AIR EMISSIONS RISK ASSESSMENT

Stanmore Business Park, Bridgnorth

Prepared for: Circular Resources (UK)

SLR Ref: 416.10377.00001
Version No: v1.0
February 2022

BASIS OF REPORT

CONTENTS

DOCUMENT REFERENCES

TABLES

FIGURES

Executive Summary

SLR Consulting Ltd (SLR) has been commissioned by Circular Resources (UK) (‘CRUK’) to undertake an Air Emissions Risk Assessment (AERA) for a proposed small waste incineration process (SWIP) (‘Proposed Installation’) at Stanmore Business Park, Bridgnorth (the ‘Site’). The Site lies within the administrative area of Shropshire Council (SC).

The scope of the assessment is to model emissions to air resulting from two 15m flue gas exhaust stacks. The objective of the assessment is to determine the potential effects of these emissions on the air quality environment, by comparison to relevant guidelines for the protection of human health and sensitive habitats.

Atmospheric dispersion modelling has been untaken with use of the United States (US) Environmental Protection Agency (EPA) approved AERMOD model. The AERMOD dispersion model is widely used and accepted by UK regulators, including the Environment Agency (EA). The assessment methodology applied is consistent with relevant guidance and established best practice. Furthermore, to provide certainty with respect to the assessment outcomes, wherever possible, this assessment has incorporated a number of conservative assumptions, which will result in an overestimation of predicted ground level concentrations. As such, the actual predicted ground level concentrations are expected to be lower than this and, in some cases, significantly lower, with the operation of the Site.

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

- there are no predicted exceedances of air quality standards for the protection of human health at the point of maximum ground level impact for any of the scenarios assessed;
- predicted impacts upon the Bridgnorth Air Quality Management Area (AQMA) with respect to nitrogen dioxide (NO_2) concentrations are considered insignificant; and
- predicted impacts on designated sensitive habitats are considered insignificant.

1.0 Introduction

SLR Consulting Ltd (SLR) has been commissioned by Circular Resources (UK) ('CRUK') to undertake an Air Emissions Risk Assessment (AERA) for a proposed small waste incineration process (SWIP) ('Proposed Installation') at Stanmore Business Park, Bridgnorth (the 'Site'). The Site lies within the administrative area of Shropshire Council (SC).

The Site is located at the approximate National Grid Reference (NGR): x374706, y292787 and is bounded by:

- mixed commercial and industrial premises to the north;
- industrial premises to the east, beyond which is Estate Road and agricultural land / woodland;
- Estate Road and commercial properties to the south, beyond which is agricultural land / woodland; and
- mixed commercial and industrial premises to the west, beyond which is Stanmore Country Park.

1.1 Scope of Assessment

The scope of the assessment is to model emissions to air resulting from two 15m flue gas exhaust stacks at the Proposed Installation. The objective of the assessment is to determine the potential effects of these emissions on the air quality environment, by comparison to relevant guidelines for the protection of human health and sensitive habitats.

2.0 Legislative Context and Guidance

In the interim period the UK has formally left the EU, however, despite this the EU law and regulations referred to throughout this report have subsequently been ratified into UK law (principally via the EU (Withdrawal) Act) and thus are still of relevance.

2.1 National Air Quality Legislation

2.1.1 Air Quality Standards Regulations

The Air Quality Standards Regulations 2010[1] (AQSR) transpose both the EU Ambient Air Quality Directive (2008/50/EC)[2], and the Fourth Daughter Directive (2004/107/EC)[3] within UK legislation, in order to align and bring together in one statutory instrument the Government's obligations. The AQSR includes Limit Values, Target Values, Objectives, Critical Levels and Exposure Reduction Targets for the protection of human health and the environment.

Limit values are legally binding and are considered to apply everywhere with the exception of the carriageway and central reservation of roads and any location where the public do not have access (e.g. industrial sites).

2.1.2 Air Quality Strategy

The UK Air Quality Strategy (AQS) 2007 for England, Scotland, Wales and Northern Ireland[4] provides the over-arching strategic framework for air quality management in the UK and contains national air quality standards and objectives established by the UK Government and Devolved Administrations for the protection of public health and the environment.

The AQS objectives are only applicable 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.

As such, compliance with the objectives should focus on areas where members of the general public are present over the entire duration of the concentration averaging period specific to the relevant objective.

2.1.3 Local Air Quality Management

As reinforced within the AQS, Part IV of the Environment Act 1995 induces a statutory duty for local authorities to undergo a process of Local Air Quality Management (LAQM). This requires local authorities to Review and Assess air quality within their boundaries to determine the likeliness of compliance, regularly and systematically.

Where any of the prescribed AQS objectives are not likely to be achieved, the authority must designate an Air Quality Management Area (AQMA). For each AQMA, the local authority is required to prepare an Air Quality Action Plan (AQAP), which details measures the authority intends to introduce to deliver improvements in local air quality in pursuit of the objective. AQMAs can give rise to potential constraints to development, or at least a higher degree of scrutiny to air quality assessment work.

2.1.4 Protection of Nature Conservation Sites

Ecological habitats vary in terms of their sensitivity, perceived ecological value, geographic importance, and level of protection. Within the UK, there are three types of nature conservation designations: international, national and

[1] The Air Quality Standards Regulations (England) 2010, Statutory Instrument No 1001, The Stationary Office Limited.

[2] Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on Ambient Air Quality and Cleaner Air for Europe.

[3] Directive 2004/107/EC of the European Parliament and of the Council of 15 December 2004.

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

local designations, which are all provided environmental protection from developments, including from atmospheric emissions, with a greater level of protection afforded to the former, relative to the latter.

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[5] (IED) recast seven existing directives including the Waste Incineration Directive (WID)[6]. 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 legislative requirements for facilities classified as waste incinerators under the IED definition, including:

- operating conditions, including gas temperatures and residence times, such as 850°C / 2 seconds;
- maximum emission limit values (ELVs) for a range of substances to air and water; and
- emissions monitoring requirements.

The IED ELVs of relevance to this study are detailed in Table 2-1

Table 2-1
Relevant IED Chapter IV ELVs

Pollutant	Emission Limits (mg/Nm^3) (a)		
	Daily average values	Half hourly averages	
		100th Percentile	97th Percentile
Continuous Monitoring			
Particulate Matter (PM)	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 (NO_x)	200	400	200
Carbon Monoxide (CO) (b)	50	150	100
Spot Sample Measurements			
Group 1 Metals (c)	0.05		
Group 2 Metals (c)	0.05		
Group 3 Metals (c)	0.5		
Dioxins and Furans (d)	1E-07		

5 Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control).

6 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/Nm³) [(a)]		
	Daily average values	Half hourly averages	
		100th Percentile	97th Percentile

Table Notes:
(a) Concentrations referenced to temperature 273 K, pressure 101.3 kPa, 11% oxygen, dry gas.
(b) 150mg/Nm³ of combustion gas for at least 95% of all measurements determined as 10 minute averages or 100mg/Nm³ 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).

Best Available Techniques

The IED requires all installations to use the best available techniques (BAT), where possible, and that the BAT conclusions (BATc) documents produced by the European Commission are the reference for relevant BAT.

An updated BAT Reference Document (BREF)[7] for waste incineration, and the associated BATc document[8], was published in December 2019. These publications set out new BAT-associated emission levels (BAT-AELs) which new waste incineration facilities are expected to meet, based upon the application of relevant BAT. These are more stringent than the ELVs set out in the IED as they reflect advancements in technology.

Whilst the BAT-AELs relate to advisable emission limits waste incineration plant can meet (based upon a review of industry and available technology), the recommendations of the BREF will become enforceable through regulation i.e. inclusion of these BAT-AELs within Environmental Permits, unless a derogation is justified.

The BAT-AELs of relevance to this study are detailed in Table 2-2.

Table 2-2
Relevant BAT-AELs

Pollutant	BAT-AEL (mg/Nm³) [(a)]
	Daily average values
Continuous Monitoring	
Particulate Matter (PM)	2-5
Total Organic Carbon (TOC)	3-10
Hydrogen Chloride (HCl)	2-6
Hydrogen Fluoride (HF)	<1
Sulphur Dioxide (SO_2)	5-30
Oxides of Nitrogen (NO_x)	50-120
Carbon Monoxide (CO)	10-50
Spot Sample Measurements	
Group 1 Metals [(b)]	0.005-0.02

[7] European Commission. Best Available Techniques (BAT) Reference Document for Waste Incineration. December 2019.

[8] European Commission. Commission Implementing Decision (EU) 2019/2010 of 12 November 2019 establishing the best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for waste incineration.

Pollutant	BAT-AEL (mg/Nm^3) [(a)]
	Daily average values
Group 2 Metals [(b)]	0.005-0.02
Group 3 Metals [(b)]	0.01-0.3
Dioxins and Furans [(c)]	1E-08-8E-08

Table Notes:
(a) Concentrations referenced to temperature 273K, pressure 101.3 kPa, 11% oxygen, dry gas
(b) 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)

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

2.2.2 Environmental Permitting

In England, the Environmental Permitting (England and Wales) Regulations (EPR) 2016 (as amended)[9] transpose the IED into UK legislation. The EPR are designed to ensure the competent authority regulates emissions, including emissions to air, from processes to minimise adverse impacts.

The EPR states that a SWIP is defined as a waste incineration plant or waste co-incineration plant with a capacity less than or equal to 10 tonnes per day for hazardous waste or 3 tonnes per hour for non-hazardous waste, as is the case for the Proposed Installation.

Environmental permits for SWIP are issued by the local authority.

Of particular relevance to the assessment of air quality impacts is the Environment Agency's (EA) 'Air Emission Risk Assessment for your Environmental Permit' guidance[10] (herein referred to as 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 Environmental Permitting 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). Those relevant to this assessment are presented within Table 2-3 below.

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

2.2.3 Standards for Protection of Human Health

The standards applied in this assessment are taken from the EA's AERA guidance (collectively termed Air Quality Assessment Levels (AQAL) throughout this report).

The AERA guidance provides the relative environmental thresholds provided in the AQS and AQSR, as well as EALs provided by the EA, for the protection of health. Table 2-3 sets out those AQALs that are relevant to the assessment with regard to human receptors.

[9] The Environmental Permitting (England and Wales) Regulations 2016 Statutory Instruments No. 1154.
[10] https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit

Table 2-3
Relevant AQALs Applied

Pollutant		Standard (µg/m^3)		Reference
		Annual	Short Term	
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)	EAL
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)	EAL
Hydrogen Fluoride	(HF)	16 (monthly)	160 (1-hour)	EAL
Benzene	(C_6H_6)	5	30 (24-hour)	AQSR/EAL
Arsenic	(As)	0.006	-	EAL
Antimony	(Sb)	5	150 (1-hour)	EAL
Cadmium	(Cd)	0.005	-	AQSR
Chromium (II and III)	(Cr)	5	150 (1-hour)	EAL
Chromium (VI)		0.0002	-	EAL
Copper	(Cu)	10	200 (1-hour)	EAL
Lead	(Pb)	0.25	-	AQS
Manganese	(Mn)	0.15	1500 (1-hour)	EAL
Mercury	(Hg)	0.25	7.5 (1-hour)	EAL
Nickel	(Ni)	0.02	-	AQSR
Vanadium	(V)	5	1 (1-hour)	EAL
Polyaromatic Hydrocarbons	(PAH)	0.001	-	AQSR
Polychlorinated Biphenyls	(PCBs)	0.2	6 (1-hour)	EAL
Dioxins and Furans	(Dioxin)	$3x10^{-7}$	-	WHO [(a)]
Table Notes: (a) No assessment criteria defined for dioxins and furans. The World Health Organisation (WHO)[11] provides an indicator for the air concentrations above which it considers it necessary to identify and control local emission sources; this value is 0.3pg/m^3 (300fg/m^3) and has been adopted as an AQAL in this assessment.				

2.2.4 Relevant Exposure

In accordance with Defra's technical guidance on Local Air Quality Management (LAQM.TG(16))[12], the AQALs presented in Table 2-3 should only be assessed at locations of relevant exposure i.e. where members of the public

[11] WHO (2000) World Health Organisation, Air quality Guidelines for Europe (Second Edition).

[12] Local Air Quality Management Technical Guidance 16, Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland. April 2021.

are regularly present and might reasonably be expected to be exposed to pollutant concentrations over the relevant averaging period. These AQALs do not apply to exposure at the workplace.

A summary of the typical relevant locations associated with each applicable AQAL assessed is detailed below in Table 2-4.

Table 2-4
Relevant Public Exposure

Averaging Period	Locations AQALs Should Apply At	Locations AQALs Should Not Apply At
Annual mean	Building facades of residential properties, schools, hospitals etc.	Facades of offices, hotels, gardens of residences and kerbside sites
24-hour mean	As above together with hotels and gardens of residential properties	Kerbside sites where public exposure is expected to be short term
8-hour mean	As above together with hotels and gardens of residential properties	Kerbside sites where public exposure is expected to be short term
1-hour mean	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	-

2.2.5 Standards for the Protection of Ecosystems and Vegetation

Sites of nature conservation importance are provided environmental protection with respect to air quality, through the application of standards known as Critical Levels (CLe) for airborne concentrations and Critical Loads (CLo) for deposition to land from air.

Critical Levels (CLe)

CLe 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 for the protection of vegetation and ecosystems are specified within relevant European air quality directives and corresponding UK air quality regulations (see Table 2-5).

To provide a conservative assessment, the CLe for annual mean SO_2 at all ecological designations has assumed to be 10µg/m^3 which is only applicable where lichens or bryophytes are present, otherwise 20µg/m^3 is appropriate.

Table 2-5
Critical Levels for the Protection of Vegetation and Ecosystems

Pollutant	Concentration (µg/m^3)	Habitat and Averaging Period
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)
NO_x	30	Annual mean (all ecosystems)
	75 (200) [(a) (b)]	Daily mean (all ecosystems)
HF	5	Daily mean
	0.5	Weekly mean

Pollutant	Concentration ($\mu g/m^3$)	Habitat and Averaging Period
Table Notes: (a) Non statutory (b) $75\mu g/m^3$ CLe only considered appropriate where levels of SO_2 and O_3 are close to their CLe. Where O_3 and SO_2 are not elevated above their CLe (common across the UK) a value of $200\mu g/m^3$ is recommended for assessments (IAQM, 2020).		

Critical Loads (CLo)

CLo 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. CLo are set for the deposition of various substances to sensitive ecosystems.

In relation to combustion emissions, CLo for eutrophication and acidification are relevant which can both occur via wet and dry deposition. Wet deposition occurs due to rainout (within cloud) scavenging and washout (below cloud) scavenging, whereas dry deposition occurs when particles are brought to the surface by gravitational settling and turbulence. For the assessment of short range emissions, dry deposition is considered the predominant removal mechanism. Wet deposition can therefore be discounted from further assessment[13].

CLo for the habitats and species of relevance to this assessment have been obtained from the Air Pollution Information System (APIS) website[14], whereby the most sensitive habitat listed has been used/provided to facilitate a worst-case assessment. These are presented in Section 4.3.

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

[14] Air Pollution Information System http://www.apis.ac.uk/

3.0 ASSESSMENT METHODOLOGY

3.1 Dispersion Model

For this assessment the United States (US) Environmental Protection Agency (EPA) approved AERMOD model has been applied. The AERMOD dispersion 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 US EPA. It is therefore considered a suitable model for this assessment.

3.2 Receptors

The modelling has been undertaken using a nested receptor grid (i.e. receptor grids plotted at a series of defined spatial densities with distance from the Site) (titled gridded receptors). This method allows the maximum ground level concentration outside the Site boundary to be assessed.

A nested receptor grid of 8km by 8km centred upon the Site was applied as follows:

- 250m x 250m at 10m grid resolution;
- 500m x 500m at 25m grid resolution;
- 1,000m x 1,000m at 50m grid resolution;
- 2,000m x 2,000m at 100m grid resolution;
- 5,000m x 5,000m at 250m grid resolution; and
- 8,000m x 8,000m at 500m grid resolution.

The spatial extent of the grid has been selected to ensure that all local receptors are within the gridded area and the resolution is such that the maximum impact will be identified.

3.2.1 Human Receptors

Human receptors considered in the assessment are shown in Table 3-1 and their locations are illustrated in Figure 3-1 (titled discrete receptors). These receptor locations are considered to capture worst-case relevant exposure relative to the Site, in accordance with LAQM.TG(16) presented in Table 2-4 and excludes workplace locations. Consideration has also been given to land uses with sensitive populations for inclusion within the model (e.g. elderly care home, schools etc.).

Table 3-1
Modelled Discrete Human Receptor Locations

Receptor	Details	Relevant Exposure	NGR		AQMA	Height (m)
			X	Y		
R1	Residential	Short and Long Term	374493	292470	-	1.5
R2	Residential	Short and Long Term	374398	292533	-	1.5
R3	Residential	Short and Long Term	374779	292159	-	1.5
R4	Residential	Short and Long Term	375127	292331	-	1.5
R5	Residential	Short and Long Term	375400	292849	-	1.5
R6	Residential	Short and Long Term	375385	292945	-	1.5
R7	Residential	Short and Long Term	374026	292557	-	1.5
R8	Residential	Short and Long Term	374225	293167	-	1.5
R9	Residential	Short and Long Term	374311	293156	-	1.5
R10	Residential	Short and Long Term	374800	293449	-	1.5
R11	Residential	Short and Long Term	375578	294126	-	1.5
R12	Residential	Short and Long Term	373990	293247	-	1.5

Receptor	Details	Relevant Exposure	NGR		AQMA	Height (m)
			X	Y		
R13	Touring Park	Short Term	374451	292207	-	1.5
R14	Residential	Short and Long Term	373448	293061	-	1.5
R15	Residential	Short and Long Term	374207	292326	-	1.5
R16	Residential	Short and Long Term	374872	291640	-	1.5
R17	Residential	Short and Long Term	376367	293282	-	1.5
R18	Residential	Short and Long Term	372830	292703	-	1.5
R19	Residential	Short and Long Term	376300	293840	-	1.5
R20	Residential	Short and Long Term	375384	293025	-	1.5
R21	Residential	Short and Long Term	375849	291955	-	1.5
R22	Residential	Short and Long Term	374173	293968	-	1.5
R23	Hotel / Pub	Short Term	371964	292991	-	1.5
R24	Residential	Short and Long Term	371333	293140	Bridgnorth	1.5
R25	Residential	Short and Long Term	371345	293086	Bridgnorth	1.5
R26	Residential	Short and Long Term	373605	293149	-	1.5
R27	Residential	Short and Long Term	376307	291703	-	1.5
R28	Residential	Short and Long Term	376726	291712	-	1.5
R29	Residential	Short and Long Term	377035	291940	-	1.5
R30	Railway Depot	Short Term	371518	292598	Bridgnorth	1.5
R31	Residential	Short and Long Term	371444	292727	-	1.5
R32	Residential	Short and Long Term	376864	290874	-	1.5
R33	Residential	Short and Long Term	377256	293113	-	1.5
R34	Residential	Short and Long Term	377065	293660	-	1.5
R35	Residential	Short and Long Term	376177	294311	-	1.5
R36	Residential	Short and Long Term	377354	294262	-	1.5
R37	Residential	Short and Long Term	376971	293279	-	1.5
R38	Residential	Short and Long Term	376857	292821	-	1.5
R39	Residential	Short and Long Term	372828	292704	-	1.5
R40	Residential	Short and Long Term	372720	293019	-	1.5
R41	Residential	Short and Long Term	373061	294489	-	1.5
R42	Residential	Short and Long Term	371527	292569	-	1.5
R43	Residential	Short and Long Term	371647	292409	-	1.5
R44	Residential	Short and Long Term	374251	291517	-	1.5
R45	Residential	Short and Long Term	375327	294218	-	1.5
R46	Residential	Short and Long Term	374519	294189	-	1.5
R47	Residential	Short and Long Term	375826	290284	-	1.5

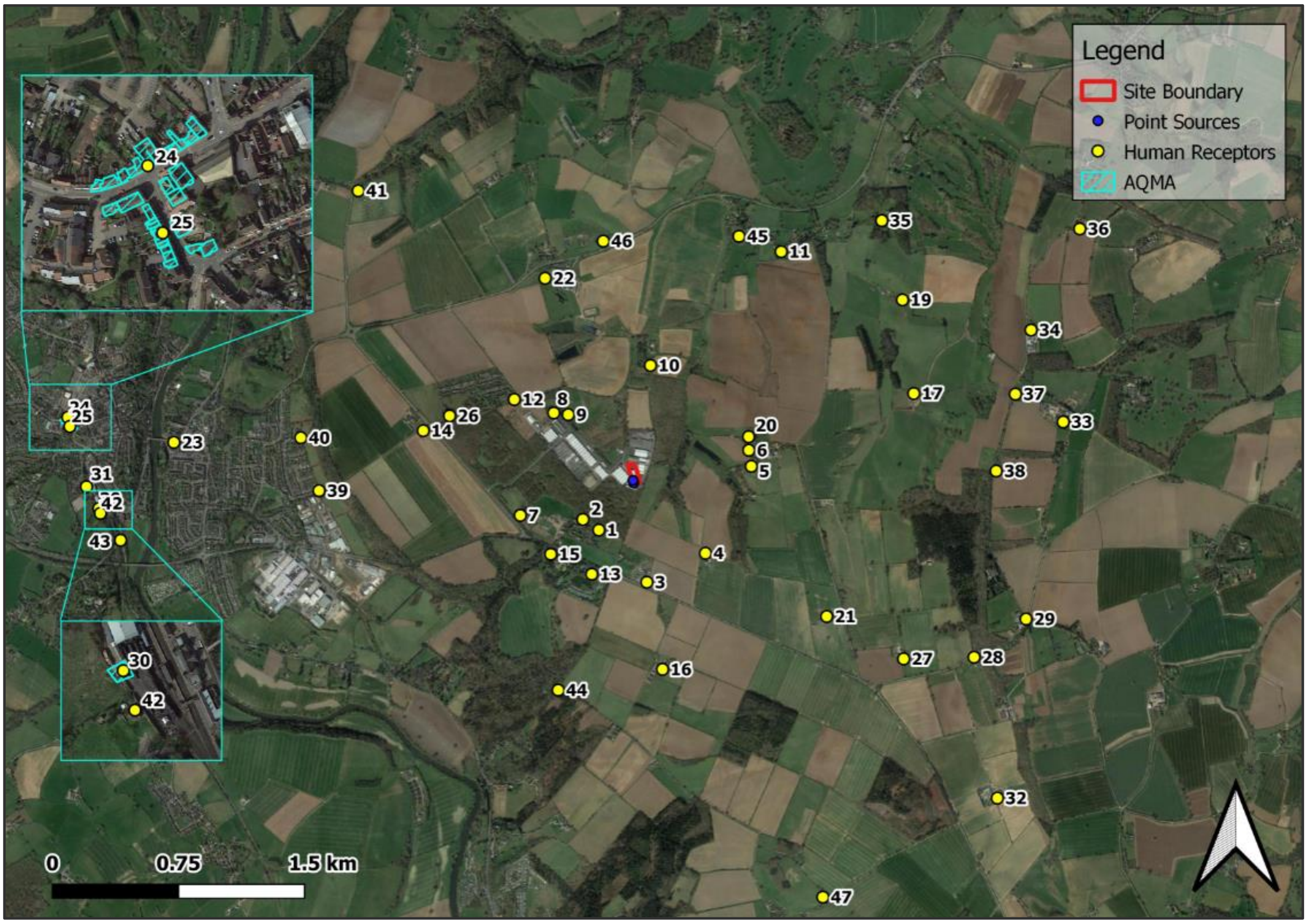

Figure 3-1
Discrete Human Receptors

3.2.2 Ecological Receptors

The EA's AERA Guidance states that the following ecological sites need to be considered:

- SPAs, SACs and Ramsar Sites (protected wetlands) within 10km of the Site; and
- SSSIs and local nature sites (AW, LWS, NNR and LNR) within 2km of the Site.

Following application of these distance thresholds, Table 3-1 provides details of ecological receptors considered within this assessment, and are illustrated in Figure 3-2. Identification of these designations are consistent with the EA pre-application conservation screening report[15].

All receptors have assumed a height of 0m and represented in the model using gridded and polygon boundary receptors.

Table 3-2
Designated Ecological Sites of Relevance

Receptor ID	Site Name	Designation	Distance to Site
ER1	Hermitage Hill Coppice	AW	785m

[15] Environment Agency. Pre-Application Nature and Heritage Conservation Screening Report. Reference EPR/CP3105MG/A001. 23/07/2021.

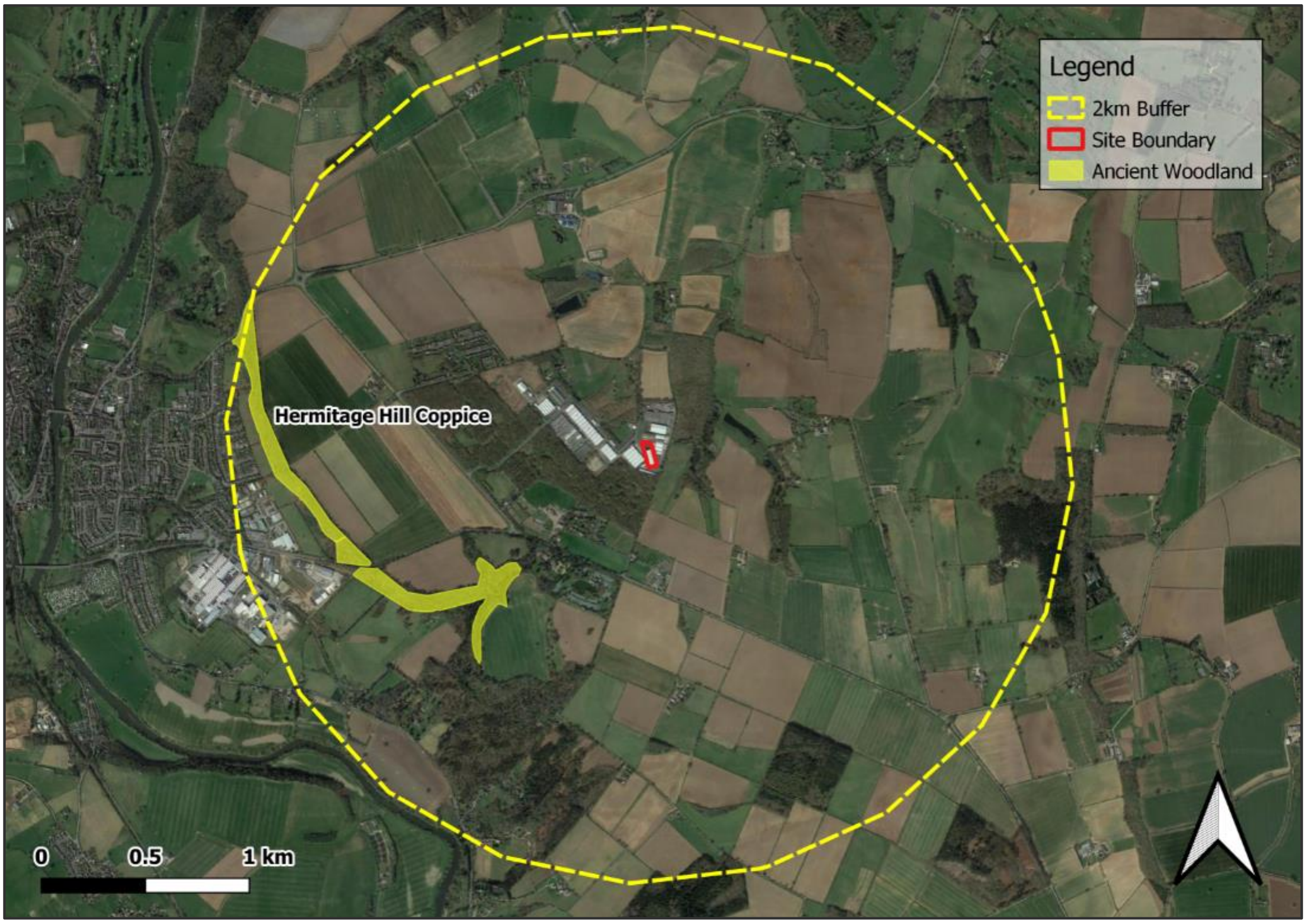

Figure 3-2
Ecological Designations of Relevance

3.3 Terrain

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.

Topography has been incorporated within the AERMOD dispersion model 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 3-3). These ground level elevations were in addition applied to all receptors included within the AERMOD dispersion model, however, were entered manually for buildings and sources.

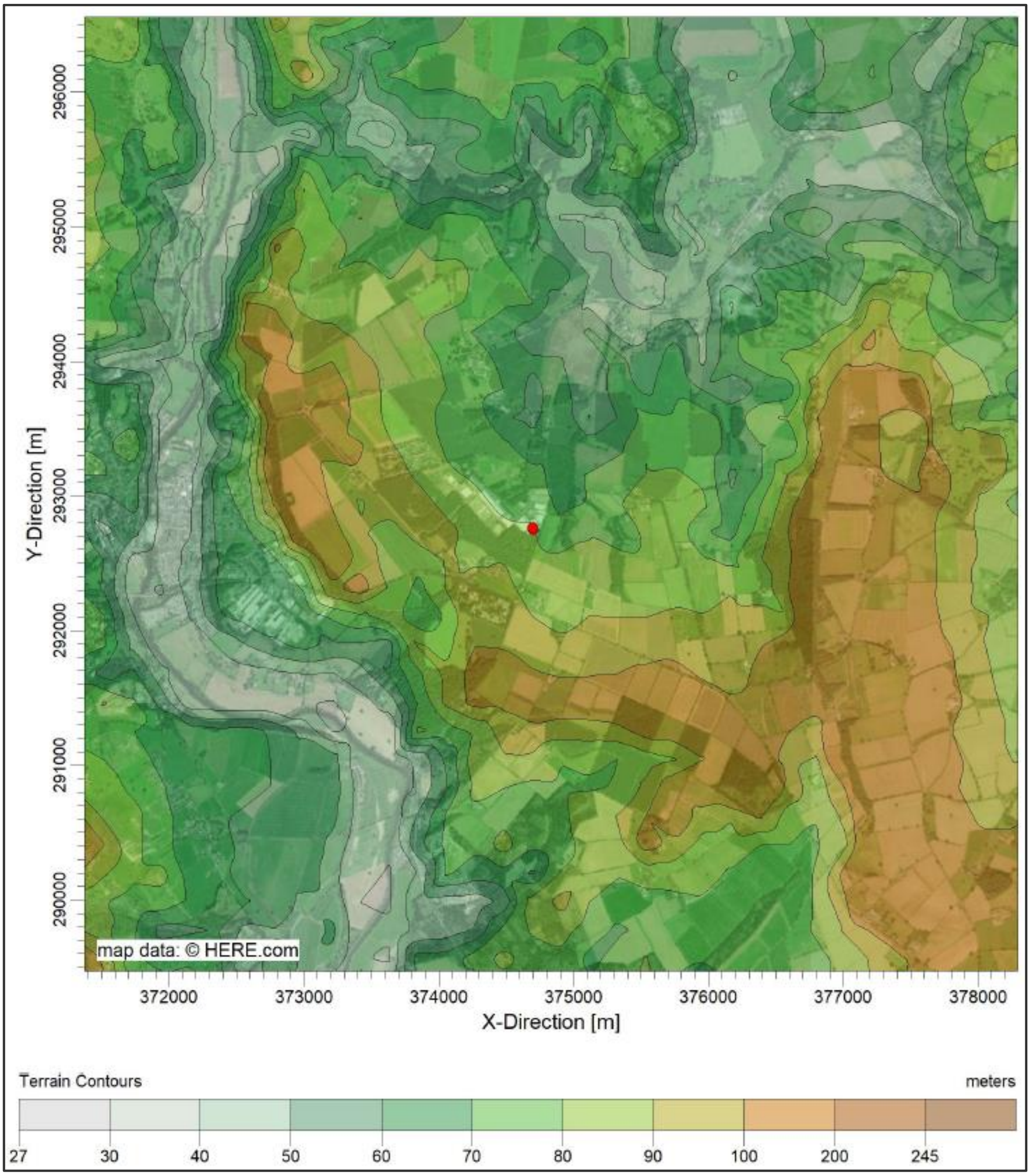

Figure 3-3
Surrounding Topography

3.4 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, which can result in elevated ground level concentrations.

The integrated Building Profile Input Programme (BPIP) module within AERMOD has been used to incorporate buildings within the model, in line with EA guidance, where:

- the maximum height of the building is equivalent to at least 40% of the emission height (i.e. 6m); and
- are within a distance defined as five times the lesser of the height or maximum projected width of the building (referred to as 5L)).

Details of the buildings are illustrated in Figure 3-4. All buildings have been modelled at a height of 9.5m.

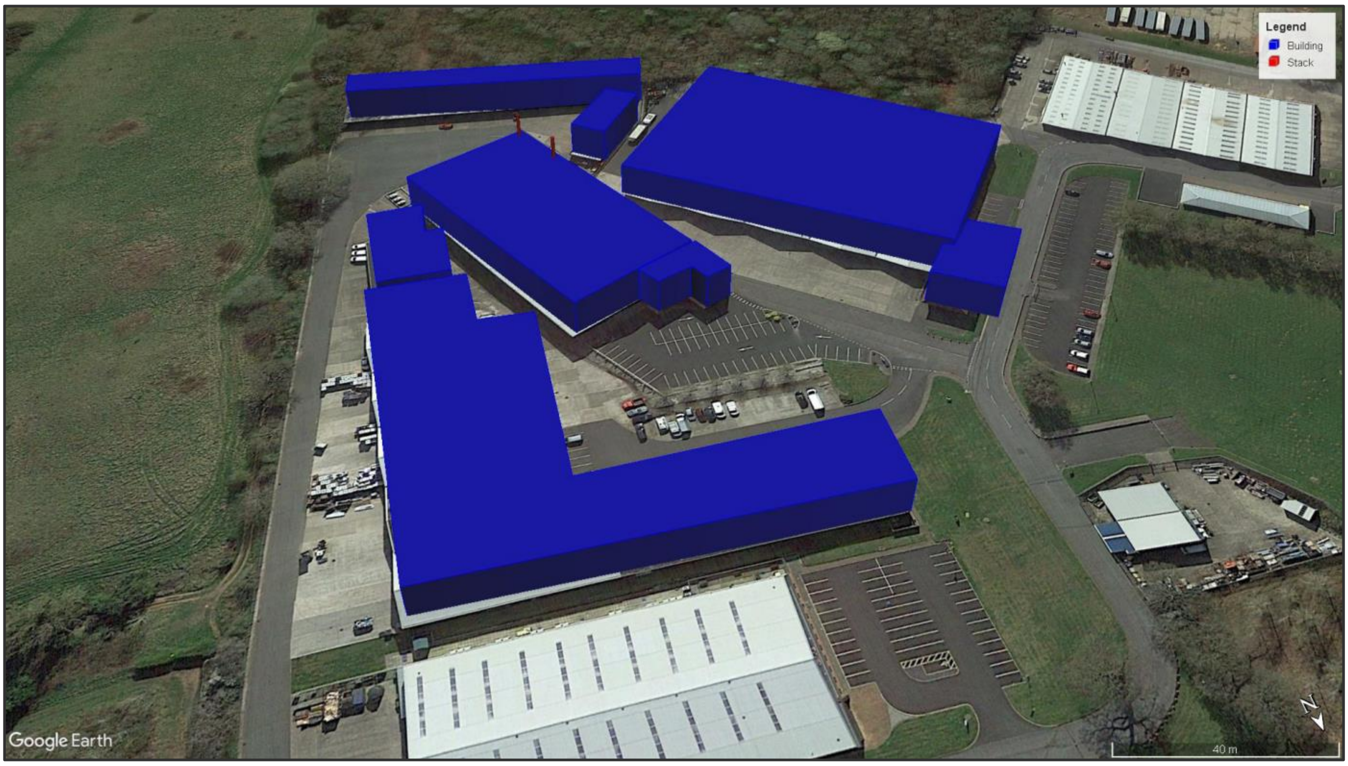

Figure 3-4
Modelled Buildings

3.5 Meteorological Data

The meteorological data provider was consulted for the closest and most representative dataset appropriate to the study area recording all the parameters necessary for dispersion modelling. The observation site selected for use in the assessment was Shawbury, located approximately 35.7km to the north-west of the Site.

The meteorological data (5 years of hourly sequential data for 2016-2020 inclusive) 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.

The European Commission CORINE (Co-Ordinated Information on the Environment) 100m spatial resolution land cover dataset was used with AERSURFACE to determine the surface roughness, albedo and bowen ratio of the Site and wider environment, as per AERMOD guidance[16] (Table 3-3).

Table 3-3
Applied Surface Characteristics

Zone (start)	Zone (end)	Albedo [(a)]	Bowen Ratio [(a)]	Surface Roughness (m) [(b)]
0	60	0.18	0.57	0.037
60	90	0.18	0.57	0.053
90	120	0.18	0.57	0.057
120	240	0.18	0.57	0.075
240	270	0.18	0.57	0.066

[16] EPA, AERMOD Implementation Workgroup, AERMOD Implementation Guide (August 2019)

Zone (start)	Zone (end)	Albedo [(a)]	Bowen Ratio [(a)]	Surface Roughness (m) [(b)]
270	300	0.18	0.57	0.056
300	330	0.18	0.57	0.047
330	0	0.18	0.57	0.032
Table Notes: (a) Reflective of the 10km x 10km grid square centred on the Site (b) 1km boundary from the Site				

A windrose for the period 2016-2020 from Shawbury station is presented in Figure 3-5 – showing winds from the south-west to be predominate in the area. Sensitive land uses located north-east of the Proposed Installation would therefore be downwind.

The average concentration reported at each receptor location relative to five years was used for assessment purposes. This is to ensure all variances of local meteorological conditions are captured within the dispersion model to minimise uncertainty.

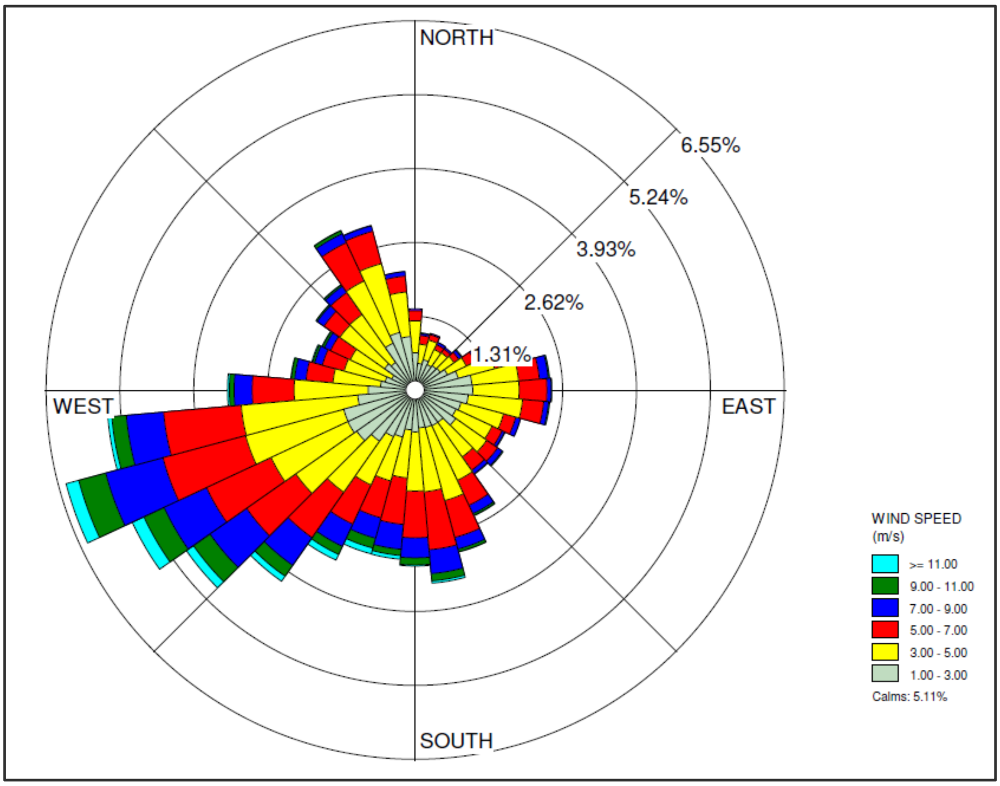

Figure 3-5
Shawbury 2016-2020 Windrose

3.6 Advanced Dispersion Parameters

3.6.1 Dispersion Coefficients

Urban locations are prone to higher temperatures, specifically during night-time periods, in comparison to surrounding rural areas. This phenonium is known as the 'urban heat island effect' and is largely attributed to the enhanced thermal heating capacities of urban surfaces, alongside anthropogenic sources of heat emissions prevalent in urban areas. As such, rural areas often experience stable conditions in comparison to urban locations which experience convective turbulence during night-time conditions. This can ultimately impact dispersion and subsequent ground level concentrations.

In recognition of this, AERMOD enhances the rate of turbulence for urban night-time conditions, relative to that of the adjacent rural, stable boundary layer and also defines an urban boundary layer height to account for limited mixing that may occur under these conditions. This is determined through specifying the local environment (i.e. 'urban' or 'rural'). AERMOD also uses population as a surrogate to define the magnitude of the differential heating effect at urban locations.

In accordance with AERMOD guidance[16], 'rural' was selected given the surrounding environment of the Site.

3.7 Model Outputs

Predicted pollutant concentrations are summarised in the following formats:

- process contribution (PC) – the predicted contributions from the installation alone, as output from AERMOD (averaged over five years); and
- predicted environmental concentration (PEC) – the resultant predicted concentration (i.e. PC + ambient background concentration value).

Table 3-4 presents the treatment of averaging periods of relevance to this assessment to arrive at the PEC.

Table 3-4
Model Outputs

Averaging Period	PC [(a)]	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 * 1.34 [(b)]	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	PC + 2 x Annual mean background
24 hour mean. Not to be exceeded more than 3 times a calendar year	99.18%ile of 24 hour means	PC + 2 x Annual mean background
24 hour mean. Not to be exceeded more than 35 times a calendar year	90.4%ile of 24 hour means	PC + Annual mean background
1-hour maximum	Maximum 1-hour mean	PC + 2 x Annual mean background
8-hour rolling mean (maximum daily)	8-hour rolling mean (maximum daily)	PC + 2 x Annual mean background
24 hour mean	Maximum 24-hour mean	PC + 2 x Annual mean background
1 week mean maximum	Maximum 24-hour mean / 1.97	PC + 2 x Annual mean background
Monthly mean maximum	Maximum 1-month mean	PC + Annual mean background
Calendar year	Annual mean	PC + Annual mean background

Table Notes:
(a) Averaged across five years of meteorological data (Shawbury 16-20 inclusive)
(b) Based upon AERA guidance

3.7.1 Operational Envelope

The assessment has assumed that all proposed plant equipment will be operational for 8760 hours per year (i.e. continuously), however based upon a 3 hour batch cycle. Further detail on the representation of operational emissions is provided in Section 5.1.

3.7.2 Conversion of NO_x to NO_2

In line with EA Air Quality Modelling and Assessment Unit (AQMAU) guidance[17], the assessment has used a NO_x to NO_2 ratio of:

- 70% for long-term average concentrations; and
- 35% for short-term average concentrations.

It should be noted that the use of these conversion ratios is highlighted to be 'worst-case' by the EA.

3.7.3 Calculation of PC to Deposition Rates

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

Dry deposition flux (µg/m²/s) = ground level concentration (µg/m³) x deposition velocity (m/s)

The applied deposition velocities for the relevant chemical species are as shown in Table 3-5.

Table 3-5
Applied Deposition Velocities

Chemical Species	Recommended deposition velocity (m/s)	
NO_2	Grassland	0.0015
	Woodland	0.0030
SO_2	Grassland	0.0120
	Woodland	0.0240
HCl	Grassland	0.0250
	Woodland	0.0600

Critical Loads – Eutrophication

The critical loads for N deposition are recorded in units of kgN/ha/yr. The units are converted from µg/m²/s to units of kgN/ha/year by multiplying the dry deposition flux by standard conversion factors as summarised in Table 3-6. These values are then compared to the habitat specific CLo.

Table 3-6
Applied Deposition Conversion Factors

Chemical Species	Conversion factor [µg/m²/s to kgN/ha/year]	
NO_2	of N:	95.9

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/m²/s) by standard conversion factors as presented in Table 3-7.

Table 3-7
Applied Acidification Conversion Factors

Chemical Species	Conversion factor [µg/m²/s to k_{eq}/ha/year]
NO_2	6.84
SO_2	9.84

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

Chemical Species	Conversion factor [µg/m²/s to k_{eq}/ha/year]
HCl	8.63

Calculation of PC as a percentage of Acid Critical Load Function

The calculation of the process contribution of N, S and HCL 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"*

HCl emissions have been treated as S in accordance with AQ.TAG06 guidance.

3.8 Assessment of Impact and Significance

3.8.1 Human Receptors

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

- the long-term PC <1% of the long-term AQAL; and
- the short-term PC <10% of the short-term AQAL.

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 AQAL.

3.8.2 Vegetation and Ecosystems

In addition to the AERA guidance, the EA's Operational Instruction 66_12[18] 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 summarised in Table 3-8.

Table 3-8
Vegetation and Ecosystems PC Assessment Screening

Ecological Designation	Short Term	Long Term
European Sites and SSSIs	PC <10% CLe	PC <1% CLe and/or CLo
		PEC <70% CLe and/or CLo [(a)]
Other Conservation Sites	PC <100% CLe	PC <100% CLe and/or CLo

[18] 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

Ecological Designation	Short Term	Long Term
Table Notes: (a) Only assessed if the PC is >1% of CLe and/or CLo		

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 the EA's Operational Instruction 67_12[19]. 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.

3.9 Uncertainty

It is recognised that dispersion modelling is inherently uncertain, particularly in circumstances where verification of modelled predictions relative to real-world condition is not possible. The accuracy of modelled predictions is intrinsically reliant on assessment inputs (i.e. emission rates, exhaust temperatures etc.), and the ability of the dispersion model to replicate real-world conditions. In respect to this, all operational inputs have been provided by the client.

Model validation studies[20] 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 19191 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.

Furthermore, to provide certainty with respect to the assessment outcomes, wherever possible, this assessment has incorporated a number of conservative assumptions, which will result in an overestimation of predicted ground level concentrations. As such, the actual predicted ground level concentrations are expected to be lower than this and, in some cases, significantly lower, with the operation of the Site. Examples of these include (but not limited to):

- assumed continuous operational profile (i.e. 8760 hours per year), not accounting for any plant down time:
    - for the assessment of short term pollutant impacts (human and ecological), it has been assumed that the Site will continuously release worst-case emissions (i.e. IED Annex VI pollutants at BAT-AELs) to air - 100% over an annual period, where in reality these emissions are only released for 33.3% over an annual period.
- 100% of the total PM BAT-AEL has been assumed to be PM_{10} and $PM_{2.5}$;
- 100% of the total TOC BAT-AEL has been assumed to be Benzene;
- 100% of the total Group 1 metals BAT-AEL has been assumed to be Cadmium;

[19] EA Working Instruction 67_12 Detailed assessment of the impact of aerial emissions from new or expanding IPPC regulated industry for impacts on nature conservation.

[20] AERMOD: Latest Features and Evaluation Results, EPA-454/R-03-003, June 2003 (United States Environmental Protection Agency).

- assumed 35% and 70% for short term and long term NO_x to NO_2 conversion rates, respectively;
- consideration of the location of maximum (off-site) ground level impact for the purposes of the human health assessment, irrespective of relevant exposure – representing a conservative outlook, as concentrations predicted at all other locations, including human receptor locations would be lower;
- the approach undertaken with respect to ecological impact assessment - assuming that the most sensitive relevant feature is present at the location of maximum impact, achieved through the:
    - adoption of the minimum critical loads and levels where variability across the designation occurs;
    - consideration of the location of maximum impact across the assessed ecological – representing a conservative outlook relative to the wider site.
- use of five years of meteorological data to account for inter-annual variation.

4.0 BASELINE ENVIRONMENT

4.1 Ambient Air Quality

Monitoring data collected prior to the COVID-19 pandemic (i.e. pre-2020) has been used to characterise the baseline environment, as pollutant concentrations monitored during 2020 and 2021 are expected to be atypical, and not representative of the local environment and have therefore not been considered.

4.1.1 Local Air Quality Management

SC, in fulfilment of statutory requirements, has conducted an on-going exercise to review and assess air quality within their administrative area. The latest publicly available LAQM report for SC (not impacted by the COVID-19 pandemic) at the time of writing is the 2020 Annual Status Report[21] (ASR).

SC presently have two AQMAs, declared for exceedences of the annual mean NO_2 AQAL at locations of relevant public exposure. The nearest AQMA is located in Bridgnorth, titled Bridgnorth Pound Street, approximately 3.3km west of the Site. Road traffic is believed to be the principal contributor to elevated concentrations at this location. This AQMA has been included within the assessment via the incorporation of discrete receptors and a nested receptor grid (Section 3.2).

The second SC AQMA is located >30km from the Site in Shrewsbury. Given the separation distance relative to the Proposed Installation, no further consideration has been given to this AQMA within this assessment.

4.1.2 Nitrogen Dioxide

Monitoring of NO_2 is undertaken within SC's jurisdiction via non-automatic methodologies. SC do not presently undertake automatic monitoring of NO_2. The nearest NO_2 automatic site is Telford Hollinswood associated with the Automatic Urban and Rural Network (AURN) – located 16km away. Given the availability of NO_2 data recorded within SC's jurisdiction (considered to be more representative in comparison), no further consideration has been given to this automatic monitor.

The details and latest set of results (2015-2019) from NO_2 monitoring undertaken within 3.5km of the Site are presented in Table 4-1 and Table 4-2 respectively, whilst their locations are illustrated in Figure 4-1.

Table 4-1
Local NO_2 Monitoring: Details

Site ID	Method	Site Type	NGR (m)		AQMA	Distance to Site (km)
			X	Y		
DF13	Diffusion Tube	Roadside	371345	293081	Bridgnorth	3.4
DF20	Diffusion Tube	Roadside	371580	293257	-	3.1
DF27	Diffusion Tube	Roadside	371397	293179	-	3.3
DF28	Diffusion Tube	Roadside	371321	293131	-	3.4
DF29	Diffusion Tube	Roadside	371297	293108	-	3.4
DF58	Diffusion Tube	Roadside	371795	292947	-	2.9
DF59	Diffusion Tube	Roadside	371799	293011	-	2.9
DF61	Diffusion Tube	Roadside	371951	292992	-	2.7
DF71	Diffusion Tube	Roadside	371346	293086	Bridgnorth	3.4
DF72	Diffusion Tube	Roadside	371375	293066	-	3.3

[21] Shropshire Council, 2020 Air Quality Annual Status Report (ASR), 2020.

Site ID	Method	Site Type	NGR (m)		AQMA	Distance to Site (km)
			X	Y		
DF73	Diffusion Tube	Roadside	371354	293089	-	3.4
DF74	Diffusion Tube	Roadside	371340	293125	-	3.4
DF75	Diffusion Tube	Roadside	371345	293106	-	3.4
DF76	Diffusion Tube	Roadside	371366	293146	-	3.3
DF77	Diffusion Tube	Roadside	371375	293161	-	3.3
DF78	Diffusion Tube	Roadside	371360	293152	-	3.4
DF79	Diffusion Tube	Roadside	371346	293143	-	3.4
DF80	Diffusion Tube	Roadside	371334	293139	Bridgnorth	3.4
DF81	Diffusion Tube	Roadside	371288	293119	-	3.4
DF82	Diffusion Tube	Roadside	371264	293120	-	3.4

Table 4-2
Local NO_2 Monitoring: 2015-2019 Results

Site ID	2019 Data Capture (%)	Annual Mean NO_2 Concentration (µg/m^3)				
		2015	2016	2017	2018	2019
DF13	100	41.9	41.5	44.0	40.5	35.6
DF20	100	21.3	22.9	31.8	22.7	20.8
DF27	100	26.5	27.8	28.2	26.0	25.8
DF28	100	51.2	52.9	40.3	48.2	43.4
DF29	92	29.0	29.7	29.4	28.9	28.5
DF58	100	37.4	35.8	31.7	33.1	28.5
DF59	100	32.1	33.0	34.2	29.6	28.5
DF61	100	31.6	30.4	32.2	28.0	27.0
DF71	100	-	-	58.5	50.9	49.1
DF72	100	-	-	-	30.0	28.2
DF73	92	-	-	-	34.1	34.2
DF74	100	-	-	-	30.9	29.4
DF75	100	-	-	-	30.9	27.6
DF76	100	-	-	-	33.8	31.8
DF77	100	-	-	-	40.3	38.7
DF78	100	-	-	-	39.9	38.5
DF79	100	-	-	-	48.8	42.3
DF80	100	-	-	-	50.3	43.6
DF81	100	-	-	-	28.8	26.7
DF82	100	-	-	-	27.4	22.7

Annual mean NO_2 concentrations recorded within 3.5km of the Site were observed to be above the AQAL at certain monitors during the period assessed (2015-2019) – monitors DF13, DF28, DF71, DF77, DF79 and DF80. All of these sites occupy urbanised roadside locations within or adjacent to the Bridgnorth Pound Street AQMA, and therefore reflect localised elevated conditions relative to the wider area and Site locate. Concentrations are expected to reduce with distance from the roadside, in addition to locations away from AQMAs. For instance, the three nearest passive monitoring locations relative to the Site (DF58, DF59 and DF61) (2.7-2.9km), have all reported concentrations to be below the annual mean NO_2 AQAL for the period assessed, and 'well-below' within 2019 (i.e. <75% of the AQAL). These three sites occupy roadside locations. Concentrations anticipated within the Site locale are expected to be lower in comparison, given the rural setting and reduced prominence of road traffic vehicles – the primary contributor to elevated contributions within Bridgnorth.

There appears to be a long-term reduction in NO_2 annual mean concentrations recorded at the majority of the sites assessed, when comparing 2015 and 2019 data – principally at locations recording elevated concentrations (e.g. >40µg/m^3). This demonstrates local improvements at key roadside locations.

Figure 4-1
NO_2 Diffusion Tubes and Bridgnorth AQMA Relative to the Site

4.1.3 UK AIR Modelled Data

Defra maintains a nationwide model of existing and future background air quality concentrations at a 1km grid square resolution which is routinely used to support LAQM requirements and air quality assessments.

The datasets include annual average concentration estimates for NO_x, NO_2, PM_{10} and $PM_{2.5}$ using a reference year of 2018 (the year in which comparisons between modelled and monitoring are made). Background pollutant concentrations of CO, Benzene and SO_2 are based upon a 2001 reference year, therefore these values are likely to be overly conservative upon application.

Annual mean background concentrations of NO_2, PM_{10}, $PM_{2.5}$, CO and SO_2 for the 1km grid squares which cover the modelled domain are presented in Table 4-3. Values refer to reference concentrations (i.e. the year in which comparisons between modelled and monitoring are made), to represent the latest year of ratified data and minimise uncertainties with regards future year projections.

Table 4-3
Relevant Defra Mapped Annual Mean Background Concentrations

Pollutant	Reference Year	Annual Mean Reference Concentration (µg/m^3)
NO_2	2018	3.9 – 9.5
PM_{10}	2018	10.4 – 16.1
$PM_{2.5}$	2018	6.8 – 9.0
SO_2	2001	1.8 – 4.1
CO	2001	194 – 242

4.1.4 Particulate Matter

Particulate matter is monitored at Birmingham Ladywood AURN, an urban background site located approximately 32km east of the Site.

Given the separation distance and availability of up-to-date semi empirical PM concentration estimates contained within the 1km Defra background maps (2018 reference year), no further consideration has been given to this AURN with respect to PM concentrations. Preference was to utilise the PM_{10} and $PM_{2.5}$ Defra background maps.

4.1.5 Benzene

Benzene is monitored at Birmingham Ladywood AURN, located approximately 32km east of the Site. Preference was therefore to utilise background benzene concentrations recorded at Birmingham Ladywood AURN over 2001 modelled estimates provided by Defra.

The 2019 annual mean concentration of benzene was 0.48µg/m^3 and has subsequently been used to define background concentrations across the study area.

4.1.6 Metals

Monitoring of metals is currently carried out on behalf of Defra at 25 sites around the UK (termed the Heavy Metals Monitoring Network (HMMN)). The closest location to the Site with available 2019 baseline monitoring data is Fenny Compton, a rural background site, located approximately 78km south-east of the Site, as presented in Table 4-4. Walsall Pleck Park is located 25km east of the Site, however monitoring only commenced in 2021.

Mercury was not monitored at Fenny Compton, baseline concentrations derive from 2013 concentrations recorded at Sheffield Tinsley, the next closest monitoring site.

Table 4-4
Baseline Metals Monitoring Data

Metal		2019 Annual Average (ng/m^3)
Arsenic	As	0.78
Cadmium	Cd	0.11
Chromium (total)	Cr	1.07
Copper	Cu	3.06
Manganese	Mn	2.71
Nickel	Ni	0.41
Lead	Pb	4.20

Metal		2019 Annual Average (ng/m^3)
Vanadium	V	0.61
Antimony	Sb	Not measured
Chromium (VI)	CrVI	0.09
Mercury	Hg	0.003 (2013 data as measurements ceased)

Monitoring is not routinely undertaken for antimony or hexavalent chromium (Cr(VI)) in the UK and therefore no background data for these pollutants is available. The adopted practice in the UK for estimating Cr(VI) is to assume it is a fraction of total Cr. The EA indicate[22] that a value of 20% should be applied unless otherwise justified. An Expert Panel on Air Quality Standards (EPAQS) report[23] states 'data from Canada, quoted by Rowbotham et al. (2000), suggest that Cr(VI) constitutes between 3 and 8% of total airborne chromium in that country'; therefore a value of 8% has been adopted in this detailed assessment.

4.1.7 Hydrogen Halides

Hydrogen Chloride

Hydrogen chloride is monitored as part of the UK Acid Gases & Aerosol Network (AGANet), which predominately form a collection of rural background monitors. The nearest in relation monitor is Rosemaund located 48km south-west of the Site. The annual mean concentration of HCl from the most recent data available (2015), is $0.26\mu g/m^3$.

Hydrogen Fluoride

In 2005, The 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 $3.5\mu g/m^3$ as approximate monthly averages. Therefore $3.5\mu g/m^3$ has been assumed as an appropriate monthly mean background concentration for HF.

4.1.8 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 monitoring site is the Manchester Law Courts, located 105km north of the Site. The most recent data available from the Manchester Law Courts site is from 2016 – as detailed in Table 4-5.

Table 4-5
Baseline Dioxins and PCBs Monitoring Data

Pollutant	Value	2016 Annual Average [(a)]
Dioxins and Furans (Toxic Equivalent Quotient)	$fgTEQ/m^3$	12.3
Seven indicator PCB congeners (PCBs 28,52,101,118,138,153,180)	pg/m^3	93.5
Table Notes: (a) Inclusive of monitoring from 22/12/2015		

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

[23] Expert Panel on Air Quality Standards Guidelines for metals and metalloids in ambient air for the protection of human health (2009).

4.1.9 Polycyclic Aromatic Hydrocarbon (PAH)

The measurement of polycyclic aromatic hydrocarbon (PAH) in the Network began in 1991. The closest monitoring site is Birmingham Ladywood AURN located approximately 32km east of the Site. The 2019 annual mean concentration recorded at this site was 0.13ng/m^3 of benzo(a)pyrene.

4.2 Applied Background Concentrations

The applied annual mean backgrounds in relation to the assessment of human health are provided in Table 4-6 below. Baseline concentrations for short-term averaging periods have assumed to be twice the long-term mean concentration, in accordance with AERA guidance (except for PM_{10} 24-hour mean, as per LAQM.TG(16)). This method is considered to derive conservative short-term ambient background concentrations.

Table 4-6
Applied Long Term Background Concentrations

Pollutant	Unit	Annual Background Concentration	Data Source
NO_2	µg/m^3	(3.9 – 9.5)	Value from the relevant 2018 Defra 1km^2 background maps covering the modelled domain
NO_2 (Bridgnorth AQMA)	µg/m^3	58.5	Maximum recorded annual mean concentration for the monitoring locations within / adjacent to the Bridgnorth AQMA (DF71)
PM_{10}	µg/m^3	10.4 – 16.1	Value from the relevant 2018 Defra 1km^2 background maps covering the modelled domain
$PM_{2.5}$	µg/m^3	6.8 – 9.0	
SO_2	µg/m^3	1.8 – 4.1	Value from the relevant 2001 Defra 1km^2 background maps covering the modelled domain
CO	µg/m^3	194 – 242	
HCl	µg/m^3	0.26	2015 UK AGANet Rosemaund
HF	µg/m^3	3.5 [(a)]	EPAQS
Benzene	µg/m^3	0.48	2019 Birmingham Ladywood
Mercury	ηg/m^3	0.003	2013 Sheffield Tinsley
Antimony	ηg/m^3	-	2019 Fenny Compton HMMN
Cadmium	ηg/m^3	0.11	
Arsenic	ηg/m^3	0.78	
Chromium (total)	ηg/m^3	1.07	
Copper	ηg/m^3	3.06	
Lead	ηg/m^3	4.20	
Manganese	ηg/m^3	2.71	
Nickel	ηg/m^3	0.41	
Vanadium	ηg/m^3	0.61	
Chromium VI	ηg/m^3	0.09	8% of total Cr

Pollutant	Unit	Annual Background Concentration	Data Source
PCB	pg/m^3	93.5	TOMPS (Manchester Law Courts 2016)
Dioxins furans	fgTEQ/m^3	12.3	TOMPS (Manchester Law Courts 2016)
B(a)P	ηg/m^3	0.13	PAH Network (Birmingham Ladywood 2019)

4.3 Baseline Conditions at Ecological Receptors

APIS is a support tool for the 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 has been used to provide information on:

- identification of whether the habitats present are sensitive;
- current ambient baseline concentrations (Table 4-7); and
- CLo and current deposition rates for nutrient N and for acidity (Table 4-8 and Table 4-9).

Background concentrations and deposition rates are provided at a 5km grid square (excluding NOx at 1km) resolution across the UK, calculated via a Concentration Based Estimated Deposition (CBED) approach based upon measured-interpolated data for a three-year rolling mean average (presently 2017 – 2019).

APIS provides details of habitats and corresponding CLo/deposition rates for SSSIs, SPAs and SACs via the 'site relevant critical load search' function. For the assessment of locally important designations, appropriate CLo/deposition rates were obtained via the 'search by location' function using the NGR for the location of maximum PC relative to the assessed habitat. Assumptions regarding the primary habitat type present at each LWS were made based upon online literature and satellite imagery, where relevant.

The most sensitive habitat listed on APIS has been used to provide a worst-case assessment, documented below.

4.3.1 Critical Levels

The baseline concentrations of NO_x and SO_2 are summarised in Table 4-7 below. Values relates to the maximum reported concentration across the habitat.

Table 4-7
Baseline Maximum Annual Mean Concentrations at Ecological Receptors

Site	Habitat	Maximum Annual Mean Concentration (µg/m^3)	
		NO_x	SO_2
ER1 (AW)	Broadleaved, Mixed and Yew Woodland	8.1	1.4

4.3.2 Critical Loads

Nutrient N

CLo and baseline deposition rates in relation to nutrient N are provided in Table 4-8.

Nutrient N CLo are habitat/species specific (derived from a range of experimental studies) available via APIS. Given that CLo are often reported in ranges in relation to eutrophication, representing the upper and lower bounds where impacts are perceptible, those values which facilitate a worst-case assessment have been used (i.e. min CLo for nutrient N deposition).

Table 4-8
Relevant N Critical Loads and Baseline Deposition Rates

Site	Habitat/N Class (Most Sensitive)	CLo Range (Min – Max)	CLo Adopted	Current N Load (Max)
		(kgN/ha/yr)		
ER1 (AW)	Broadleaved deciduous woodland	10 – 20	10	35.6

Acidification

CLo and baseline deposition rates in relation to acidification are provided in Table 4-9.

Acidification CLo are dependent on soil chemistry, as well as habitat type. In the UK, empirical CLo have been assigned at a 1km grid square resolution based upon the mineralogy and chemistry of the dominant soil series present in the grid square, as provided on APIS. These values have been utilised to determine the CLo for each ecological designation of interest to this assessment.

Receptor specific CLo (location of maximum impact) have been used in relation to ecological sites where not provided on APIS (i.e. via the 'site relevant critical load search').

Table 4-9
Relevant Acid Critical Load Functions and Baseline Deposition Rates

Site	Habitat/Acidity Class (Most Sensitive)	Critical Load			Baseline Deposition		Sensitivity
		CLminN	CLmaxS	CLmaxN	N	S	
		(keq/ha/yr)					
ER1 (AW)	Broadleafed/Coniferous unmanaged woodland	0.142	1.073	1.215	2.54	0.2	N

5.0 EMISSIONS TO ATMOSPHERE

5.1 Process Description

Each stack serves two separate machines operating sequentially in a batch cycle (i.e. 4 machines overall). Each individual batch (per machine) is split into three phases, constituting an hour each (i.e. 3 hours cumulatively):

- Warm up;
- Syngas generation; and
- Cool down.

This individual batch cycle is detailed in Table 5-1, whereby the sequencing at a singular stack (comprising two machines) is illustrated in Table 5-2.

Table 5-1
Emissions Batch Cycle

Hour	Description	Emissions	Percentage of Cycle (%)
1	Warm Up (firing on natural gas)	NOx at 150mg/Nm^3 (273K, 3% O_2, dry)	33.3
2	Syngas	IED Annex VI pollutants at BAT-AELs	33.3
3	Cool Down	No emission release	33.3

Table 5-2
Batch Sequencing (Singular Stack)

Stack	Machine	Hour		
		1	2	3
1	1	Warm Up (NOx)	Syngas (BAT-AELs)	Cool Down
	2	Cool Down	Warm Up (NOx)	Syngas (BAT-AELs)
2	3	Warm Up (NOx)	Syngas (BAT-AELs)	Cool Down
	4	Cool Down	Warm Up (NOx)	Syngas (BAT-AELs)

Emissions to air generated from the Site are only released for two out of three hours. For the first hour (warm up phase) exhaust gas from a thermal oxidiser (TO) is solely emitted, limited to NOx (based upon information provided by the operator). For the second hour, (syngas generation phase), IED Annex VI pollutants are emitted (BAT-AELs). For the third hour, no emissions are released during the cool down phase.

This three hour batch (per machine) has assumed to operate for 8,760 hours per year (i.e. continuously), with no allowance for downtime/maintenance, which represents a conservative assessment.

Given that each batch cycle (per machine) lasts three hours, due consideration has been given to the representation of the variable emission releases for the two machines supporting each stack within the dispersion modelling exercise.

5.1.1 Assessment Approach

For those pollutant impacts which have an exposure reference period greater than 3-hours (i.e. pollutants with annual mean, daily mean, or 8-hour limit values)), a time weighted emission rate has been used to represent the three hour cycle and associated variability in emissions (e.g. warm up, syngas and cool down). Mass emission rates for each cycle were calculated separately (where relevant), with use of respective normalised inputs. As these emission rates relate to one machine, the calculated time weighted emission rate for each pollutant has been doubled (multiplied by 2) to account for two machines supporting each stack (Table 5-2).

For those pollutant impacts which have an exposure period less than 3-hours (i.e. pollutants with 1-hour mean, or 15-minute mean limit values), the assessment has assumed that the Site will emit at the maximum potential emission levels in the batch cycle (i.e. hour 2) continuously (100% of an annual period i.e. 8,760 hours per year). In reality this scenario will only occur for 33.3% of the time (Table 5-2), however the approach ensures worst case impacts with respect to meteorological conditions are captured within the dispersion model.

Table 5-3 provides a tabulated explanation of the treatment of emission rates for each averaging period.

Table 5-3
Treatment of Emissions Rates for Each Considered Averaging Period

Averaging Period	Emission Rate Adopted
1 hour mean. Not to be exceeded more than 18 times a calendar year	Maximum release
15 minute mean. Not to be exceeded more than 35 times a calendar year	Maximum release
1 hour mean. Not to be exceeded more than 24 times a calendar year	Maximum release
1-hour maximum	Maximum release
24 hour mean. Not to be exceeded more than 3 times a calendar year	Time weighted
24 hour mean. Not to be exceeded more than 35 times a calendar year	Time weighted
8-hour rolling mean (maximum daily)	Time weighted
24 hour mean	Time weighted
1 week mean maximum	Time weighted
Monthly mean maximum	Time weighted
Calendar year	Time weighted

5.1.2 Emission Parameters

The following emission parameters and process conditions were used to determine the pollutant emission rates and as input to the dispersion modelling exercise. During the batch cycles, efflux velocity and release temperature remain constant.

Table 5-4
Emission Characteristics

Parameter	Cycle	Stack 1	Stack 2
Stack Location (NGR x/y)	-	374700, 292750	374696, 292765
Stack Internal Diameter (m)	-	0.4	
Stack Exhaust Height (m)	-	15.0	
Normalised Volume Flow (Nm^3/s)	Warm Up	0.7	
	Syngas	1.693	
Emission Temperature (°C)	-	195	
Oxygen Content (% O_2 dry gas)	Warm Up	9.53	
	Syngas	4.08	
Moisture content (% H_2O)	Warm Up	32.8	
	Syngas	38.8	
Actual Flow Rate (Am^3/s) (wet, at stack conditions)	-	2.799	
Emission Velocity (m/s)	-	22.3	

Parameter	Cycle	Stack 1	Stack 2
Table Notes: Warm Up Reference Conditions (273K, 3% O_2, dry) Syngas Reference Conditions (273K, 11% O_2, dry)			

5.2 Emission Scenarios

The following scenarios have been assessed, based upon the exhaust emission concentration thresholds and corresponding averaging periods provided within the IED and BATC documents:

- normal 'daily average' emission limits; and
- half-hourly emission limits.

It should be reinforced that the BAT-AELs relate to advisable emission limits waste incineration plant can meet (based upon a review of industry and available technology). Whereas the IED emission limits relate to the maximum permissible limits waste incineration plant must meet, as enforced by legislation. However, at this point, the recommendations of the BREF will become enforceable through regulation i.e. inclusion of these BAT-AELs within Environmental Permits.

5.2.1 Daily Average Pollutant Emission Scenario

Emission rates for the daily average pollutant emission scenario have been calculated, based upon the treatment of process conditions detailed in Section 5.1, and in conjunction with the relevant emission limit concentrations (e.g. BAT-AELs and TO manufacturer's specifications). Where the BAT-AELs were provided as a range, the upper values were used to provide a conservative assessment.

Other pollutant specific issues are discussed in the sections below.

Table 5-5
Daily Average Pollutant Emission Rates (per stack)

Pollutant	Emission Exhaust Concentration (mg/Nm^3)		Daily Average Emission Rate		
	Syngas (BAT-AELs)	Warm Up	Weighted [b]	Maximum [c]	Unit
			Value		
Nitrogen Dioxide	120	150	0.2053883	0.3080825	g/s
Particulate Matter	5	-	0.0056422	0.0084633	g/s
Sulphur Dioxide	30	-	0.0338534	0.0507801	g/s
Carbon Monoxide	50	-	0.0564223	0.0846335	g/s
Hydrogen Chloride	6	-	0.0067707	0.0101560	g/s
Hydrogen Fluoride	1	-	0.0011284	0.0016927	g/s
Organics (TOC)	10	-	0.0112845	0.0169267	g/s
Group 1 metals (total)	0.02	-	0.0225689	0.03385338	mg/s
Group 2 metals (total)	0.02	-	0.0225689	0.03385338	mg/s
Group 3 metals (total)	0.3	-	0.3385338	0.50780070	mg/s
Dioxins and furans	6E-08	-	0.0902757	0.13541352	ng/s
PAH (BaP)	0.001	-	0.0011284	0.00169267	mg/s
PCBs	0.005	-	0.0056422	0.00846335	mg/s

Table Notes:
[a] Based upon manufacturers specification sheet (rounded up from 146mg/Nm^3)
[b] Time weighted emission rate (accounting for 2 machines) - based upon batch cycle profiles. Used in relation to pollutant impacts with an exposure period greater than 3 hours (i.e. greater than the duration of the batch cycle)

Pollutant	Emission Exhaust Concentration (mg/Nm³)		Daily Average Emission Rate		
	Syngas (BAT-AELs)	Warm Up	Weighted [(b)]	Maximum [(c)]	Unit
			Value		

[(c)] Assumed the maximum potential emission release (Hour 2 of Batch Cycle) at a singular stack (in consideration of batch cycles at both machines) in relation to pollutant impacts with an exposure period of less than 3 hours (i.e. less than the duration of the batch cycle)
Warm Up Reference Conditions (273K, 3% O_2, dry)
Syngas Reference Conditions (273K, 11% O_2, dry)

Particle Size

Particulate matter (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 $PM_{2.5}$.

ELVs prescribed within the BREF relate to total PM. To facilitate a conservative assessment, 100% of the ELV has been assumed to be PM_{10} and $PM_{2.5}$.

Total Organic Carbon (TOC)

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 100% of TOCs would be benzene, in line with the AERA guidance.

B(a)P

There is no ELV for PAHs (or B(a)P specifically) provided in the IED. The current Waste Incineration BREF Note (2009) states *"emission levels range … from 0.004 ng/Nm³ to 1 µg/Nm³ for BaP".* A value of 0.001mg/Nm³ (1µg/Nm³) has been adopted as an ELV in this assessment and is considered to represent a precautionary approach.

Polychlorinated Biphenyl (PCBs)

There is no ELV for PCBs provided in the IED, nor within the current Waste Incineration BREF Note. However, however the 2006 Waste Incineration BREF Note (May 2017), indicates potential PCB emissions of <0.005mg/Nm³. This value has been applied in the assessment.

Metals

As shown in Table 2-2, the BAT-AELs for metals are based on the total aggregated emission rates for 3 different groups.

The aggregated ELV for Group 1 has been assumed to be Cadmium for conservatism.

The EA's approach to assessment of Group 3 metals[22] 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 5-6.

Table 5-6
EA Group 3 Metals Monitoring Data

Parameter	Measured Concentrations (mg/Nm³)			Maximum % of Group 3	Modelled Emission Rate (mg/s)
	Maximum	Mean	Minimum		
Antimony	0.0115	0.0014	0.0001	2.3	0.008463345
Arsenic	0.0250	0.0010	0.0002	5.0	0.003893139
Chromium (II and III)	0.0920	0.0084	0.0002	18.4	0.031145110
Chromium (VI)	1.3×10^{-4}	3.5×10^{-5}	2.3×10^{-6}	0.03	0.000050780

Parameter	Measured Concentrations (mg/Nm^3)			Maximum % of Group 3	Modelled Emission Rate (mg/s)
	Maximum	Mean	Minimum		
Copper	0.0290	0.0075	0.0019	5.8	0.009817480
Lead	0.0503	0.0109	0.0003	10.1	0.017095957
Manganese	0.0600	0.0168	0.0015	12.0	0.020312028
Nickel	0.2200	0.0150	0.0025	44.0	0.074477436
Vanadium	0.0060	0.0004	0.0001	1.2	0.002031203

5.2.2 Half Hourly Emission Limits Scenario

In addition to the daily average ELVs assessed, the IED also stipulates half-hourly ELVs 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 (Table 2-1). As such consideration has been given to potential short term elevated emissions that could occur for 3% of half hourly averages for those pollutants which have AQALs at hourly resolution or lesser (e.g. NO_2, SO_2, HCl and HF). Greater averaging periods would not be significantly affected by the half-hourly IED ELVs.

No half hourly BAT-AELs are provided. Application of the IED half-hourly ELVs within the assessment could potentially overestimate short term emission releases, via the omittance of relevant BAT applied. To recognise the application of BAT at the Site, the ratios between the daily and half-hourly average IED ELVs (Table 2-1) for the relevant pollutants have been applied to the daily BAT-AELs to derive an estimated half-hourly limit.

Table 5-7
Half Hourly Pollutant Emission Rates

Pollutant	Emission Exhaust Concentration (mg/Nm^3)		Maximum Half Hourly Emission Rate [(a)]	
	Adjusted IED Half Hourly Rate [(b)]	Warm Up [(c)]	Value	Units
NO_2	240	150	0.5112028	g/s
PM	15	-	0.0253900	g/s
SO_2	120	-	0.2031203	g/s
CO	60	-	0.1692669	g/s
HCl	36	-	0.0609361	g/s
HF	4	-	0.0067707	g/s
TOC	20	-	0.0338534	g/s

Table Notes:
(a) Assumed the maximum potential emission release at a singular stack (in consideration of batch cycles at both machines) in relation to pollutant impacts with an exposure period of less than 3 hours (i.e. less than the duration of the batch cycle)
(b) Calculated half hourly concentration, based upon the ratios between the daily and half-hourly average IED ELVs, applied to the daily BAT-AELs
(c) Based upon manufacturers specification sheet (rounded up from 146mg/Nm^3)
Warm Up Reference Conditions (273K, 3% O_2, dry)
Syngas Reference Conditions (273K, 11% O_2, dry)

6.0 PREDICTED AIR QUALITY IMPACTS

6.1 Human Health

Results presented herein relate to the maximum ground level PC predicted across the entirety of the gridded receptors irrespective of relevant exposure, and as such, represents a conservative outlook. PCs predicted at all other locations, including human receptor locations would be lower. Therefore, if impacts can be screened out at the location of maximum ground level PC, impacts at other areas can also be screened out.

Notwithstanding the above, in recognition of local sensitivities, specifically the Bridgnorth AQMA – declared for the exceedences of the annual mean NO_2 AQAL at locations of relevant exposure, further consideration has been given to modelled NO_2 concentrations at discrete receptors within this AQMA.

6.1.1 Long-Term Impacts

Predicted long-term impacts are summarised in Table 6-1.

Isopleth plots are presented in Appendix B for those PCs that are >1%. For those PCs that cannot be considered insignificant, the PEC is below the AQAL.

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

AQAL			PC (µg/m³)	PC % of AQAL	PEC (µg/m³)	PEC % of AQAL
Pollutant	Period	µg/m³				
NO_2	Annual	40	6.5	16.2	14.1	35.3
PM_{10}	Annual	40	0.3	0.6	n/c	n/c
$PM_{2.5}$	Annual	25	0.3	1.0	7.7	30.8
Benzene	Annual	5	0.5	10.2	0.7	13.9
Cadmium	Annual	0.005	0.001	20.3	0.001	22.6
Mercury	Annual	0.25	0.001	0.4	n/c	n/c
Antimony	Annual	5	0.0004	<0.1	n/c	n/c
Arsenic	Annual	0.006	0.001	12.7	0.002	25.7
Chromium (III)	Annual	5	0.003	0.1	n/c	n/c
Chromium (VI)	Annual	0.0002	5E-06	2.3	9E-05	45.1
Copper	Annual	10	0.001	<0.1	n/c	n/c
Lead	Annual	0.25	0.002	0.6	n/c	n/c
Manganese	Annual	0.15	0.002	1.2	0.005	3.0
Nickel	Annual	0.02	0.007	33.5	0.007	35.6
Vanadium	Annual	5	0.0002	<0.1	n/c	n/c
HF	Monthly	16	0.1	0.5	n/c	n/c
PCB	Annual	0.2	0.0003	0.1	n/c	n/c
PAH (BaP)	Annual	0.001	0.0001	5.1	0.0002	17.6
Dioxins	Annual	3E-07	4E-09	1.4	2E-08	5.4

AQAL			PC (µg/m³)	PC % of AQAL	PEC (µg/m³)	PEC % of AQAL
Pollutant	Period	µg/m³				
Table Notes: n/c = not calculated: following AERA guidance the PEC has only been calculated where the PC is 1% or above.						

Bridgnorth AQMA Long Term NO_2 Impacts

In recognition of local sensitivities, Table 6-2 details the results of the impact assessment for annual mean NO_2 concentrations at relevant human receptor locations within the Bridgnorth AQMA.

The PCs at all relevant receptor locations are <1% of the AQAL and can therefore be described as insignificant.

Table 6-2
Long Term NO_2 Impacts at Human Receptors Within the Bridgnorth AQMA

Receptor	Annual Mean (40µg/m³)			
	PC (µg/m³)	PC as % of AQAL	PEC (µg/m³)	PEC as % of AQAL
R24	<0.1	<0.1	n/c	n/c
R25	<0.1	<0.1	n/c	n/c
R30	*Short Term Exposure Only*			
Table Notes: n/c = not calculated: following AERA guidance the PEC has only been calculated where the PC is 1% or above.				

6.1.2 Short-Term Impacts

Predicted short-term impacts are summarised in Table 6-3.

Isopleth plots are presented in Appendix B for those PCs that are >10%. The resultant PECs for all pollutants (where relevant) are below the AQAL.

Table 6-3
Predicted Maximum Ground Level Short-Term Impacts

AQAL			PC (µg/m³)	PC % of AQAL	PEC (µg/m³)	PEC % of AQAL
Pollutant	Period	µg/m³				
NO_2	1-Hour (99.79%ile)	200	51.8	25.9	67.1	33.5
PM_{10}	24-Hour (90.4%ile)	50	0.7	1.4	n/c	n/c
Benzene	24-Hour	30	3.0	10.0	3.3	11.2
CO	Daily 8-Hour	10,000	20.3	0.2	n/c	n/c
CO	1-Hour	30,000	45.5	0.2	n/c	n/c
SO_2	24-Hour (99.18%ile)	125	7.7	6.2	n/c	n/c
SO_2	1-Hour (99.73%ile)	350	24.1	6.9	n/c	n/c
SO_2	15-Min (99.9%ile)	266	34.1	12.8	39.1	14.7
HCl	1-Hour	750	5.5	0.7	n/c	n/c
HF	1-Hour	160	0.9	0.6	n/c	n/c
Mercury	1-Hour	7.5	0.02	0.2	n/c	n/c
Antimony	1-Hour	150	0.01	n/c	n/c	n/c

AQAL			PC (µg/m³)	PC % of AQAL	PEC (µg/m³)	PEC % of AQAL
Pollutant	Period	µg/m³				
Chromium (III)	1-Hour	150	0.1	n/c	n/c	n/c
Copper	1-Hour	200	0.02	n/c	n/c	n/c
Manganese	1-Hour	1,500	0.033	n/c	n/c	n/c
Vanadium	1-Hour	1	0.003	0.3	n/c	n/c
PCB	1-Hour	6	0.005	0.1	n/c	n/c
Table Notes: n/c = not calculated: following AERA guidance the PEC has not been calculated as all PCs are less than 10%.						

Bridgnorth AQMA Short Term NO_2 Impacts

In recognition of local sensitivities, Table 6-4 details the results of the impact assessment for 1-hour (99.79%ile) NO_2 concentrations at relevant human receptor locations within the Bridgnorth AQMA.

The PCs at all relevant receptor locations are <10% of the AQAL and can therefore be described as insignificant.

Table 6-4
Short Term NO_2 Impacts at Human Receptors Within the Bridgnorth AQMA

Receptor	Annual Mean (40µg/m³)			
	PC (µg/m³)	PC as % of AQAL	PEC (µg/m³)	PEC as % of AQAL
R24	1.0	0.5	n/c	n/c
R25	0.9	0.5	n/c	n/c
R30	0.9	0.5	n/c	n/c
Table Notes: n/c = not calculated: following AERA guidance the PEC has only been calculated where the PC is 1% or above.				

6.1.3 Impacts from Half Hourly Emission Limits

Predicted short-term impacts from half-hourly (BAT adjusted) emission limits are summarised in Table 6-5.

Table 6-5
Maximum Short Term Impacts using Half-Hourly BAT adjusted IED Chapter IV ELVs

AQAL			PC (µg/m³)	PC % of AQAL	PEC (µg/m³)	PEC % of AQAL
Pollutant	Period	µg/m³				
NO_2	1-Hour (99.79%ile)	200	85.9	43.0	101.2	50.6
CO	1-Hour	30,000	91.0	0.3	n/c	n/c
SO_2	1-Hour (99.73%ile)	350	96.3	27.5	101.3	28.9
SO_2	15-Min (99.9%ile)	266	136.3	51.2	141.3	53.1
HCl	1-Hour	750	32.8	4.4	n/c	n/c
HF	1-Hour	160	3.6	2.3	n/c	n/c
Table Notes: n/c = not calculated: following AERA guidance the PEC has not been calculated as all PCs are less than 10%.						

Maximum ground level PCs are less than 10% of the corresponding AQALs for all emissions with the exception of NO_2 1-hour mean and SO_2 1-hour and 15-min means. However, resultant PECs are below the corresponding AQALs.

6.2 Sensitive Ecosystems

Results presented herein relates to the maximum modelled impact of each individual ecological designation requiring assessment, and as such, represents a conservative outlook.

6.2.1 Critical Levels

Table 6-6 and Table 6-7 details the predicted impacts on long term and short term CLe, respectively, at the identified ecological sites. The presented PC relates to the maximum modelled impact at each individual ecological designation requiring assessment.

Table 6-6
Predicted Impacts on Long-Term Critical Levels

Site	PC Screening Threshold (%)	NOx Annual Mean		SO_2 Annual Mean [(a)]	
		PC (µg/m^3)	PC as % CLe	PC (µg/m^3)	PC as % Cle
ER1 (AW)	100	0.2	0.6	0.2	0.6

Table Notes:
(a) To provide a conservative assessment, the Cle for annual mean SO_2 at all ecological designations has assumed to be 10µg/m^3 which is only applicable where lichens or bryophytes are present.

Table 6-7
Predicted Impacts on Short-Term Critical Levels

Site	PC Screening Threshold (%)	NOx 24-Hour Mean		HF 24-Hour Mean		HF Weekly Mean	
		PC (µg/m^3)	PC as % CLe	PC (µg/m^3)	PC as % CLe	PC (µg/m^3)	PC as % CLe
ER1 (AW)	100	3.2	4.3	<0.1	0.4	<0.1	1.8

All short and long-term PCs are below the relevant designation-specific assessment criteria. Impacts can therefore be considered insignificant, and will cause 'no significant pollution' for the AW.

6.2.2 Critical Loads

The predicted impact on CLo at the identified ecological sites for nitrogen and acid deposition are presented in Table 6-8 and Table 6-9, respectively. The presented PC relates to the maximum modelled impact at each individual ecological designation requiring assessment.

Table 6-8
Maximum Predicted Nutrient Nitrogen Deposition Impacts at Ecological Receptors

Site	PC Screening Threshold (%)	PC N	Applied CLo (Min)	PC as % C_{Lo}
		(kg/ha/yr)		
ER1 (AW)	100	0.034	10	0.3

Table 6-9
Acid Deposition Impacts at Ecological Receptors

Site	PC Screening Threshold (%)	Sensitivity [(a)]	Applied CLo (MaxS/MaxN)	PC	PC as % CLo
			(keq/ha/yr)		
ER1 (AW)	100	N	1.215	0.01	1.0

Site	PC Screening Threshold (%)	Sensitivity [a]	Applied CLo (MaxS/MaxN)	PC	PC as % CLo
			(keq/ha/yr)		

Table Notes:
(a) Whether Nitrogen or Sulphur is the principal constraint in the local setting (Critical Load Function)

All long-term PCs are below the relevant designation-specific assessment criteria. Impacts can therefore be considered insignificant, and will cause 'no significant pollution' for the AW.

7.0 Conclusions

The conclusions of the detailed atmospheric dispersion modelling assessment of combustion emissions on sensitive human and ecological receptor locations arising from the Proposed Installation are as follows:

- there are no predicted exceedances of air quality standards for the protection of human health at the point of maximum ground level impact for any of the scenarios assessed;
- impacts upon the Bridgnorth AQMA with respect to NO_2 concentrations are considered insignificant;
- the predicted impact on designated sensitive habitats are considered insignificant and will cause 'no significant pollution' for the AW.

Appendix A – Modelling Checklist

Table A-1
Modelling Checklist

Item	Yes / No	Details / Reason for omission
Location map	Yes	Figure 3-1
Site plan	Yes	Figure 3-1
Pollutants modelled and relevant environmental standards	Yes	Section 2.2 and Section 5.2
Details of modelled scenarios	Yes	Section 5.2
Details of relevant ambient concentrations	Yes	Section 4.0
Model description and justification	Yes	Section 3.1
Special model treatment used	No	-
Table of emission parameters used	Yes	Section 5.0 (Table 5-4, Table 5-5 and Table 5-7)
Details of modelled domain and receptors	Yes	Section 3.2
Details of meteorological data used	Yes	Section 3.5
Details of terrain treatment	Yes	Section 3.3
Details of building treatment	Yes	Section 3.4
Model uncertainty and sensitivity	Yes	Section 3.9
Assessment of impacts	Yes	Section 6.0
Contour plots	Yes	Appendix B

APPENDIX B – Process Contribution Isopleths

Figure B-1
Arsenic Annual Mean PCs as a % of the AQAL: Isopleth

Figure B-2
Cadmium Annual Mean PCs as a % of the AQAL: Isopleth

Figure B-3
Chromium (VI) Annual Mean PCs as a % of the AQAL: Isopleth

Figure B-4
Dioxins and Furans Annual Mean PCs as a % of the AQAL: Isopleth

Figure B-5
Manganese Annual Mean PCs as a % of the AQAL: Isopleth

Figure B-6
Nickel Annual Mean PCs as a % of the AQAL: Isopleth

Figure B-7
Nitrogen Dioxide Annual Mean PCs as a % of the AQAL: Isopleth

Figure B-8
Benzene Annual Mean PCs as a % of the AQAL: Isopleth

Figure B-9
PAHs as BaP Annual Mean PCs as a % of the AQAL: Isopleth

Figure B-10
$PM_{2.5}$ Annual Mean PCs as a % of the AQAL: Isopleth

Figure B-11
TOC (as Benzene) 24-Hour Mean PCs as a % of the AQAL: Isopleth

Figure B-12
Nitrogen Dioxide 1-Hour Mean (99.79%ile) PCs as a % of the AQAL: Isopleth

Figure B-13
Sulphur Dioxide 15-Minute Mean (99.9%ile) PCs as a % of the AQAL: Isopleth

EUROPEAN OFFICES

United Kingdom

AYLESBURY
T: +44 (0)1844 337380

BELFAST
belfast@slrconsulting.com

BRADFORD-ON-AVON
T: +44 (0)1225 309400

BRISTOL
T: +44 (0)117 906 4280

CARDIFF
T: +44 (0)29 2049 1010

CHELMSFORD
T: +44 (0)1245 392170

EDINBURGH
T: +44 (0)131 335 6830

EXETER
T: + 44 (0)1392 490152

GLASGOW
glasgow@slrconsulting.com

GUILDFORD
guildford@slrconsulting.com

LONDON
T: +44 (0)203 805 6418

MAIDSTONE
T: +44 (0)1622 609242

MANCHESTER (Media City)
T: +44 (0)161 872 7564

NEWCASTLE UPON TYNE
T: +44 (0)191 261 1966

NOTTINGHAM
T: +44 (0)115 964 7280

SHEFFIELD
T: +44 (0)114 245 5153

SHREWSBURY
T: +44 (0)1743 23 9250

STIRLING
T: +44 (0)1786 239900

WORCESTER
T: +44 (0)1905 751310

Ireland

DUBLIN
T: + 353 (0)1 296 4667

France

GRENOBLE
T: +33 (0)6 23 37 14 14