SKELTON GRANGE ENERGY FROM WASTE FACILITY ENVIRONMENTAL PERMIT APPLICATION

Appendix ERA 2: Air Emissions Risk Assessment

Prepared for: WTI EfW Holdings Limited

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1.0 Introduction

1.1 Background

WTI EfW Holdings Limited has retained SLR Consulting to prepare the Environmental Permit (EP) application as required by the Environmental Permitting Regulations 2016 (as amended) for the Skelton Grange Energy from Waste Facility (EfW) located at Skelton Grange Road, Leeds, West Yorkshire (the Site). The facility will be operated by WTI UK Limited (WTI).

This report presents the Air Emissions Risk Assessment undertaken in accordance with Environment Agency guidance and forms Appendix ERA 2 to the Environmental Risk Assessment submitted at Section 5 of the application.

The Non-Technical Summary provided in Section 1 of the application gives a full description of all the EP application and the facility. The key details of relevance to this air quality assessment are that the facility will comprise:

- an EfW receiving up to 410,000 tonnes per annum (tpa) as feedstock;
- twin-line (70MW_{th} input each) furnace/boiler units incorporating moving grate technology and steam boiler with an energy recovery system;
- flue gas treatment (FGT) system comprising selective non catalytic reduction (SNCR – urea/ammonia based nitrogen oxides (NOx) control), reactor (employing lime and activated carbon) and bag house filters; and
- discharge of treated flue gases via 2 stacks at 90m above ground level.

1.2 Scope of Assessment

The scope of this assessment is specifically concerned with emissions from the stacks. The scope incorporates:

- a review of relevant legislation and guidance;
- a review of baseline conditions at the site and potential for cumulative effects with other local emitters;
- quantification of pollutant emissions to air;
- prediction of the impact of emissions to air using atmospheric dispersion modelling techniques;
- consideration of model uncertainties and sensitivities; and
- assessment of the significance of these predicted impacts on air quality.

The objective of the assessment is to determine the potential effect of emissions from the proposed EfW on the air quality environment by comparison to relevant guidelines for the protection of human health and the environment (i.e. protected sensitive habitats).

2.0 LEGISLATION AND RELEVANT GUIDANCE

The following legislation and guidance relates to the assessment of potential air quality impacts from the EfW.

2.1 National Legislation

2.1.1 Air Quality Standards Regulations

The Air Quality Standards Regulations 2010 (the AQSR) transpose the Air Quality Directive (2008/50/EC) and Fourth Daughter Directive (2004/107/EC) into UK legislation. The regulations include Limit Values, Target Values, Objectives, Critical Levels and Exposure Reduction Targets for the protection of human health and the environment. Those relevant to this assessment are presented within Table 2-2.

2.1.2 Air Quality Strategy

The Air Quality Strategy[1] (AQS) 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 the Government, industry, Environment Agency (EA), local government, business, individuals and transport have in protecting and improving air quality. The AQS contains Air Quality Objectives (AQOs) for the protection of both human health and vegetation (ecosystems). Those relevant to this assessment are presented within Table 2-2.

2.1.3 Local Air Quality Management

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

Where any of the prescribed standards 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 standards. As such, Local Authorities (LAs), have formal powers to control air quality through a combination of LAQM and by use of their wider planning policies.

Defra has published technical guidance for use by local authorities in their LAQM work[2]. This guidance, referred to in this report as LAQM.TG(16), has been used where appropriate in the assessment presented here.

2.1.4 Protection of Nature Conservation Sites

Sites of nature conservation importance at a European, national and local level, are provided environmental protection from developments, including from atmospheric emissions.

The Conservation of Habitats and Species Regulations 2010 introduces the precautionary principle for protected areas, i.e. that projects can only be permitted to proceed; having ascertained that there will be no adverse effect on the integrity of the designated site. It requires an assessment to determine if significant effects (alone or in combination) are likely, followed by an 'appropriate assessment' by the competent authority, if necessary.

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[1] The Air Quality Strategy for England, Scotland, Wales and Northern Ireland, DEFRA. July 2007

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

Similarly, the Countryside and Rights of Way (CRoW) Act 2000 provides protection to Sites of Special Scientific Interest (SSSIs) to ensure that developments are not likely to cause them damage.

Locally important sites (such as National Nature Reserves (NNR), Local Nature Reserves (LNR), Local Wildlife Sites (LWS) or Sites of Importance for Nature Conservation (SINCs) and Ancient Woodland (AW)) are also protected by legislation to ensure that developments do not cause significant pollution.

2.2 Regulation of Industrial Emissions

2.2.1 Industrial Emissions Directive

The Industrial Emissions Directive[3] (IED) recast seven existing directives including the Waste Incineration Directive (WID)[4]. Chapter IV of the IED applies to incineration and co-incineration plants (which accept waste and other fuels such as biomass) which thermally treat waste as defined in the Waste Framework Directive.

The IED defines requirements for facilities classified as waste incinerators under the IED definition including:

- operating conditions, including gas temperatures and residence times, such as 850ºC / 2 seconds;
- emission limit values for a range of substance to air and water; and
- emissions monitoring requirements.

2.2.2 Emission Limit Values to Air

The IED defines emission limit values (ELVs) for emissions to air from installations as described above. These ELVs are detailed in Table 2-1. The final Draft BREF note (December 2018) includes BAT-Associated Emission Levels (BAT-AEL) that are more stringent than the IED ELV's. Although WTI will meet BAT-AELs, the IED as transposed into EP regulations represents the regulatory ELVs which are modelled here.

Table 2-1
IED Chapter IV Emission Limit Values

Pollutant	Emission Limits (mg/Nm^3) (a)		
	Daily average values	Half hourly averages	
		100th Percentile	97th Percentile
Continuous Monitoring			
Total Particulate Matter	10	30	10
Total Organic Carbon (TOC)	10	20	10
Hydrogen chloride (HCl)	10	60	10
Hydrogen fluoride (HF)	1	4	2
Sulphur dioxide (SO_2)	50	200	50
Oxides of nitrogen (NOx)	200	400	200
Carbon Monoxide (CO(b))	50	150	100
Spot sample measurements			

[3] Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control).
[4] Directive 2000/76/EC of the European Parliament and of the Council of 4 December 2000 on the incineration of waste.

Pollutant	Emission Limits (mg/Nm^3) [a]		
	Daily average values	Half hourly averages	
		100th Percentile	97th Percentile
Group 1 metals[c]	0.05		
Group 2 metals[c]	0.05		
Group 3 metals[c]	0.5		
Dioxins and furans[d]	0.0000001		

Table Notes:

a) Concentrations referenced to temperature 273 K, pressure 101.3 kPa, 11% oxygen, dry gas.

b) 150 mg/Nm^3 of combustion gas for at least 95% of all measurements determined as 10 minute averages or 100 mg/Nm^3 of combustion gas of all measurements determined as half-hourly average values taken in any 24 hour period.

c) Metal groups are as follows:

Group 1: Cadmium (Cd) and thallium (Tl)

Group 2: Mercury (Hg)

Group 3: Antimony (Sb), arsenic (As), lead (Pb), chromium (Cr), cobalt (Co), copper (Cu), manganese (Mn), nickel (Ni), and vanadium (V).

d) The emission limit value refers to the total concentration of dioxins and furans calculated using the concept of toxic equivalence (TEQ).

2.2.3 Environmental Permitting

In England, the Environmental Permitting (England and Wales) Regulations 2016 (SI 2016 No.1154 as amended) transpose the IED in UK legislation. The proposed installation would be regulated by the EA under the Environmental Permitting (EP) Regulations which includes regulating emissions to air.

Guidance Notes produced by Defra provide a framework for regulation of installations and additional Technical Guidance Notes produced by the EA are used to provide the basis for Environmental Permit conditions as regards releases to air and mitigation measures.

Of particular relevance to the assessment of air quality impacts is the EA's '*air emission risk assessment for your environmental permit*' guidance[5] (referred to as the AERA guidance throughout this report). 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 EP Regulations. This guidance sets out Environmental Assessment Levels (EALs) which are taken from the AQS and AQSR but also includes EALs for additional pollutants derived from occupational exposure limits (OEL) and maximum exposure levels (MEL) presented in HSE EH40[6]. Those relevant to this assessment are presented within Table 2-2 below.

2.3 Environmental Standards

The environmental standards for air, taken from the legislation and guidance outlined above, for the protection of human health and sensitive ecological receptors are presented in the sections below.

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

[6] HSE (2011) EH40/2005 Workplace Exposure Limits.

2.3.1 Standards for Protection of Human Health

The standards applied in this assessment, taken from the AQSR, AQS and AERA guidance are set out in Table 2-2 below.

Table 2-2
Relevant Standards (µg/m^3)

Pollutant		Annual Standard (µg/m^3)	Short Term Standard (µg/m^3)	Ref
Nitrogen dioxide	(NO_2)	40	200 (1-hour) not to be exceeded more than 18 times per year	AQSR
Particulates	(PM_{10})	40	50 (24-hour) not to be exceeded more than 35 times per year	AQSR
Particulates	($PM_{2.5}$)	25	---	AQSR
Carbon monoxide	(CO)	---	10,000 (Max 8-hour daily mean)	AQSR
			30,000 (Max 1-hour)	AERA
Sulphur dioxide	(SO_2)	---	266 (15-minute) not to be exceeded more than 35 times per year	AQS
			350 (1-hour) not to be exceeded more than 24 times per year	AQSR
			125 (24-hour) not to be exceeded more than 3 times per year	AQSR
Hydrogen chloride	(HCl)	---	750 (1-hour)	AERA
Hydrogen fluoride	(HF)	16 (monthly)	160 (1-hour)	AERA
Total Organic Compounds	(TOC)	5	--	AERA
Benzene	(C_6H_6)	5	--	AQSR
Ammonia	(NH_3)	180	2,500 (1-hour)	AERA
Arsenic	(As)	0.003	---	AERA
Antimony	(Sb)	5	150 (1-hour)	AERA
Cadmium	(Cd)	0.005	---	AQSR
Chromium (II and III)	(Cr)	5	150 (1-hour)	AERA
Chromium (VI)		0.0002	---	AERA
Copper	(Cu)	10	200 (1-hour)	AERA
Lead	(Pb)	0.25	---	AQS
Manganese	(Mn)	0.15	1500 (1-hour)	AERA
Mercury	(Hg)	0.25	7.5 (1-hour)	AERA
Nickel	(Ni)	0.02	---	AQSR
Vanadium	(V)	5	1 (1-hour)	AERA
Benzo(a)pyrene	(BaP)	0.001	---	AQSR
Polychlorinated biphenyls	(PCBs)	0.2	6 (1-hour)	AERA

The regulations[7] state that exceedances of the objectives should be assessed in relation to "the quality of the air at locations which are situated outside of buildings or other natural or man-made structures, above or below ground, and where members of the public are regularly present". LAQM.TG(16) provides guidance on relevant exposure locations that are summarised in Table 2-3 below.

Table 2-3
Relevant Public Exposure

Averaging Period	Relevant Locations	AQO's should apply at:	AQO's don't apply at:
Annual mean	Where individuals are exposed for a cumulative period of 6 months in a year	Building facades of residential properties, schools, hospitals etc.	Facades of offices Hotels Gardens of residences Kerbside sites
24-hour mean	Where individuals may be exposed for eight hours or more in a day	As above together with hotels and gardens of residential properties	Kerbside sites where public exposure is expected to be short term
8-hour mean	Where individuals may be exposed for eight hours or more in a day	As above together with hotels and gardens of residential properties	Kerbside sites where public exposure is expected to be short term
1-hour mean	Where individuals might reasonably expected to spend one hour or longer	As above together with kerbside sites of regular access, car parks, bus stations etc.	Kerbside sites where public would not be expected to have regular access
15-minute mean	All locations where members of the public might reasonably be exposed for a period of 15-minutes or longer		-

2.3.2 Standards for the protection of Ecosystems and Vegetation

Environmental Quality Standards exist for nature conservation sites known as Critical Levels (for airborne concentrations) and Critical Loads (for deposition of nitrogen or acid forming compounds).

Critical Levels (CLe)

CLe's 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. CLe's for the protection of vegetation and ecosystems are specified within relevant European air quality directives and corresponding UK air quality regulations (see Table 2-4).

Table 2-4
Critical Levels for the Protection of Vegetation and Ecosystems

Pollutant	Concentration (µg/m^3)	Habitat and Averaging Period
Ammonia (NH_3)	1	Annual mean. Sensitive lichen communities & bryophytes and ecosystems where lichens & bryophytes are an important part of the ecosystem's integrity

[7] The Air Quality (England) Regulations 2000 2000 No. 928

Pollutant	Concentration (μg/m^3)	Habitat and Averaging Period
	3	Annual mean. For all higher plants (all other ecosystems)
Sulphur dioxide (SO_2)	10	Annual mean. Sensitive lichen communities & bryophytes and ecosystems where lichens & bryophytes are an important part of the ecosystem's integrity
	20	Annual mean. For all higher plants (all other ecosystems)
Nitrogen oxides (NO_x)(1)	30	Annual mean (all ecosystems)
	75	Daily mean (all ecosystems)
Hydrogen fluoride (HF)	5	Daily Mean.
	0.5	Weekly Mean

Table note: 1) APIS states that *'the critical level for NO_X should only be applied where levels of SO_2 and O_3 are close to their critical levels'*.

Critical Loads (C_{Lo})

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. C_{Lo}'s are set for the deposition of various substances to sensitive ecosystems. In relation to combustion emissions, C_{Lo}'s 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}'s for eutrophication (derived from a range of experimental studies) are assigned based on 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/).

C_{Lo}'s for acidification have been set in the UK using an empirical approach for non-woodland habitats on a 1km grid square based upon the mineralogy and chemistry of the dominant soil series present in the grid square, and the simple mass balance (SMB) equation for both managed and unmanaged woodland habitats.

The C_{Lo}'s relevant to this assessment are presented in Section 4.7.

3.0 ASSESSMENT METHODOLOGY

3.1 Approach

The assessment has been undertaken as a 'detailed assessment' using dispersion modelling. The assessment incorporates:

- identification of sensitive receptors and compilation of the existing air quality baseline;
- quantification of emissions from the installation;
- atmospheric dispersion modelling to determine process contribution to ground level concentrations and calculate deposition rates; and
- assessment of impacts by comparison to standards for protection of human health and ecological receptors.

3.2 Dispersion Modelling

3.2.1 Dispersion Model

The model used is the US American Meteorological Society and Environmental Protection Agency Regulatory Model (AERMOD[8]) dispersion model. This model is commonly used for assessments of this kind and has been accepted as suitable for use by the EA on similar projects. An assessment of the sensitivity of model results to various inputs is presented in Section 7.0.

3.2.2 Model Domain / Receptors

The modelling has been undertaken using a 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 receptor grid was applied as follows:

- 2000m x 2000m at 50m grid resolution;
- 4000m x 4000m at 100m grid resolution;
- 8000m x 8000m at 200m grid resolution; and
- 12000m x 12000m at 500m grid resolution

In addition, the modelling of discrete sensitive receptor locations as described in Section 4.1 was undertaken to facilitate the discussion of results.

3.2.3 Topography

The presence of elevated terrain can significantly 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

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

(SRTM) terrain data files. Data was processed by the AERMAP function within AERMOD to calculate terrain heights.

3.2.4 Building Downwash

The integrated Building Profile Input Programme (BPIP) module within AERMOD was used to assess the potential impact of building downwash upon predicted dispersion characteristics.

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. All buildings input to the model are represented in Figure 3-1. The key building effecting downwash are buildings that have a maximum height equivalent to at least 40% of the emission height (i.e. 36m) and which are within a distance defined as five times the lesser of the height or maximum projected width of the building. The structure modelled is presented in Figure 3-1.

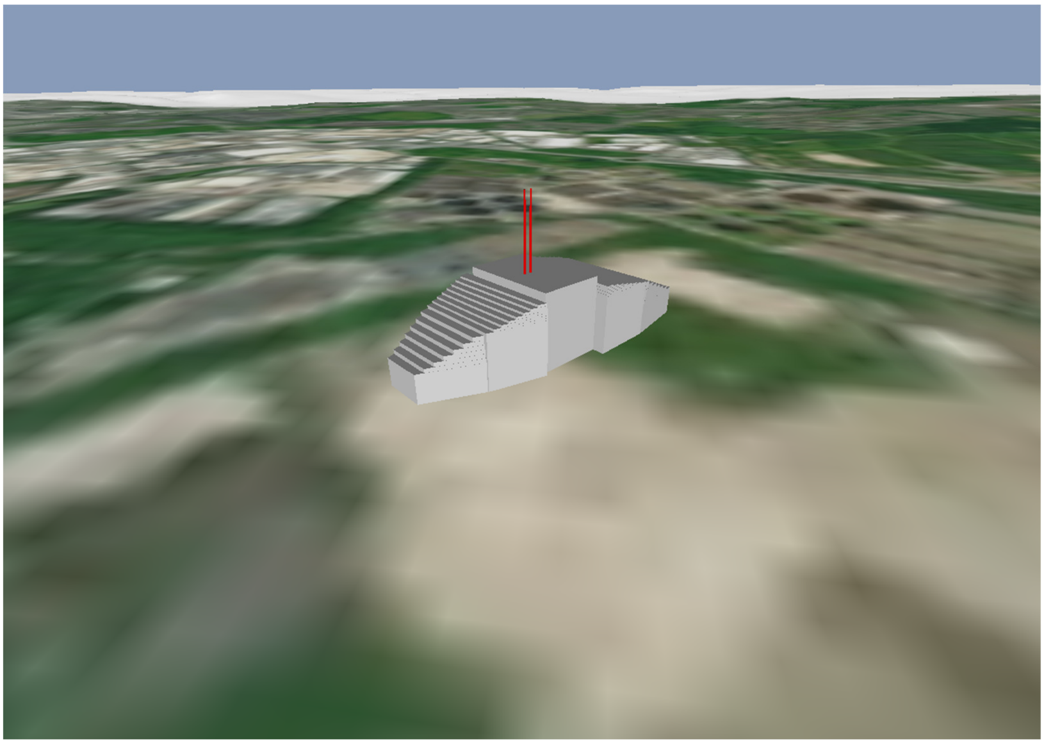

Figure 3-1
Modelled Buildings

3.2.5 Dispersion Coefficients

The 'rural' option for dispersion coefficients was selected in accordance with AERMOD guidance[9].

3.2.6 Meteorological Data

Following consultation with the meteorological data provider, it was concluded that Leeds-Bradford Airport, located approximately 14km to the north west of the Site, would provide the most complete and representative meteorological data set for purposes of this assessment. Meteorological data used in this

[9] EPA, AERMOD Implementation Workgroup, Aermod Implementation Guide (August 3, 2015)

assessment was for the years 2013 to 2017 (inclusive). This accounts for inter-year variability in meteorological conditions. From the dataset used, a total of 197 missing hours occur (i.e. representing 0.45% data loss), were recorded over the 5-year period. A windrose is presented in Figure 4-2.

The meteorological data was obtained in .met format from the data supplier and converted to the required surface and profile formats for use in AERMOD using AERMET View meteorological pre-processor. Surface characteristics were assigned for the rural surroundings as presented in Table 3-1.

Table 3-1
Applied Surface Characteristics

Zone (Start)	Zone (end)	Albedo	Bowen	Roughness
0	200	0.28	0.75	0.15
200	280			0.38
280	320			0.02
320	0			0.38

3.3 Assessment of Impacts on Standards for Air Quality

3.3.1 Treatment of Model Output and Significance

The assessment of impacts against the standards as defined in Section 2.3 was undertaken using model outputs as described in Table 3-2 below.

With respect to NOx emissions the EA Air Quality Modelling and Assessment Unit (AQMAU) guidance[10] 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.

Table 3-2
Model Outputs

Averaging Period	Model Output – Process Contribution (PC)	Predicted Environmental Concentration (PEC)
1 hour mean. Not to be exceeded more than 18 times a calendar year	99.79%ile of 1-hour means	PC + 2 x annual mean background
15 minute mean. Not to be exceeded more than 35 times a calendar year	99.9%ile of 1 hour means for SO_2 multiplied by 1.34	PC + 2 x annual mean background
1 hour mean. Not to be exceeded more than 24 times a calendar year	99.73%ile of 1 hour means for SO_2	PC + 2 x annual mean background
24 hour mean. Not to be exceeded more	99.18%ile of 24 hour means for	PC + 2 x annual mean

[10] Environment Agency, Air Quality Modelling and Assessment Unit, 'Conversion Ratios for NOx and NO_2' (no date)

than 3 times a calendar year	SO_2	background
24 hour mean. Not to be exceeded more than 35 times a calendar year	90.4%ile of 24 hour means for PM_{10}	PC + annual mean background
1-hour maximum	Maximum 1-hour mean	PC + 2 x annual mean background
8-hour rolling mean	Maximum 8-hour mean	PC + 2 x annual mean background
Calendar year	Annual Mean	PC + annual mean background

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

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

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 EAL.

3.4 Assessment of Impacts on Vegetation and Ecosystems

In addition to the AERA guidance, the EA's Operational Instruction 66_12[11] 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 <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 and HF (if applicable) 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 and HF (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<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;

[11] NRW/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

- 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.

Calculation of Contribution to Critical Loads

Deposition rates were calculated using empirical methods recommended by the EA AQTAG06[12]. 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 (AQTAG06) compared with dry deposition and therefore for the purposes of this assessment, wet deposition has not been considered.

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

Table 3-3
Applied Deposition Velocities

Chemical Species	Recommended deposition velocity (m/s)	
NO_2	Grassland	0.0015
	Woodland	0.003
SO_2	Grassland	0.012
	Woodland	0.024
NH_3	Grassland	0.02
	Woodland	0.03
HCl	Grassland	0.025
	Woodland	0.06

Critical Loads - Eutrophication

The contribution to critical loads for nitrogen deposition (N) are recorded as kgN/ha/yr. The units are converted from µg/m^2/s to units of kgN/ha/year by multiplying the dry deposition flux by standard conversion factors as summarised in Table 3-4.

Table 3-4
Applied Deposition Conversion Factors

Chemical Species	Conversion factor [µg/m^2/s to kgN/ha/year]	
NO_2	of N:	95.9
NH_3	of N:	260

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

Critical Loads - Acidification

The predicted deposition rates are converted to units of equivalents (keq/ha/year), which is a measure of how acidifying the chemical species can be, by multiplying the dry deposition flux (µg/m^2/s) by standard conversion factors as presented in Table 3-5.

Table 3-5
Applied Acidification Conversion Factors

Chemical Species	Conversion factor [kg/ha/year to keq/ha/year]
NO_2	6.84
NH_3	18.5
SO_2	9.84
HCl	8.63

Calculation of PC as a percentage of Acid Critical Load Function

The calculation of the process contribution of N, S and Cl 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 affects 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

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

The predicted dry N, sulphur (S) and chlorine (Cl) deposition (k_{eq}/ha/year) are summed to determine total acid deposition.

4.0 BASELINE ENVIRONMENT

4.1 Site Setting and Sensitive Receptors

The Site is located in Skelton at National Grid Reference (NGR) SE 334 312. The Site is approximately 4.5km south east of Leeds city centre in an industrial area. The closest residential areas in the surrounding environment are Hunslet (approximately 1.3km northwest), Belle Isle (approximately 2.0km west), Rothwell (approximately 2.0km south), and Halton (approximately 1.6km north east).

There are also a number of sensitive habitats within the AERA screening distances of the Site which are detailed in the section below.

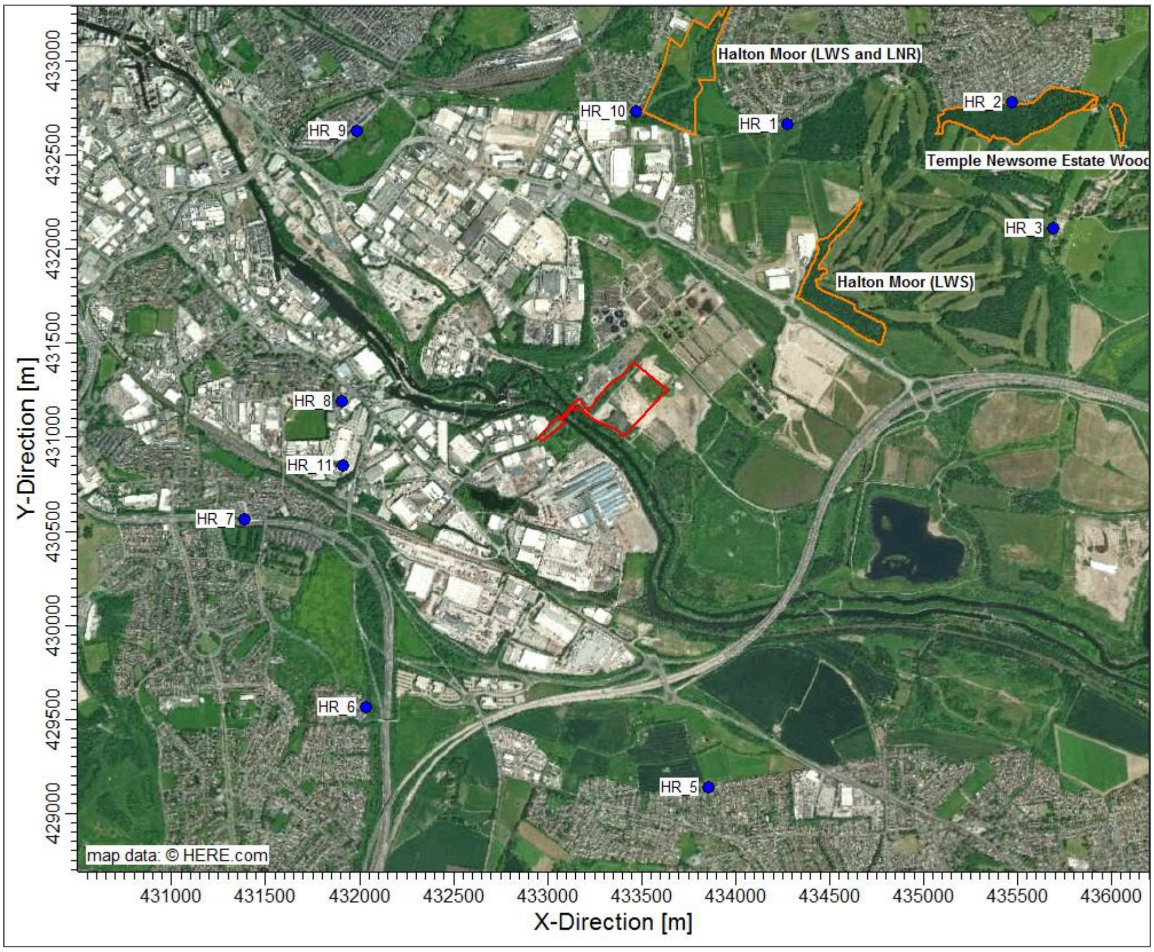

Figure 4-1
Site Setting and Modelled Human and Ecological Receptors

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 standard as summarised in Table 2-3. The dispersion modelling has been completed using a receptor grid, as such the impact concentration has been assessed at all potential exposure locations surrounding the site. Ten discrete sensitive receptors have been modelled (shown in Figure 4-1 and listed in Table 4-1) representing the closest human locations (relevant to annual mean exposure). The receptor grid allows the maximum ground level impact to be assessed including potential short-term exposure locations.

Table 4-1
Assessed Annual Mean Exposure Locations

Ref.	Description	NGR X	NGR Y
HR1	Halton Moor Road (Halton Moor)	434278	432666
HR2	Templegate Avenue (Halton)	435473	432780
HR3	Temple Newsam House	435687	432110
HR4	Newsam Green Farm	436682	430692
HR5	Mill Pit Lane (Rothwell)	433854	429138
HR6	Middlecroft Rd (Belle Isle)	432036	429565
HR7	Woodhouse Hill Road (Stourton)	431385	430562
HR8	Sussex Avenue (Stourton)	431903	431194
HR9	Cross Green Lane (Cross Green)	431983	432629
HR10	Halton Moor Avenue (Newmarket)	433474	432735
HR11	Daycare Nursery (Stourton)	431912	430852

4.1.2 Ecological Receptors

The EA AERA guidance states that ecological habitats should be screened against relevant standards if they are located within the following set distances from the facility:

- SPAs, SACs or Ramsar sites within 10km of the installation; and
- SSSIs, NNRs, LNRs, local wildlife sites (LWS or SINCs) and AW within 2km of the location of the installation.

The sites identified using the EA screening service are detailed in Table 4-2 and termed ER1 to ER2 in the assessment (shown in Figure 4-1).

Table 4-2
Designated Sites Requiring Assessment

Ref.	Site (Designation)	Habitat Type (APIS categories)
ER1	Temple Newsome Wood (LWS)	Broadleaved deciduous woodland
ER2	Halton Moor (LNR and LWS)	Broadleaved deciduous woodland

4.2 Other Combustion Emissions

The majority of combustion emissions in the local area (e.g. traffic emissions, local boiler plant etc) will be incorporated into the baseline data applied in the assessment. Veolia opened a waste incinerator in 2016 situated in Newmarket (known as the Recycling and Energy Recovery Facility (RERF)), approximately 1.4km north west from the Site. All emissions from this facility may not be adequately incorporated into the baseline data. As such emissions from this facility have been explicitly modelled in a cumulative impact assessment (emissions are detailed in Section 5.6 and impacts in Section 6.5).

4.3 Meteorological Conditions

A windrose for Leeds-Bradford station for a 5 year period (hourly sequential data), providing the frequency of wind speed and direction, is presented in presented in Figure 4-2. The windrose shows winds from the west are most frequent with winds from the south east least frequent.

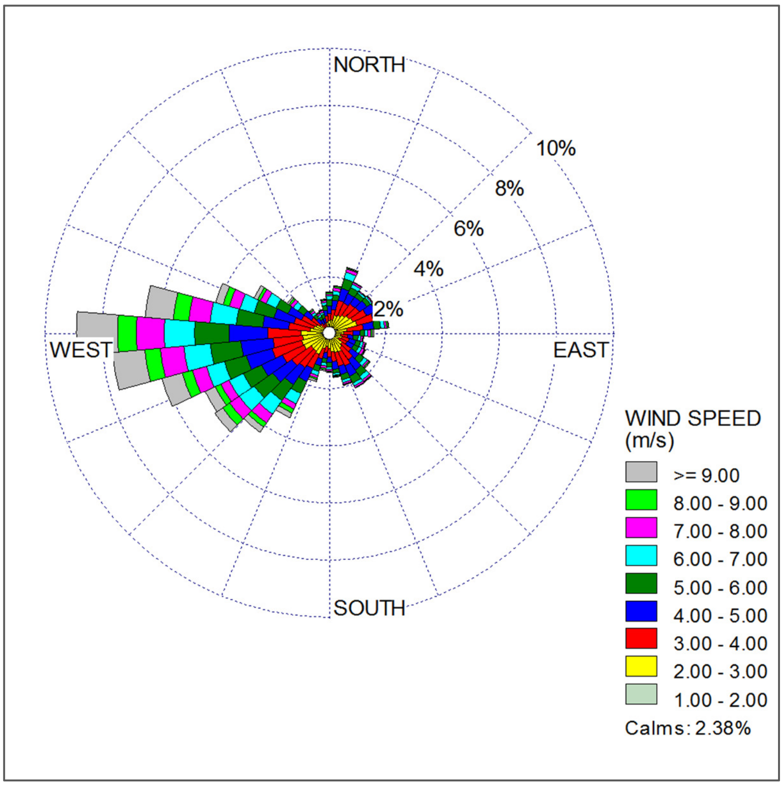

Figure 4-2
Windrose for Leeds-Bradford Airport Meteorological Station (2013-17)

4.4 Topography

The Site lies on a flat area at approximately 25m AOD close to the River Aire. Within approximately 2km the land is relatively flat to the north west and south east along the river plain. To the north east and south west the terrain rises with hill tops up to 120m AOD at approximately 2.5km distance. The local topography is illustrated in Figure 4-3.

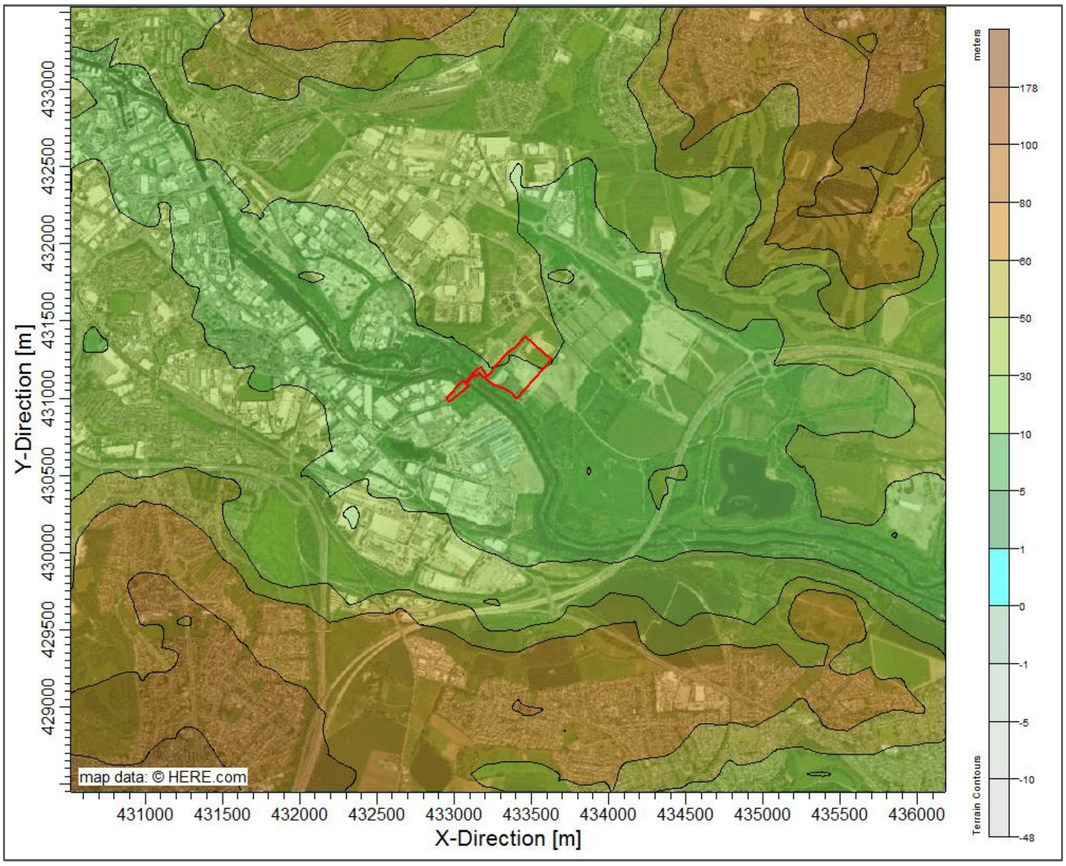

Figure 4-3
Local Topography

4.5 Baseline Air Quality

This section reviews the existing baseline air quality and deposition in the vicinity of the proposed installation according to monitoring and/or modelling from LCC, Defra, and APIS.

4.5.1 Local Air Quality Management and Monitoring

The Site lies within LCC's area of jurisdiction with respect to LAQM, who have declared six AQMAs for risk of exceedances of the annual mean standard for NO_2. To the south (south of the M62) lies Wakefield Borough Council who have also declared AQMAs for NO_2. The positions of the AQMA's in relation to the Site are illustrated in Figure 4-4 below.

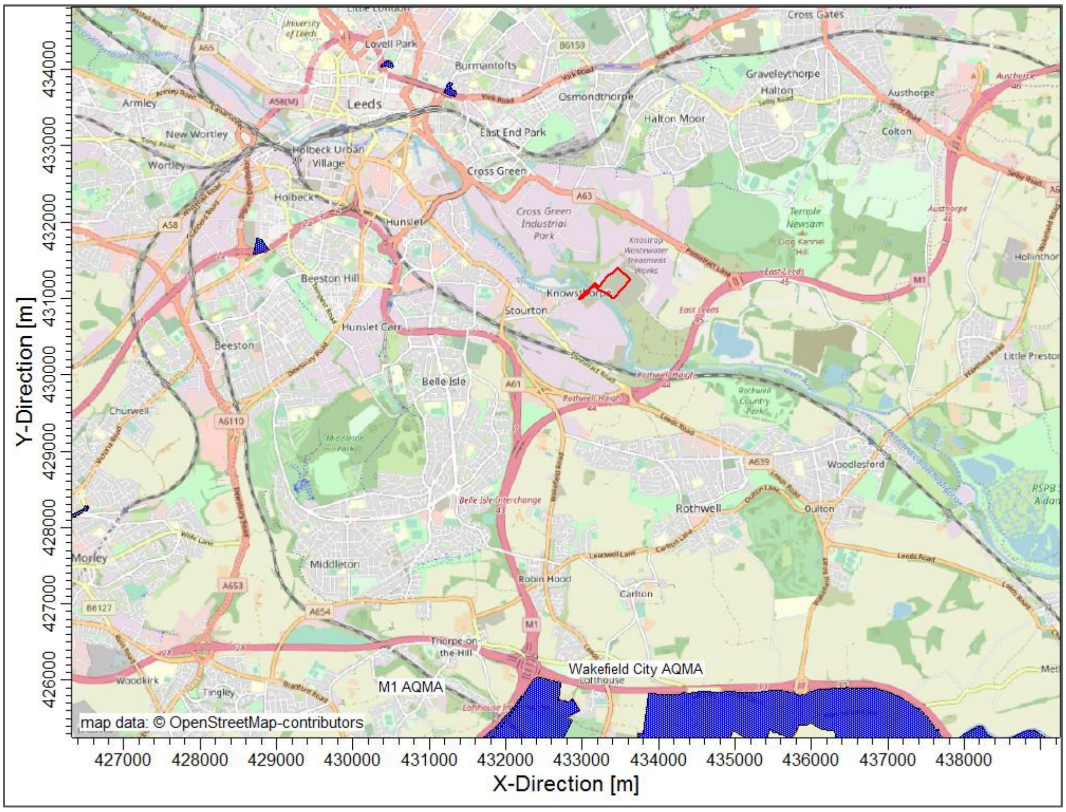

Figure 4-4
Location of AQMAs

LCC's latest LAQM report[13] has been reviewed for monitoring data close to the Site (within circa 2.5km based upon the ground level impacts) from both background and roadside locations. The recent results are presented in Table 4-3 below; the locations are presented in Figure 4-5. The monitoring shows that background concentrations range between 22 and 24µg/m^3. Two roadside monitoring locations (D265 and D267) show exceedances of the limit value however there is no relevant exposure.

Table 4-3
LCC NO_2 Diffusion Tube Monitoring Results

ID	Type	Distance to kerb (m)	Distance to Relevant exposure (m)	2016 µg/m^3	2017 µg/m^3
D70	Roadside	7	0	35	35
D126	Roadside	2	0	32	32
D199	Industrial	25	N/A	N/M	29
D232	Urban Background	100	0	N/M	22
D233	Urban Background	150	0	N/M	22

[13] Leeds City Council, 2018 Air Quality Annual Status Report (ASR), (June 2018)

D234	Urban Background	115	0	N/M	24
D239	Roadside	2	N/A	N/M	20
D240	Roadside	3	N/A	N/M	18
D241	Roadside	3	N/A	N/M	23
D263	Roadside	3	N/A	N/M	35
D264	Kerbside	0	N/A	N/M	31
D265	Roadside	2	N/A	N/M	**44**
D266	Roadside	15	0	N/M	27
D267	Roadside	3	N/A	N/M	**46**
D268	Roadside	4	N/A	N/M	35
D274	Roadside	3	8	N/M	30
D275	Roadside	2	8	N/M	25
D276	Roadside	2	10	N/M	26
D277	Roadside	3	12	N/M	20

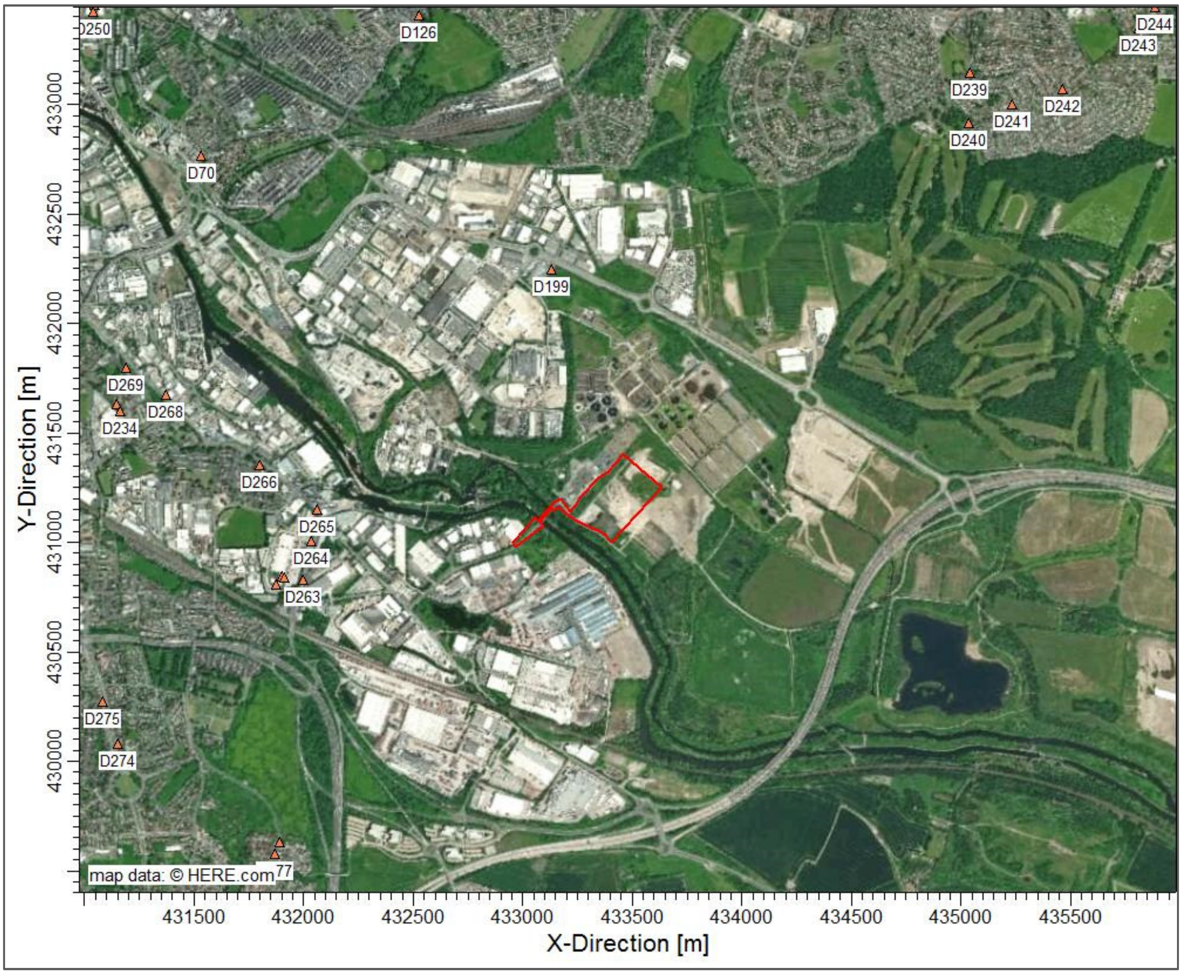

Figure 4-5
Local Diffusion Tube Monitoring Locations

4.5.2 UK AIR Modelled Data

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 of NOx, NO_2, PM_{10} and $PM_{2.5}$ are based upon a 2015 base year[14] and background pollutant concentrations of CO and Benzene are based upon a 2001 base year. Projection factors for SO_2 are not provided in LAQM.TG(16) since 2001 therefore values are likely to be an over prediction. For this reason the more up-to-date APIS modelled 3 year average values (2013-2015) have been applied, for the 5km grid square containing the site the APIS background value is 1.13µg/m^3.

The mapped background concentrations for the 9 grid squares containing the Site (centred on x433500,y431500) and nearby receptors are shown in Table 4-4. The NO_2 background monitoring data shows reasonable agreement with the 2015 base year data.

[14] Background mapping data for local authorities – http://uk-air.defra.gov.uk/data/laqm-background-home, accessed November 2017.

Table 4-4
Modelled 2015 Annual Mean Background Concentrations (µg/m³)

X – NGR	Y-NGR	NO_2	PM_{10}	$PM_{2.5}$	Benzene	CO
432500	430500	23.6	15.9	11.1	0.54	444
433500	430500	19.4	13.4	8.9	0.51	430
434500	430500	19.9	14.9	9.5	0.49	413
432500	431500	23.6	14.4	9.3	0.61	484
433500	431500	17.7	13.2	8.8	0.55	454
434500	431500	17.2	14.3	9.2	0.50	421
432500	432500	22.6	14.0	9.7	0.67	524
433500	432500	18.8	13.3	8.8	0.64	501
434500	432500	16.9	13.0	8.5	0.58	464

4.5.3 Metals

Monitoring of metals is currently carried out on behalf of Defra at 24 sites around the UK (termed the Heavy Metals Monitoring Network). The closest location to the Site at which heavy metals have been monitored is at Beacon Hill (of a rural classification) located approximately 5km to the southeast, however the site was closed in 2014. Monitoring has been undertaken within Leeds for 12 months between 2010 and 2011 as part of an EfW application in Newmarket, Leeds. This data, taken from the application[15], is shown in Table 4-5.

Table 4-5
Metals Monitoring Data from Newmarket Leeds

Metal		Annual average (ng/m³)
Arsenic	As	1.1
Cadmium	Cd	0.20
Chromium (total)	Cr	6.3
Copper	Cu	17
Manganese	Mn	100
Nickel	Ni	6.6
Lead	Pb	34
Vanadium	V	1.1
Antimony	Sb	2.3
Chromium (VI)	CrVI	1.3 (estimated as 20% of total Cr)
Mercury	Hg	0.00017

[15] Assessment of Impacts to Air Quality Arising from the Operation of the Proposed Leeds RERF Appendix D1 June 2012

Monitoring is not routinely undertaken for thallium or hexavalent chromium (Cr(VI)) in the UK and therefore no background data are available. The adopted approach of the EA for estimating Cr(VI) is to assume it is a fraction of total Cr, guidance[16] states that a value of 20% should be applied unless otherwise justified.

4.5.4 Hydrogen Halides

Hydrogen Chloride

Hydrogen chloride is monitored as part of the UK Acid Gases & Aerosol Network (AGANET) at Ladybower located approximately 45km southwest of the Site. The annual mean concentration of HCl from the most recent ratified data, i.e. 2014 and 2015 is 0.40µg/m^3 and 0.23µg/m^3.

Hydrogen Fluoride

In 2005 The Expert Panel on Air Quality Standards (EPAQS) published a draft report entitled 'Guidelines for halogen and hydrogen halides in ambient air for protecting human health against acute irritancy effects'. The report noted that only a small number of measurements of ambient concentrations of hydrogen fluoride have been made in the UK. All of these have been made in the vicinity of three industrial plants. Many samples were below the limit of detection. However, measurable values were in the range 0.05 to 3.5µg/m^3 as approximate monthly averages.

4.5.5 Ammonia

Ammonia is monitored at 85 sites as part of the National Ammonia Monitoring Network (NAMN). The closest monitoring station is at Tadcaster (a rural background site approximately 20km north east). The most recent ratified data shows average annual mean concentration between 2016 and 2018 of 2.02µg/m^3.

The APIS modelled 3 year average value (2013-2015) for the 5km grid square containing the site is 1.89µg/m^3.

4.5.6 Dioxins and PCBs

The Toxic Organic Micro-Pollutants (TOMPs) network measures ambient air concentrations for a range of persistent organic pollutants (POPs) across the UK, including polychlorinated biphenyls (PCBs), polychlorinated-p-dioxins (PCDDs - dioxins), polychlorinated dibenzofurans (PCDFs - furans). The closest urban monitoring site is the Manchester Law Courts data from 2016, as follows:

- sum of dioxins and furans (Toxic Equivalent Quotient): 12fgTEQ/m^3
- sum of seven indicator PCB congeners (PCBs 28,52,101,118,138,153,180): 105pg/m^3.

4.5.7 PAH

The measurement of polycyclic aromatic hydrocarbon (PAH) in the Network began in 1991. Currently the network consists of over 30 PAH measurement sites. The closest urban monitoring site is Leeds Millshaw (x427874, y430056) located approximately 5.3km west of the site. The latest annual means from the monitoring at this site are 2018: 0.18ng/m^3, 2019: 0.40ng/m^3.

4.6 Applied Background Concentrations

The applied backgrounds are provided in Table 4-6 below. Baseline concentrations for short-term averaging periods have been converted from annual mean in accordance with AERA guidance and LAQM.TG16.

[16] Releases from waste incinerators – Guidance on assessing group 3 metal stack emissions from incinerators. Version 4. Environment Agency, June 2016.

Table 4-6
Applied Background Concentrations

Pollutant	Units	Background Concentration		Data Source
		Short Term [(a)]	Annual	
NO_2	µg/m^3	48	24	LCC Diffusion Tube Monitoring - highest urban background
PM_{10}	µg/m^3	15.9	15.9	UK-AIR 2015 background map – highest in study area.
$PM_{2.5}$	µg/m^3	22.2	11.1	
CO	µg/m^3	1048.0	524.0	
SO_2	µg/m^3	2.3	1.1	APIS Background map (2013 -15)
HCl	µg/m^3	0.8	0.4	UK AGNET Ladybower 2014
HF	µg/m^3	7.0	3.5	EPAQS
Benzene	µg/m^3	1.3	0.7	UK-AIR 2015 background map
Ammonia	µg/m^3	4.0	2.0	NAMN Tadcaster 2016-2018
Antimony	ηg/m^3	4.6	2.3	Monitoring commissioned as part of the Leeds RERF work at the former Wholesale Market site
Cadmium	ηg/m^3	0.4	0.2	
Mercury	ηg/m^3	0.00034	0.00017	
Arsenic	ηg/m^3	2.2	1.1	
Chromium	ηg/m^3	12.6	6.3	
Copper	ηg/m^3	34.0	17.0	
Lead	ηg/m^3	68.0	34.0	
Manganese	ηg/m^3	200.0	100.0	
Nickel	ηg/m^3	13.2	6.6	
Vanadium	ηg/m^3	2.2	1.1	
Chromium VI	ηg/m^3	2.52	1.3	EA guidance 20% of total Cr
PCB	pg/m^3	210	105	TOMPS (Manchester Law Courts 2016)
Dioxins furans	fgTEQ/m^3	24	12	TOMPS (Manchester Law Courts 2016)
B(a)P	ηg/m^3	0.0008	0.0004	PAH Network (Leeds Milshaw 2019)

4.7 Critical Levels and Loads

APIS is 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. APIS[17] has been used to provide information on:

- identification of whether the habitats present are sensitive;
- critical levels and current baseline levels (Table 4-7); and
- critical loads and current loads (Table 4-8 and Table 4-9).

The baseline concentrations (3-year average 2013 - 2015) of NOx, SO_2 and NH_3 are summarised in Table 4-7 below.

Table 4-7
Baseline Concentrations

Site	NO_x (µg/m³)	SO_2 (µg/m³)	NH_3 (µg/m³)
ER1	26.4	1.1	1.9
ER2	31.2	1.1	1.9

4.7.1 Relevant Critical Loads

APIS was used to obtain location specific C_{Lo} of nitrogen and acid deposition and current loads (3-year average 2013 - 2015) as summarised in Table 4-8 and Table 4-9 below. The most sensitive habitat type listed on APIS has been used for the assessment and nitrogen C_{Lo} applied according to APIS guidance[18].

Table 4-8
Relevant N Critical Loads (kgN/ha/yr)

Site	APIS Habitat (most sensitive to N deposition)	C_{Lo} for Assessment (kgN/ha/yr)	Current N Load (kgN/ha/yr)
ER1	Broadleaved deciduous woodland	10	36.26
ER2	Broadleaved deciduous woodland	10	36.26

Table 4-9
Relevant Acid Critical Loads and Baseline Deposition

Site	Habitat (most sensitive to acid deposition)	Critical Level (k_{eq}/ha/yr)			Current Load (k_{eq}/ha/yr)	
		CLmaxS	CLminN	CLmaxN	N	S
ER1	Broadleafed/Coniferous unmanaged woodland	1.501	0.142	1.643	2.59	0.43
ER2	Broadleafed/Coniferous unmanaged woodland	2.500	0.357	2.857	2.59	0.43

[17] At the time of writing the APIS baseline data has reverted to 2013-2015 averages
[18] 'Indicative values within nutrient nitrogen critical load ranges for use in air pollution impact assessments' (http://www.apis.ac.uk/indicative-critical-load-values)

5.0 EMISSIONS TO ATMOSPHERE

5.1 Emission Scenarios

For the purposes of the dispersion modelling assessment, to represent a precautionary (worst case) approach, it has been assumed that the plant will operate at maximum throughput, 24-hours per day for 365 days per year (i.e. 8,760 hours per year), with emission concentrations at the Permitted ELVs. In reality operational hours are likely to be less than this to allow for maintenance and emissions control would reduce emissions to meet the limits achievable by the use of Best Available Techniques (BAT-AELs) as set out in the Revised Waste Incineration BREF Final Draft, December 2018, which sit some way below the Permitted ELVs. As such the following scenarios have been assessed:

- Normal 'daily average' emission limits;
- Half-hourly emission limits; and
- Plausible abnormal emissions

5.2 Emission Parameters

The following emission parameters and process conditions were used to determine the pollutant emission rates and as input to the dispersion modelling. These are common to all scenarios assessed with variations to a number of parameters investigated in Section 7.0.

Table 5-1
Emission Characteristics

Parameter	Stack 1	Stack 2
Stack Location (NGR x/y)	433470/431232	433472/431235
Stack Internal Diameter (m)	1.9	1.9
Stack Exhaust Height (m AGL)	90m	90m
Volume Flow (Nm^3/s) (273K, 11% O_2, dry)	37.92	37.92
Emission Temperature (^oC)	140	140
Oxygen Content (% O_2 dry gas)	7.64	7.64
Moisture content (% H_2O)	19.07	19.07
Actual Flow Rate (Am^3/s) (wet, at stack conditions)	52.88	52.88
Emission velocity (m/s)	18.8	18.8

5.3 'Daily Average' Pollutant Emission Scenario

The pollutants emitted from the EFW stacks and their emission concentration limit values, as stated in the IED are shown in Table 2-1. The emission rates are presented in Table 5-2 and have been calculated from the process conditions detailed above and the emission limits as detailed in Table 2-1. Other pollutant specific issues are discussed in the sections below.

Table 5-2
'Daily Average' Pollutant Emission Rates

Pollutant	Emission Concentration (mg/Nm3)	Daily Average Emission Rate (per stack)	Emission Rate Units
Particulate Matter	10	0.379	g/s
Nitrogen Dioxide	200	7.584	g/s
Carbon Monoxide	50	1.896	g/s
Sulphur Dioxide	50	1.896	g/s
Hydrogen Chloride	10	0.379	g/s
Hydrogen Fluoride	1	0.038	g/s
Organics (TOC)	10	0.379	g/s
Group 1 metals (total)	0.05	1.896	mg/s
Group 2 metal	0.05	1.896	mg/s
Group 3 metals (total)	0.5	18.960	mg/s
Dioxins and furans	0.0000001	3.792	ng/s
Ammonia	10	0.379	g/s
PCB's	0.005	0.190	mg/s
PAH's	0.001	0.038	mg/s

5.3.1 Particle Size

In air quality terms PM is classified in terms of its aerodynamic diameter; with PM_{10} relating to particles with an aerodynamic diameter of less than 10µm. Other smaller relevant fractions of particulate matter such as $PM_{2.5}$ (aerodynamic diameter less than 2.5µm) are a sub-fraction of the PM_{10} fraction i.e. PM_{10} includes $PM_{2.5}$.

For the purposes of this assessment 100% of particulate matter has been assumed to be PM_{10} and 100% to be $PM_{2.5}$. This approach ensures that a worst case scenario has been considered for the smallest particles.

5.3.2 Total Organic Carbon

There are no relevant air quality assessment levels or backgrounds for TOC. Whilst it is unlikely that any benzene would be released from the process due to the high temperature of combustion a cautious approach has been adopted by assuming all the organic carbon would be in the form of benzene in line with AERA guidance.

5.3.3 Ammonia

The plant utilises a selective-catalytic-reduction system (SCR) to abate emission of NO_x. The manufacturer information indicates very low levels of residual ammonia present; however as a precautionary approach an annual average of 10mg/Nm^3 has been applied in the assessment.

5.3.4 PCBs

There is no ELV for PCB's provided in the IED. The 2006 Waste Incineration BREF Note (May 2017), indicates potential PCB emissions of <0.005mg/Nm^3. This value has been applied in the assessment. The current draft BREF (December 2018) contains information on dioxin-like PCBs that are addressed in the Human Health Risk Assessment.

5.3.5 B(a)P

There is no ELV for PAH's (or B(a)P specifically) provided in the IED. The current draft BREF (December 2018) states *"emission levels range from 0.004 ng/Nm^3 to 1 µg/Nm^3 for BaP"*. A value of 0.001mg/Nm^3 (1µg/Nm^3) has been applied in the assessment and is considered to represent a precautionary approach.

5.3.6 Metals

As shown in Table 2-1, the IED emission limits for metals are based on total emission rates for 3 different groups. Additionally, in relation to chromium, different EALs apply depending on the oxidation state of chromium. The EPAQS recommended annual mean limit of 0.2ηg/m^3 relates specifically to chromium (VI) (i.e. hexavalent chromium), with the long-term EAL of 5µg/m^3 applying to all other oxidation states of chromium.

The EA's approach to assessment of Group 3 metals[19] is based on emissions monitoring data from the UK and includes two steps. Step 1 is a screening stage and requires each metal to be modelled at 100% of the group limit and Step 2, which has been applied in this detailed assessment, requires the maximum measured value to be applied from the data presented in Table 5-3.

Table 5-3
EA Group 3 Metals Monitoring Data

Parameter	Measured Concentrations (mg/Nm^3)			Maximum as a % of Group 3 total	Modelled emission rate (mg/s)
	Maximum	Mean	Minimum		
Antimony	0.0115	0.0014	0.0001	2.3%	0.44
Arsenic	0.0250	0.0010	0.0002	5.0%	0.95
Chromium (II and III)	0.0920	0.0084	0.0002	18.4%	3.49
Chromium (VI)	1.3×10^{-4}	3.5×10^{-5}	2.3×10^{-6}	0.003%	0.01
Cobalt	0.0056	0.0011	0.0002	1.1%	0.21
Copper	0.0290	0.0075	0.0019	5.80	1.10
Lead	0.0503	0.0109	0.0003	10.1%	1.91
Manganese	0.0600	0.0168	0.0015	12.0%	2.28
Nickel	0.2200	0.0150	0.0025	44.0%	8.34
Vanadium	0.0060	0.0004	0.0001	1.2%	0.23

[19] Releases from waste incinerators – Guidance on assessing group 3 metal stack emissions from incinerators. Version 4. Environment Agency, June 2016.

5.4 Half Hourly Emission Limits Scenario

In addition to the daily average emission limits assessed, the IED also stipulates half-hourly emission limit values with the 97th percentile at levels that mirror the daily average levels (with the exception of HF and CO), but with 100th percentile values that are elevated. As such the model scenarios include an assessment of elevated emissions that could occur for 3% of half hourly averages as detailed in Table 2-1.

Table 5-4
'Half hourly' Pollutant Emission Rates

Pollutant	Emission Concentration (mg/Nm3)	Daily Average Emission Rate (per stack)	Emission Rate Units
Particulate Matter	30	1.14	g/s
Nitrogen Dioxide	400	15.17	g/s
Carbon Monoxide	150	5.69	g/s
Sulphur Dioxide	200	7.58	g/s
Hydrogen Chloride	60	2.28	g/s
Hydrogen Fluoride	4	0.15	g/s
TOC	20	0.76	g/s

5.5 Abnormal Operating Conditions Scenario

The IED allows for elevated emissions of some pollutants for limited periods of time during 'abnormal operating conditions' from facilities undertaking the incineration of waste. Under such abnormal operating conditions, waste feed to the plant must be stopped and the plant is required to cease the incineration of waste as soon as practicable, within a maximum timeframe of 4 hours. Such abnormal operating conditions are only allowed to occur for 60-hours per year per line:

> *'the waste incineration plant or waste co-incineration plant or individual furnaces being part of a waste incineration plant or waste co-incineration plant shall under no circumstances continue to incinerate waste for a period of more than 4 hours uninterrupted where emission limit values are exceeded.*
>
> *The cumulative duration of operation in such conditions over 1 year shall not exceed 60 hours.'*

UK data for plant that thermally treat residual municipal solid waste shows that the reported occurrence of abnormal operating conditions (or exceedences of permitted emission limits) is very infrequent (far below the 60-hours allowed for abnormal operating conditions under the IED).

Based on annual reports for similar operational facilities in the UK, the following are considered to be examples of abnormal operating conditions which may lead to 'abnormal emission levels' of pollutants:

- significant variation in waste composition (i.e. very high moisture) promoting poor combustion, leading to CO exceedences;
- reduced efficiency of FGT injection system such as through blockages or failure of pumps leading to elevated acid gas emissions;
- reduced efficiency of particulate filtration system due to bag failure and inadequate isolation, leading to elevated particulate emissions; or

- reduced efficiency of SNCR system as a result of blockages or failure of ammonia injection system, leading to elevated NOx emissions.

The potential impact of plausible abnormal emissions has been investigated using emission concentrations consistent with documented events for mass-burn incineration facilities in the UK and as detailed in available EA decision documents (see Table 5-5 below).

It should be noted that the definition of 'abnormal operating conditions' also encompasses periods where the continuous emission monitoring equipment is not operatively correctly and data relating to the actual emission concentrations are not available. This assessment has only used data where the concentration of continuously monitored pollutants has been quantified. Furthermore no data on flow characteristics (flow rate, temperate etc.) during these abnormal operating conditions is available, so for the purposes of this assessment the design flow characteristics have been applied to the plausible emission levels to derive an emission rate and assess impact.

Table 5-5
Plausible Abnormal Emissions

Pollutant	Permitted Emission (mg/m^3)		Plausible Abnormal Emission (mg/m^3)(a)	% increase above Permitted Emission
	Daily Average	½ hourly max		
Particulate Matter	10	30	150(b)	1400%
Nitrogen Dioxide	200	400	600	200%
Carbon Monoxide	50	150	400	700%
Sulphur Dioxide	50	200	600	1100%
Hydrogen Chloride	10	60	900	8900%
Hydrogen Fluoride	1	4	10	900%
TOC	10	20	100	900%
Group 1 Metal	0.05		0.1	100%
Group 2 Metal	0.05		0.2	300%
Group 3 Metal	0.5		1.5	200%

Table note:
a) Based upon a review of EA decision documents and annual reports for similar facilities.
b) Based upon IED

5.6 RERF Emissions for Cumulative Impact Assessment

The Veolia RERF emission parameters and buildings have been based upon the impact assessment undertaken for the facility[15]. The same approach to pollutant emissions has been adopted as described in Section 5.3.

Table 5-6
RERF Emission Characteristics

Parameter	Stack 1
Stack Location (NGR x/y)	432815/432450
Stack Internal Diameter (m)	1.6

Stack Exhaust Height (m AGL)	75
Volume Flow (Nm^3/s) (273K, 11% O_2, dry)	28.4
Emission Temperature (°C)	140
Oxygen Content (% O_2 dry gas)	9.3
Moisture content (% v/v H_2O)	17.4
Actual Flow Rate (Am^3/s) (wet, at stack conditions)	44.3
Emission velocity (m/s)	22.2

Table 5-7
RERF 'Daily Average' Pollutant Emission Rates

Pollutant	Emission Concentration (mg/Nm^3)	Daily Average Emission Rate (per stack)	Emission Rate Units
Particulate Matter	10	0.284	g/s
Nitrogen Dioxide	200	5.68	g/s
Carbon Monoxide	50	1.42	g/s
Sulphur Dioxide	50	1.42	g/s
Hydrogen Chloride	10	0.284	g/s
Hydrogen Fluoride	1	0.0284	g/s
Organics (TOC)	10	0.284	g/s
Group 1 metals (total)	0.05	1.42	mg/s
Group 2 metal	0.05	1.42	mg/s
Group 3 metals (total)	0.5	14.2	mg/s
Dioxins and furans	0.0000001	2.84	ng/s
Ammonia	8	0.2272	g/s
PCB's	0.005	0.142	mg/s

6.0 PREDICTED AIR QUALITY IMPACTS

6.1 Predicted Long-term Impacts

Predicted long-term impacts are summarised in Table 6-1. The results are the maximum predicted long-term impacts and relate to the highest predicted level of impact at any location on the receptor grid and impacts at all other locations will be lower. Isopleth plots are presented in Appendix A for those PCs that are not insignificant.

The maximum ground level PC is insignificant for the majority of emissions and can be considered insignificant. For those PC's that cannot be considered insignificant the PEC does not exceed standard.

Table 6-1
Predicted Maximum Ground Level Long-term Impacts

Pollutant	Standard (µg/m^3)	PC (µg/m^3)	PC as % Standard	PEC (µg/m^3)[(a)]	PEC as % Standard
NO_2	40	1.21	3.0%	25.2	63.0%
PM_{10}	40	0.09	0.2%	n/c	n/c
$PM_{2.5}$	25	0.09	0.3%	n/c	n/c
HF (monthly)	16	0.02	0.1%	n/c	n/c
TOC (as Benzene)	5	0.09	1.7%	0.76	15.1%
NH_3	180	0.09	<0.1%	n/c	n/c
Cadmium	0.005	0.0002	4.3%	0.0004	8.3%
Mercury	0.25	0.0004	0.2%	n/c	n/c
Antimony	5	0.0001	<0.1%	n/c	n/c
Arsenic	0.003	0.0002	7.2%	0.0013	43.9%
Chromium (III)	5	0.0008	<0.1%	n/c	n/c
Chromium (VI)	0.0002	1.3E-06	0.6%	n/c	n/c
Lead	0.25	0.0004	0.2%	n/c	n/c
Manganese	0.15	0.0005	0.3%	n/c	n/c
Nickel	0.02	0.0019	9.5%	0.0085	42.5%
Vanadium	5	0.00005	<0.1%	n/c	n/c
PCB	0.2	4E-05	<0.1%	n/c	n/c
B(a)P	0.001	0.00001	0.9%	n/c	n/c

Table note: n/c = not calculated: following AERA guidance the PEC has only been calculated where the PC is 1% or above.

The NO_2 annual mean process contribution is not insignificant at the point of maximum ground level concentration, although this is not a location of relevant exposure. The impact at receptor locations including the highest impact at an AQMA is presented in Table 6-2. The NO_2 PC is less than 1% of the standard at the assessed human receptor locations and AQMAs.

Table 6-2
Predicted Long-term NO_2 Impacts at Receptor Locations

Receptor	PC (µg/m^3)	PC as % Standard
HR1	0.28	0.7%
HR2	0.28	0.7%
HR3	0.37	0.9%
HR4	0.22	0.6%
HR5	0.10	0.2%
HR6	0.10	0.3%
HR7	0.12	0.3%
HR8	0.16	0.4%
HR9	0.09	0.2%
HR10	0.14	0.3%
HR11	0.18	0.4%
Maximum at an AQMA	0.10	0.2%

Table note: PEC not calculated: following AERA guidance the PEC has only been calculated where the PC is 1% or above.

The impact at receptors for the other PC's (TOC, As, Cd, and Ni) that are not insignificant at the point of maximum ground level concentration are presented in Table 6-3. At locations where the PC cannot be considered insignificant the PEC does not exceed standard.

Table 6-3
Predicted Long-term Impacts at Receptor Locations

Rec.	TOC PC (µg/m³)	% EAL	PEC (µg/m³)	PEC as % EAL	Cd PC (µg/m³)	% EAL	PEC (µg/m³)	PEC as % EAL	As PC (µg/m³)	% EAL	PEC (µg/m³)	PEC as % EAL	Ni PC (µg/m³)	% EAL	PEC (µg/m³)	PEC as % EAL
HR1	0.0201	0.4%	n/c	n/c	0.0001	1.0%	0.0003	5.0%	0.0001	1.7%	0.0012	38.3%	0.0004	2.2%	0.0070	35.2%
HR2	0.0201	0.4%	n/c	n/c	0.0001	1.0%	0.0003	5.0%	0.0001	1.0%	0.0012	38.3%	0.0004	2.2%	0.0070	35.2%
HR3	0.0261	0.5%	n/c	n/c	0.0001	1.3%	0.0003	5.3%	0.0001	1.3%	0.0012	38.8%	0.0006	2.9%	0.0072	35.9%
HR4	0.0159	0.3%	n/c	n/c	<0.0001	n/c	n/c	n/c	<0.0001	0.8%	n/c	n/c	0.0004	1.8%	0.0070	34.8%
HR5	0.0068	0.1%	n/c	n/c	<0.0001	n/c	n/c	n/c	<0.0001	0.3%	n/c	n/c	0.0002	0.8%	n/c	n/c
HR6	0.0075	0.1%	n/c	n/c	<0.0001	n/c	n/c	n/c	<0.0001	0.4%	n/c	n/c	0.0002	0.8%	n/c	n/c
HR7	0.0085	0.2%	n/c	n/c	<0.0001	n/c	n/c	n/c	<0.0001	0.4%	n/c	n/c	0.0002	0.9%	n/c	n/c
HR8	0.0111	0.2%	n/c	n/c	<0.0001	n/c	n/c	n/c	<0.0001	0.6%	n/c	n/c	0.0002	1.2%	0.0068	34.2%
HR9	0.0064	0.1%	n/c	n/c	<0.0001	n/c	n/c	n/c	<0.0001	0.3%	n/c	n/c	0.0001	0.7%	n/c	n/c
HR10	0.0097	0.2%	n/c	n/c	<0.0001	n/c	n/c	n/c	<0.0001	0.5%	n/c	n/c	0.0002	1.1%	0.0068	34.1%
HR11	0.0128	0.3%	n/c	n/c	<0.0001	n/c	n/c	n/c	<0.0001	0.6%	n/c	n/c	0.0003	1.4%	0.0069	34.4%

Table note: n/c = not calculated: following AERA guidance the PEC has only been calculated where the PC is 1% or above.

6.2 Predicted Short-term Impacts

Predicted short-term impacts are summarised in Table 6-4. The results presented are the maximum predicted short-term impacts and relate to the highest predicted level of impact at any location on the receptor grid and impacts at all other locations, and at all other times, will be lower. The maximum ground level PCs are insignificant for all emissions.

Table 6-4
Predicted Maximum Ground Level Short-term Impacts

Pollutant	Standard (µg/m^3)	PC (µg/m^3)	PC as % Standard
NO_2	200	7.5	3.7%
PM_{10}	50	0.24	0.5%
CO (8-hr)	10000	3.9	<0.1%
CO (1-hr)	30000	14.6	<0.1%
SO_2 (24-hr)	125	2.0	1.6%
SO_2 (1-hr)	350	5	1.5%
SO_2 (15-min)	267	11	4.1%
HCl	750	2.9	0.4%
HF	160	0.29	0.2%
NH_3	2500	2.9	0.1%
Mercury	7.5	0.01	0.2%
Antimony	150	0.003	<0.1%
Chromium (III)	150	0.03	<0.1%
Copper	200	0.01	<0.1%
Manganese	1500	0.02	<0.1%
Vanadium	1	0.002	0.2%
PCB	6	1.5E-03	<0.1%

6.2.1 Impacts from Half Hourly Emission Limits

In addition to the daily average emission limits assessed, the IED also stipulates half-hourly emission limit values with the 97th percentile at levels above the daily average levels. The significance of the half-hourly emission limits has been investigated for NO_2, SO_2, HCl and HF that have Standards set on an hourly average period but not for standards based on 24-hour or longer averaging periods that would not be significantly affected by the half-hourly IED emission limit. Even with the highly conservative (worst case) assumption that allowable elevated emissions coincide with the worst case meteorological conditions for dispersal over the year, the PC's are insignificant with the one exception (SO_2 15-minute averaging period) for which the PEC remains well below the Standard.

Table 6-5
Maximum Impacts using Half-hourly IED Chapter IV Limits

Pollutant	Standard (µg/m³)	PC (µg/m³)	PC as % Standard	PEC (µg/m³)[(a)]	PEC as % Standard
NO_2	200 (1-hr 99.89%ile)	15.0	7.5%	n/c	n/c
CO	30,000 (1-hr)	43.8	0.1%	n/c	n/c
SO_2	350 (1-hr 99.73%ile)	20.6	5.9%	n/c	n/c
SO_2	266 (15-min 99.9%ile)	44.3	16.6%	46.6	17.4%
HCl	750 (1-hr maximum)	17.5	2.3%	n/c	n/c
HF	160 (1-hr maximum)	1.17	0.7%	n/c	n/c

Table note: n/c = not calculated: following AERA guidance the PEC has only been calculated where the PC is 10% or above.

6.3 Impacts from Plausible Abnormal Emissions

Table 6-6 presents the potential short-term impacts from the plausible abnormal emissions scenario. Even with the highly conservative (worst case) assumption that abnormal emissions coincide with the worst case meteorological conditions for dispersal over the year, the PC's are insignificant with the six exceptions for which PECs remain well below the Standard.

Table 6-6
Predicted Maximum Ground Level Short-term Impacts (Abnormal Emissions)

Pollutant	Standard (µg/m³)	PC (µg/m³)	PC as % Standard	PEC (µg/m³)[(a)]	PEC as % Standard
NO_2	200 (1-hr 99.89%ile)	22.5	11.2%	70	35.2%
PM_{10}	50 (24-hr 90.4%ile)	3.60	7.2%	n/c	n/c
CO	10,000(8-hour)	31.3	0.3%	n/c	n/c
CO	30,000 (1-hr)	116.8	0.4%	n/c	n/c
SO_2	125 (24-hr 99.18%ile)	23.7	19.0%	26	20.8%
SO_2	350 (1-hr 99.73%ile)	62	17.6%	64	18.3%
SO_2	266 (15-min 99.9%ile)	133	49.8%	135	50.6%
HCl	750	262.7	35.0%	263.5	35.1%
HF	160	2.92	1.8%	n/c	n/c
Mercury	7.5	1.46	19.5%	1.46	19.5%
Antimony	150	0.02	0.0%	n/c	n/c
Chromium (III)	150	0.13	0.1%	n/c	n/c
Copper	200	0.04	0.0%	n/c	n/c
Manganese	1500	0.09	0.0%	n/c	n/c
Vanadium	1	0.01	0.9%	n/c	n/c
PCB	6	2.9E-06	0.0%	n/c	n/c

Table note: n/c = not calculated: following AERA guidance the PEC has only been calculated where the PC is 10% or above.

In order to assess the effect on long-term ground level concentrations associated with the plant operating at the identified plausible abnormal emission levels; the calculated long-term ground level concentrations have been increased pro-rata according to Table 5-5. This assumes that the plant is operating at the daily average IED emission limits for 8700 hours per year and at the plausible abnormal emission levels for 60-hours per year. Given this low frequency of occurrence, the plausible abnormal emissions are predicted to have little effect on long-term impacts as shown in Table 6-7.

Table 6-7
Predicted Maximum Ground Level Long-term Impacts (Abnormal Emissions)

Pollutant	Standard (µg/m^3)	PC (µg/m^3)	PC as % Standard	PEC (µg/m^3)[(a)]	PEC as % Standard
NO_2	40	1.2	3.1%	25.2	63.1%
PM_{10}	40	0.09	0.2%	n/c	n/c
$PM_{2.5}$	25	0.09	0.4%	n/c	n/c
HF (monthly)	16	0.01	0.1%	n/c	n/c
TOC (as Benzene)	5	0.09	1.8%	0.76	15.2%
Cadmium	0.005	0.0002	4.4%	0.0004	8.4%
Mercury	0.25	0.0007	0.3%	n/c	n/c
Antimony	5	0.0001	<0.1%	n/c	n/c
Arsenic	0.003	0.0002	7.4%	0.0013	44.1%
Chromium (III)	5	0.0008	<0.1%	n/c	n/c
Chromium (VI)	0.0002	1.3E-06	0.7%	n/c	n/c
Lead	0.25	0.0004	0.2%	n/c	n/c
Manganese	0.15	0.0005	0.4%	n/c	n/c
Nickel	0.02	0.0020	9.8%	0.0086	42.8%
Vanadium	5	0.0001	<0.1%	n/c	n/c

Table Note:
n/c = not calculated: following AERA guidance the PEC has only been calculated where the PC is 1% or above.

6.4 Predicted Impacts at Sensitive Ecosystems

6.4.1 Critical Levels

The predicted impacts on C_{Le} at the identified ecological sites are presented in Table 6-8 and Table 6-9. The findings are that the PC's are less than 100% of the C_{Le} at the LNR and LWS and therefore the impact is considered insignificant and will cause *'no significant pollution'*.

Table 6-8
Predicted Impacts on Long-term Critical Levels

Site	PC SO_2 (µg/m³)	PC as % C_{Le}	PC NO_x (µg/m³)	PC as % C_{Le}	PC NH_3 (µg/m³)	PC as % C_{Le}
ER1	0.36	2%	1.43	5%	0.07	2%
ER2	0.05	<1%	0.18	<1%	0.01	<1%

Table 6-9
Predicted Impacts on Short-term Critical Levels

Site	PC NO_x Daily (µg/m³)	PC as % C_{Le}	PC HF Daily (µg/m³)	PC as % C_{Le}	PC HF Weekly (µg/m³)	PC as % C_{Le}
ER1	7.8	10%	0.04	1%	0.02	4%
ER2	3.6	5%	0.02	<1%	0.01	2%

6.4.2 Critical Loads

The predicted impact on C_{Lo}'s at the identified ecological sites for nitrogen and acid deposition are presented in Table 6-10 and Table 6-11 respectively. The findings are that the PC's are less than 100% for the LNR and LWS therefore the impact is considered insignificant and will cause *'no significant pollution'*.

Table 6-10
Predicted Impacts on Nitrogen Critical Loads

Site	PC N (kg/ha/yr)	Applied C_{Lo}	PC as % C_{L0}
ER1	0.85	10	8.5%
ER2	0.11	10	1.1%

Table 6-11
Predicted Impacts on Acid Critical Loads

Site	PC N (kg/ha/yr)	PC S (kg/ha/yr)	Applied C_{Lo} CLmaxN (kg/ha/yr)	PC as % C_{L0} (PC S + N as % CLmaxN)
ER1	0.060	0.121	1.643	11.1%
ER2	0.008	0.016	2.857	0.8%

6.5 Cumulative Impact Assessment with RERF

For those Skelton Grange EfW PCs that are not insignificant, the cumulative impact with the Veolia RERF has been predicted. The predicted long-term impacts are summarised in Table 6-12. The PEC does not exceed the relevant standards.

Table 6-12
Predicted Cumulative Maximum Ground Level Long-term Impacts

Pollutant	Standard (µg/m^3)	PC (µg/m^3)	PC as % Standard	PEC (µg/m^3)[(a)]	PEC as % Standard
NO_2	40	1.48	3.7%	25.5	63.7%
TOC (as Benzene)	5	0.11	2.1%	0.78	15.5%
Cadmium	0.005	0.0003	5.3%	0.0005	9.3%
Arsenic	0.003	0.0003	8.8%	0.0014	45.5%
Nickel	0.02	0.0023	11.6%	0.0089	44.6%

The cumulative impact at receptor locations including the highest impact at an AQMA is presented in Table 6-13. The PEC does not exceed the relevant standards.

Table 6-13
Predicted Cumulative Long-term NO_2 Impacts at Receptor Locations

Receptor	PC (µg/m^3)	PC as % Standard	PEC (µg/m^3)	PEC as % Standard
HR1	0.7	1.7%	24.7	62%
HR2	0.5	1.1%	24.5	61%
HR3	0.5	1.3%	24.5	61%
HR4	0.3	0.7%	24.3	61%
HR5	0.1	0.3%	n/c	n/c
HR6	0.2	0.4%	n/c	n/c
HR7	0.2	0.5%	n/c	n/c
HR8	0.3	0.8%	n/c	n/c
HR9	0.2	0.5%	n/c	n/c
HR10	1.2	3.0%	25.2	63%
HR11	0.3	0.8%	n/c	n/c
Max at an AQMA	0.2	0.4%	n/c	n/c

Table note: n/c = not calculated: following AERA guidance the PEC has only been calculated where the PC is 1% or above.

The Skelton Grange EfW PC's (TOC, As, Cd, and Ni) that are not insignificant at the point of maximum ground level concentration have been combined with the RERF PC's to present a cumulative impact assessment in Table 6-14. The findings are that the PEC does not exceed the standard at any receptor location.

Table 6-14
Predicted Cumulative Long-term Impacts at Receptor Locations

Rec.	TOC PC (µg/m³)	% EAL	PEC (µg/m³)	PEC as % EAL	Cd PC (µg/m³)	% EAL	PEC (µg/m³)	PEC as % EAL	As PC (µg/m³)	% EAL	PEC (µg/m³)	PEC as % EAL	Ni PC (µg/m³)	% EAL	PEC (µg/m³)	PEC as % EAL
HR1	0.0472	0.9%	n/c	n/c	0.0001	2.4%	0.0003	6.4%	0.0001	3.9%	0.0012	40.6%	0.0010	5.2%	0.0076	38.2%
HR2	0.0327	0.7%	n/c	n/c	0.0001	1.6%	0.0003	5.6%	0.0001	1.6%	0.0012	39.4%	0.0007	3.6%	0.0073	36.6%
HR3	0.0358	0.7%	n/c	n/c	0.0001	1.8%	0.0003	5.8%	0.0001	1.8%	0.0012	39.7%	0.0008	3.9%	0.0074	36.9%
HR4	0.0199	0.4%	n/c	n/c	0.0000	1.0%	0.0002	5.0%	0.0000	1.0%	0.0011	38.3%	0.0004	2.2%	0.0070	35.2%
HR5	0.0088	0.2%	n/c	n/c	0.0000	0.4%	n/c	n/c	0.0000	0.4%	n/c	n/c	0.0002	1.0%	0.0068	34.0%
HR6	0.0118	0.2%	n/c	n/c	0.0000	0.6%	n/c	n/c	0.0000	0.6%	n/c	n/c	0.0003	1.3%	0.0069	34.3%
HR7	0.0143	0.3%	n/c	n/c	0.0000	0.7%	n/c	n/c	0.0000	0.7%	n/c	n/c	0.0003	1.6%	0.0069	34.6%
HR8	0.0220	0.4%	n/c	n/c	0.0001	1.1%	0.0003	5.1%	0.0001	1.1%	0.0012	38.5%	0.0005	2.4%	0.0071	35.4%
HR9	0.0154	0.3%	n/c	n/c	0.0000	0.8%	0.0002	4.8%	0.0000	0.8%	n/c	n/c	0.0003	1.7%	0.0069	34.7%
HR10	0.0867	1.7%	0.757	15.1%	0.0002	4.3%	0.0004	8.3%	0.0002	4.3%	0.0013	43.9%	0.0019	9.5%	0.0085	42.5%
HR11	0.0226	0.5%	n/c	n/c	0.0001	1.1%	0.0003	5.1%	0.0001	1.1%	0.0012	38.5%	0.0005	2.5%	0.0071	35.5%

Table note: n/c = not calculated: following AERA guidance the PEC has only been calculated where the PC is 1% or above.

7.0 MODEL SENSITIVITY ASSESSMENT

The sensitivity of a dispersion model is defined in the UK Atmospheric Dispersion Modelling Committee (ADMLC) guidance[20] as the differential of model output by model input. In accordance with EA guidance the following key input variables were subject to sensitivity analysis:

- meteorological data, such as different weather stations, inter-annual variation and surface characteristics;
- emission parameters;
- the receptor grid resolution; and
- treatment of terrain and buildings.

Therefore, in order to investigate the sensitivity of the dispersion model to relation the input parameters stated above the following scenarios were investigated:

- Sensitivity 0 - Baseline, 2017 meteorological data (meteorological data that gave peak long-term impacts);
- Sensitivity 1 - increased temperature by 30ºC. All other parameters unchanged;
- Sensitivity 2 - decreased temperature by 30ºC. All other parameters unchanged;
- Sensitivity 3 - increased discharge velocity by 10%. Normalised flow (and mass emission) remains as baseline;
- Sensitivity 4 - decreased discharge velocity by 10%. Normalised flow (and mass emission) remains as baseline;
- Sensitivity 5 - Flat terrain;
- Sensitivity 6 - No buildings;
- Sensitivity 7 - higher receptor grid resolution (closer spacing resolution doubled);
- Sensitivity 8 - Met Data Preparation: Increased Roughness (Z_0 = 1); and
- Sensitivity 9 - Met Data Preparation: Decreased Roughness (Z_0 = 0.001).

Inter-annual variation in the meteorological data results in annual mean NO_2 ranges from 1.1µg/m^3 to 1.6µg/m^3 and 1-hour mean (99.9%ile) from 7.7µg/m^3 to 11.7µg/m^3.

The results are summarised in Table 7-1 for NO_2 annual and 1-hour (99.79%ile) means. None of the variations in the parameters investigated leads to a breach of the NO_2 standards. The level of variation is broadly applicable to other pollutants, on the basis of which it can be concluded that the level of variation in the parameters investigated would not lead to exceedances of standards.

Table 7-1
Model Sensitivity Assessment

Scenario	Max GLC ST NO_2 (µg/m^3)	PC as % of Standard	PEC (µg/m^3)	PEC as % of Standard	Max GLC LT NO_2 (µg/m^3)	PC % of Standard	PEC (µg/m^3)	PEC as % of Standard
0	8.2	4.1%	56	28.1%	1.6	3.9%	25.6	63.9%
1	7.8	3.9%	56	27.9%	1.5	3.6%	25.5	63.6%

[20] Guidelines for the Preparation of Dispersion Modelling Assessment for Compliance with Regulatory Requirements – an update to the 1995 Royal Meteorological Society guidance. UK Atmospheric Dispersion Modelling Committee (ADMLC), Version 1.4, 2004

2	9.0	4.5%	57	28.5%	1.7	4.3%	25.7	64.3%
3	7.8	3.9%	56	27.9%	1.5	3.6%	25.5	63.6%
4	8.9	4.5%	57	28.5%	1.7	4.2%	25.7	64.2%
5	8.3	4.1%	56	28.1%	1.6	3.9%	25.6	63.9%
6	5.6	2.8%	54	26.8%	0.9	2.3%	24.9	62.3%
7	8.5	4.2%	56	28.2%	1.6	3.9%	25.6	63.9%
8	5.9	3.0%	54	27.0%	1.6	4.0%	25.6	64.0%
9	18.2	9.1%	66	33.1%	1.0	2.5%	25.0	62.5%

8.0 Conclusions

The conclusions of the detailed atmospheric dispersion modelling assessment of the EFW combustion emissions are as follows:

- there are no predicted exceedances of short-term or long-term standards at the point of maximum ground level impact or at relevant exposure locations for any of the scenarios assessed;
- the predicted impact on designated sensitive habitats are considered insignificant and will cause *'no significant pollution'* according to EA/Natural England guidance; and
- the model sensitivity assessment indicates none of the variations in the parameters investigated lead to exceedances of the standards or any material change to the overall conclusions of the assessment.

APPENDIX A

Process Contribution Isopleths

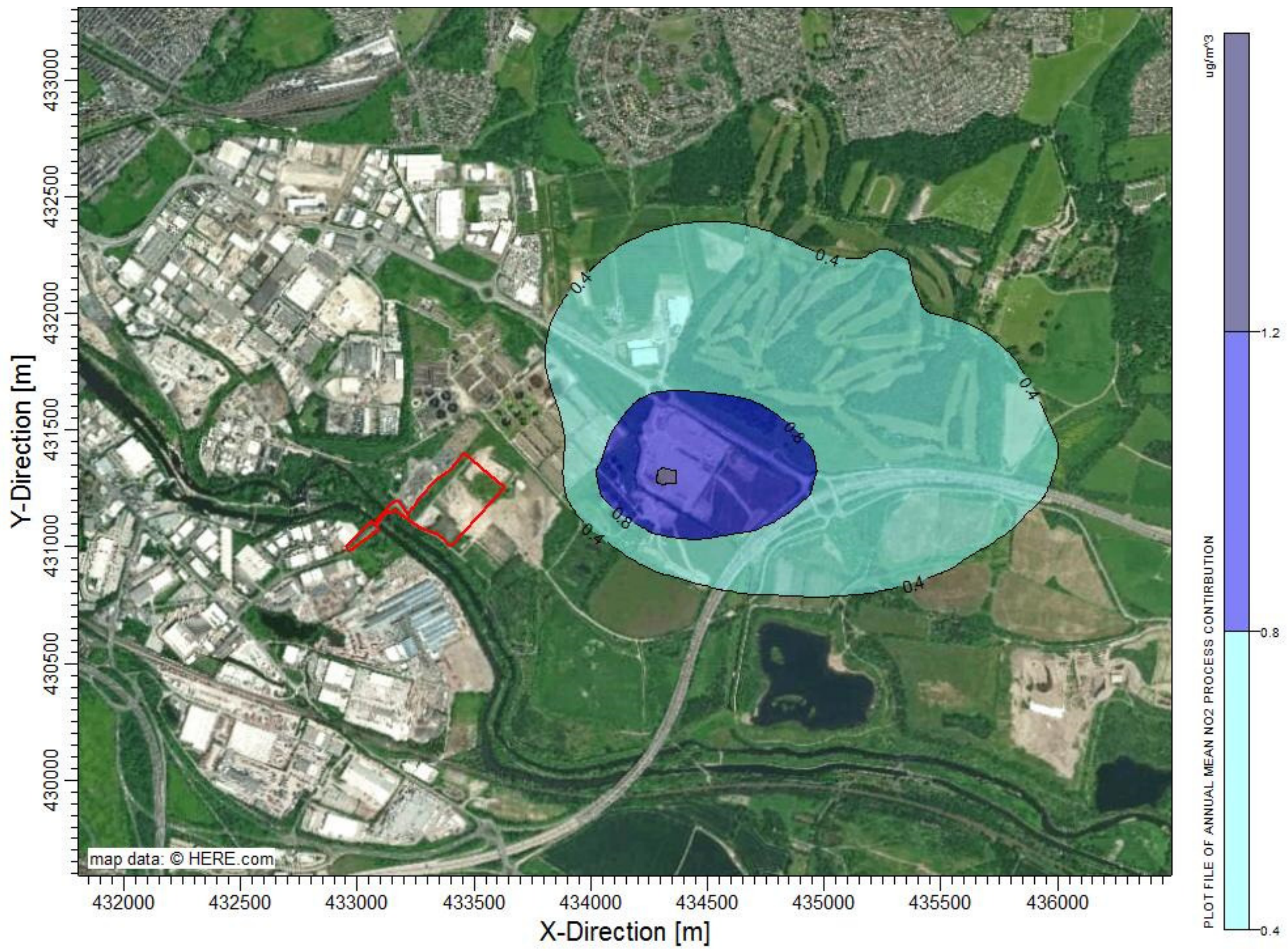

Figure A-1
Plot of NO_2 Annual Mean Process Contribution

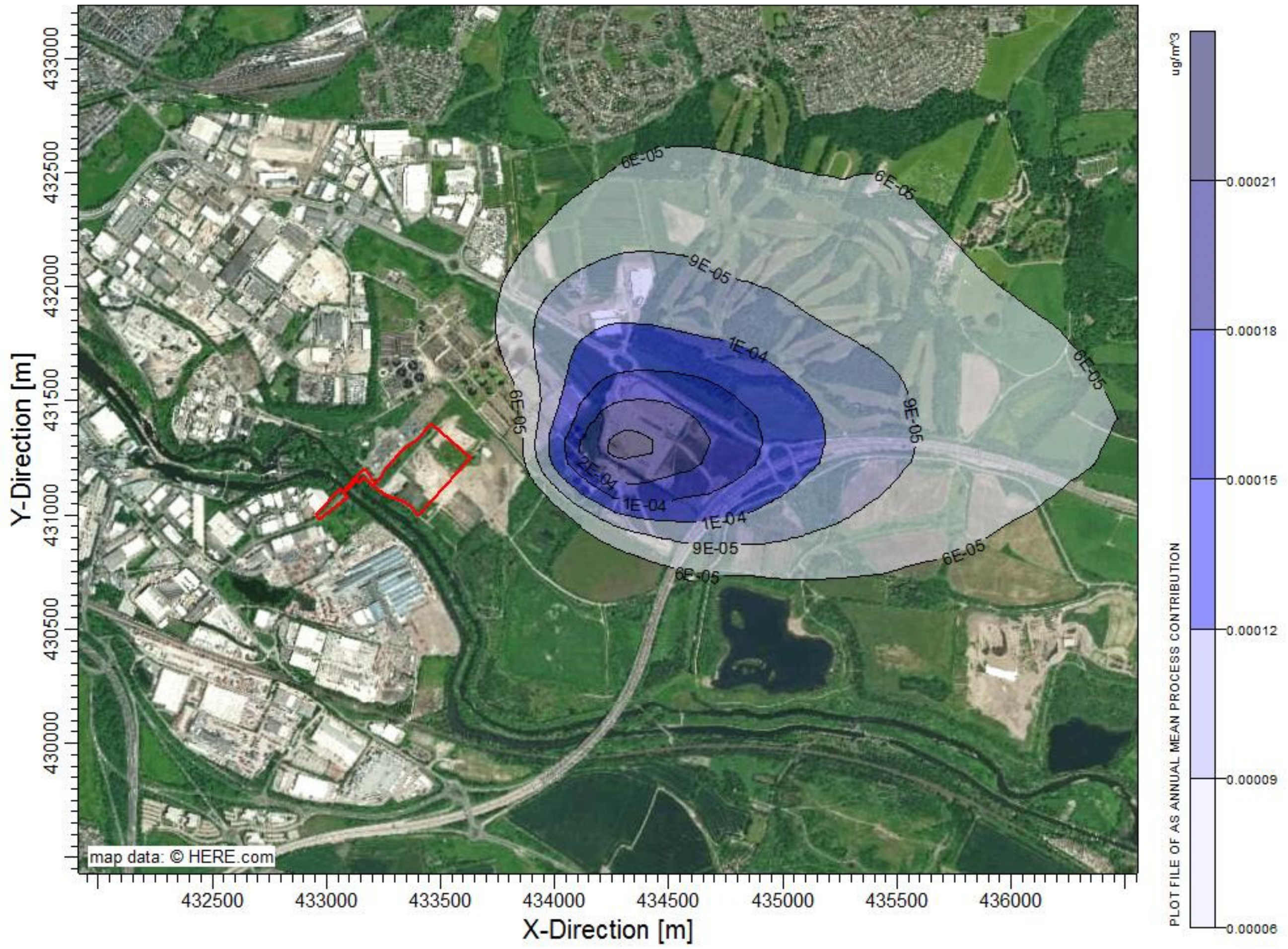

Figure A-2
Plot of Arsenic Annual Mean Process Contribution

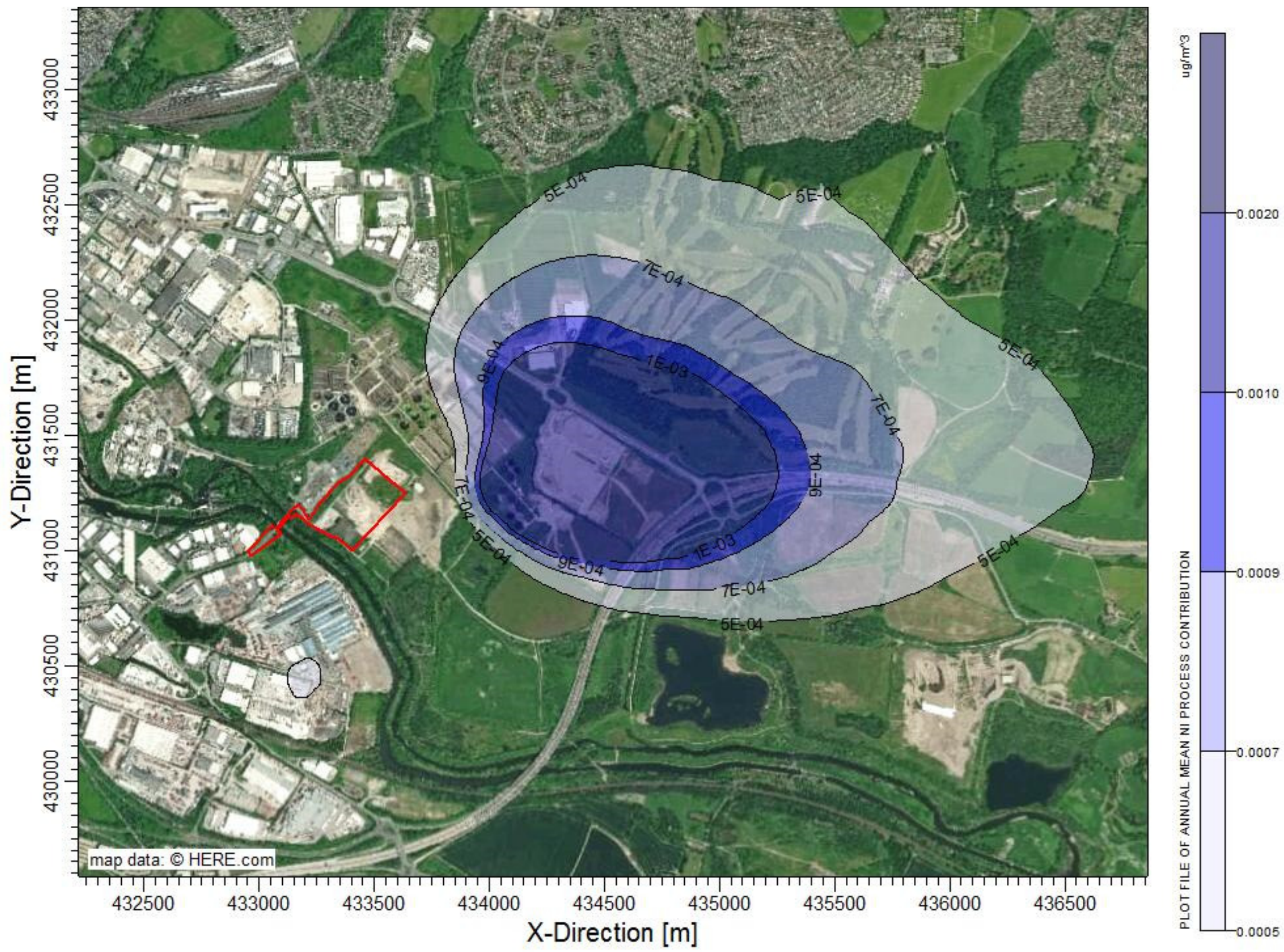

Figure A-3
Plot of Nickel Annual Mean Process Contribution

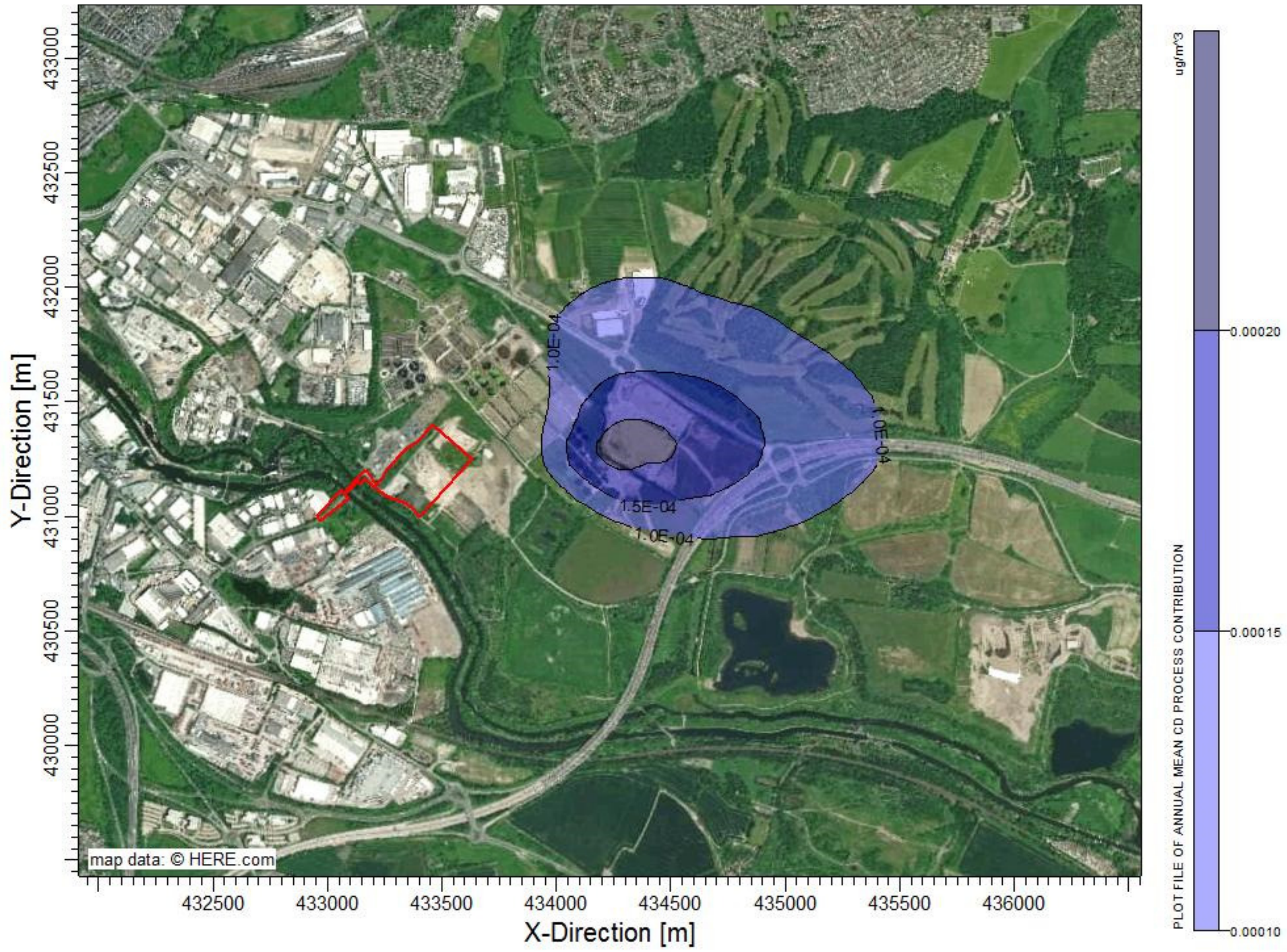

Figure A-4
Plot of Cadmium Annual Mean Process Contribution

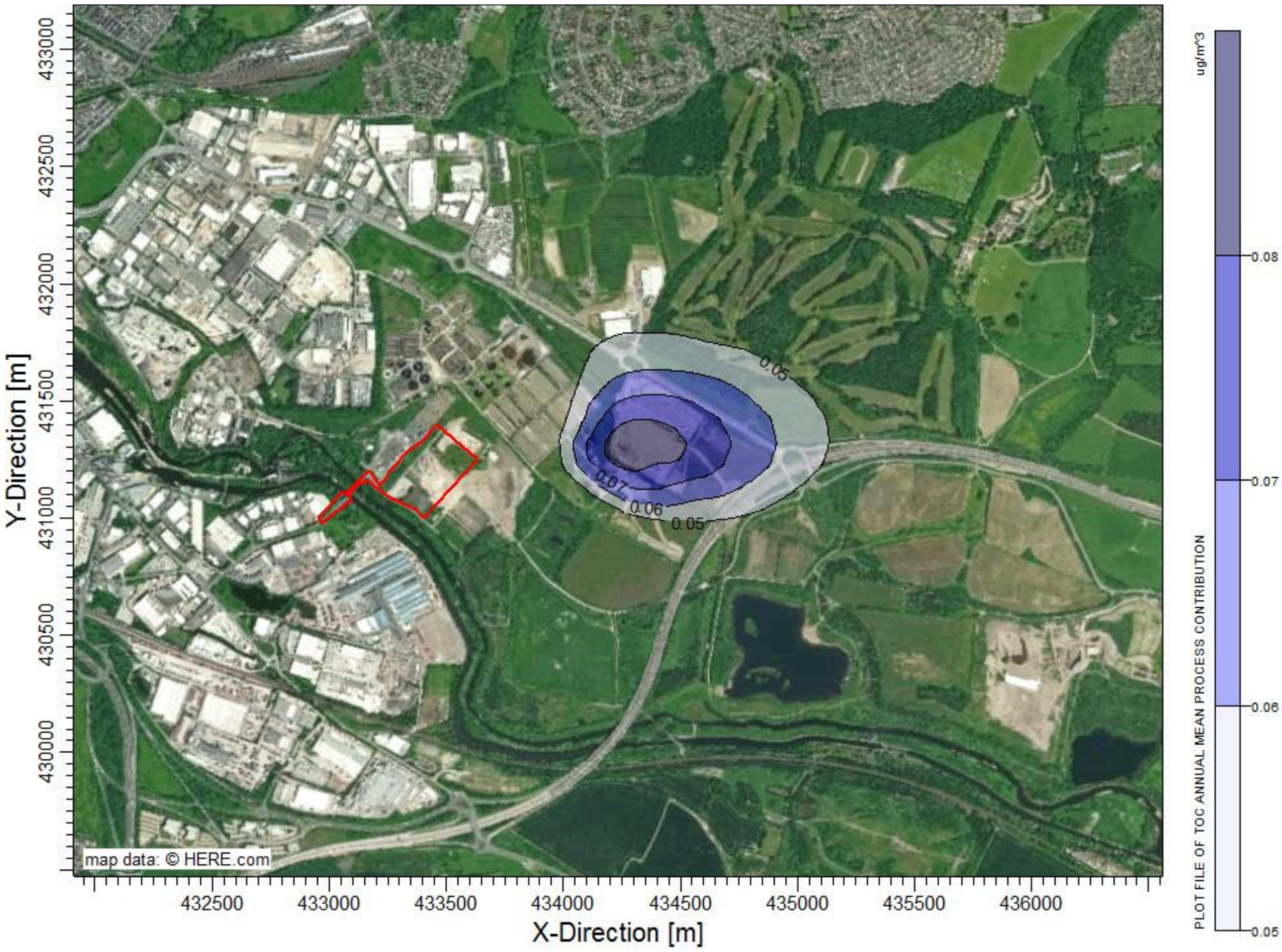

Figure A-5
Plot of TOC Annual Mean Process Contribution

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