NO}_2$  concentrations for the most recent meteorological year (2022), are presented as contour plots in **Figure 5.1** and **Figure 5.2**, respectively.



*Figure 5.1: Predicted Annual Mean  $\text{NO}_2$  Concentrations ( $\mu\text{g}/\text{m}^3$ )*

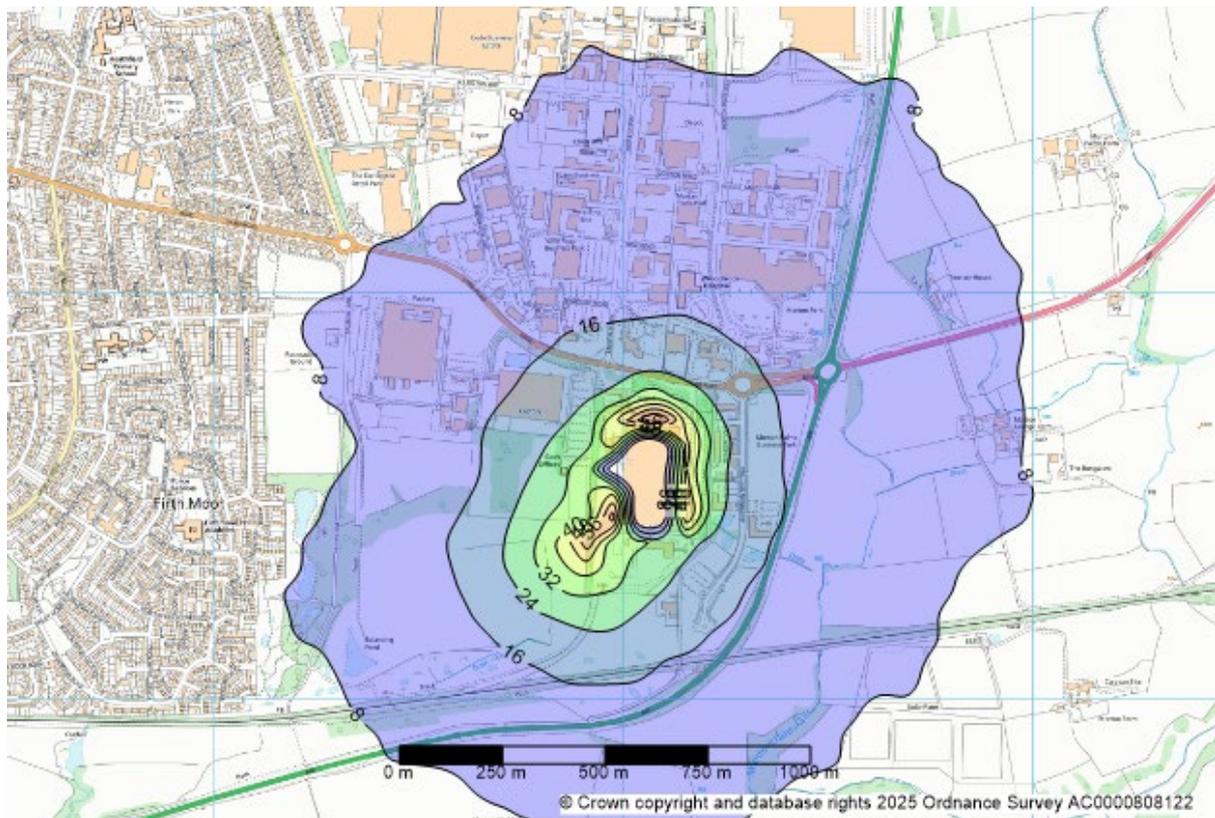


Figure 5.2: Predicted 99.8<sup>th</sup> Percentile of 1-Hour Mean NO<sub>2</sub> Concentrations (µg/m<sup>3</sup>)

### 5.1.3 Carbon Monoxide (CO)

Maximum predicted 8-hour and 1-hour mean ground level CO concentrations are compared to the relevant AQAL in Table 5.3 and Table 5.4, respectively. Emissions from sources A1a, A1b, A2a, A2b, A5, A6a, A6b and A7 have been included in the dispersion model for CO.

Table 5.3: Predicted Maximum 8-hour Mean CO Concentrations

Receptor	PC (µg/m <sup>3</sup> )	PC (% AQAL)	PEC (µg/m <sup>3</sup> )	PEC (% AQAL)
Maximum Predicted	152	1.5%	561	5.6%
R1. Business Park	55.6	0.6%	465	4.6%
R2. Pioneer Court	62.6	0.6%	472	4.7%
R3. Morton Park Hotel	42.2	0.4%	451	4.5%
R4. Offices	42.1	0.4%	451	4.5%
R5. Driving Test Centre	77.7	0.8%	487	4.9%
R6. Farmhouse	47.6	0.5%	457	4.6%
R7. Morton Grange Farm	17.5	0.2%	427	4.3%
R8. Aeolian House	21.8	0.2%	431	4.3%
R9. Woodlands Hospital	35.2	0.4%	444	4.4%
R10. Travelodge	22.4	0.2%	431	4.3%
R11. Yarm Road	12.9	0.1%	422	4.2%

R12. Recreation Ground	19.0	0.2%	428	4.3%
R13. Estoril Road	15.4	0.2%	424	4.2%
R14. School	7.5	0.1%	417	4.2%
R15. Warren Close	15.7	0.2%	425	4.2%
R16. Firthmoor Academy	14.5	0.1%	423	4.2%
<b>AQAL (<math>\mu\text{g}/\text{m}^3</math>)</b>	<b>10,000</b>			
<b>Background (<math>\mu\text{g}/\text{m}^3</math>)</b>	<b>409</b>			
<b>Maximum PC as %age of AQAL</b>	<b>0.8%</b>			
<b>Maximum PEC as %age of AQAL</b>	<b>4.9%</b>			

**Table 5.4: Predicted Maximum 1-hour Mean CO Concentrations**

Receptor	PC ( $\mu\text{g}/\text{m}^3$ )	PC (% AQAL)	PEC ( $\mu\text{g}/\text{m}^3$ )	PEC (% AQAL)
Maximum Predicted	239	0.8%	823	2.7%
R1. Business Park	74.5	0.2%	659	2.2%
R2. Pioneer Court	81.2	0.3%	665	2.2%
R3. Morton Park Hotel	57.8	0.2%	642	2.1%
R4. Offices	52.3	0.2%	636	2.1%
R5. Driving Test Centre	102	0.3%	686	2.3%
R6. Farmhouse	56.9	0.2%	641	2.1%
R7. Morton Grange Farm	31.3	0.1%	615	2.1%
R8. Aeolian House	39.5	0.1%	624	2.1%
R9. Woodlands Hospital	49.6	0.2%	634	2.1%
R10. Travelodge	38.3	0.1%	622	2.1%
R11. Yarm Road	38.8	0.1%	623	2.1%
R12. Recreation Ground	42.4	0.1%	626	2.1%
R13. Estoril Road	35.6	0.1%	620	2.1%
R14. School	22.2	0.1%	606	2.0%
R15. Warren Close	27.3	0.1%	611	2.0%
R16. Firthmoor Academy	25.0	0.1%	609	2.0%
<b>AQAL (<math>\mu\text{g}/\text{m}^3</math>)</b>	<b>30,000</b>			
<b>Background (<math>\mu\text{g}/\text{m}^3</math>)</b>	<b>584</b>			
<b>Maximum PC as %age of AQAL</b>	<b>0.3%</b>			
<b>Maximum PEC as %age of AQAL</b>	<b>2.3%</b>			

The maximum 8-hour and 1-hour mean concentrations are all less than 10% of the AQALs and the impact at all receptors would be assessed as 'not significant' in accordance with the Environment Agency's Risk Assessment Guidance.

### 5.1.4 Sulphur Dioxide (SO<sub>2</sub>)

The predicted SO<sub>2</sub> concentrations (PC) at identified sensitive receptor locations are compared to the relevant AQAL in **Table 5.5**, **Table 5.6** and **Table 5.7**. A contour plot of the 99.2<sup>nd</sup> percentile of 24-hour means is also presented in **Figure 5.3**. Emissions from sources A1a, A1b, A2a and A2b have been included in the dispersion model for SO<sub>2</sub>.

**Table 5.5: Predicted SO<sub>2</sub> Concentrations as the 99.2<sup>nd</sup> Percentile of 24-hour Means**

Receptor	PC (µg/m <sup>3</sup> )	PC (% AQAL)	PEC (µg/m <sup>3</sup> )	PEC (% AQAL)
Maximum Predicted	7.6	6.0%	11.0	8.8%
R1. Business Park	4.9	3.9%	8.3	6.6%
R2. Pioneer Court	3.9	3.1%	7.3	5.9%
R3. Morton Park Hotel	2.6	2.1%	6.1	4.9%
R4. Offices	3.5	2.8%	6.9	5.5%
R5. Driving Test Centre	3.8	3.0%	7.2	5.7%
R6. Farmhouse	4.0	3.2%	7.4	5.9%
R7. Morton Grange Farm	0.96	0.8%	4.4	3.5%
R8. Aeolian House	0.86	0.7%	4.3	3.4%
R9. Woodlands Hospital	2.3	1.8%	5.7	4.5%
R10. Travelodge	2.1	1.7%	5.6	4.5%
R11. Yarm Road	0.9	0.7%	4.3	3.5%
R12. Recreation Ground	1.1	0.8%	4.5	3.6%
R13. Estoril Road	0.77	0.6%	4.2	3.4%
R14. School	0.49	0.4%	3.9	3.1%
R15. Warren Close	0.81	0.7%	4.2	3.4%
R16. Firthmoor Academy	0.81	0.6%	4.2	3.4%
<b>AQAL (µg/m<sup>3</sup>)</b>	<b>125</b>			
<b>Background (µg/m<sup>3</sup>)</b>	<b>3.4</b>			
<b>Maximum PC as %age of AQAL</b>	<b>3.9%</b>			
<b>Maximum PEC as %age of AQAL</b>	<b>6.6%</b>			

**Table 5.6: Predicted SO<sub>2</sub> Concentrations as the 99.7<sup>th</sup> Percentile of 1-hour Means**

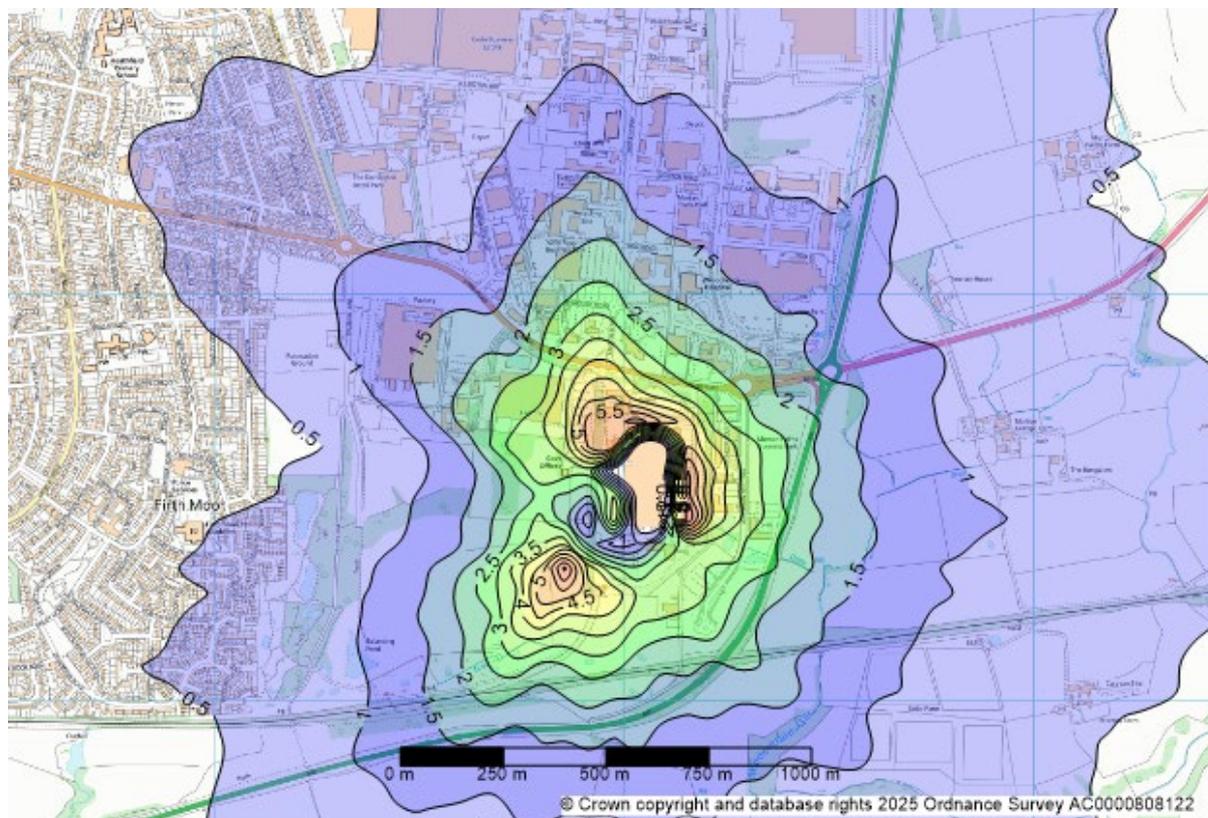
Receptor	PC (µg/m <sup>3</sup> )	PC (% AQAL)	PEC (µg/m <sup>3</sup> )	PEC (% AQAL)
Maximum Predicted	22.9	6.6%	28.7	8.2%
R1. Business Park	10.0	2.9%	15.8	4.5%
R2. Pioneer Court	9.2	2.6%	15.0	4.3%
R3. Morton Park Hotel	5.7	1.6%	11.5	3.3%
R4. Offices	6.5	1.8%	12.3	3.5%
R5. Driving Test Centre	12.7	3.6%	18.5	5.3%
R6. Farmhouse	8.0	2.3%	13.8	3.9%

R7. Morton Grange Farm	2.8	0.8%	8.6	2.4%
R8. Aeolian House	2.9	0.8%	8.7	2.5%
R9. Woodlands Hospital	4.9	1.4%	10.7	3.1%
R10. Travelodge	4.7	1.3%	10.5	3.0%
R11. Yarm Road	2.8	0.8%	8.6	2.4%
R12. Recreation Ground	3.0	0.9%	8.8	2.5%
R13. Estoril Road	2.6	0.7%	8.4	2.4%
R14. School	1.7	0.5%	7.5	2.1%
R15. Warren Close	2.5	0.7%	8.3	2.4%
R16. Firthmoor Academy	2.2	0.6%	8.0	2.3%
<b>AQAL (<math>\mu\text{g}/\text{m}^3</math>)</b>	<b>350</b>			
<b>Background (<math>\mu\text{g}/\text{m}^3</math>)</b>	<b>5.8</b>			
<b>Maximum PC as %age of AQAL</b>	<b>3.6%</b>			
<b>Maximum PEC as %age of AQAL</b>	<b>5.3%</b>			

**Table 5.7: Predicted SO<sub>2</sub> Concentrations as the 99.9<sup>th</sup> Percentile of 15-minute Means**

Receptor	PC ( $\mu\text{g}/\text{m}^3$ )	PC (% AQAL)	PEC ( $\mu\text{g}/\text{m}^3$ )	PEC (% AQAL)
Maximum Predicted	30.2	11.3%	37.9	14.3%
R1. Business Park	11.4	4.3%	19.2	7.2%
R2. Pioneer Court	10.9	4.1%	18.6	7.0%
R3. Morton Park Hotel	7.0	2.6%	14.8	5.6%
R4. Offices	7.7	2.9%	15.5	5.8%
R5. Driving Test Centre	14.2	5.3%	22.0	8.3%
R6. Farmhouse	9.5	3.6%	17.3	6.5%
R7. Morton Grange Farm	4.4	1.6%	12.2	4.6%
R8. Aeolian House	4.6	1.7%	12.3	4.6%
R9. Woodlands Hospital	6.1	2.3%	13.9	5.2%
R10. Travelodge	6.1	2.3%	13.9	5.2%
R11. Yarm Road	4.3	1.6%	12.1	4.5%
R12. Recreation Ground	4.6	1.7%	12.3	4.6%
R13. Estoril Road	4.1	1.5%	11.9	4.5%
R14. School	3.2	1.2%	11.0	4.1%
R15. Warren Close	4.2	1.6%	12.0	4.5%
R16. Firthmoor Academy	3.5	1.3%	11.3	4.3%
<b>AQAL (<math>\mu\text{g}/\text{m}^3</math>)</b>	<b>266</b>			
<b>Background (<math>\mu\text{g}/\text{m}^3</math>)</b>	<b>7.8</b>			
<b>Maximum PC as %age of AQAL</b>	<b>5.3%</b>			
<b>Maximum PEC as %age of AQAL</b>	<b>8.3%</b>			

The contribution from the facility (PC) is less than 10% of the AQALs at all locations and the impact at all locations would be assessed as 'not significant' in accordance with the Environment Agency's Risk Assessment Guidance.



**Figure 5.3: Predicted 99.2<sup>nd</sup> Percentile of 24-Hour Mean SO<sub>2</sub> Concentrations (µg/m<sup>3</sup>)**

### 5.1.5 Particles (as PM<sub>10</sub>)

Predicted annual mean and 90.4<sup>th</sup> percentile of 24-hour mean PM<sub>10</sub> concentrations at the selected receptor locations are presented in **Table 5.8** and **Table 5.9**, respectively. Emissions from sources A1a, A1b, A2a, A2b, A3a and A3b have been included in the dispersion model for particles. The predictions assume that 100% of the particulate matter emitted is in the PM<sub>10</sub> fraction. A contour plot of the 90.4<sup>th</sup> percentile of 24-hour means is also presented in **Figure 5.4**.

**Table 5.8: Predicted Annual Mean PM<sub>10</sub> Concentrations**

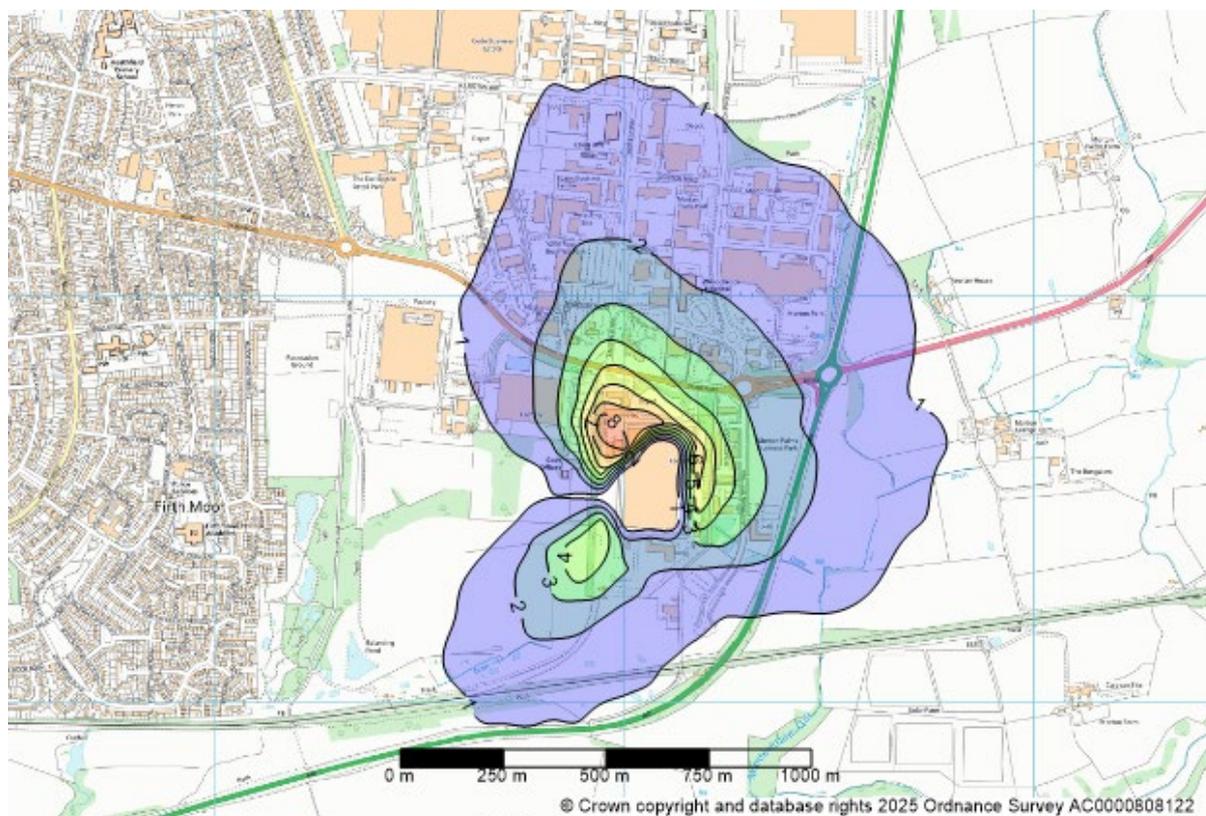
Receptor	PC (µg/m <sup>3</sup> )	PC (% AQAL)	PEC (µg/m <sup>3</sup> )	PEC (% AQAL)
Maximum Predicted	4.3	10.8%	16.1	40.3%
R1. Business Park	1.2	3.1%	13.0	32.6%
R2. Pioneer Court	1.5	3.8%	13.3	33.3%
R3. Morton Park Hotel	1.2	2.9%	13.0	32.4%
R4. Offices	1.6	4.0%	13.4	33.5%
R5. Driving Test Centre	0.58	1.4%	12.4	30.9%
R6. Farmhouse	0.69	1.7%	12.5	31.2%
R7. Morton Grange Farm	0.25	0.6%	12.0	30.1%

R8. Aeolian House	0.31	0.8%	12.1	30.3%
R9. Woodlands Hospital	0.96	2.4%	12.8	31.9%
R10. Travelodge	0.48	1.2%	12.3	30.7%
R11. Yarm Road	0.14	0.3%	11.9	29.8%
R12. Recreation Ground	0.11	0.3%	11.9	29.8%
R13. Estoril Road	0.09	0.2%	11.9	29.7%
R14. School	0.05	0.1%	11.8	29.6%
R15. Warren Close	0.09	0.2%	11.9	29.7%
R16. Firthmoor Academy	0.07	0.2%	11.9	29.7%
<b>AQAL (<math>\mu\text{g}/\text{m}^3</math>)</b>	<b>40</b>			
<b>Background (<math>\mu\text{g}/\text{m}^3</math>)</b>	<b>11.8</b>			
<b>Maximum PC as %age of AQAL</b>	<b>4.0%</b>			
<b>Maximum PEC as %age of AQAL</b>	<b>33.5%</b>			

*Table 5.9: Predicted PM<sub>10</sub> Concentrations as the 90.4<sup>th</sup> Percentile of 24-hour Means*

Receptor	PC ( $\mu\text{g}/\text{m}^3$ )	PC (% AQAL)	PEC ( $\mu\text{g}/\text{m}^3$ )	PEC (% AQAL)
Maximum Predicted	12.8	25.7%	26.7	53.5%
R1. Business Park	4.3	8.7%	18.2	36.5%
R2. Pioneer Court	4.9	9.8%	18.8	37.6%
R3. Morton Park Hotel	3.1	6.2%	17.0	34.0%
R4. Offices	4.3	8.5%	18.2	36.3%
R5. Driving Test Centre	2.2	4.3%	16.1	32.1%
R6. Farmhouse	2.7	5.3%	16.6	33.1%
R7. Morton Grange Farm	0.81	1.6%	14.7	29.4%
R8. Aeolian House	0.87	1.7%	14.8	29.5%
R9. Woodlands Hospital	2.5	5.1%	16.4	32.9%
R10. Travelodge	1.6	3.2%	15.5	31.0%
R11. Yarm Road	0.52	1.0%	14.4	28.8%
R12. Recreation Ground	0.38	0.8%	14.3	28.6%
R13. Estoril Road	0.33	0.7%	14.2	28.5%
R14. School	0.18	0.4%	14.1	28.2%
R15. Warren Close	0.32	0.6%	14.2	28.4%
R16. Firthmoor Academy	0.20	0.4%	14.1	28.2%
<b>AQAL (<math>\mu\text{g}/\text{m}^3</math>)</b>	<b>40</b>			
<b>Background (<math>\mu\text{g}/\text{m}^3</math>)</b>	<b>13.9</b>			
<b>Maximum PC as %age of AQAL</b>	<b>9.8%</b>			
<b>Maximum PEC as %age of AQAL</b>	<b>37.6%</b>			

The maximum predicted annual mean PM<sub>10</sub> concentration at sensitive receptors is 3.8% of the annual mean AQAL of 40 µg/m<sup>3</sup>. However, the PEC is well below 70% of the AQAL and in accordance with the Environment Agency’s Risk Assessment Guidance it is ‘unlikely that this would be exceeded’. Predicted 24-hour mean concentrations are 10% or less of the short-term AQAL and would be assessed as ‘not significant’. Therefore, it is concluded that the impact of PM<sub>10</sub> emissions on local air quality is ‘not significant’ or ‘unlikely that the AQAL would be exceeded’.



*Figure 5.4: Predicted 90.4<sup>th</sup> Percentile of 24-Hour Mean PM<sub>10</sub> Concentrations (µg/m<sup>3</sup>)*

### 5.1.6 Particles (as PM<sub>2.5</sub>)

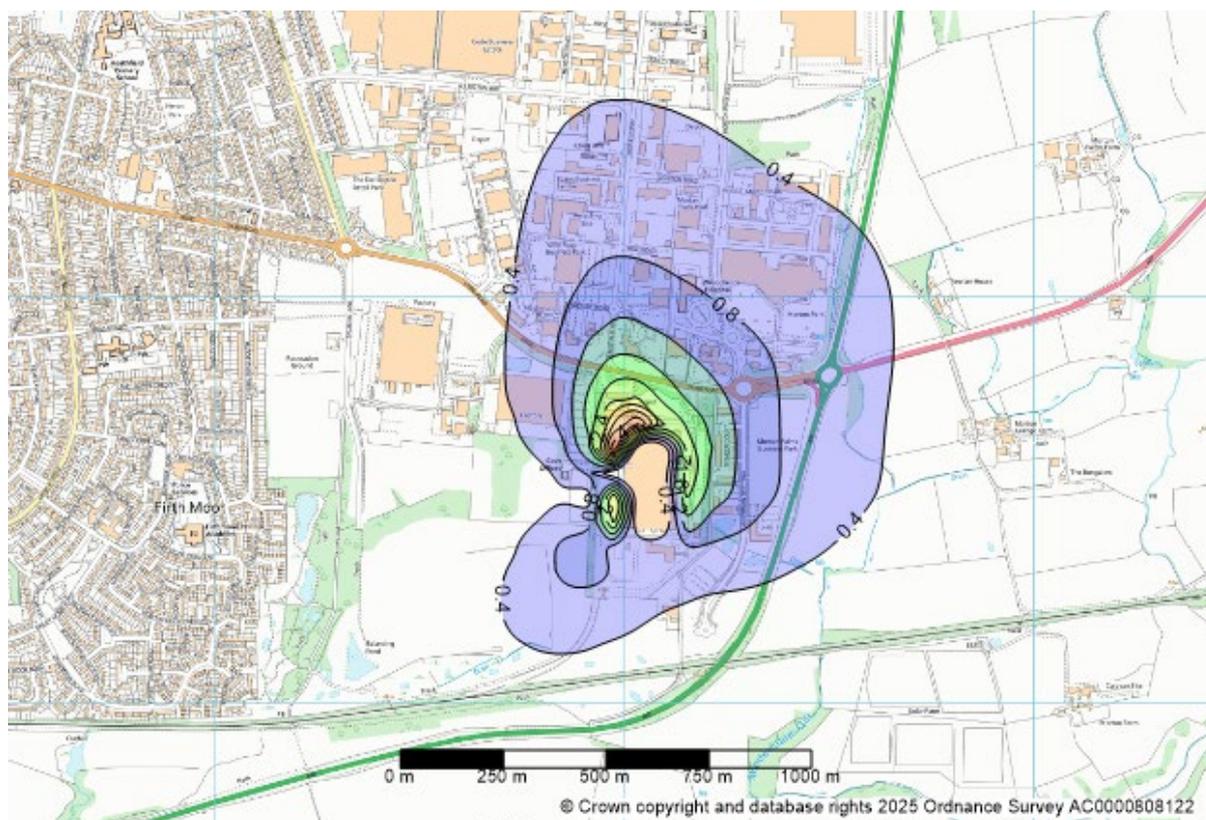
Predicted annual mean PM<sub>2.5</sub> concentrations at the selected receptor locations are presented in **Table 5.10**. Emissions from sources A1a, A1b, A2a, A2b, A3a and A3b have been included in the dispersion model for particles. The predictions assume that 100% of the particulate matter emitted is in the PM<sub>2.5</sub> fraction. A contour plot of annual mean PM<sub>2.5</sub> (and PM<sub>10</sub>) is presented in **Figure 5.5**.

*Table 5.10: Predicted Annual Mean PM<sub>2.5</sub> Concentrations*

Receptor	PC (µg/m <sup>3</sup> )	PC (% AQAL)	PEC (µg/m <sup>3</sup> )	PEC (% AQAL)
Maximum Predicted	4.3	21.6%	10.4	52.1%
R1. Business Park	1.2	6.2%	7.3	36.7%
R2. Pioneer Court	1.5	7.6%	7.6	38.1%
R3. Morton Park Hotel	1.2	5.8%	7.3	36.3%
R4. Offices	1.6	7.9%	7.7	38.4%

R5. Driving Test Centre	0.58	2.9%	6.7	33.4%
R6. Farmhouse	0.69	3.4%	6.8	33.9%
R7. Morton Grange Farm	0.25	1.2%	6.3	31.7%
R8. Aeolian House	0.31	1.6%	6.4	32.1%
R9. Woodlands Hospital	0.96	4.8%	7.1	35.3%
R10. Travelodge	0.48	2.4%	6.6	32.9%
R11. Yarm Road	0.14	0.7%	6.2	31.2%
R12. Recreation Ground	0.11	0.5%	6.2	31.0%
R13. Estoril Road	0.09	0.4%	6.2	30.9%
R14. School	0.05	0.2%	6.1	30.7%
R15. Warren Close	0.09	0.4%	6.2	30.9%
R16. Firthmoor Academy	0.07	0.3%	6.2	30.8%
<b>AQAL (<math>\mu\text{g}/\text{m}^3</math>)</b>	<b>20</b>			
<b>Background (<math>\mu\text{g}/\text{m}^3</math>)</b>	<b>6.1</b>			
<b>Maximum PC as %age of AQAL</b>	<b>7.9%</b>			
<b>Maximum PEC as %age of AQAL</b>	<b>38.4%</b>			

At sensitive receptors, the maximum predicted  $\text{PM}_{2.5}$  concentration is 7.9% of the AQAL and the PEC is 38.4% of the AQAL and it is concluded that it is 'unlikely that the AQAL would be exceeded in accordance with the Environment Agency's Risk Assessment Guidance. Furthermore, this assumes as a worst-case that all of the particles emitted are in the  $\text{PM}_{2.5}$  fraction. Predicted concentrations at sensitive receptors with the addition of background concentrations (PEC) are also well below the annual mean concentration target of  $10 \mu\text{g}/\text{m}^3$  to be met by 2040. Therefore, taking into consideration the worst-case assumptions adopted, it is concluded that the impact of  $\text{PM}_{2.5}$  emissions on local air quality would be 'not significant' or 'unlikely that the AQAL would be exceeded'.



**Figure 5.5: Predicted Annual Mean  $PM_{2.5}$  and  $PM_{10}$  Concentrations ( $\mu\text{g}/\text{m}^3$ )**

### 5.1.7 Total Organic Carbon (as Benzene)

Predicted annual mean and maximum 24-hour mean ground-level concentrations of TOC (as benzene) are presented in **Table 5.11** and **Table 5.12**, respectively. Emissions from sources A1a, A1b, A2a, A2b, A6a and A6b have been included in the dispersion model for TOC. It is assumed that all of the total organic carbon is made up entirely of benzene and represents a very worst-case.

**Table 5.11: Predicted Annual Mean Benzene Concentrations**

Receptor	PC ( $\mu\text{g}/\text{m}^3$ )	PC (% AQAL)	PEC ( $\mu\text{g}/\text{m}^3$ )	PEC (% AQAL)
Maximum Predicted	0.55	10.9%	0.85	16.9%
R1. Business Park	0.21	4.3%	0.51	10.3%
R2. Pioneer Court	0.25	4.9%	0.55	10.9%
R3. Morton Park Hotel	0.19	3.8%	0.49	9.8%
R4. Offices	0.26	5.3%	0.56	11.3%
R5. Driving Test Centre	0.11	2.1%	0.41	8.1%
R6. Farmhouse	0.13	2.6%	0.43	8.6%
R7. Morton Grange Farm	0.048	1.0%	0.35	7.0%
R8. Aeolian House	0.056	1.1%	0.36	7.1%
R9. Woodlands Hospital	0.17	3.4%	0.47	9.4%
R10. Travelodge	0.11	2.2%	0.41	8.2%
R11. Yarm Road	0.025	0.5%	0.32	6.5%

R12. Recreation Ground	0.022	0.4%	0.32	6.4%
R13. Estoril Road	0.017	0.3%	0.32	6.3%
R14. School	0.009	0.2%	0.31	6.2%
R15. Warren Close	0.016	0.3%	0.32	6.3%
R16. Firthmoor Academy	0.013	0.3%	0.31	6.3%
<b>AQAL (<math>\mu\text{g}/\text{m}^3</math>)</b>	<b>5</b>			
<b>Background (<math>\mu\text{g}/\text{m}^3</math>)</b>	<b>0.30</b>			
<b>Maximum PC as %age of AQAL</b>	<b>5.3%</b>			
<b>Maximum PEC as %age of AQAL</b>	<b>11.3%</b>			

At sensitive receptor locations, maximum predicted annual mean ground level benzene concentrations are 5.3% of the AQAL and the PEC is only 11.3% of the AQAL. Therefore, in accordance with the Environment Agency's Risk Assessment Guidance it is concluded that it is 'unlikely that the AQAL would be exceeded'. Furthermore, as a worst-case it is assumed that all of the TOC is emitted as benzene. In reality, predicted concentrations would be substantially less than presented in **Table 5.11**.

**Table 5.12 Predicted Maximum 24-hour Mean Benzene Concentrations**

Receptor	PC ( $\mu\text{g}/\text{m}^3$ )	PC (% AQAL)	PEC ( $\mu\text{g}/\text{m}^3$ )	PEC (% AQAL)
Maximum Predicted	11.3	37.6%	11.6	38.8%
R1. Business Park	3.0	10.0%	3.4	11.2%
R2. Pioneer Court	2.3	7.7%	2.7	8.9%
R3. Morton Park Hotel	1.5	5.0%	1.9	6.2%
R4. Offices	1.8	5.8%	2.1	7.0%
R5. Driving Test Centre	2.8	9.4%	3.2	10.6%
R6. Farmhouse	2.5	8.2%	2.8	9.4%
R7. Morton Grange Farm	0.60	2.0%	1.0	3.2%
R8. Aeolian House	0.48	1.6%	0.8	2.8%
R9. Woodlands Hospital	1.3	4.2%	1.6	5.4%
R10. Travelodge	1.2	3.9%	1.5	5.1%
R11. Yarm Road	0.53	1.8%	0.9	2.9%
R12. Recreation Ground	0.65	2.2%	1.0	3.3%
R13. Estoril Road	0.46	1.5%	0.8	2.7%
R14. School	0.29	1.0%	0.6	2.1%
R15. Warren Close	0.56	1.9%	0.9	3.0%
R16. Firthmoor Academy	0.42	1.4%	0.8	2.6%
<b>AQAL (<math>\mu\text{g}/\text{m}^3</math>)</b>	<b>30</b>			
<b>Background (<math>\mu\text{g}/\text{m}^3</math>)</b>	<b>0.35</b>			
<b>Maximum PC as %age of AQAL</b>	<b>10.0%</b>			
<b>Maximum PEC as %age of AQAL</b>	<b>11.2%</b>			

Maximum 24-hourly mean concentrations of benzene at all sensitive receptors are 10% or less of the AQAL and would be assessed as 'not significant'. Therefore, taking into consideration the conservative nature of the assessment, it is concluded that the impact on air quality of total organic carbon emissions from the facility would be 'not significant' or 'unlikely that the AQAL would be exceeded'.

### 5.1.8 Hydrogen Chloride (HCl)

The predicted maximum 1-hour mean ground-level hydrogen chloride concentrations at identified sensitive receptor locations are presented in **Table 5.13**. Emissions from sources A1a, A1b, A2a and A2b have been included in the dispersion model for HCl.

**Table 5.13: Predicted Maximum 1-hour Mean HCl Concentrations**

Receptor	PC ( $\mu\text{g}/\text{m}^3$ )	PC (% AQAL)	PEC ( $\mu\text{g}/\text{m}^3$ )	PEC (% AQAL)
Maximum Predicted	9.8	1.3%	10.2	1.4%
R1. Business Park	2.5	0.3%	2.9	0.4%
R2. Pioneer Court	2.3	0.3%	2.7	0.4%
R3. Morton Park Hotel	1.5	0.2%	1.9	0.2%
R4. Offices	1.5	0.2%	1.9	0.3%
R5. Driving Test Centre	3.3	0.4%	3.7	0.5%
R6. Farmhouse	1.9	0.3%	2.3	0.3%
R7. Morton Grange Farm	1.0	0.1%	1.4	0.2%
R8. Aeolian House	1.3	0.2%	1.7	0.2%
R9. Woodlands Hospital	1.4	0.2%	1.8	0.2%
R10. Travelodge	1.1	0.2%	1.6	0.2%
R11. Yarm Road	1.3	0.2%	1.7	0.2%
R12. Recreation Ground	1.5	0.2%	1.9	0.2%
R13. Estoril Road	1.2	0.2%	1.6	0.2%
R14. School	0.68	0.1%	1.1	0.1%
R15. Warren Close	0.73	0.1%	1.2	0.2%
R16. Firthmoor Academy	0.83	0.1%	1.2	0.2%
AQAL ( $\mu\text{g}/\text{m}^3$ )	750			
Background ( $\mu\text{g}/\text{m}^3$ )	0.42			
Maximum PC as %age of AQAL	0.4%			
Maximum PEC as %age of AQAL	0.5%			

The maximum predicted hourly mean concentrations are less than 10% of the AQAL and would be assessed as 'not significant' in accordance with the Environment Agency's Risk Assessment Guidance.

### 5.1.9 Hydrogen Fluoride (HF)

The predicted maximum monthly (weekly) mean and 1-hour mean ground-level hydrogen fluoride concentrations at identified sensitive receptor locations are presented in **Table 5.14** and **Table 5.15**,

respectively. Emissions from sources A1a, A1b, A2a and A2b have been included in the dispersion model for HF.

**Table 5.14: Predicted Maximum Monthly (Weekly) Mean HF Concentrations**

Receptor	PC ( $\mu\text{g}/\text{m}^3$ )	PC (% AQAL)	PEC ( $\mu\text{g}/\text{m}^3$ )	PEC (% AQAL)
Maximum Predicted	0.16	1.0%	0.36	2.3%
R1. Business Park	0.075	0.5%	0.27	1.7%
R2. Pioneer Court	0.065	0.4%	0.27	1.7%
R3. Morton Park Hotel	0.044	0.3%	0.24	1.5%
R4. Offices	0.073	0.5%	0.27	1.7%
R5. Driving Test Centre	0.053	0.3%	0.25	1.6%
R6. Farmhouse	0.056	0.3%	0.26	1.6%
R7. Morton Grange Farm	0.013	0.1%	0.21	1.3%
R8. Aeolian House	0.015	0.1%	0.22	1.3%
R9. Woodlands Hospital	0.052	0.3%	0.25	1.6%
R10. Travelodge	0.058	0.4%	0.26	1.6%
R11. Yarm Road	0.015	0.1%	0.22	1.3%
R12. Recreation Ground	0.015	0.1%	0.22	1.3%
R13. Estoril Road	0.012	0.1%	0.21	1.3%
R14. School	0.0068	<0.1%	0.21	1.3%
R15. Warren Close	0.019	0.1%	0.22	1.4%
R16. Firthmoor Academy	0.016	0.1%	0.22	1.3%
<b>AQAL (<math>\mu\text{g}/\text{m}^3</math>)</b>	<b>16</b>			
<b>Background (<math>\mu\text{g}/\text{m}^3</math>)</b>	<b>0.2</b>			
<b>Maximum PC as %age of AQAL</b>	<b>0.5%</b>			
<b>Maximum PEC as %age of AQAL</b>	<b>1.7%</b>			

At sensitive receptors, the maximum predicted weekly HF concentrations are less than 1% of the AQAL of  $16 \mu\text{g}/\text{m}^3$ . Therefore, in accordance with the Environment Agency's Risk Assessment Guidance the impacts would be assessed as 'not significant'.

**Table 5.15: Predicted Maximum Hourly Mean HF Concentrations**

Receptor	PC ( $\mu\text{g}/\text{m}^3$ )	PC (% AQAL)	PEC ( $\mu\text{g}/\text{m}^3$ )	PEC (% AQAL)
Maximum Predicted	1.6	1.0%	1.8	1.1%
R1. Business Park	0.42	0.3%	0.62	0.4%
R2. Pioneer Court	0.39	0.2%	0.59	0.4%
R3. Morton Park Hotel	0.24	0.2%	0.44	0.3%
R4. Offices	0.24	0.2%	0.44	0.3%
R5. Driving Test Centre	0.55	0.3%	0.75	0.5%
R6. Farmhouse	0.31	0.2%	0.51	0.3%

R7. Morton Grange Farm	0.16	0.1%	0.36	0.2%
R8. Aeolian House	0.22	0.1%	0.42	0.3%
R9. Woodlands Hospital	0.23	0.1%	0.43	0.3%
R10. Travelodge	0.19	0.1%	0.39	0.2%
R11. Yarm Road	0.21	0.1%	0.41	0.3%
R12. Recreation Ground	0.24	0.2%	0.44	0.3%
R13. Estoril Road	0.20	0.1%	0.40	0.2%
R14. School	0.11	0.1%	0.31	0.2%
R15. Warren Close	0.12	0.1%	0.32	0.2%
R16. Firthmoor Academy	0.14	0.1%	0.34	0.2%
<b>AQAL (<math>\mu\text{g}/\text{m}^3</math>)</b>	<b>160</b>			
<b>Background (<math>\mu\text{g}/\text{m}^3</math>)</b>	<b>0.2</b>			
<b>Maximum PC as %age of AQAL</b>	<b>0.3%</b>			
<b>Maximum PEC as %age of AQAL</b>	<b>0.5%</b>			

The maximum predicted hourly mean HF concentrations are less than 10% of the short-term AQAL and, in accordance with the Environment Agency's Risk Assessment Guidance, the impacts would be assessed as 'not significant'.

#### 5.1.10 Trace Metals

The predicted maximum long and short-term trace metal concentrations for emissions at the maximum ELV are presented in **Table 5.16** and **Table 5.17**, respectively. Predicted concentrations are the maximum anywhere within the model domain and represent the worst-case. Emissions from sources A1a, A1b, A2a and A2b have been included in the dispersion model for trace metals.

For the Step 1 screening it is assumed that for chromium VI the predicted PC and background concentrations are apportioned 20% of the total chromium concentration.

**Table 5.16: Predicted Maximum Long-Term Trace Metal Concentrations - Step 1**

Pollutant	AQAL ( $\text{ng}/\text{m}^3$ )	Max. PC ( $\text{ng}/\text{m}^3$ )	Background ( $\text{ng}/\text{m}^3$ )	PC (% AQAL)	PEC (% of AQAL)	Further Assessment Required?
Cadmium (Cd)	5	1.0	0.091	20.9%	22.8%	No
Thallium (Tl)	1,000	1.0	-	0.1%	0.1%	No
Mercury (Hg) (b)	60	7.0	3.2	11.7%	17.0%	No
Antimony (Sb)	5,000	15.7	-	0.3%	0.3%	No
<b>Arsenic (As)</b>	<b>6</b>	<b>15.7</b>	<b>0.91</b>	<b>262%</b>	<b>277%</b>	<b>Yes</b>
Chromium (Cr) (b)	2,000	106	3.3	5.3%	5.4%	No
<b>Chromium VI</b>	<b>0.25</b>	<b>3.1</b>	<b>0.56</b>	<b>1257%</b>	<b>1481%</b>	<b>Yes</b>
Cobalt (Co)	1,000	15.7	0.071	1.6%	1.6%	No
<b>Copper (Cu) (b)</b>	<b>50</b>	<b>106</b>	<b>4.1</b>	<b>211%</b>	<b>219%</b>	<b>Yes</b>

Manganese (Mn)	150	15.7	3.9	10.5%	13.1%	No
Nickel (Ni)	20	15.7	1.3	78.6%	85.1%	No
Lead (Pb)	250	15.7	4.4	6.3%	8.0%	No

- (a) The predicted and background concentrations are apportioned 20% Cr(VI) in accordance with the Environment Agency's guidance  
(b) 24 hour (long term) mean

**Table 5.17: Predicted Maximum Short-Term Trace Metal Concentrations - Step 1**

Pollutant	AQAL (ng/m <sup>3</sup> )	Max. PC (ng/m <sup>3</sup> )	Background (ng/m <sup>3</sup> )	PC (% AQAL)	PEC (% AQAL)	Further Assessment Required?
Cd (24-hour)	30	7.0	0.11	23.4%	23.8%	No
Hg (1-hour)	600	32.6	5.4	5.4%	5.4%	No
Sb (1-hour)	150,000	490	-	0.3%	0.3%	No
Mn (1-hour)	1,500,000	490	7.8	<0.1%	<0.1%	No
Ni (1-hour)	700	490	2.6	69.9%	70.3%	No
V (24-hour)	1,000	106	0.59	10.6%	10.6%	No

For the Group III metals, on the basis of the Step 1 screening advice provided by the Environment Agency, further assessment is required for long term arsenic (annual mean), chromium VI (annual mean) and copper (24-hour long term mean). Emissions of all the remaining trace metals are considered to be 'not significant', or it is 'unlikely that the AQAL would be exceeded'.

The Environment Agency guidance note for the assessment of Group III metals provides measured concentrations of emissions of metals from waste Incinerators. In accordance with the guidance note, revised concentrations for As, CrVI and Cu have been predicted using the maximum measured emission concentrations (0.025 mg/Nm<sup>3</sup>, 0.00013 mg/Nm<sup>3</sup> and 0.029 mg/Nm<sup>3</sup> for As, CrVI and Cu, respectively). For these typical emission concentrations, maximum predicted ground level concentrations are presented in **Table 5.18**.

**Table 5.18: Maximum Long-Term Trace Metal Concentrations – Typical Emissions**

Pollutant	AQAL (ng/m <sup>3</sup> )	PC (% of AQAL)	PEC (% of AQAL)	Further Assessment Required?
As	6	21.8%	37.0%	No
<b>Cr (VI) (a)</b>	<b>0.25</b>	<b>2.7%</b>	<b>227%</b>	<b>Yes</b>
Cu (b)	50	20.4%	28.7%	No

- (a) The background concentration is apportioned 20% Cr(VI) in accordance with the Environment Agency's guidance.  
(b) 24 hour (long term) mean

On the basis of Step 2 of the assessment, no further assessment is required for As or Cu. Although the PC's for As and Cu exceed 1% of the AQALs, the PECs are less than 100% of the AQALs and it is unlikely that these would be exceeded. Further assessment is required for CrVI as the PC exceeds 1% of the AQAL and the PEC exceeds 100% of the AQAL.

Predicted concentrations presented in **Table 5.18** are the maximum predicted anywhere within the model domain. Predicted concentrations at sensitive receptors are lower, particularly at residential receptors where there would be relevant public exposure. Predicted concentrations of CrVI for typical emissions at the sensitive receptors are presented in **Table 5.19**. A contour plot of annual mean concentrations is also presented in **Figure 5.6** with the contour highlighted in red that is representative of 1% of the AQAL.

**Table 5.19: Predicted Annual Mean CrVI Concentrations – Typical Emissions**

Receptor	PC ( $\mu\text{g}/\text{m}^3$ )	PC (% AQAL)
R1. Business Park	0.0027	1.1%
R2. Pioneer Court	0.0031	1.2%
R3. Morton Park Hotel	0.0024	1.0%
R4. Offices	0.0034	1.3%
R5. Driving Test Centre	0.0013	0.5%
R6. Farmhouse	0.0017	0.7%
R7. Morton Grange Farm	0.00061	0.2%
R8. Aeolian House	0.00071	0.3%
R9. Woodlands Hospital	0.0022	0.9%
R10. Travelodge	0.0014	0.6%
R11. Yarm Road	0.00032	0.1%
R12. Recreation Ground	0.00028	0.1%
R13. Estoril Road	0.00021	0.1%
R14. School	0.00012	<0.1%
R15. Warren Close	0.00021	0.1%
R16. Firthmoor Academy	0.00017	0.1%
<b>AQAL (<math>\mu\text{g}/\text{m}^3</math>)</b>	<b>0.25</b>	
<b>Maximum PC as %age of AQAL</b>		<b>1.3%</b>

Predicted concentrations exceed 1% of the AQAL at three receptors but there is no relevant exposure at these locations (commercial rather than residential receptors). At all residential receptors the contribution is 1% or less of the AQAL. Furthermore, the syngas is a clean fuel as evidenced by the very low sulphur and chloride concentrations present (refer **Section 5.4.4**). It is expected that the concentration of trace metals within the syngas will also be very low. Since emissions of trace metals can only arise from contaminants present within the syngas, it is concluded that even typical emission concentrations adopted for trace metals are overly cautious and that emissions would be a lower than that typically emitted from energy from waste plant. Therefore, it is concluded that the impact of trace metal emissions from the facility would be 'not significant'.

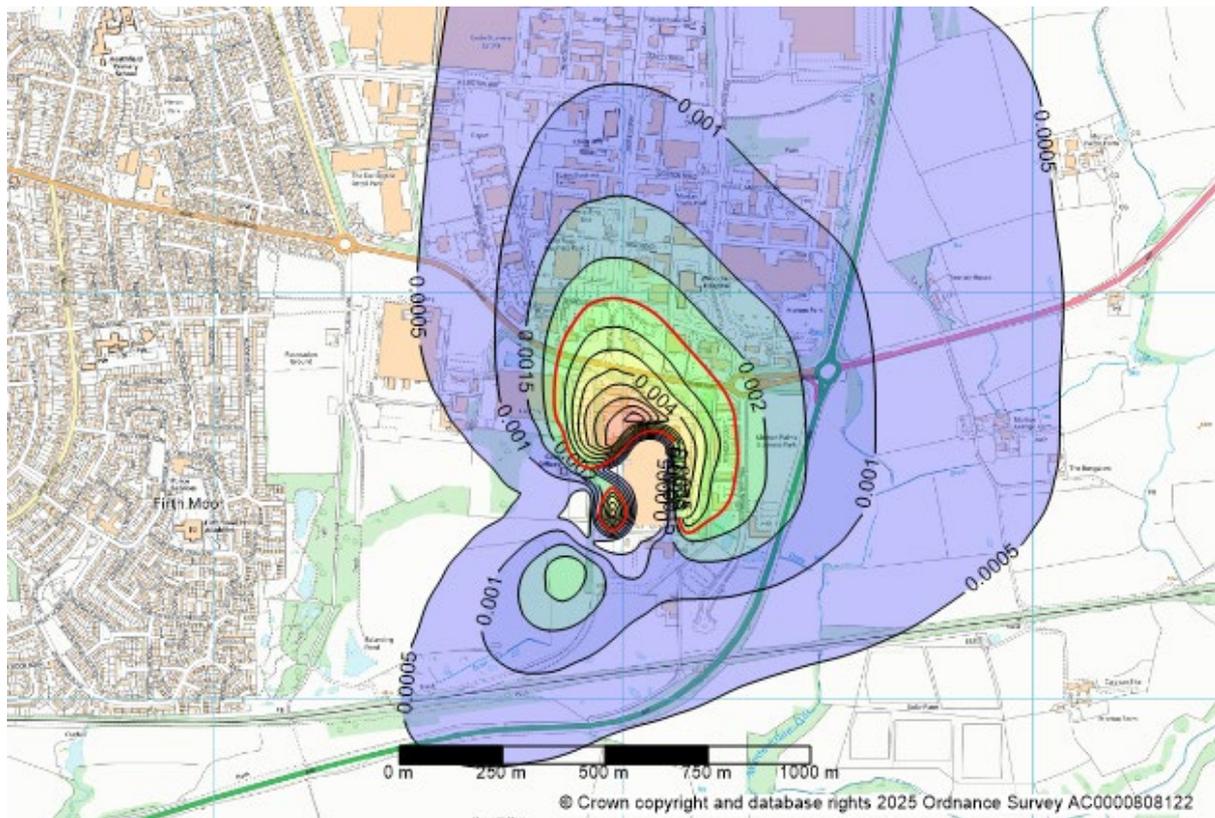


Figure 5.6: Predicted Annual Mean CrVI Concentrations for Typical Emissions ( $\text{ng}/\text{m}^3$ )

### 5.1.11 Dioxins and Furans

The predicted annual mean ground level dioxin and furan (PCDD/F) concentrations (PC) at identified sensitive receptor locations are presented in **Table 5.20**. Emissions from sources A1a, A1b, A2a and A2b have been included in the dispersion model for PCDD/Fs.

Table 5.20: Predicted Annual Mean PCDD/Fs Concentrations

Receptor	Annual Mean PC ( $\text{fg}/\text{m}^3$ )	Percentage of Background
Maximum predicted	3.1	209%
R1. Business Park	1.2	83.2%
R2. Pioneer Court	1.4	96.1%
R3. Morton Park Hotel	1.1	75.0%
R4. Offices	1.6	104%
R5. Driving Test Centre	0.60	40.2%
R6. Farmhouse	0.77	51.6%
R7. Morton Grange Farm	0.28	18.7%
R8. Aeolian House	0.33	21.9%
R9. Woodlands Hospital	0.99	66.2%
R10. Travelodge	0.65	43.4%
R11. Yarm Road	0.15	9.8%

R12. Recreation Ground	0.13	8.5%
R13. Estoril Road	0.099	6.6%
R14. School	0.055	3.7%
R15. Warren Close	0.096	6.4%
R16. Firthmoor Academy	0.080	5.3%
<b>Background (fg/m<sup>3</sup>)</b>	<b>1.5</b>	
<b>PC as a %age of background Concentrations</b>	<b>104%</b>	

There are no air quality assessment levels for dioxins and furans. Compared with the average background concentration measured at rural monitoring sites in the UK, the maximum predicted impact of the facility represents 209% of the background concentration and 104% of the background at sensitive receptors. Furthermore, it should be noted that health impacts from exposure to dioxins and furans can arise via inhalation and ingestion exposure. Therefore, the health impacts of the emissions of dioxins and furans and dioxin-like PCBs have been assessed in the human health risk assessment (HHRA) submitted in support of this permit application for the facility.

#### 5.1.12 PAH (as Benzo(a)pyrene)

Predicted annual mean ground-level benzo(a)pyrene concentrations are presented in **Table 5.21**. Emissions from sources A1a, A1b, A2a and A2b have been included in the dispersion model for PAH.

**Table 5.21: Predicted Annual Mean Benzo(a)pyrene Concentrations**

Receptor	PC (ng/m <sup>3</sup> )	PC (% AQAL)	PEC (ng/m <sup>3</sup> )	PEC (% AQAL)
Maximum Predicted	0.0047	1.9%	0.17	69.9%
R1. Business Park	0.0019	0.7%	0.17	68.7%
R2. Pioneer Court	0.0022	0.9%	0.17	68.9%
R3. Morton Park Hotel	0.0017	0.7%	0.17	68.7%
R4. Offices	0.0023	0.9%	0.17	68.9%
R5. Driving Test Centre	0.00090	0.4%	0.17	68.4%
R6. Farmhouse	0.0012	0.5%	0.17	68.5%
R7. Morton Grange Farm	0.00042	0.2%	0.17	68.2%
R8. Aeolian House	0.00049	0.2%	0.17	68.2%
R9. Woodlands Hospital	0.0015	0.6%	0.17	68.6%
R10. Travelodge	0.00098	0.4%	0.17	68.4%
R11. Yarm Road	0.00022	0.1%	0.17	68.1%
R12. Recreation Ground	0.00019	0.1%	0.17	68.1%
R13. Estoril Road	0.00015	0.1%	0.17	68.1%
R14. School	0.000083	<0.1%	0.17	68.0%
R15. Warren Close	0.00015	0.1%	0.17	68.1%
R16. Firthmoor Academy	0.00012	<0.1%	0.17	68.0%
<b>AQAL (ng/m<sup>3</sup>)</b>	<b>0.25</b>			

Background (ng/m <sup>3</sup> )	0.17
Maximum PC as %age of AQAL	0.9%
Maximum PEC as %age of AQAL	68.9%

At sensitive receptor locations, predicted ground level benzo(a)pyrene concentrations would be described as 'not significant' according to the Environment Agency's Risk Assessment Guidance.

### 5.1.13 Polychlorinated Biphenyls

The predicted maximum annual and 1-hour mean ground-level PCB concentrations at the identified sensitive receptor locations are presented in **Table 5.22** and **Table 5.23**, respectively.

**Table 5.22: Predicted Annual Mean PCB Concentrations**

Receptor	PC (ng/m <sup>3</sup> )	PC (% AQAL)	PEC (ng/m <sup>3</sup> )	PEC (% AQAL)
Maximum Predicted	0.26	0.1%	0.29	0.1%
R1. Business Park	0.10	0.1%	0.13	0.1%
R2. Pioneer Court	0.12	0.1%	0.14	0.1%
R3. Morton Park Hotel	0.09	<0.1%	0.12	0.1%
R4. Offices	0.13	0.1%	0.15	0.1%
R5. Driving Test Centre	0.050	<0.1%	0.074	<0.1%
R6. Farmhouse	0.065	<0.1%	0.089	<0.1%
R7. Morton Grange Farm	0.023	<0.1%	0.047	<0.1%
R8. Aeolian House	0.027	<0.1%	0.051	<0.1%
R9. Woodlands Hospital	0.083	<0.1%	0.11	0.1%
R10. Travelodge	0.054	<0.1%	0.078	<0.1%
R11. Yarm Road	0.012	<0.1%	0.036	<0.1%
R12. Recreation Ground	0.011	<0.1%	0.035	<0.1%
R13. Estoril Road	0.0082	<0.1%	0.032	<0.1%
R14. School	0.0046	<0.1%	0.029	<0.1%
R15. Warren Close	0.0080	<0.1%	0.032	<0.1%
R16. Firthmoor Academy	0.0066	<0.1%	0.031	<0.1%
AQAL (ng/m <sup>3</sup> )	200			
Background (ng/m <sup>3</sup> )	0.024			
Maximum PC as %age of AQAL	0.1%			
Maximum PEC as %age of AQAL	0.1%			

**Table 5.23: Predicted Maximum Hourly Mean PCB Concentrations**

Receptor	PC (ng/m <sup>3</sup> )	PC (% AQAL)	PEC (ng/m <sup>3</sup> )	PEC (% AQAL)
Maximum Predicted	8.2	0.1%	8.2	0.1%
R1. Business Park	2.1	<0.1%	2.1	<0.1%
R2. Pioneer Court	1.9	<0.1%	2.0	<0.1%
R3. Morton Park Hotel	1.2	<0.1%	1.3	<0.1%
R4. Offices	1.2	<0.1%	1.3	<0.1%
R5. Driving Test Centre	2.8	<0.1%	2.8	<0.1%
R6. Farmhouse	1.6	<0.1%	1.6	<0.1%
R7. Morton Grange Farm	0.82	<0.1%	0.9	<0.1%
R8. Aeolian House	1.1	<0.1%	1.1	<0.1%
R9. Woodlands Hospital	1.1	<0.1%	1.2	<0.1%
R10. Travelodge	0.95	<0.1%	1.0	<0.1%
R11. Yarm Road	1.1	<0.1%	1.1	<0.1%
R12. Recreation Ground	1.2	<0.1%	1.3	<0.1%
R13. Estoril Road	0.99	<0.1%	1.0	<0.1%
R14. School	0.57	<0.1%	0.6	<0.1%
R15. Warren Close	0.61	<0.1%	0.7	<0.1%
R16. Firthmoor Academy	0.69	<0.1%	0.7	<0.1%
AQAL (ng/m <sup>3</sup> )	6,000			
Background (ng/m <sup>3</sup> )	0.048			
Maximum PC as %age of AQAL	<0.1%			
Maximum PEC as %age of AQAL	<0.1%			

The maximum predicted PCB concentrations are less than 1% and 10% of the long and short-term AQALs, respectively. In accordance with the Environment Agency’s Risk Assessment Guidance the impact at all receptors would be described as ‘not significant’.

## 5.2 Habitat Impact

### 5.2.1 Airborne Concentrations of NO<sub>x</sub>, SO<sub>2</sub>, NH<sub>3</sub> and HF

Predicted maximum ground level concentrations of NO<sub>x</sub>, SO<sub>2</sub>, NH<sub>3</sub> and HF at the identified habitat sites are compared with the relevant critical levels in **Table 5.24** to **Table 5.27**. For NO<sub>x</sub>, emissions arise from emissions sources A1a, A1b, A2a, A2b, A5, A6a, A6b and A7. For SO<sub>2</sub>, NH<sub>3</sub> and HF, emissions arise from emissions sources A1a, A1b, A2a and A2b. Background concentrations of NO<sub>x</sub>, SO<sub>2</sub>, NH<sub>3</sub> and HF are provided in **Table E2** in **Appendix E**.

**Table 5.24: Predicted Maximum NO<sub>x</sub> Concentrations (µg/m<sup>3</sup>)**

Habitat Site	Annual Mean		24-Hour Mean	
	PC (µg/m <sup>3</sup> )	PC (% of CL)	PC (µg/m <sup>3</sup> )	PC (% of CL)
H1. Maidendale Fishing & Nature Reserve LNR/LWS	0.30	1.0%	13.5	18.0%
H2. Brankin Moor LNR/LWS	0.12	0.4%	4.8	6.5%
H3. Hunger Hill Farm LWS	0.30	1.0%	8.1	10.8%
H4. Red Hall LWS	0.54	1.8%	5.4	7.1%
<b>Critical Level (µg/m<sup>3</sup>)</b>	<b>30</b>		<b>75</b>	

For the locally designated sites, predicted annual mean and 24-hour mean concentrations of NO<sub>x</sub> are less than 100% of the critical levels and would be assessed as ‘not significant’ in accordance with Environment Agency’s Risk Assessment Guidance.

**Table 5.25: Predicted Maximum SO<sub>2</sub> Concentrations (µg/m<sup>3</sup>)**

Habitat Site	Annual Mean	
	PC (µg/m <sup>3</sup> )	PC (% of CL)
H1. Maidendale Fishing & Nature Reserve LNR/LWS	0.058	0.3%
H2. Brankin Moor LNR/LWS	0.023	0.2%
H3. Hunger Hill Farm LWS	0.060	0.6%
H4. Red Hall LWS	0.11	0.6%
<b>Critical Level (µg/m<sup>3</sup>)</b>	<b>10 (for H2 and H3) 20 (for H1 and H4)</b>	

For sulphur dioxide, there are two critical levels depending on the presence of lichens and bryophytes. For the woodland sites (H2 and H3), it is assumed that lichens or bryophytes may be present and the more stringent critical level has been applied. For the grassland sites (H1 and H4), the less stringent critical level has been applied.

For the LWS, the PCs are all less than 100% of the critical level for SO<sub>2</sub>. Therefore, it is concluded that the impact of emissions of SO<sub>2</sub> on habitat sites would be ‘not significant’ in accordance with Environment Agency’s Risk Assessment Guidance.

For ammonia, there are also two critical levels depending on the presence of lichens and bryophytes. For the woodland sites (H2 and H3), it is assumed that lichens or bryophytes may be present and the more stringent critical level has been applied. For the grassland sites (H1 and H4), the less stringent critical level has been applied.

**Table 5.26: Predicted Maximum NH<sub>3</sub> Concentrations (µg/m<sup>3</sup>)**

Habitat Site	Annual Mean	
	PC (µg/m <sup>3</sup> )	PC (% of CL)
H1. Maidendale Fishing & Nature Reserve LNR/LWS	0.019	0.6%
H2. Brankin Moor LNR/LWS	0.008	0.8%
H3. Hunger Hill Farm LWS	0.020	2.0%
H4. Red Hall LWS	0.037	1.2%
<b>Critical Level (µg/m<sup>3</sup>)</b>	<b>1 (for H2 and H3) 3 (for H1 and H4)</b>	

For the LWS, the PCs are all less than 100% of the critical levels for NH<sub>3</sub> and would be assessed as ‘not significant’ in accordance with the Environment Agency’s Risk Assessment Guidance.

**Table 5.27: Predicted Maximum HF Concentrations (µg/m<sup>3</sup>)**

Habitat Site	Weekly Mean		24-Hour Mean	
	PC (µg/m <sup>3</sup> )	PC (% of CL)	PC (µg/m <sup>3</sup> )	PC (% of CL)
H1. Maidendale Fishing & Nature Reserve LNR/LWS	0.024	4.7%	0.056	1.1%
H2. Brankin Moor LNR/LWS	0.010	2.0%	0.019	0.4%
H3. Hunger Hill Farm LWS	0.0099	2.0%	0.035	0.7%
H4. Red Hall LWS	0.0098	2.0%	0.021	0.4%
<b>Critical Level (µg/m<sup>3</sup>)</b>	<b>0.5</b>		<b>5</b>	

Predicted weekly mean and 24-hour mean HF concentrations are less than 100% of the respective critical levels and would be assessed as ‘not significant’ in accordance with the Environment Agency’s Risk Assessment Guidance.

### 5.2.2 Eutrophication

Predicted maximum nutrient nitrogen deposition rates arising from emissions of NO<sub>x</sub> and NH<sub>3</sub> from the various on-site emissions are presented in **Table 5.28**. The process contributions (PC) are compared with the relevant critical loads (CL) and combined with the relevant background deposition rates (refer to **Appendix E**).

**Table 5.28: Predicted Eutrophication Rates (kg N/ha/a)**

Habitat Site	PC	Total Deposition (PEC)	Lowest CL	PC (% CL)
H1. Maidendale Fishing & Nature Reserve LNR/LWS	0.14	17.92	10	1.4%
H2. Brankin Moor LNR/LWS	0.094	33.55	10	0.9%
H3. Hunger Hill Farm LWS	0.24	34.12	10	2.4%

H4. Red Hall LWS	0.27	17.49	10	2.7%
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For the LWS, the PCs are all less than 100% of the critical loads for nutrient nitrogen deposition and would be assessed as ‘not significant’ according to the Environment Agency’s Risk Assessment Guidance.

### 5.2.3 Acidification

Predicted maximum acid deposition rates predicted over the five years of meteorological data are presented in **Table 5.29**. The contribution from HCl has been included with 100% assigned to sulphur. The process contributions (PC) are compared with the relevant critical loads provided in **Appendix E**. The percentage of the critical load has been calculated using the Critical Load Function Tool on the APIS website.

**Table 5.29: Predicted Acid Deposition Rates (keq/ha/a)**

Habitat Site	PC (N+S)	PC (% CL)	PEC (% CL)
H1. Maidendale Fishing & Nature Reserve LNR/LWS	0.022	0.4%	27.1%
H2. Brankin Moor LNR/LWS	0.017	0.6%	91.6%
H3. Hunger Hill Farm LWS	0.044	1.6%	93.5%
H4. Red Hall LWS	0.042	0.8%	27.0%

For the LWS, the PCs are all less than 100% of the critical loads for acidification and would be assessed as ‘not significant’ according to the Environment Agency’s Risk Assessment Guidance.

## 5.3 Emissions at Half-hourly ELVs

The dispersion modelling results presented in **Section 5.1** have been predicted assuming that the facility is operating for all hours in the year with the pollutant concentrations exactly at the daily emission limit value prescribed by the IED/BREF. This is an extreme assumption, especially for the annual average concentrations since the facility could never operate with release rates as high as this in practice and remain compliant with legislation.

Short term peak concentrations may arise if the installation emits pollutants at levels approaching the half hourly limit values prescribed in the IED. These pollutants are particulate matter, nitrogen dioxide, sulphur dioxide, hydrogen chloride, hydrogen fluoride and carbon monoxide and have the following half-hourly emission limit values:

- total dust – 30 mg/Nm<sup>3</sup> (10 mg Nm<sup>-3</sup> 97% compliance);
- hydrogen chloride – 60 mg/Nm<sup>3</sup> (10 mg/Nm<sup>3</sup> 97% compliance);
- hydrogen fluoride – 4 mg/Nm<sup>3</sup> (2 mg/Nm<sup>3</sup> 97% compliance);
- sulphur dioxide – 200 mg/Nm<sup>3</sup> (50 mg/Nm<sup>3</sup> 97% compliance);
- oxides of nitrogen – 400 mg/Nm<sup>3</sup> (200 mg/Nm<sup>3</sup> 97% compliance); and
- carbon monoxide – 100 mg/m<sup>3</sup>.

Such excursions above daily limit values are permitted for only 3% of a year. The probability of such occasions occurring at the same time as the meteorological conditions that produce the highest one hour

mean ground level concentrations is unlikely. On the basis of these worst-case assumptions, maximum predicted short-term concentrations for emissions at the half hourly limit values are provided in **Table 5.30**. This assumes that each source operates continuously at the half-hourly ELV and for 8-hour and 24-hour means, emissions are at the half-hourly ELV for the entire averaging period.

**Table 5.30: Maximum Predicted Short-term Concentrations at the Half-hourly ELVs**

Pollutant	PC ( $\mu\text{g}/\text{m}^3$ )	PC (%)
NO <sub>2</sub> (maximum 99.8 <sup>th</sup> percentile of 1-hour means)	139	69.5%
SO <sub>2</sub> (maximum 99.9 <sup>th</sup> percentile of 15-minute means)	201	75.6%
SO <sub>2</sub> (maximum 99.7 <sup>th</sup> percentile of 1-hour means)	153	43.7%
SO <sub>2</sub> (maximum 99.2 <sup>nd</sup> percentile of 24-hour means)	50.3	40.3%
PM <sub>10</sub> (maximum 90.4 <sup>th</sup> percentile of 24-hour means)	15.2	30.4%
HCl (maximum 1-hour)	97.9	13.1%
HF (maximum 1-hour)	6.53	4.1%
CO (maximum 8-hour)	172	1.7%
CO (maximum 1-hour)	308	1.0%

Predicted concentrations are between 1.0% and 75.6% of the short term AQAL. Highest concentrations relative to the AQAL are predicted for SO<sub>2</sub> as the 15-minute mean. The PECs for all pollutants and averaging periods are all well below 100% of the respective AQALs (as a worst-case, 78.6% for 15-minute SO<sub>2</sub>). On the basis of these worst-case results, it is very unlikely that the AQALs would be exceeded anywhere within the model domain. Therefore, it is concluded that emissions at the half hourly limits would not have a significant impact on air quality even assuming worst case dispersion conditions occurring during periods of elevated emissions.

## 5.4 Abnormal Emissions

### 5.4.1 Introduction

For the IED emission sources (A1a, A1b, A1c and A1d), results are based on normal operating conditions and using daily emission limits where daily and half hourly values are provided. Article 46 of the Industrial Emissions Directive (IED) allows abnormal operation, where emission limit values can be exceeded for certain periods, without being in contravention of the Environmental Permit for the plant. This assessment identifies foreseeable events at the plant which constitute abnormal operations for these sources, which may have an impact on the subsequent emissions to air. The assessment then goes on to quantify the impacts to air quality in the vicinity of the plant as a result of these changes in emissions. The assessment focuses on the potential changes in emissions arising from failure of abatement plant, and mechanical failure. These failures are assumed to occur for the IED sources but include combined modelling with other sources operating normally that have these pollutant emissions.

### 5.4.2 Overview of Abnormal Emissions

In the event of any process upset or mechanical failure the immediate action to implement process controls, which ensure that standby equipment, where available and associated abatement systems are operational. In addition, various actions and monitoring procedures will be initiated by the Operator to ensure that the plant combustion parameters and emissions remain within the Environmental Permit, thereby avoiding an

abnormal operation where possible. If any process upset or mechanical failure results in a significant change to the emission conditions or process that cannot be easily and quickly remedied, the primary response from the operator will be to reduce load or initiate a controlled shutdown of the plant as appropriate.

Abnormal operation is not applicable to high CO or total organic carbon (TOC) emissions; in the event of emission levels of either being above the Emission Limit Value (ELV) the plant load would be reduced and a controlled shutdown initiated. Therefore, it is considered that periods where the plant continues to operate for extended periods with CO or TOC above the ELV would not occur.

### 5.4.3 Approach

The abnormal modelling approach has considered the short-term impacts during periods of abnormal operation, assuming a worst case of complete abatement failure of the air pollution control plant. A series of factors have been derived in order to ascertain the likely increases in emissions that may occur for each pollutant due to various foreseeable abnormal operations. For particulate matter, CO, and TOC the limits in Annex VI, Part 3 of the IED were used for this assessment.

The dispersion modelling approach used to assess impacts under normal operating conditions uses daily emission limits to predict short term ground level pollutant concentrations. These predictions are then compared to the relevant air quality standard. For the assessment of abnormal emissions, the impact on short term concentrations is of more importance since occasional excursions above the ELV would have negligible impact on long term air quality impacts. However, the Environment Agency generally require that the long-term impact of abnormal conditions is considered for some pollutants namely dioxins and furans, mercury and PCBs.

### 5.4.4 Abnormal Emissions – Short-term Impacts

Article 46(6) of the IED states that ‘under no circumstances continue to incinerate waste for a period of more than 4 hours uninterrupted where emission limits values are exceeded’. In addition, Article 46(6) also states that ‘the cumulative duration of operation in such conditions over one year shall not exceed 60 hours’. Therefore, in order to assess the short-term ground level conditions that would result from the facility operating at a plausible abnormal operational emission levels for four hours, the assessment has considered the short-term ground level concentrations where emissions occur at above half-hourly emission limits. The short-term emissions that are assumed to occur during abnormal conditions for the IED emission sources are presented in **Table 5.31**.

For SO<sub>2</sub>, HCl and HF, abnormal emissions are based on the sulphur and chloride content of the syngas and the fuel use at maximum load. This assumes that contaminants present in the syngas are released uncontrolled. Calculations are based on the following:

- a syngas throughput of 1,256 kg/hour and 831 kg/hour for the A1 and A2 sources, respectively;
- a syngas density of 1.6 kg/Nm<sup>3</sup>;
- an H<sub>2</sub>S concentration in the syngas of 3.8 mg/Nm<sup>3</sup> which is equivalent to a SO<sub>2</sub> concentration in syngas of 7.2 mg/Nm<sup>3</sup>;
- an HCl concentration in syngas of 1 ppm (v/v);

- HF concentrations are assumed to be the same as HCl in the absence of measured concentrations.

**Table 5.31: Short-term Abnormal Emission Concentrations – Non-metals**

Pollutant	Half-hour ELV (mg/Nm <sup>3</sup> )	Daily ELV (mg/Nm <sup>3</sup> )	Plausible Abnormal Emission (mg/Nm <sup>3</sup> )(a)	Plausible Abnormal Emission (g/s)	
				A1a & A1b	A2a & A2b
NO <sub>x</sub>	400	120	500 (b)	2.27	1.78
SO <sub>2</sub>	200	30	0.34 (c)	0.0016	0.0010
Total dust (PM <sub>10</sub> )	30	5	29.2 (d)(e)	0.132	0.104
HCl	60	6	0.078 (c)	3.6 x 10 <sup>-4</sup>	2.4 x 10 <sup>-4</sup>
HF	4	1	0.043 (c)	1.9 x 10 <sup>-4</sup>	1.3 x 10 <sup>-4</sup>
CO	100	50	75 (8-hourly) (f)	0.341	0.266
			100 (hourly)	0.454	0.355
PCBs	-	0.005 (g)	0.5 (h)	0.0023	0.0018

(a) Abnormal emissions assumed to occur for 4 hours, for the remainder of the averaging period (e.g. for emissions with 24-hour or 8-hour AQAL) emissions are assumed to be at the daily ELV

(b) Typical unabated NO<sub>x</sub> concentrations

(c) Based on the composition of the syngas and the syngas throughput

(d) The maximum total dust emission is restricted to 150 mg/Nm<sup>3</sup> (Annex VI, Part 3(2) of the IED)

(e) Calculated as 4 hours at 150 mg/Nm<sup>3</sup> and 20 hours at 5 mg/Nm<sup>3</sup>

(f) Calculated as 4 hours at 100 mg/Nm<sup>3</sup> and 4 hours at 50 mg/Nm<sup>3</sup>, half hour emission limit not to be exceeded

(g) Assumed emission concentration in the absence of an emission limit and as assumed for normal emissions

(h) Assumed to increase by a factor of 100

As the syngas is clean, concentrations of sulphur and chloride within the syngas are very low and based on the syngas composition, unabated emissions would be substantially less than the daily mean ELVs. Therefore, the impact of abnormal emissions of SO<sub>2</sub> and HCl are excluded from the abnormal emission assessment. It is anticipated that emissions of HF would be no higher than HCl and HF emissions are also excluded from the assessment on the basis that they are extremely low.

For metals other than mercury, it is assumed that metals are associated with the particle phase and that the emission will increase as the ratio between the abnormal dust emission and the half-hourly ELV (i.e. by a factor of 5 = 150/30). For mercury, it is assumed that the abnormal emission concentration is 100 times the emission limit. Therefore, short-term emission concentrations for trace metals are provided in **Table 5.32**.

**Table 5.32: Short-term Abnormal Emission Concentrations – Metals**

Metal	Daily ELV (mg/Nm <sup>3</sup> )	Hourly Abnormal Emission (mg/Nm <sup>3</sup> )	Plausible Abnormal Emission (g/s)	
			A1a & A1b	A2a & A2b
Cd (24-hour mean) (a)	0.02	0.1	1.5 x 10 <sup>-4</sup>	1.2 x 10 <sup>-4</sup>
Hg (24-hour mean) (a)	0.02	2	1.6 x 10 <sup>-3</sup>	1.2 x 10 <sup>-3</sup>
Hg (1-hour mean)	0.02	2	9.1 x 10 <sup>-3</sup>	7.1 x 10 <sup>-3</sup>
Sb (1-hour mean)	0.3	1.5	6.8 x 10 <sup>-3</sup>	5.3 x 10 <sup>-3</sup>
Cr (24-hour mean) (a)	0.3	1.5	2.3 x 10 <sup>-3</sup>	1.8 x 10 <sup>-3</sup>
Cu (24-hour mean) (a)	0.3	1.5	2.3 x 10 <sup>-3</sup>	1.8 x 10 <sup>-3</sup>
Mn (1-hour mean)	0.3	1.5	6.8 x 10 <sup>-3</sup>	5.3 x 10 <sup>-3</sup>
Ni (1-hour mean)	0.3	1.5	6.8 x 10 <sup>-3</sup>	5.3 x 10 <sup>-3</sup>
V (24-hour mean) (a)	0.3	1.5	2.3 x 10 <sup>-3</sup>	1.8 x 10 <sup>-3</sup>

(a) Abnormal emissions assumed to occur for 4 hours, for the remainder of the averaging period (e.g. for emissions with 24-hour or 8-hour AQAL) emissions are assumed to be at the daily ELV

#### 5.4.5 Abnormal Emissions – Long-term Impacts

For assessing abnormal emissions on long-term concentrations of dioxins and furans and PCBs, it is assumed that complete failure of the abatement equipment occurs for the full 60 hours allowed per annum and that emissions are 100 times the limit for all of these 60 hours. There is no air quality objective (AQO) or environmental assessment level (EAL) for dioxins/furans. Therefore, the impact of abnormal emissions of dioxins/furans is provided in the human health risk assessment (HHRA) submitted in support of the permit application and is not considered further here. Assuming that the plant operates at the emission limit (or assumed emission concentration) for 8,700 hours and at 100 times the limit for 60 hours of the year, the emission concentrations for PCBs would be and 0.0084 mg/Nm<sup>3</sup> (3.8 x 10<sup>-5</sup> g/s for A1 sources and 3.0 x 10<sup>-5</sup> g/s for A2 sources, respectively).

#### 5.4.6 Results – Short-term Impacts

Maximum predicted concentrations are provided for the relevant averaging period assuming that abnormal emissions occur during the period of worst-case dispersion conditions for the five years of meteorological data in **Table 5.33**. The predicted ground level concentrations have been determined assuming that operating conditions, such as volumetric flow and temperature, remain the same.

**Table 5.33: Maximum Predicted Short-term Concentrations for Abnormal Emissions**

Pollutant	PC (µg/m <sup>3</sup> )	PC (%)	PEC (%)
NO <sub>2</sub> (maximum 99.8 <sup>th</sup> percentile of 1-hour means)	162	81.1%	100.7%
PM <sub>10</sub> (maximum 90.4 <sup>th</sup> percentile of 24-hour means)	15.1	30.2%	74.3%
CO (maximum 8-hour)	162	1.6%	3.8%
CO (maximum 1-hour)	308	1.0%	2.0%
Pollutant	PC (ng/m <sup>3</sup> )	PC (%)	PEC (%)
Cd (24-hour maximum)	11.7	39.1%	39.4%

<b>Hg (24-hour maximum)</b>	<b>123</b>	<b>205%</b>	<b>210%</b>
<b>Hg (1-hour maximum)</b>	<b>3,264</b>	<b>544%</b>	<b>544%</b>
Sb (1-hour maximum)	2448	1.6%	1.6%
Cr (24-hour maximum)	176	8.8%	8.9%
<b>Cu (24-hour maximum)</b>	<b>176</b>	<b>352%</b>	<b>352%</b>
Mn (1-hour maximum)	2448	1.6%	1.6%
<b>Ni (1-hour maximum)</b>	<b>2,448</b>	<b>350%</b>	<b>350%</b>
V (24-hour maximum)	176	17.6%	18.0%
PCBs (1-hour maximum)	816	13.6%	13.6%

For some pollutants (Hg, Cu and Ni), the PC exceeds the respective AQAL. However, these are for the worst-case assumptions adopted for the abnormal emissions assessment. This includes the worst-case meteorological conditions, continuous operation at the abnormal emission level and maximum predicted concentrations anywhere within the model domain. The syngas is a clean fuel as evidenced by the very low sulphur and chloride concentrations present. It is expected that the concentration of trace metals within the syngas will also be very low. Since emissions of trace metals can only arise from contaminants present within the syngas, it is concluded that the abnormal assumptions adopted for these trace metals are extremely onerous and that emissions would be a fraction of what has been assumed for this abnormal emissions assessment.

#### 5.4.7 Results – Long-term Impacts

The long-term impact of abnormal emissions of PCBs is summarised in **Table 5.34**. Predicted concentrations are provided for the worst-case meteorological year and the maximum predicted concentration anywhere within the model domain. The predicted ground level concentrations have been determined assuming that operating conditions, such as volumetric flow and temperature, remain the same. Predicted concentrations are less than 1% of the relevant AQAL and would be assessed as not significant.

**Table 5.34: Predicted Annual Mean Concentrations for Abnormal Emissions**

Pollutant	PC (ng/m <sup>3</sup> )	PC (%)	PEC (%)
PCBs	0.44	0.2%	0.2%

## 5.5 Sensitivity Analysis

### 5.5.1 Introduction

For the detailed assessment provided, a conservative approach has been undertaken in order to avoid underestimating the impact of the installation on local air quality. This has included emissions at the maximum permissible, the worst-case meteorological year for each averaging period and continuous operation of the installation at full load. The effect of varying some of these parameters is considered. This sensitivity analysis has been carried out for emissions of NO<sub>x</sub> as this is considered to be the key pollutant emitted from the installation and has both a long-term and short-term AQAL. Predicted concentrations of NO<sub>2</sub> are provided as the maximum predicted for the annual mean and the 99.8<sup>th</sup> percentile of hourly means.

### 5.5.2 Meteorological Data

Dispersion modelling for five years of Durham Tees Valley Airport meteorological data was undertaken. Results presented in **Section 5.1** are the highest predicted for each averaging period and each receptor. A comparison of predicted concentrations of NO<sub>2</sub> for each of the five years is presented in **Table 5.35** as the maximum predicted anywhere within the modelling domain.

**Table 5.35: Maximum Predicted Concentrations of NO<sub>2</sub> for Annual Meteorological Data Sets**

Year	Annual Mean		99.8 <sup>th</sup> Percentile of 1-hour Means	
	PC (µg/m <sup>3</sup> )	PC (%age AQAL)	PC (µg/m <sup>3</sup> )	PC (ug/m <sup>3</sup> )
Durham Tees Valley 2018	5.4	13.5%	89.4	44.7%
Durham Tees Valley 2019	6.0	15.0%	92.3	46.1%
Durham Tees Valley 2020	5.7	14.2%	91.3	45.7%
Durham Tees Valley 2021	5.1	12.6%	75.4	37.7%
Durham Tees Valley 2022	6.2	15.4%	77.2	38.6%
Durham Tees Valley Average	5.7	14.1%	85.1	42.6%

For the annual mean, predicted concentrations for the five years are reasonably variable with the lowest concentration (2021) being 82% of the highest concentration (2022). The average for the five years is 5.7 µg/m<sup>3</sup> (92% of the maximum year). The hourly mean concentrations show similar variability with the lowest concentration (2022) 84% of the highest concentration (2019).

### 5.5.3 Surface Roughness

Within ADMS surface roughness is defined for the site and for the selected meteorological station. For the detailed modelling, the site surface roughness was defined as 0.5 m and for the meteorological station 0.3 m. A value of 0.3 m for the site was defined as the surrounding area is semi-rural.

The effect of increasing the site surface roughness on the model results has been determined with values of 0.3 m and 0.7 m tested. A summary of these results is compared to the original results for a site surface roughness of 0.5 m in **Table 5.36**.

**Table 5.36: Maximum Predicted Concentrations of NO<sub>2</sub> for Varying Surface Roughness Values**

Surface Roughness	Annual Mean		99.8 <sup>th</sup> Percentile of 1-hour Means	
	PC (µg/m <sup>3</sup> )	PC (%age AQAL)	PC (µg/m <sup>3</sup> )	PC (ug/m <sup>3</sup> )
2019 Surface Roughness 0.3 m	5.2	13.0%	88.7	44.4%
2019 Surface Roughness 0.5 m	6.0	15.0%	92.3	46.1%
2019 Surface Roughness 0.7 m	6.8	17.0%	93.5	46.8%

Increasing the surface roughness length for the site has the effect of increasing the predicted annual mean concentrations. However, compared to the original settings these changes are relatively small, at most 2.0% of the annual mean AQO. For short-term concentrations the effect of increasing the surface roughness also results in an increase in predicted concentrations but the difference between a surface roughness of 0.5 m and 0.7 m is negligible.

#### 5.5.4 *Summary*

The sensitivity analysis has demonstrated that varying the assumptions made for the assessment does not significantly vary the predicted concentrations for most choices. Furthermore, in most cases, the assumptions adopted for the detailed assessment are representative of the worst-case. The most variable parameter was the selection of meteorological year where predicted concentrations for the worst-case year are  $6.2 \mu\text{g}/\text{m}^3$  compared to an average for the five years of  $5.7 \mu\text{g}/\text{m}^3$ . Therefore, the highest concentration is 8% higher than the average. For the detailed assessment provided, the maximum predicted concentration for each averaging period and each receptor was presented for the five years of meteorological data. Therefore, it is concluded that the assessment provided is robust and representative of worst-case conditions.

It should also be noted that the locations of these maxima are within the site boundary where there would be no relevant public exposure.

## 6. CONCLUSIONS

Sol Environment Ltd has been commissioned by Endolys Ltd to undertake an air quality assessment for a proposed plastic waste recycling facility on land to the southeast of Darlington, County Durham. The facility will utilise advanced thermal treatment (pyrolysis) to manufacture pyrolysis oil (PyOil) from around 120,000 tonnes of waste plastic film per annum. The project will be undertaken in two distinct phases; six modular pyrolysis units will be installed in Phase 1, with a further six modular pyrolysis units in Phase 2. By project completion there will be a total of twelve pyrolysis units, each with a capacity of 1.3 tonnes per hour. Allowing for maintenance and downtime and assuming 90% availability the plant will process approximately 330 tonnes per day and produce approximately 81,000 tonnes per annum of PyOil. The assessment is provided to support an Environmental Permit application for the waste recycling facility.

The potential air quality impacts arising from the facility are as follows:

- the generation of odours and off-site odour annoyance; and
- emissions to air from the various on-site activities.

Odour has been screened out of the assessment due to no odorous materials being accepted onto site, as well as the waste acceptance, handling and processing occurring internally. In addition, the implementation of an Odour Management Plan will be an operational requirement of the permit.

Detailed air quality modelling using the UK ADMS dispersion model has been undertaken to predict the impact associated with the various stack emissions from the facility.

Predicted concentrations at sensitive human receptors are assessed as 'not significant' or 'unlikely that the air quality assessment level would be exceeded'. Therefore, the assessment concluded that the impact on human health would be 'not significant'.

The impact of emissions from the facility on the identified habitat sites was also determined and assessed as 'not significant' in accordance with Environment Agency's Risk Assessment Guidance.

Therefore, it is concluded that the impact of the facility on local air quality would be 'not significant'.

## APPENDIX A AIR QUALITY TERMINOLOGY

Term	Definition
Accuracy	A measure of how well a set of data fits the true value.
Air quality objective	Policy target generally expressed as a maximum ambient concentration to be achieved, either without exception or with a permitted number of exceedances within a specific timescale (see also air quality standard).
Air quality standard	The concentrations of pollutants in the atmosphere which can broadly be taken to achieve a certain level of environmental quality. The standards are based on the assessment of the effects of each pollutant on human health including the effects on sensitive sub groups (see also air quality objective).
Ambient air	Outdoor air in the troposphere, excluding workplace air.
Annual mean	The average (mean) of the concentrations measured for each pollutant for one year. Usually this is for a calendar year, but some species are reported for the period April to March, known as a pollution year. This period avoids splitting winter season between 2 years, which is useful for pollutants that have higher concentrations during the winter months.
AQMA	Air Quality Management Area.
Defra	Department for Environment, Food and Rural Affairs.
Exceedence	A period of time where the concentrations of a pollutant is greater than, or equal to, the appropriate air quality standard.
Fugitive emissions	Emissions arising from the passage of vehicles that do not arise from the exhaust system.
LAQM	Local Air Quality Management.
NO	Nitrogen monoxide, a.k.a. nitric oxide.
NO <sub>2</sub>	Nitrogen dioxide.
NO <sub>x</sub>	Nitrogen oxides.
O <sub>3</sub>	Ozone.
Percentile	The percentage of results below a given value.
PM <sub>10</sub>	Particulate matter with an aerodynamic diameter of less than 10 micrometres.
ppb parts per billion	The concentration of a pollutant in the air in terms of volume ratio. A concentration of 1 ppb means that for every billion (10 <sup>9</sup> ) units of air, there is one unit of pollutant present.
ppm parts per million	The concentration of a pollutant in the air in terms of volume ratio. A concentration of 1 ppm means that for every billion (10 <sup>6</sup> ) units of air, there is one unit of pollutant present.
Ratification (Monitoring)	Involves a critical review of all information relating to a data set, in order to amend or reject the data. When the data have been ratified they represent the final data to be used (see also validation).
µg/m <sup>3</sup> micrograms per cubic metre	A measure of concentration in terms of mass per unit volume. A concentration of 1µg/m <sup>3</sup> means that one cubic metre of air contains one microgram (millionth of a gram) of pollutant.
UKAS	United Kingdom Accreditation Service.
Uncertainty	A measure, associated with the result of a measurement, which characterizes the range of values within which the true value is expected to lie. Uncertainty is usually expressed as the range within which the true value is expected to lie with a 95% probability, where standard statistical and other procedures have been used to evaluate this figure. Uncertainty is more clearly defined than the closely related parameter 'accuracy', and has replaced it on recent European legislation.
USA	Updating and Screening Assessment.
Validation (modelling)	Refers to the general comparison of modelled results against monitoring data carried out by model developers.
Validation (monitoring)	Screening monitoring data by visual examination to check for spurious and unusual measurements (see also ratification).

Term	Definition
Verification (modelling)	Comparison of modelled results versus any local monitoring data at relevant locations.

APPENDIX B AIR QUALITY STANDARDS AND OBJECTIVES AND ENVIRONMENTAL ASSESSMENT LEVELS

Pollutant	Averaging Period	AQAL ( $\mu\text{g}/\text{m}^3$ )	Comments
Nitrogen dioxide (NO <sub>2</sub> )	annual	40	UK AQO and EU Limit Value
	1-hour	200	UK AQO and EU Limit Value, not to be exceeded more than 18 times per annum, equivalent to the 99.8 <sup>th</sup> percentile of 1-hour means
Sulphur dioxide (SO <sub>2</sub> )	24-hour	125	UK AQO and EU Limit Value, not to be exceeded more than 3 times per annum, equivalent to the 99.2 <sup>nd</sup> percentile of 24-hour means
	1-hour	350	UK AQO and EU Limit Value, not to be exceeded more than 24 times per annum, equivalent to the 99.7 <sup>th</sup> percentile of 1-hour means
	15-minute	266	UK AQO, not to be exceeded more than 35 times per annum, equivalent to the 99.9 <sup>th</sup> percentile of 15-minute means
Carbon monoxide (CO)	8-hour	10,000	UK AQO and EU Limit Value
	1-hour	30,000	EAL
Particulate matter (as PM <sub>10</sub> )	annual	40	UK AQO and EU Limit Value
	24-hour	50	UK AQO and EU Limit Value, not to be exceeded more than 35 times per annum, equivalent to the 90.4 <sup>th</sup> percentile of 24 hour means
Particulate matter (as PM <sub>2.5</sub> )	annual	20	EU Target Value
1,3-Butadiene	annual	2.25	AQO (England and Wales)
	24-hour (short term)	2.25	EAL
Hydrogen Chloride (HCl)	1-hour	750	EAL
Hydrogen Fluoride (HF)	1 hour	160	EAL
	monthly	16	EAL
Ammonia (NH <sub>3</sub> )	annual	180	EAL
	1-hour	2,500	EAL
Antimony (Sb)	annual	5	EAL
	1-hour	150	EAL
Arsenic (As)	annual	0.006	EU Target Value
Cadmium (Cd)	annual	0.005	EU Target Value
	24-hour (short term)	0.03	EAL
Chromium III (CrIII)	24-hour (long term)	2.0	EAL
Chromium VI (CrVI)	annual	0.00025	EAL
Cobalt (Co)	annual	1	Derived from HSE EH40/2002 OEL
Copper (Cu)	24-hour (long term)	0.05	EAL
Manganese (Mn)	annual	0.15	EAL
	1-hour	1,500	EAL
Lead (Pb)	annual	0.25	UK AQO
Mercury (Hg)	24-hour (long term)	0.06	EAL
	1-hour	0.6	EAL
Nickel (Ni)	annual	0.02	EU Target Value
	1-hour	0.7	EAL
Thallium (Tl)	annual	1	Derived from HSE EH40/2002 OEL
Vanadium (V)	24-hour	1	WHO
Polycyclic Aromatic Hydrocarbons (PAH) as Benzo[a]Pyrene	annual	0.00025	UK AQO
Polychlorinated Biphenyls (PCBs)	annual	0.2	EAL
	1-hour	6	EAL

## APPENDIX C DISPERSION MODEL INPUT PARAMETERS

**Table C1: Stack Emission Parameters – Pyrolysis Heating (Emissions A1a and A1b)**

Parameter	Pyrolysis Heating (Emissions A1a and A1b) – Per Unit	
Stack height (m)	25	
Flue exit diameter (m)	0.8	
Temperature of release (°C)	50	
Moisture content (%v/v)	5 to 13% (a)	
Oxygen content (%v/v dry)	10 to 15% (b)	
Actual flow rate (Am <sup>3</sup> /s)	5.14	
Normalised flow rate (Nm <sup>3</sup> /s) (c)	4.34	
Emission velocity at flue exit (m/s)	10.2	
Operational hours (h/a)	7,200	
Emissions	Emission Concentration (mg/Nm <sup>3</sup> ) (c)	Emission Rate (g/s)
PM <sub>10</sub>	5	0.0227
TOC	10	0.0454
HCl	6	0.0272
HF	1	0.00454
CO	50	0.227
SO <sub>2</sub>	30	0.136
NO <sub>x</sub>	120	0.545
NH <sub>3</sub>	10	0.0454
Group I (Cd, Tl)	0.02	9.1 x 10 <sup>-5</sup>
Group II (Hg)	0.02	9.1 x 10 <sup>-5</sup>
Group III (Sb, As, Pb, Cr, Co, Cu, Mn, Ni, V)	0.3	1.4 x 10 <sup>-3</sup>
Dioxins and Furans	0.06 ng/Nm <sup>3</sup>	2.7 x 10 <sup>-10</sup>
PAHs (as B[a]P)	9 x 10 <sup>-5</sup>	4.1 x 10 <sup>-7</sup>
PCBs	0.005	2.3 x 10 <sup>-5</sup>
(a) 5% assumed as a worst-case		
(b) 10% assumed as a worst-case		
(c) Normalised to 273K, 1 atmosphere, dry and 11% O <sub>2</sub>		

**Table C2: Stack Emission Parameters – Boilers for Excess Syngas (Emissions A2a and A2b)**

Parameter	Boilers (Emissions A2a and A2b) – Per Unit	
Stack height (m)	25	
Flue exit diameter (m)	0.81	
Temperature of release (°C)	180	
Moisture content (%v/v)	5%	
Oxygen content (%v/v dry)	13%	
Actual flow rate (Am <sup>3</sup> /s)	7.76	
Normalised flow rate (Nm <sup>3</sup> /s) (a)	3.55	
Emission velocity at flue exit (m/s)	10.2	
Operational hours (h/a)	7,200	
Emissions	Emission Concentration (mg/Nm <sup>3</sup> ) (a)	Emission Rate (g/s)
PM <sub>10</sub>	5	0.0177
TOC	10	0.0355
HCl	6	0.0213
HF	1	0.00355
CO	50	0.177
SO <sub>2</sub>	30	0.107
NO <sub>x</sub>	120	0.426
NH <sub>3</sub>	10	0.0355
Group I (Cd, Tl)	0.02	7.1 x 10 <sup>-5</sup>
Group II (Hg)	0.02	7.1 x 10 <sup>-5</sup>
Group III (Sb, As, Pb, Cr, Co, Cu, Mn, Ni, V)	0.3	1.1 x 10 <sup>-3</sup>
Dioxins and Furans	0.06 ng/Nm <sup>3</sup>	2.1 x 10 <sup>-10</sup>
PAHs (as B[a]P)	9 x 10 <sup>-5</sup>	3.2 x 10 <sup>-7</sup>
PCBs	0.005	1.8 x 10 <sup>-5</sup>
(a) Normalised to 273K, 1 atmosphere, dry and 11% O <sub>2</sub>		

**Table C3: Stack Emission Parameters – Ventilation (Emissions A3a and A3b)**

Parameter	Ventilation (Emissions A3a and A3b) – Per Unit
Stack height (m)	15
Flue exit diameter (m)	1.51
Temperature of release (°C)	15
Actual flow rate (Am <sup>3</sup> /s)	26.9
Normalised flow rate (Nm <sup>3</sup> /s) (a)	25.5
Emission velocity at flue exit (m/s)	15.0
Operational hours (h/a)	
Dust (mg/Nm <sup>3</sup> )	10 (a)
Dust (g/s)	0.255
(a) Normalised to 273K	

**Table C4: Stack Emission Parameters – Natural Gas Engine (Emission A5)**

Parameter	Natural Gas Engine (Emission A5)
Stack height (m)	15
Flue exit diameter (m)	0.4
Temperature of release (°C)	120
Moisture content (%v/v)	10.76
Oxygen content (%v/v dry)	9.98
Actual flow rate (Am <sup>3</sup> /s)	2.99
Normalised flow rate (Nm <sup>3</sup> /s) (a)	3.43
Emission velocity at flue exit (m/s)	23.8
Operational hours (h/a)	7,500
NOx (mg/Nm <sup>3</sup> ) (a)	95
NOx (g/s)	0.326
CO (mg/Nm <sup>3</sup> ) (a)	400
CO (g/s)	1.37
(a) Normalised to 273K, 1 atmosphere, dry and 15% O <sub>2</sub>	

**Table C4: Stack Emission Parameters – Flare (Emission A6a and A6b)**

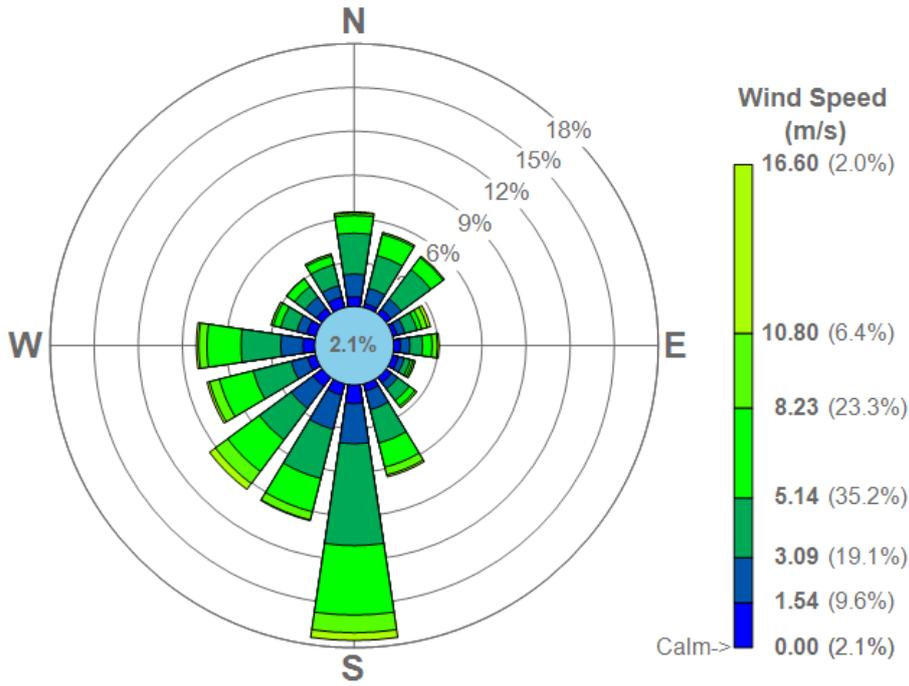
Parameter	Flare (Emission A6a and A6b) – Per Unit		
	Scenario 1	Scenario 2	Scenario 3
Stack height (m)	11	11	11
Flue exit diameter (m)	2.45	2.45	2.45
Temperature of release (°C)	800	800	800
Moisture content (%v/v)	10	10	10
Oxygen content (%v/v dry)	8	8	8
Actual flow rate (Am <sup>3</sup> /s)	32.8	14.4	6.1
Normalised flow rate (Nm <sup>3</sup> /s) (a)	5.41	2.38	1.01
Emission velocity at flue exit (m/s)	6.95	3.06	1.30
Operational hours (h/a)	6	24	876
NO <sub>x</sub> (mg/Nm <sup>3</sup> ) (a)	150		
NO <sub>x</sub> (g/s) - long-term	0.0167 (b)		
No <sub>x</sub> (g/s) - short-term	0.811		
CO (mg/Nm <sup>3</sup> ) (a)	400		
CO (g/s)	0.270		
VOCs (mg/Nm <sup>3</sup> ) (a)	10		
VOCs (g/s) - long-term	0.011 (b)		
VOCs (g/s) - short-term (g/s)	0.054		

(a) Normalised to 273K, 1 atmosphere, dry and 3% O<sub>2</sub>

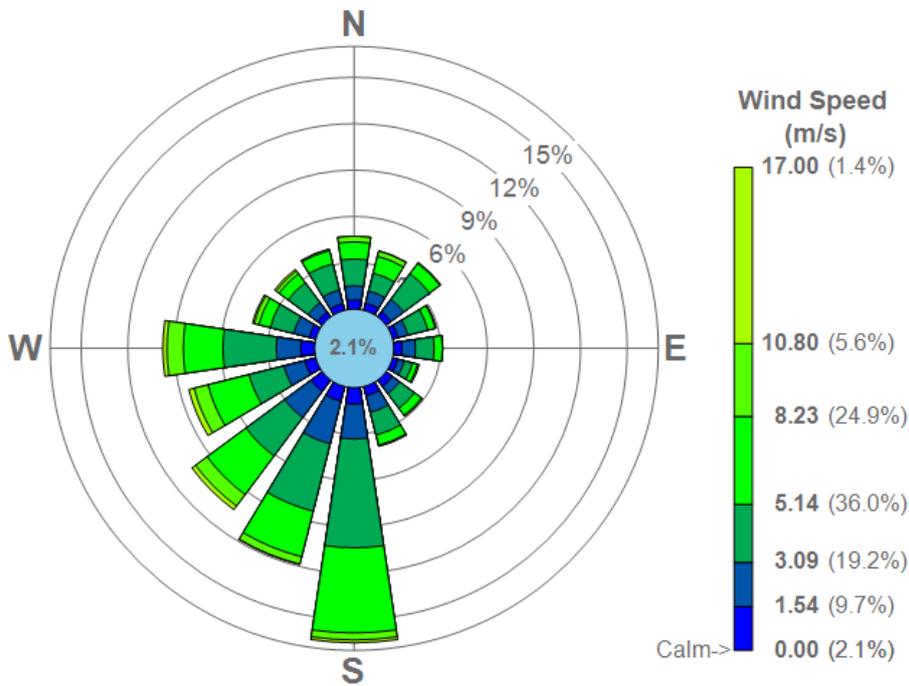
(b) Combined emissions for Scenario 1 for 6 hours, Scenario 2 for 24 hours and Scenario 3 for 876 hours

APPENDIX D

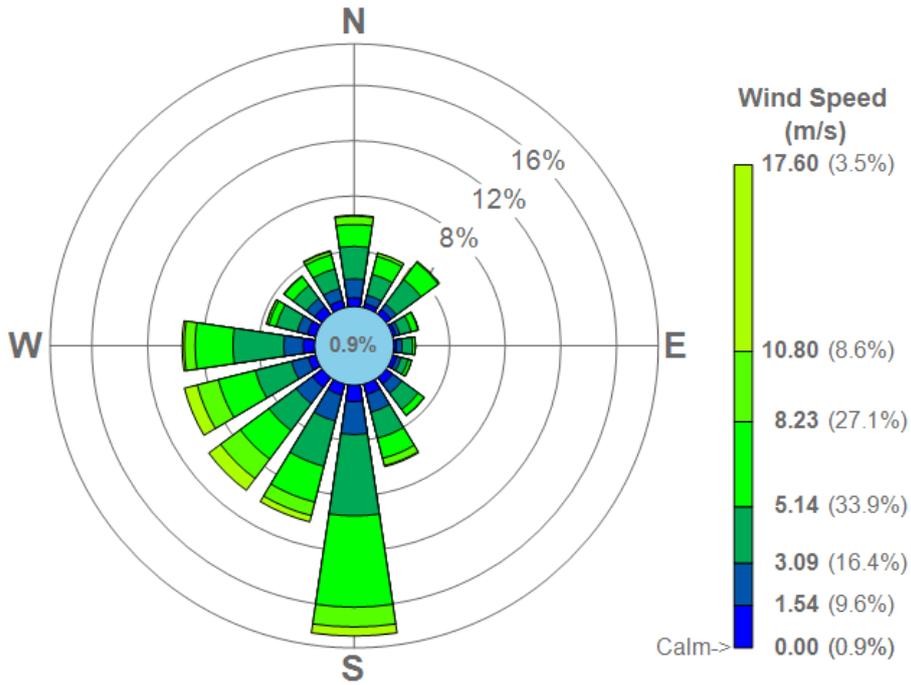
WIND ROSES FOR DURHAM TEES VALLEY AIRPORT (2018 TO 2022)



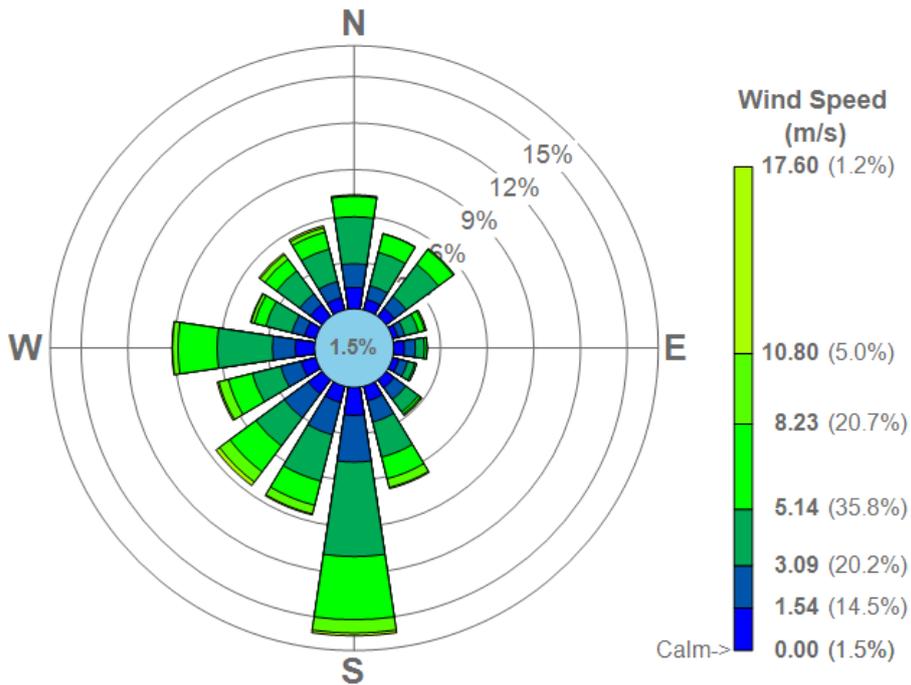
2018



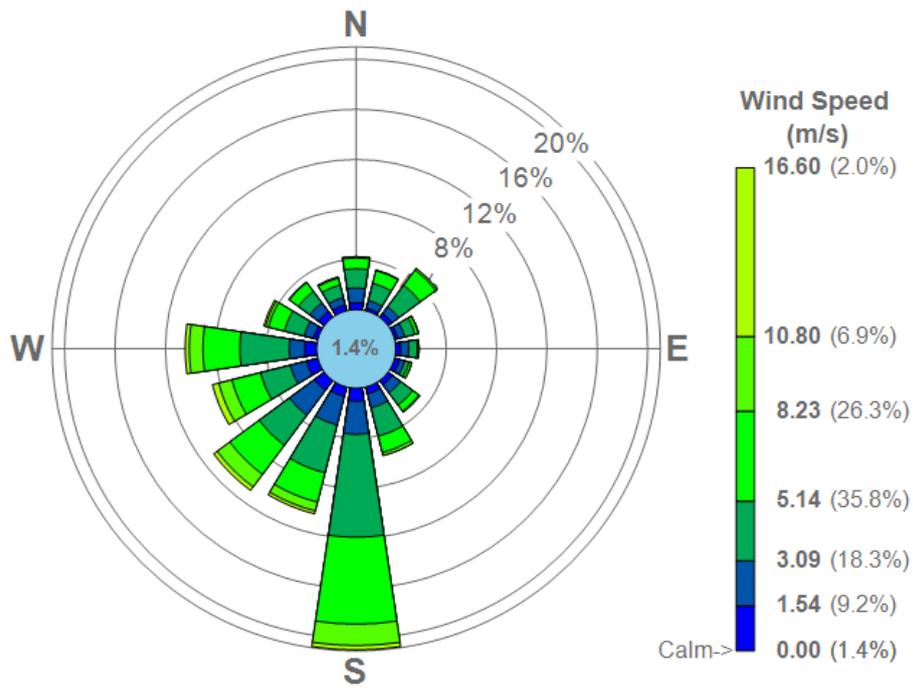
2019



2020



2021



2022

## APPENDIX E ENVIRONMENTAL ASSESSMENT LEVELS FOR THE PROTECTION OF VEGETATION AND ECOSYSTEMS

### Critical Levels

Critical levels are thresholds of airborne pollutant concentrations above which damage may be sustained to sensitive plants and animals.

The critical levels for the protection of vegetation and ecosystems (as defined by the EU Directive 2008/50/EC and the 2010 UK Air Quality Standards Regulations) that are relevant to the assessment are summarised in **Table E1**.

**Table E1: Critical Levels for the Protection of Vegetation and Ecosystems**

Pollutant	Averaging Period	Concentration ( $\mu\text{g}/\text{m}^3$ )
Oxides of Nitrogen (NO <sub>x</sub> )	Annual Mean	30
	24-Hour Mean	75
Sulphur Dioxide (SO <sub>2</sub> )	Annual Mean / Winter Mean (31 Oct to 1 Mar)	10 (sensitive habitats with lichen and bryophytes)
		20 (all other habitats)
Ammonia (NH <sub>3</sub> )	Annual Mean	1 (sensitive habitats with lichen and bryophytes)
		3 (all other habitats)
Hydrogen Fluoride (HF)	Weekly Mean	0.5
	Daily Mean	5

Background airborne pollutant concentrations for the habitat sites included in the assessment are provided in **Table E2**. For NO<sub>x</sub>, SO<sub>2</sub> and NH<sub>3</sub>, data have been obtained from the Air Pollution Information Service and are representative of the mid-year 2021. As discussed in **Section 4**, baseline HF concentrations are assumed to be 0.2  $\mu\text{g}/\text{m}^3$  as the weekly and daily mean concentration for all habitat sites.

**Table E2: Background Concentrations of NO<sub>x</sub> and SO<sub>2</sub>**

Habitat Site	NO <sub>x</sub> ( $\mu\text{g}/\text{m}^3$ )	SO <sub>2</sub> ( $\mu\text{g}/\text{m}^3$ )	NH <sub>3</sub> ( $\mu\text{g}/\text{m}^3$ )
H1. Maidendale Fishing & Nature Reserve LNR/LWS	10.32	1.39	2.34
H2. Brankin Moor LNR/LWS	8.41	1.14	2.36
H3. Hunger Hill Farm LWS	7.05	0.94	2.55
H4. Red Hall LWS	10.21	1.59	2.18

### Critical Loads

Critical loads refer to the threshold beyond which deposition of pollutants to water or land results in measurable damage to vegetation and habitats. This takes the form of either gravitational settling of particulate matter (dry deposition) or wet deposition, where atmospheric pollutants dissolve in water vapour and then precipitate to the ground (e.g. as rain, snow, fog etc.).

Critical loads for eutrophication (nutrient nitrogen deposition) and background nutrient nitrogen deposition rates have been obtained from APIS (search by location) and are summarised in **Table E3** for the identified (assumed) habitats present.

**Table E3: Critical Loads for Eutrophication**

Habitat Site	Critical Load Class	Critical Load (kg N/ha/a)	Background N Deposition (kg N/ha/a)
H1. Maidendale Fishing & Nature Reserve LNR/LWS	Neutral grasslands	10 - 20	17.78
H2. Brankin Moor LNR/LWS	Broadleaved deciduous woodland	10 - 15	33.46
H3. Hunger Hill Farm LWS	Broadleaved deciduous woodland	10 - 15	33.88
H4. Red Hall LWS	Neutral grassland	10 - 20	17.22

For acidic deposition, the critical load of a habitat site is largely determined by the underlying geology and soils. The critical load of acidification is defined by a critical load function (CLF) which describes the relationship between the relative contributions of sulphur (S) and nitrogen (N) to the total acidification.

The critical load function is defined by the following parameters:

- CLmaxS, the maximum critical load of acidity for S, assuming there is no N deposition;
- CLminN, is the critical load of acidity due to nitrogen removal processes in the soil only (i.e. independent of deposition); and
- CLmaxN, is the maximum critical load of acidity for N, assuming there is no S deposition.

Critical loads and background acid deposition rates have been obtained from APIS (site location search) and are summarised in **Table E4** for the identified habitat sites.

**Table E4: Critical Loads for Acidification**

Habitat Site	Critical Load (keq/ha/a)			Background Deposition (keq/ha/a)
	CLmaxN	CLmaxS	CLminN	
H1. Maidendale Fishing & Nature Reserve LNR/LWS	5.071	4	1.071	1.35
H2. Brankin Moor LNR/LWS	2.749	2.392	0.357	2.50
H3. Hunger Hill Farm LWS	2.741	2.384	0.357	2.52
H4. Red Hall LWS	5.071	4	1.071	1.33