ST MARGARETS BIOMASS BOILER, DARTFORD

Air Emissions Risk Assessment

Prepared for: Darenth Farms and Cold Store Company Ltd

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1.0 Introduction

SLR Consulting Ltd (SLR) has been commissioned by Ensure Environmental Consulting Ltd, on behalf of Darenth Farms and Cold Store Company Ltd ("the Client"), to undertake an Air Emission Risk Assessment to support the Environmental Permit (EP) application for a biomass boiler (the 'Facility') on St Margaret's Road, Dartford.

The assessment describes the scope, relevant legislation, assessment methodology and the baseline conditions currently existing in the area. It then presents the potential impacts of the Proposed Development and an evaluation of the significance of the effects.

1.1 Background

Darenth Farms and Cold Store Company Ltd is applying for permit approval to operate a green composting facility with a total throughput of 5,200 tonnes per annum (tpa). The proposals include two 980 kW_{th} (output) biomass boilers, serviced by two individual stacks. The Facility is located within the administrative area of Dartford Borough Council (DBC).

1.2 Scope

This report sets out the assessment of impacts from the Facility on air quality. The scope of the assessment is limited to point source combustion emissions to air at the Facility as defined above and the key pollutant releases of oxides of nitrogen (NOx), particulate matter (PM), Carbon Monoxide (CO) and Volatile Organic Compounds (VOCs). The objective of the study is to assess the impact of NOx, NO_2, PM, CO and VOC emissions against the relevant Air Quality Standards for the protection of human health and ecological receptors.

2.0 LEGISLATION AND GUIDANCE

2.1 Environmental Permitting Regulations

The installation will be regulated under the Environmental Permitting Regulations (EPR 2016). The EPR implements European Union Directives including 2010/75/EU (the Industrial Emissions Directive, IED). EPR prescribes emission limit values for certain pollutants into the air from certain plant as a result. The biomass boilers are regulated under the Medium Combustion Plant Directive (MCPD) covered by the EPR (Amendment) Regulations 2018.

2.1.1 Permitting Guidance

Guidance Notes produced by Defra provide a framework for regulation of installations and additional technical guidance produced by the EA are used to provide the basis for permit conditions.

Of particular relevance to the assessment is the '*Air emissions risk assessment for your environmental permit*'[1] (the AERA guidance). The purpose of this guidance is to assist operators to assess risks to the environment and human health when applying for a permit under the EPR.

2.2 National Air Quality Legislation and Guidance

2.2.1 Air Quality Strategy

The United Kingdom Air Quality Strategy (AQS) 2007 for England, Scotland, Wales and Northern Ireland[2] sets out a comprehensive strategic framework within which air quality policy will be taken forward in the short to medium term, and the roles that Government, industry, the Environment Agency (EA), local government, business, individuals and transport have in protecting and improving air quality. The AQS contains Air Quality Objectives (AQOs) based on the protection of both human health and vegetation (ecosystems). The objectives and relevant Environmental Assessment Levels (EAL) for the key pollutants considered in this assessment for the protection of human health are presented in Table 2-1.

Table 2-1
Applied Air Quality Standards

Pollutant		Annual Standard (µg/m^3)	Short Term Standard/EAL (µg/m^3)
Nitrogen dioxide	(NO_2)	40	200 (1-hour) not to be exceeded more than 18 times per year
Particulate matter within an aerodynamic diameter of less than 10µm	(PM_{10})	40	50 (24 hour) not to be exceeded more than 35 times a year

[1] https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit
[2] The Air Quality Strategy for England, Scotland, Wales and Northern Ireland, DEFRA. July 2007.

Pollutant		Annual Standard (µg/m^3)	Short Term Standard/EAL (µg/m^3)
Particulate matter within an aerodynamic diameter of less than 2.5µm	($PM_{2.5}$)	25	None
Carbon Monoxide	CO	-	10,000 (8 hour rolling average over 24 period)
		-	30,000 (1 hour mean)
VOCs (assessed against Benzene standard)		5	195 (1 hour mean)

2.2.2 Air Quality Regulations

Many of the objectives in the UK AQS have been made statutory in England with the Air Quality (England) Regulations 2000[3] and the Air Quality (England) (Amendment) Regulations 2002[4] for the purpose of Local Air Quality Management (LAQM).

The Air Quality Standards Regulations 2010[5] transposed the European Union Ambient Air Quality Directive (2008/50/EC) into law in England. This Directive sets legally binding limit values for concentrations in outdoor air of major air pollutants that impact public health such as PM_{10}, $PM_{2.5}$ and NO_2. The limit values for NO_2 and PM_{10} are the same concentration levels as the relevant AQS objectives and the limit value for $PM_{2.5}$ is a concentration of 25µg/m^3 (see Table 2-1).

2.2.3 Environment Act 1995

Local Authorities (LAs), have formal powers to control air quality through a combination of Local Air Quality Management (LAQM) and by use of their wider planning policies.

Section 82 of the Environment Act 1995[6] (Part IV) requires local authorities to periodically review and assess the quality of air within their administrative area. The reviews need to consider the present and future air quality and whether any AQOs prescribed in regulations are being achieved or are likely to be achieved in the future.

Where any of the prescribed AQOs are not likely to be achieved the authority concerned must designate an Air Quality Management Area (AQMA). For each AQMA the local authority has a duty to draw up an Air Quality Action Plan (AQAP) setting out the measures the authority intends to introduce to deliver improvements in local air quality in pursuit of the AQOs.

[3] The Air Quality (England) Regulations 2000 - Statutory Instrument 2000 No.928.
[4] The Air Quality (England) (Amendment) Regulations 2002- Statutory Instrument 2002 No.3043.
[5] The Air Quality Standards Regulations 2010- Statutory Instrument 2010 No. 1001.
[6] Environment Act 1995 (1995)

2.2.4 DEFRA LAQM technical guidance (LAQM.TG (16)

DEFRA's Local Air Quality Management Technical Guidance[7] (LAQM.TG(16)) was published for use by LAs in their LAQM review and assessment work. The document provides key guidance in aspects of air quality assessment, including screening, use of monitoring data, and use of background data that are applicable to all air quality assessments. The AQOs (see Table 2-1), according to DEFRA's LAQM.TG(16) guidance, should be assessed at locations where members of the public are likely to be regularly exposed for a period of time appropriate to the averaging period of the objective. A summary of relevant exposure for the relevant AQOs are shown below.

Table 2-2
Relevant Public Exposure

Averaging Period	AQO's should apply at:	AQO's don't apply at:
Annual mean	All locations where members of the public might be regularly exposed. Building façades of residential properties, schools, hospitals, care homes etc.	Building façades of offices or other places of work where members of the public do not have regular access. Hotels, unless people live there as their permanent residence. Gardens of residential properties. Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term.
24-hour mean and 8-hour mean	All locations where the annual mean objective would apply, together with hotels. Gardens of residential properties.	Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term.
1-hour mean	Any outdoor locations where members of the public might reasonably expected to spend one hour or longer.	Kerbside sites where public would not be expected to have regular access

2.3 Protection of Ecological Receptors

Sites of nature conservation importance at a European, national and local level, are provided environmental protection with respect to air quality. Standards for the protection of ecological receptors are known as Critical Levels (C_{Le}) for airborne concentrations and Critical Loads (C_{Lo}) for deposition to land from air.

The EA's permitting guidance requires that designated ecological sites should be screened against relevant standards if they are located within the following set distances from the facility:

- Special Protection Areas (SPAs), Special Areas of Conservation (SACs) or Ramsar sites within 10km of the installation; and
- Sites of Special Scientific Interest (SSSIs), National Nature Reserves (NNR), Local Nature Reserves (LNR), Local Wildlife Sites (LWS) and Ancient Woodland (AW) within 2km of the installation.

[7] Department for Environment, Food and Rural Affairs (DEFRA): Local Air Quality Management Review and Assessment Technical Guidance LAQM.TG(16), 2016

2.3.1 Critical Levels (CLe)

C_{Le} are a quantitative estimate of exposure to one or more airborne pollutants in gaseous form, below which significant harmful effects on sensitive elements of the environment do not occur, according to present knowledge. The relevant C_{Le}'s for the protection of vegetation and ecosystems are specified within the AQS and within the EA's permitting guidance.

Table 2-3
Relevant C_{Le} for the Protection of Vegetation and Ecosystems

Pollutant	Concentration (µg/m^3)	Habitat and Averaging Period
Nitrogen oxides (NO_x)	30	Annual mean (all ecosystems)
	75	Daily mean (all ecosystems)

2.3.2 Critical Loads (CLo)

C_{Lo}'s are a quantitative estimate of exposure to deposition of one or more pollutants, below which significant harmful effects on sensitive elements of the environment do not occur, according to present knowledge. Critical loads are set for the deposition of various substances to sensitive ecosystems. In relation to combustion emissions, critical loads for eutrophication and acidification are relevant which can occur via both wet and dry deposition; however on a local scale only dry (direct deposition) is considered significant.

Empirical C_{Lo} for eutrophication (derived from a range of experimental studies) are assigned for different habitats, including grassland ecosystems, mire, bog and fen habitats, freshwaters, heathland ecosystems, coastal and marine habitats, and forest habitats and can be obtained from the UK Air Pollution Information System (APIS) website (www.apis.ac.uk/).

The C_{Lo}'s for the ecological sites subject to assessment are presented in Section 4.3.

3.0 ASSESSMENT METHODOLOGY

Detailed atmospheric dispersion modelling has been undertaken with due consideration to the AERA and dispersion modelling reporting guidance[8] (the dispersion modelling checklist is included in Appendix A). The modelling approach is based upon the following stages:

- review of process design and emission sources;
- identification of sensitive receptors;
- compilation of the existing air quality baseline and review of Local Air Quality Management status; and
- calculation of process contribution to ground level concentrations and evaluation against relevant environmental standards for both human and ecological receptors.

3.1 Emissions Scenario

Emission parameters are presented in Table 3-1 below. The emission rates have been derived on the basis of the plant details provided by the Client and pollutant emission factors from Medium Combustion Plant Directive (MCPD) 'Table 1 - Emission Limit Values for new plant other than engines and gas turbines' and from the EA's Final Draft EPR Technical note 5/1(18). Note that the MCPD limits are for dust and therefore impacts are assessed against the PM_{10} AQOs.

The assessment is considered to be conservative as it has assumed that the Facility is operating continuously throughout the year (expected to be around 80%). In addition, according to the Renewable Heat Incentive Emission Certificate for the chosen biomass boiler (Lambdamat LM 1000) measured NO_X emissions are 65.8g/GJ which equates to an emission rate of 0.08g/s. This is significantly lower (37.5%) than the 0.3g/s emission rate derived from the MCPD limit.

Table 3-1
Biomass Boilers Emission Parameters

Parameter / Source	Boiler 1	Boiler 2
Stack Locations (NGR X)	557377.6	557377.9
Stack Locations (NGR Y)	170220.3	170220.6
Stack Height (m AGL)	7	7
Stack Internal Diameter (m)	0.45	0.45
Emission Temperature (ºC)	220	220
Actual Air Flow (Am^3/s)	1.54	1.54
Emission Velocity (m/s)	9.7	9.7
Oxygen content (%O_2, dry gas)	12.5	12.5
Moisture content (%H_20)	3.7	3.7
Normalised Flow (Nm^3/s, dry, 101.3kPa ref %O_2)	0.6	0.6
Reference Oxygen (%O_2)	6	6
Emission Concentration: PM (mg/Nm^3)	50	50

[8] Air Dispersion modelling report requirements (for detailed air dispersion modelling). AQMAU, Environment Agency (not dated).

Parameter / Source	Boiler 1	Boiler 2
Emission Rate (per stack): PM (g/s)	0.03	0.03
Emission Concentration: NOx (mg/Nm^3)	500	500
Emission Rate (per stack): NOx (g/s)	0.3	0.3
Emission Concentration: CO (mg/Nm^3)	225	225
Emission Rate (per stack): CO(g/s)	0.14	0.14
Emission Concentration: VOCs (mg/Nm^3)	30	30
Emission Rate (per stack): VOCs (g/s)	0.02	0.02

3.2 Model Setup

For this assessment the AERMOD model[9] has been applied; this model is widely used and accepted by the EA for undertaking such assessments and its predictions have been validated against real-time monitoring data by the United States (US) Environmental Protection Agency (EPA). It is therefore considered a suitable model for this assessment.

3.2.1 Model Domain / Receptors

The modelling has been undertaken using a nested receptor grid across an Ordnance Survey map of the study area. Pollutant exposure isopleths are generated by interpolation between receptor points and superimposed onto the map. This method allows the maximum ground level concentration outside the site boundary to be assessed. A nested receptor grid was applied as follows:

- 400m x 400m at 40m grid resolution;
- 500m x 500m at 100m grid resolution;
- 2000m x 2000m at 200m grid resolution; and
- 4000m x 4000m at 400m grid resolution.

In addition, the modelling of discrete sensitive receptor locations as described in Section 4.1 was undertaken to assess the impact at relevant exposure locations for annual mean impact and facilitate the discussion of results.

3.2.2 Building Downwash

Building downwash occurs when turbulence, induced by nearby structures, causes pollutants emitted from an elevated source to be displaced and dispersed rapidly towards the ground, resulting in elevated ground level concentrations. Building downwash has been considered for buildings that have a maximum height equivalent to at least 40% of the emission height and which are within a distance defined as five times the lesser of the height or maximum projected width of the building.

The integrated Building Profile Input Programme (BPIP) module within AERMOD was used to assess the potential impact of building downwash upon predicted dispersion characteristics. Structures input to the model are represented in Figure 3-1.

[9] Software used: Lakes AERMOD View, (Executable Aermod_18081)

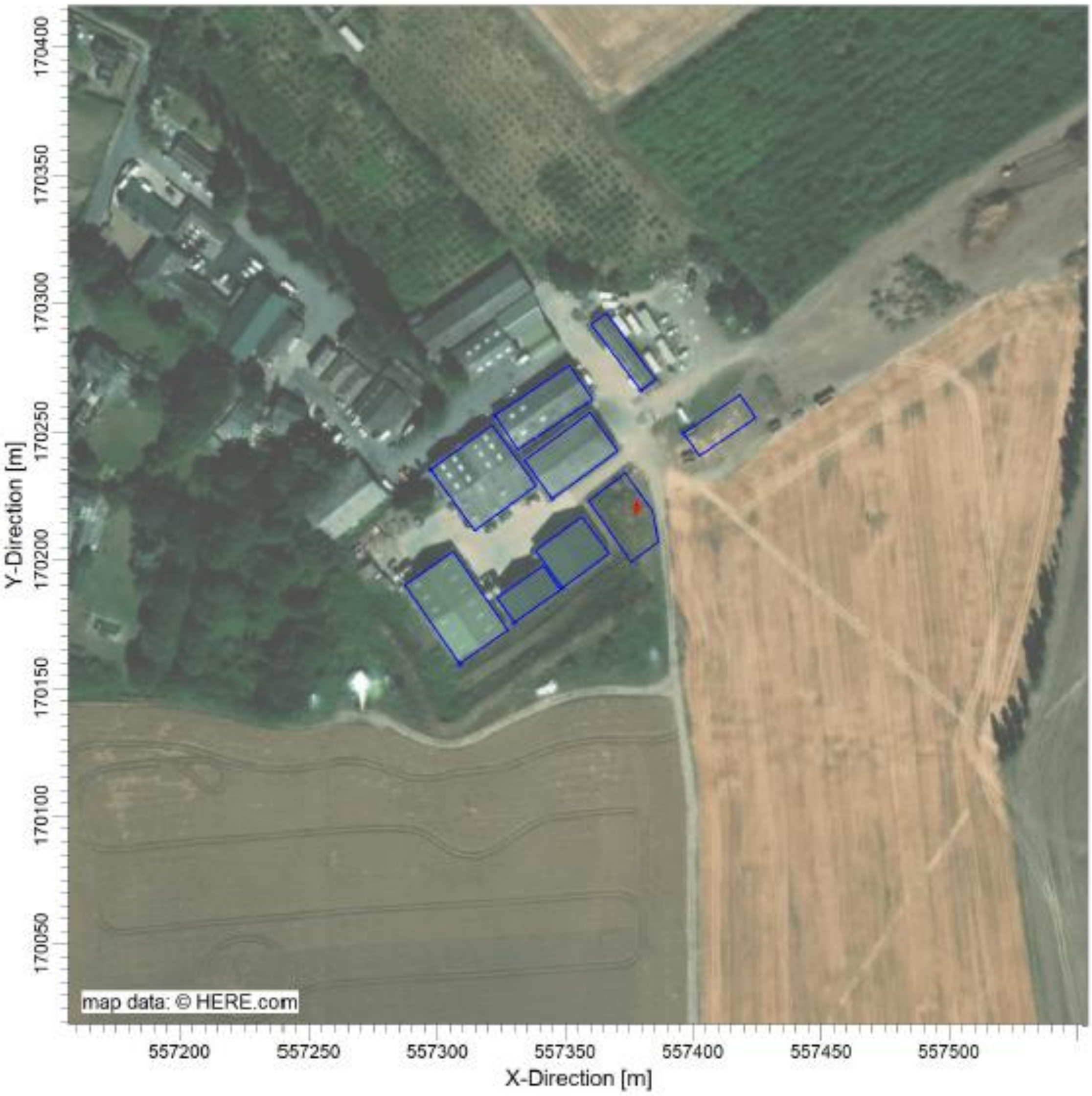

Figure 3-1
Modelled Buildings and Structures

3.2.3 Topography

The presence of elevated terrain can affect the dispersion of pollutants and the resulting ground level concentration in a number of ways. Elevated terrain reduces the distance between the plume centre line and the ground level, thereby increasing ground level concentrations. Elevated terrain can also increase turbulence and, hence, plume mixing with the effect of increasing concentrations near to a source and reducing concentrations further away.

AERMOD utilises digital elevation data to determine the impact of topography on dispersion from a source. Topography was incorporated within the modelling using 30m resolution Shuttle Radar Topography Mission (SRTM) terrain data files. Data was processed by the AERMAP function within AERMOD to calculate terrain heights (see Figure 4-4).

3.2.4 Met Data Preparation

The closest meteorological observation site (that records all the parameters necessary for dispersion modelling) is situated at Gravesend approximately 7km south. The 2013-2017 windrose (the meteorological year with the maximum impacts) are presented in Figure 4-3.

The meteorological data (5 year hourly data for 2013, 2014, 2015, 2016, and 2017) was obtained in .met format from the data supplier[10] and converted to the required surface and profile formats for use in AERMOD using AERMET View meteorological pre-processor. Details specific to the site location were used to define surface roughness, albedo and bowen ratio in the conversion (see Table 3-2).

Table 3-2
Applied Surface Characteristics

Zone (Start)	Zone (end)	Albedo	Bowen Ratio	Surface Roughness (m)
100	200	0.14	0.45	0.0001
200	100	0.29	0.925	0.04025

3.2.5 Dispersion Coefficients

The 'rural' option for dispersion coefficients was selected in accordance with AERMOD guidance[11].

3.2.6 Dispersion Model Uncertainty

Model validation studies[12] for AERMOD generally suggest that these dispersion models are for the vast majority of cases able to predict maximum short term high percentiles concentrations well within a factor of two and the latest evaluation study for AERMOD version 18081 shows the composite (geometric mean) ratio of predicted to observed short-term averages from 'test sites' (where real-time monitoring data is available to validate model performance), to be between 0.96 and 1.2.

3.3 Assessment of Impacts on Air Quality

3.3.1 Treatment of Model Output

The assessment of impacts against the standards as defined in Section 2.2 was undertaken using model outputs as described in Table 3-3 below.

With respect to NOx emissions, the EA Air Quality Modelling and Assessment Unit (AQMAU) guidance[13] on conversion ratio for NO_x and NO_2 has been followed, i.e. a worst-case scenario has been applied in that 70% of NO_x is present as NO_2 in relation to long term impacts and 35% of NOx is present as NO_2 in relation to short-term impacts.

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[10] AS Modelling & Data Ltd
[11] EPA, AERMOD Implementation Workgroup, Aermod Implementation Guide (August 3, 2015)
[12] AERMOD: Latest Features and Evaluation Results, EPA-454/R-03-003, June 2003 (United States Environmental Protection Agency)
[13] Environment Agency, Air Quality Modelling and Assessment Unit, 'Conversion Ratios for NOx and NO_2' (no date)

Table 3-3
Model Outputs

Criteria	Model Output – Process Contribution (PC)	Predicted Environmental Concentration (PEC)
NO_2 1-hour mean. Not to be exceeded more than 18 times a calendar year	99.79%ile of 1-hour means, factored by 0.35	PC + 2 x annual mean background
NO_x 24-hour maximum	Maximum 24-hour mean	PC + 1.5 x annual mean background[14]
Annual mean NO_x and NO_2	Annual Mean (NO_2 factored by 0.7)	PC + annual mean background
Annual mean PM_{10}	Annual Mean	PC + annual mean background
24 hour mean PM_{10}	90.4%ile of 24-hour means	PC + annual mean background
Annual mean Benzene	Annual Mean	PC + annual mean background
Benzene 1 Hour Mean	1 hour mean	PC + 2 x annual mean background
CO 8 hour mean	8 hour mean	PC + 2 x annual mean background
CO 1 hour mean	1 hour mean	PC + 2 x annual mean background

3.3.2 Assessment of Impact and Significance

To assess the potential impact on air quality the predicted exposure is compared to the standards. The results of the dispersion modelling have been presented in the form of:

- tabulated concentrations at discrete receptor locations to facilitate the discussion of results; and
- illustrations of the impact as isopleths (contours of concentration) for the criteria selected enabling determination of impact at any locations within the study area.

In accordance with the EA guidance, the impact is considered to be insignificant or negligible if:

- the long-term process contribution is <1% of the long-term AQO; and
- the short-term process contribution is <10% of the short-term AQO.

For process contributions that cannot be considered insignificant further assessment has been undertaken and the Predicted Environmental Concentration (PEC: PC + existing background pollutant concentration) determined for comparison as a percentage of the relevant AQO.

[14] Environment Agency (2017). Damhead Creel 2, Permitting Decision Document

3.4 Assessment of Impacts on Vegetation and Ecosystems

3.4.1 Calculation of Contribution to Critical Loads

Deposition rates were calculated using empirical methods recommended by the EA AQTAG06[15]. Dry deposition flux was calculated using the following equation:

Dry deposition flux (µg/m^2/s) = ground level concentration (µg/m^3) x deposition velocity (m/s)

Wet deposition occurs via the incorporation of the pollutant into water droplets which are then removed in rain or snow, and is not considered significant over short distances compared with dry deposition and therefore for the purposes of this assessment (in accordance with AQTAG06), wet deposition has not been considered.

The applied deposition velocities for the relevant chemical species are as shown in Table 3-4.

Table 3-4
Applied Deposition Velocities

Chemical Species	Recommended deposition velocity (m/s)	
NO_2	Grassland	0.0015
	Woodland	0.003

Critical Loads - Eutrophication

The critical loads for nitrogen deposition (N) are recorded in units of kgN/ha/yr. The deposition PC is converted from µg/m^2/s to units of kgN/ha/year by multiplying the dry deposition flux by the standard conversion factor of 95.9.

Critical Loads - Acidification

The deposition PC is converted to units of equivalents (keq/ha/year), which is a measure of how acidifying the chemical species can be, by multiplying the µg/m^2/s by standard conversion factor of 6.84.

Calculation of PC as a percentage of Acid Critical Load Function

The calculation of the process contribution of N to the critical load function has been carried out according to the guidance on APIS, which is as follows:

'The potential impacts of additional sulphur and/or nitrogen deposition from a source are partly determined by PEC, because only if PEC of nitrogen deposition is greater than CLminN will the additional nitrogen deposition from the source contribute to acidity. Consequently, if PEC is less that CLminN only the acidifying effects of sulphur from the process need to be considered:

Where PEC N Deposition < CLminN

*PC as % CL function = (PC S deposition/CLmaxS)*100*

Where PEC is greater than CLminN (the majority of cases), the combined inputs of sulphur and nitrogen need to be considered. In such cases, the total acidity input should be calculated as a proportion of the CLmaxN.

Where PEC N Deposition > CLminN

[15] AQTAG06 – Technical Guidance on detailed modelling approach for an appropriate assessment for emissions to air. Environment Agency, March 2014 version.

*PC as %CL function = ((PC of S+N deposition)/CLmaxN)*100'*

3.4.2 Assessment of Impact and Significance

In addition to the AERA guidance, the EA's Operational Instruction 66_12[16] details how the air quality impacts on ecological sites should be assessed. This guidance provides risk based screening criteria to determine whether impacts will have 'no likely significant effects (alone and in-combination)' for European sites, 'no likely damage' for SSSI's and 'no significant pollution' for other sites, as follows:

- PC does not exceed 1% long-term C_{Le} and/or C_{Lo} or that the PEC does not exceed 70% long-term C_{Le} and/or C_{Lo} for European sites and SSSIs;
- PC does not exceed 10% short-term C_{Le} for NOx for European sites and SSSIs;
- PC does not exceed 100% long-term C_{Le} and/or C_{Lo} other conservation sites; and
- PC does not exceed 100% short-term C_{Le} for NOx (if applicable) for other conservation sites.

Where impacts cannot be classified as resulting in 'no likely significant effect', more detailed assessment may be required depending on the sensitivity of the feature in accordance with EAs Operational Instruction 67_12 ('*Detailed assessment of the impact of aerial emissions from new or expanding IPPC regulated industry for impacts on nature conservation*'). This can require the consideration of the potential for in-combination effects, the actual distribution of sensitive features within the site, and local factors (such as the water table).

The guidance provides the following further criteria:

- if the PEC does not exceed 100% of the appropriate limit it can be assumed there will be no adverse effect;
- if the background is below the limit, but a small PC leads to an exceedance – decision based on local considerations;
- if the background is currently above the limit and the additional PC will cause a small increase – decision based on local considerations;
- if the background is below the limit, but a significant PC leads to an exceedance – cannot conclude no adverse effect; and
- if the background is currently above the limit and the additional PC is large - cannot conclude no adverse effect.

[16] EA Working Instruction 66_12 - Simple assessment of the impact of aerial emissions from new or expanding IPPC regulated industry for impacts on nature conservation

4.0 BASELINE ENVIRONMENT

4.1 Site Setting and Sensitive Receptors

The Facility is located approximately 1km north of South Darenth. It is in a rural area, surrounded by agricultural fields with scattered residential receptors. There is one protected ecological site within 2km, Darenth Wood SSSI, 1km to the southeast. The Site surroundings are presented in Figure 4-1.

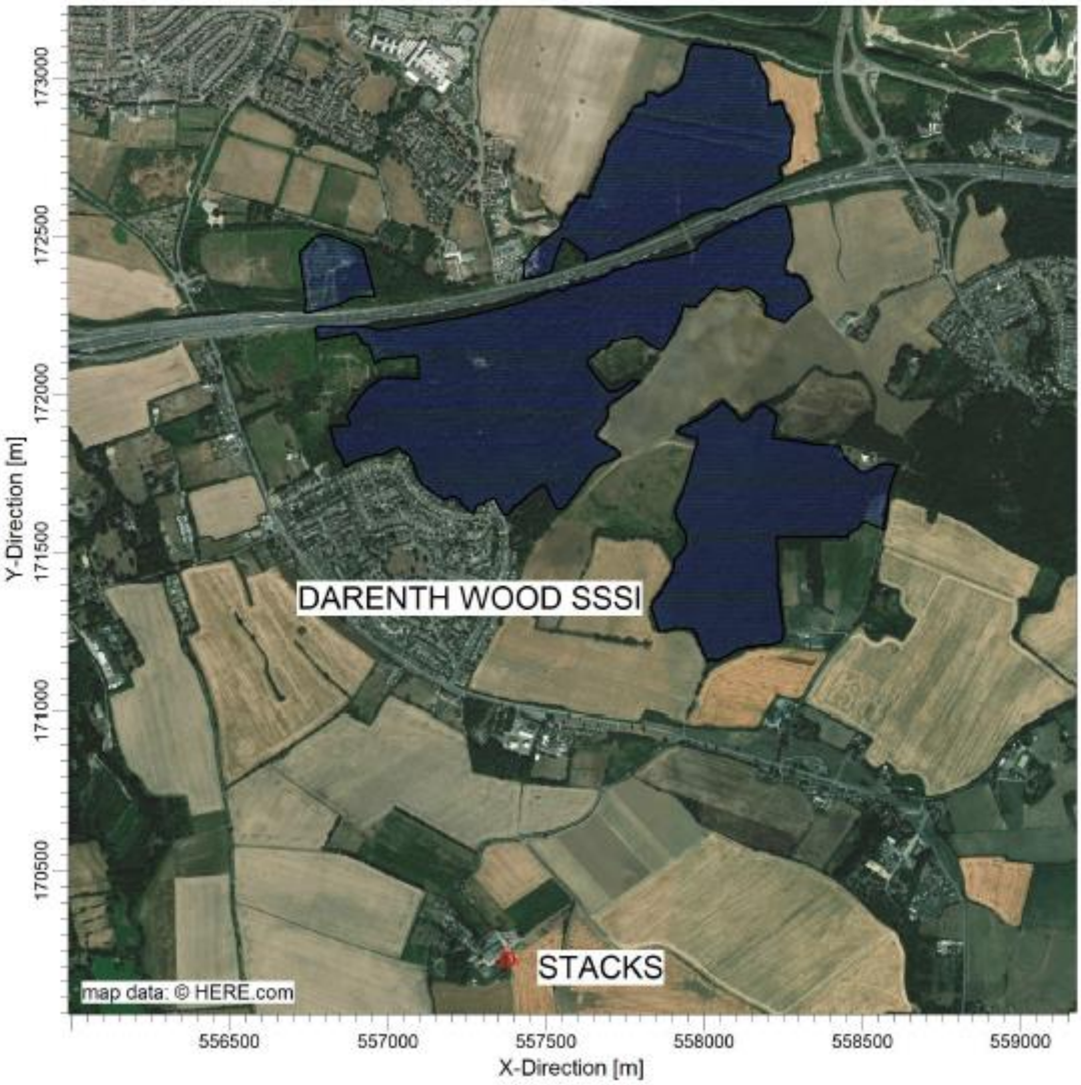

Figure 4-1
Site Setting

4.1.1 Human Receptors

According to LAQM.TG(16), air quality standards should only apply to locations where members of the public may be reasonably likely to be exposed to air pollution for the duration of the relevant limit value. As such commercial and residential locations surrounding the site have been selected to inform the risk assessment in terms of relevant hourly mean exposure (shown in Figure 4-2 as R1 to R7). Further, the dispersion modelling has been completed using a receptor grid to allow potential short-term exposure to be assessed at all locations surrounding the Site.

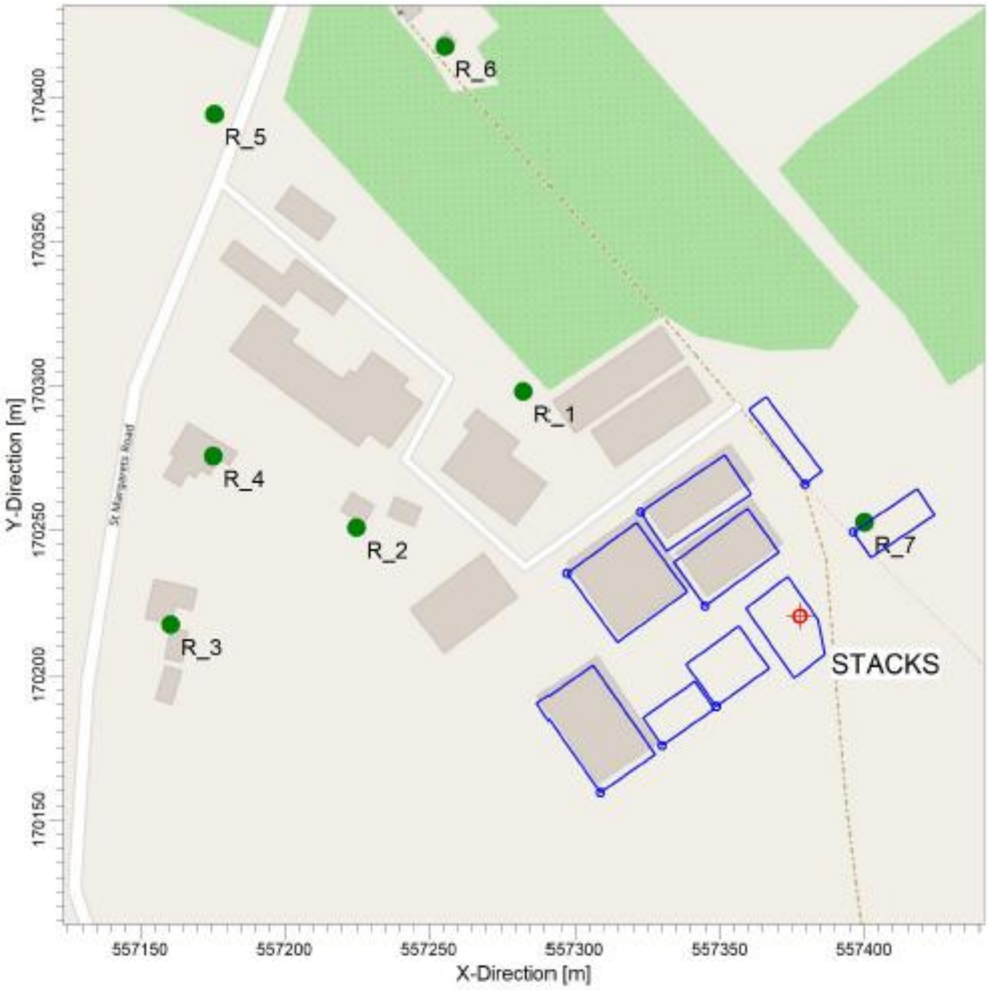

Figure 4-2
Modelled Discrete Human Receptor Locations

4.1.2 Ecological Receptors

Relevant designated ecological sites within the relevant AERA screening distances are presented in Table 4-1 and in Figure 4-1.

Table 4-1
Designated Ecological Sites

Site (Designation)	Habitat(A)	Ref. in model
Darren Wood SSSI	Broadleaved, Mixed and Yew Woodland	Modelled using grid
Notes (A) The habitat selected reflected the features at the discrete receptors		

4.2 Ambient Air Quality

4.2.1 Local Air Quality Management and Monitoring

The Facility is located within the administrative boundary of Dartford Borough Council (DBC) that has declared four Air Quality Management Areas (AQMA) within their administrative boundary. The AQMAs are not located near the Facility and are therefore not considered further.

According to the latest Annual Status Report[17] from DBC the closest air quality monitoring (diffusion tube) to the Facility is in Darenth at a roadside location. Given the rural location of the Facility roadside monitoring is not considered representative and therefore not presented in this report.

4.2.2 Defra Modelled Background Concentrations

Background pollutant concentration data on a 1km x 1km spatial resolution is provided by Defra through the UK AIR website and is routinely used to support LAQM and Air Quality Assessments. Background pollutant concentrations for NO_2, PM_{10} and $PM_{2.5}$ are based upon a 2018 base year and projected to future years[18]. Concentration of CO and Benzene were extracted from the 2001 background maps.

The 2021 (NO_2, PM_{10} and $PM_{2.5}$) and 2001 (Benzene and CO) background concentrations for the grid squares containing the Site and nearby receptors are shown in Table 4-2. The maximum values have been applied in the assessment.

Table 4-2
Estimated Annual Mean Background Concentrations

X (NGR)	Y (NGR)	NO_2 (µg/m^3)	PM_{10} (µg/m^3)	$PM_{2.5}$ (µg/m^3)	Benzene (µg/m^3)	CO (mg/m^3)
441500	354500	13.6	15.7	10.1	0.5	0.3

4.3 Baseline Conditions at Ecological Receptors

The APIS website[19], a support tool for assessment of potential effects of air pollutants on habitats and species developed in partnership by the UK conservation agencies and regulatory agencies and the Centre for Ecology and Hydrology, has been used to provide information on pollutant concentrations, current deposition rates and Critical Loads for nutrient nitrogen (Table 4-3) and for acidity (Table 4-4).

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[17] DBC(2007). 2017 Air Quality Annual Status Report, August 2017
[18] Background mapping data for local authorities – http://uk-air.defra.gov.uk/data/laqm-background-home.
[19] http://www.apis.ac.uk/.

Table 4-3
Nitrogen Critical Loads and Current Loads

Site	APIS Critical Load Class (most sensitive)	NO_x ($\mu g/m^3$)	Critical Load Range (kg N/ha/yr)	Critical Load Applied in Assessment (kg N/ha/yr)	Current Load (kg N/ha/yr)
Darenth Wood SSSI	Broadleaved, Mixed and Yew Woodland	24.6	15-20	15	27.4

Table 4-4
Acid Critical Load Functions and Current Loads

Site	APIS Critical Load Class (most sensitive)	Critical Load Function (k_{eq}/ha/yr)			Current Load (k_{eq}/ha/yr)	
		CLmaxS	CLminN	CLmaxN	N	S
Darenth Wood SSSI	Broadleaved, Mixed and Yew Woodland	1.198	0.142	1.34	2.0	0.2

4.4 Meteorological Conditions

A windrose, showing the frequency of wind speed and direction, used in the assessment is provided in Figure 4-3 below. The windrose shows winds from the south west are most frequent with winds from the south east least frequent.

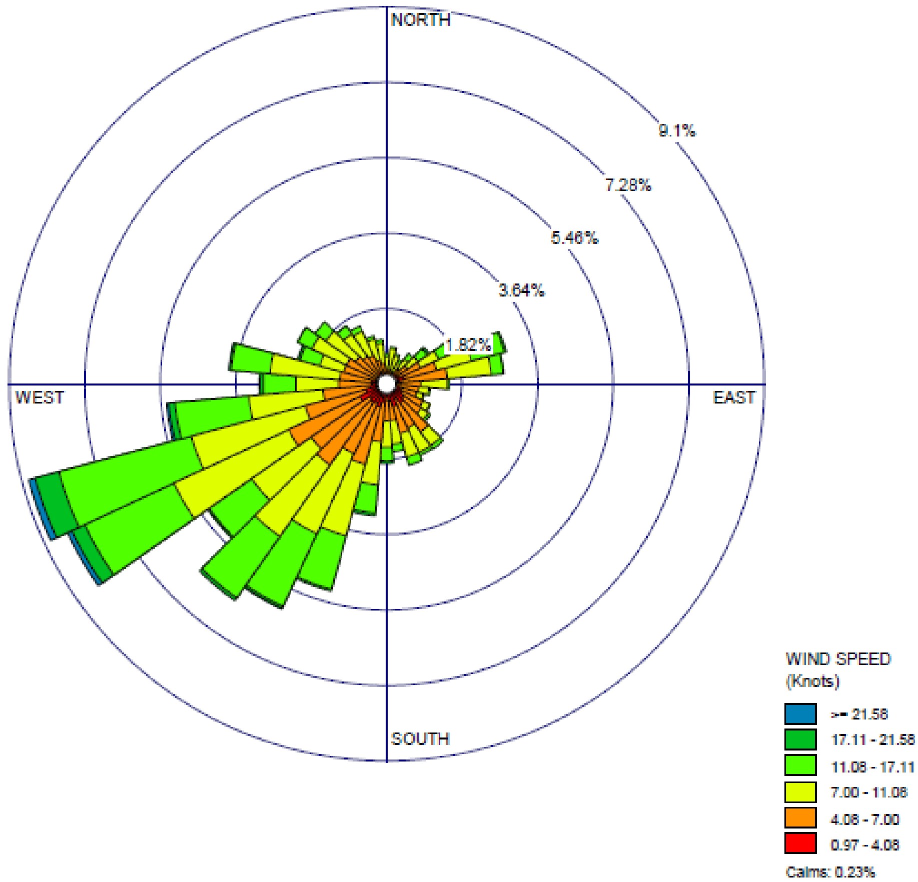

Figure 4-3
Gravesend (2013-2017)

4.5 Topography

The Sites lies at approximately 50m AOD. The land rises to 150mAOD approximately 1.5km to the southwest, and south east. The surrounding topography is illustrated in Figure 4-4 below.

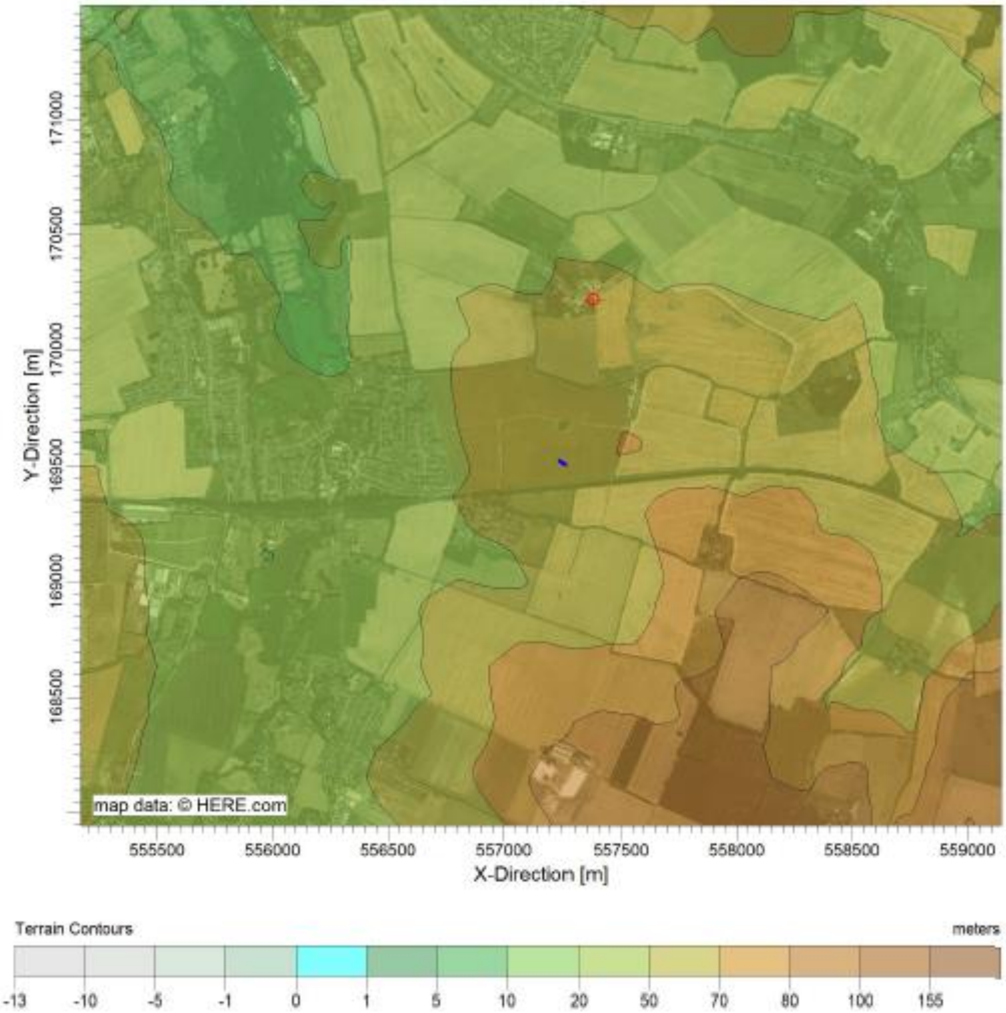

Figure 4-4
Surrounding Topography

5.0 ASSESSMENT OF RESULTS

5.1 Impacts on Human Receptors

5.1.1 NO_2 1-hour mean Impacts

Predicted short term impacts are summarised in Table 5-1 (an isopleth plot is presented in Appendix B). The PC cannot be considered insignificant at the modelled receptors due to the PC being greater than 10% and the PEC greater than 20%. However, the inclusion of background concentrations does not lead to any predicted exceedances of the relevant standard. The maximum Ground Level Concentration (GLC) (that it is not at a location of relevant exposure) is also below the relevant standard .

Table 5-1
Predicted 1-hour Mean (99.8%ile) NO_2 Impacts

Receptor	PC (µg/m^3)	PC as % of Standard	PEC* as % of Standard	PEC as % of Standard
Max GLC	118.1	59.0	145.3	72.6
R1	67.1	33.6	94.3	47.2
R2	54.6	27.3	81.8	40.9
R3	46.2	23.1	73.4	36.7
R4	45.3	22.7	72.5	36.3
R5	46.5	23.3	73.7	36.9
R6	52.6	26.3	79.8	39.9
R7	63.9	32.0	91.1	45.6

5.1.2 Annual NO_2 Impacts

Predicted annual mean NO_2 impacts at the modelled receptor locations are summarised in Table 5-2 (an isopleth plot is presented in Appendix B). The PC cannot be considered insignificant at receptors of relevant exposure due to the PC being greater than 1%. However, the PEC is less than the standard.

Table 5-2
Predicted Annual Mean NO_2 Impacts

Receptor	PC (µg/m^3)	PC as % of Standard	PEC (µg/m^3)	PEC as % of Standard
R1	3.4	8.4	17.0	42.4
R2	2.9	7.2	16.5	41.2
R3	3.1	7.7	16.7	41.7
R4	1.9	4.7	15.5	38.7
R5	1.3	3.3	14.9	37.3
R6	2.3	5.8	15.9	39.8

Receptor	PC (µg/m^3)	PC as % of Standard	PEC (µg/m^3)	PEC as % of Standard
R7	4.0	10.0	17.6	44.0

5.1.3 PM Impacts

The annual PM PC and PEC at the modelled receptor locations are summarised in Table 5-5. The annual PC exceed the EA's screening criteria at all receptors. However, the PECs do not exceed the standard.

Table 5-3
Predicted Annual PM Impacts

Receptor	PC (µg/m^3)	PC as % of Standard	PEC (µg/m^3)	PEC as % of Standard
R1	0.5	1.2	16.2	40.5
R2	0.4	1.0	16.1	40.3
R3	0.4	1.1	16.1	40.3
R4	0.3	0.7	16.0	39.9
R5	0.2	0.5	15.9	39.7
R6	0.3	0.8	16.0	40.1
R7	0.6	1.4	16.3	40.7

The 24 hour PM PC and PEC at the modelled receptor locations are summarised in Table 5-5. The PCs are insignificant at less than 10% of the standard at all locations, therefore the PEC has not been calculated.

Table 5-4
Predicted 24 hour (90.4%ile) PM Impacts

Receptor	PC (µg/m^3)	PC as % of Standard
R1	4.6	9.1
R2	1.5	2.9
R3	1.4	2.9
R4	1.4	2.9
R5	0.9	1.8
R6	0.7	1.4
R7	1.1	2.2

5.1.4 CO Impacts

The CO PC at the modelled receptor locations are summarised in Table 5-5. The PCs are insignificant at less than 10% of the standard/EAL at all locations, therefore the PEC has not been calculated.

Table 5-5
Predicted CO Impacts

Receptor	1-hour maximum PC (µg/m³)	PC as % of EAL	8-hour maximum PC (µg/m³)	PC as % of Standard
Max GLC	173.3	0.58	153.9	1.54
R1	107.1	0.36	64.4	0.64
R2	92.4	0.31	59.2	0.59
R3	70.0	0.23	36.2	0.36
R4	91.2	0.30	44.5	0.45
R5	77.1	0.26	35.5	0.35
R6	76.4	0.25	38.5	0.39
R7	98.1	0.33	68.8	0.69

5.1.5 VOCs (Benzene) Impacts

The 1 hour VOC PC and PEC at the modelled receptor locations are summarised in Table 5-6. The PECs are insignificant at less than 20% of the standard at all locations.

Table 5-6
Predicted 1-hour VOC Impacts

Receptor	PC (µg/m³)	PC as % of Standard	PEC (µg/m³)	PEC as % of Standard
Max GLC	24.8	12.7	25.8	13.2
R1	15.3	7.8	16.3	8.4
R2	13.2	6.8	14.2	7.3
R3	10.0	5.1	11.0	5.6
R4	13.0	6.7	14.0	7.2
R5	11.0	5.6	12.0	6.2
R6	10.9	5.6	11.9	6.1
R7	14.0	7.2	15.0	7.7

The annual VOC PC and PEC at the modelled receptor locations are summarised in Table 5-7. The PECs are less than the standard at all locations.

Table 5-7
Predicted Annual VOC Impacts

Receptor	PC (µg/m³)	PC as % of Standard	PC (µg/m³)	PC as % of Standard
R1	0.3	6.4	0.8	16.4

Receptor	PC (µg/m^3)	PC as % of Standard	PC (µg/m^3)	PC as % of Standard
R2	0.3	5.5	0.8	15.5
R3	0.3	5.9	0.8	15.9
R4	0.2	3.6	0.7	13.6
R5	0.1	2.5	0.6	12.5
R6	0.2	4.5	0.7	14.5
R7	0.4	7.6	0.9	17.6

5.2 Impacts on Ecological Receptors

5.2.1 Critical Levels

The results of the assessment of impacts on C_{Le}'s are presented in Table 5-8 below. The findings are as follows:

- the annual mean PEC does not exceed the C_{Le} for the SSSI, considering the conservative nature of this assessment (actual NO_x emissions are a third of the emissions modelled), it can therefore be assumed that there will be 'no likely damage' to the SSSI; and
- the short-term PC (daily) does not exceed the C_{Le} for the SSSI, considering the conservative nature of this assessment (actual NO_x emissions are a third of the emissions modelled), it can therefore be assumed that there will be 'no likely damage' to the SSSI.

Table 5-8
Impact on NOx Critical Levels

Averaging period	PC (µg/m^3)	PC as % of C_{Le}	PEC (µg/m^3)	PEC as % of C_{Le}
Annual	0.7	2.3	25.3	84.3
24 hour	12.3	16.3	49.2	65.6

5.2.2 Impacts on Critical Loads

The results of the assessment are presented in Table 5-9 and Table 5-10 below. The findings are that the PC's do not exceed 1% of the C_{Lo} at the SSSI. Therefore, the impact is considered to cause 'no likely damage' to the SSSI.

Table 5-9
Impact on Nitrogen Critical Load

Site	Annual mean PC (kg N/ha/yr)	Applied C_{Lo}	PC as % of C_{Lo}
Darenth Wood SSSI	0.14	15	0.9

Table 5-10
Impact on Acid Critical Load Functions

Site	Annual mean N PC (kg_{eq}/ha/yr)	Applied C_{Lo}	PC as % of C_{Lo}
Darenth Wood SSSI	0.010	1.34	0.7

6.0 SUMMARY AND CONCLUSIONS

This AERA has quantified and assessed the potential air quality impacts associated with combustion emissions from the installation using EA approved techniques against published standards for the protection of human health and designated ecological sites.

The conclusions of the AERA are as follows:

- the combustion emissions process contribution does not lead to any exceedances of the nitrogen dioxide (annual mean or 1-hour), carbon monoxide (8-hour or 1-hour), particulate matter (annual mean or 24-hour) and Benzene (Annual or 1 hour) standards for the protection of human health at any location outside of the Site;
- the impact from emissions from the facility are considered to cause 'no likely damage' on the Darenth SSSI.

APPENDIX A

Modelling Checklist

Item	Yes/No	Details / reason for omission
Location map	Yes	Figure 4-1
Site plan	Yes	Figure 4-2
Pollutants modelled and relevant EALs	Yes	Sections 2.2 and 3.1
Details of modelled scenarios	Yes	Section 3.1
Details of relevant ambient concentrations	Yes	Section 4.2
Model description and justification	Yes	Section 3.2
Special model treatment used	Yes	Section 3.2
Table of emission parameters used	Yes	Section 3.1
Details of modelled domain and receptors	Yes	Section 3.2.1
Details of meteorological data used	Yes	Section 3.2.4
Details of terrain treatment	Yes	Section 3.2.3
Details of building treatment	Yes	Section 3.2.2
Details of modelling deposition	Yes	Section 3.4.1
Model uncertainty and sensitivity	Yes	Section 3.2.6
Assessment of impacts	Yes	Section 5.0
Contour plots	Yes	Appendix B
Model input files	Yes	Appendix D

APPENDIX B

Isopleth Plots

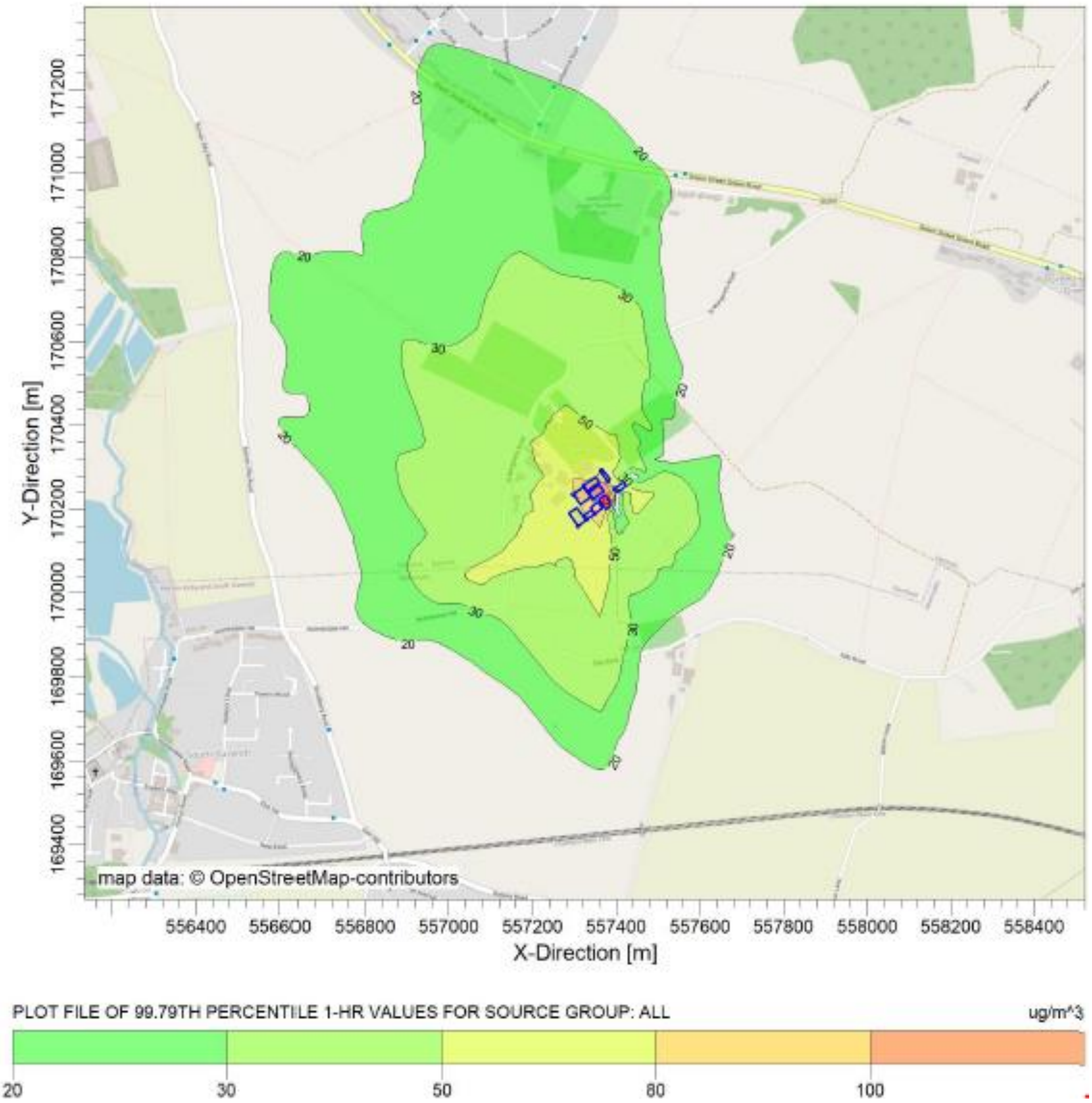

Figure B-1
Hourly Mean 99.79th Percentile Nitrogen Dioxide Process Contribution

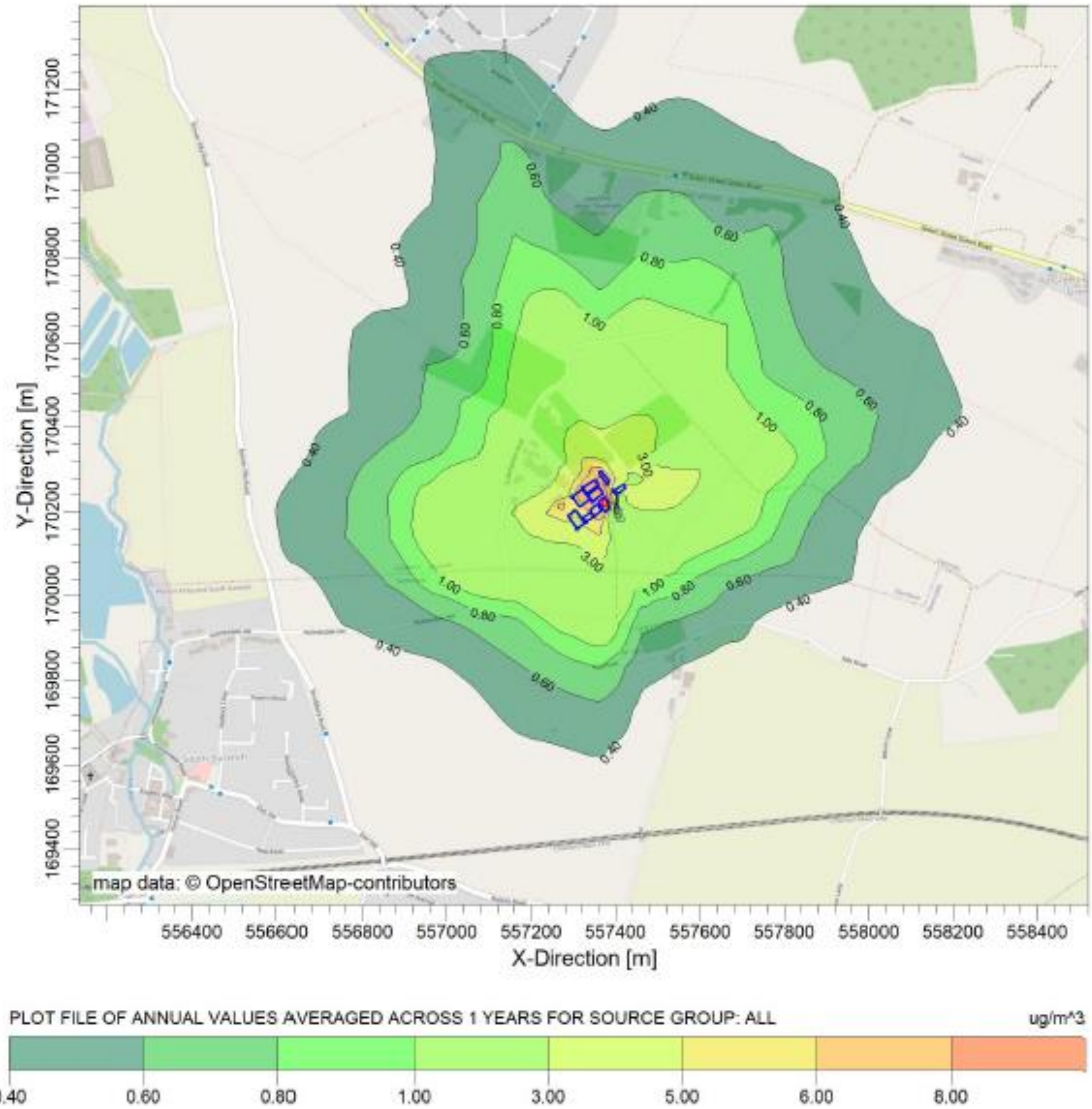

Figure B-2
Annual Mean Nitrogen Dioxide Process Contribution

APPENDIX C

Model and Input Files

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