AIR DISPERSION MODELLING ASSESSMENT OF RELEASES FROM THE PROPOSED HIGH TEMPERATURE INCINERATION PLANT, NEWTON AYCLIFFE

ECL Ref: OLCO.01.01/ADM
February 2024
Version: Issue 1

AIR DISPERSION MODELLING REPORT OF RELEASES FROM THE PROPOSED HIGH TEMPERATURE INCINERATION PLANT

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ACRONYMS / TERMS USED IN THIS REPORT

AAD	Ambient Air Directive
ADMS	Atmospheric Dispersion Modelling System
APIS	Air Pollution Information System
AQAL	Air Quality Assessment Level
AQDD	Air Quality Daughter Directive
AQMA	Air Quality Management Area
AQMAU	Air Quality Modelling Assessment Unit
AQO	Air Quality Objective
AQS	Air Quality Standard
As	Arsenic
ASR	Annual Status Report
B[a]P	Benzo[a]Pyrene
BAT	Best Available Techniques
BAT-AEL	Best Available Techniques–Associated Emission Level
Bref	Best Available Techniques Reference Document
Cd	Cadmium
CERC	Cambridge Environmental Research Consultants
CO	Carbon monoxide
Co	Cobalt
CrIII	Chromium III
CrVI	Chromium VI
cSAC	Candidate Special Areas of Conservation
Cu	Copper
DCC	Durham County Council
DBC	Darlington County Borough Council
DEFRA	Department for Environment, Food and Rural Affairs
DT	Diffusion Tube
EA	Environment Agency
ECL	Environmental Compliance Ltd
ELV	Emission Limit Value
EP	Environmental Permit
EPAQS	Expert Panel on Air Quality Standards
EPR	Environmental Permitting Regulations
EPUK	Environmental Protection UK
GLC	Ground Level Concentration
HCl	Hydrogen Chloride
HF	Hydrogen Fluoride
Hg	Mercury
HTI	High Temperature Incineration
IAQM	Institute of Air Quality Management
IED	Industrial Emissions Directive
LNR	Local Nature Reserve
LWS	Local Wildlife Site
Met Data	Meteorological Data
Met Office	Meteorological Office
Met Station	Meteorological Station
Met Year	Meteorological Year

ACRONYMS / TERMS USED IN THIS REPORT (cont.)

Mn	Manganese
N	Nitrogen
NH_3	Ammonia
Ni	Nickel
NO_2	Nitrogen dioxide
NO_x	Oxides of nitrogen
OCL	Olive Compliance Limited
PAH	Polyaromatic Hydrocarbons
Pb	Lead
PC	Process Contribution
PCB	Polychlorinated Biphenyls
PEC	Predicted Environmental Concentration
PM_{10}	Particulate Matter (with a diameter of 10 µm or less)
$PM_{2.5}$	Particulate Matter (with a diameter of 2.5 µm or less)
Ramsar	Ramsar Convention on Wetlands of International Importance
S	Sulphur
SAC	Special Areas of Conservation
Sb	Antimony
SEPA	Scottish Environment Protection Agency
SO_2	Sulphur Dioxide
SPA	Special Protection Areas
SSSI	Site of Special Scientific Interest
Tl	Thallium
The Installation	Proposed High Temperature Incineration Plant
V	Vanadium
VOC	Volatile Organic Compounds
WHO	World Health Organisation

1. INTRODUCTION

1.1. The Study

1.1.1. Environmental Compliance Ltd ("ECL") were commissioned by Olive Compliance Limited ("OCL") to undertake an air quality assessment of releases from the proposed High Temperature Incineration ("HTI") plant ("the Installation"), at Land north of Hitachi Rail Europe Limited, Millenium Way, Aycliffe Business Park, Newton Aycliffe, in support of an Environmental Permit ("EP") application to the Environment Agency ("EA").

1.1.2. The study was conducted to determine the impact of emissions to air from the proposed Installation on both human health and local environmentally sensitive sites.

1.1.3. The study was undertaken using the Atmospheric Dispersion Modelling System ("ADMS") modelling package, which is one of the models recognised as being suitable for this type of study.

1.1.4. The approximate site location is shown on the Site Location Map, outlined in red, which is presented as Figure 1.

Figure 1: Site Location Map

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1.2. Objectives of the Study

1.2.1. The objectives of this study are as follows:

- to determine the maximum ground level concentrations ("GLCs") arising from the emission of pollutants from the Installation's discharge stack; the pollutants are assumed to be released from the Installation at the upper end of the Emission Limit Values ("ELVs") defined in the Best Available Techniques ("BAT") Reference Document ("Bref") for Waste Incineration[1] (i.e., the BAT-associated emission levels ("BAT-AELs") will be used). Annex VI of the Industrial Emissions Directive ("IED")[2] - *Technical provisions relating to waste incineration plants and waste co-incineration plants* will also be referred to. Maximum GLCs have been determined with the plant operating normally and abnormally;
- to assess the impact of emissions from the Installation's discharge stack on existing local air quality in relation to human health at a range of potentially sensitive receptors by comparison with relevant air quality standards ("AQSs");
- to assess the impact of emissions from the Installation's discharge stack on potentially sensitive ecological receptors and compare these to the Critical Levels set for the protection of Ecosystems;
- to predict deposition rates of acids and nutrient nitrogen from the modelled emissions and compare these with relevant Critical Loads at a range of sensitive habitat sites;
- to assess plume visibility;
- to assess abnormal emissions as detailed in IED.

1.3. Scope of the Study

1.3.1. The main study determined the maximum predicted GLCs of the following pollutants:

- nitrogen oxides (NO_x and NO_2);
- total fine particles (PM_{10} and $PM_{2.5}$);
- carbon monoxide;
- gaseous and vaporous organic substances ("VOCs"), expressed as total organic carbon and assumed to comprise entirely of benzene (this is in accordance with the EA's guidance when grouping air emissions[3], which says where characterisation of VOCs has not been undertaken, treat all VOCs as benzene);
- sulphur dioxide;
- hydrogen chloride;
- hydrogen fluoride;
- ammonia;
- mercury and its compounds;
- cadmium and thallium and their compounds;
- antimony, arsenic, chromium, cobalt, copper, lead, manganese, nickel, vanadium and their compounds (note for ease of reporting, this group of nine metals and

[1] *Best Available Techniques (BAT) Reference Document for Waste Incineration* (published December 2019). Available online via: https://eippcb.jrc.ec.europa.eu/sites/default/files/2020-01/JRC118637_WI_Bref_2019_published_0.pdf

[2] Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) (Recast)

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

their compounds are hereinafter referred to as "Group 3 metals and their compounds";
- dioxins and furans;
- polychlorinated biphenyls and
- PAH, as benzo[a]pyrene (the AQS for PAH is expressed as benzo[a]pyrene, and, accordingly, for the purposes of the assessment, all PAH are assumed to be present as benzo[a]pyrene).

1.3.2. Modelling was carried out using the upper end of the BAT-AELs outlined for New Plant; as specified in the BAT conclusions of the Bref document on waste incineration (published December 2019). Where short-term half-hourly ELVs are specified in the guidance (i.e., in Annex VI of the IED), these have also been used. It has been considered that, by assessing the impact of abnormal releases, this will help to ensure the assessment is as conservative as possible. The Daily BAT-AELs were used for the pollutants in which half-hourly ELVs have not been assigned.

1.3.3. The effects of prevailing meteorological conditions, building downwash effects, local terrain and existing ambient air quality were also taken into account.

1.3.4. The maximum predicted pollutant ground level concentrations ("GLCs") - also known as the process contributions ("PCs") - for each of the releases were compared with the relevant AQSs.

1.3.5. The predicted environmental concentrations ("PECs") - the sum of the pollutant PC and the existing pollutant background concentration from other sources - were also compared to the relevant standards. Results are presented as the maximum predicted GLC and the maximum sensitive receptor GLC.

1.3.6. The maximum predicted annual mean GLCs of NO_x, sulphur dioxide ("SO_2"), hydrogen fluoride ("HF") and ammonia ("NH_3") were compared with the Critical Levels for the Protection of Ecosystems or Vegetation detailed in the Environment Agency's online guidance[4].

1.3.7. The maximum predicted pollutant GLCs at eighteen human receptors were also compared to the relevant AQSs.

1.3.8. The Site is located within Darlington Borough Council ("DBC") which currently has not declared any Air Quality Management Area ("AQMAs"). The neighbouring Durham County Council ("DCC") has one active AQMA (declared on the 9th of May 2011 for NO_2 (and amended most recently on the 20th of September 2022)) – however, this is situated approximately 19 km north from the proposed Installation. Consequently, given the considerable distance of the nearest AQMA from the proposed Installation, AQMAs will not need to be considered as part of this assessment.

1.3.9. Using ADMS, the rates of deposition for acids (nitrogen and sulphur, as kilo-equivalents) and nutrient nitrogen were predicted for all relevant habitat sites. These rates were then compared to the appropriate critical loads for the type and location of each habitat.

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

1.3.10. Abnormal operating conditions were also considered in the study to take account of short-term abnormal conditions permitted under Article 46(6) of the IED.

1.3.11. A discussion of cumulative impacts is provided in the Committee Report, as provided with the planning application documents for the proposed development[5]. Paragraph 339 of the Committee Report states:

Cumulative impacts from proposed or committed developments in the vicinity of the proposed development have been considered within the technical chapters of the ES. The ES states that there are no identified already constructed and established waste management or other technically similar facilities within close proximity to the site for which cumulative effects have been considered. In addition, the applicant has investigated the details of any other projects which could in combination with the proposed development, give rise to cumulative significant effects and no such other schemes have been identified. The assessment of cumulative impact concludes that no unacceptable successive or simultaneous effects are likely to occur as a result of the proposed development. In terms of the assessment of the combined and the cumulative effects from the proposed development on the site on the surrounding areas, the ES considers it has been determined that there are no likely significant such effects on these areas. Given that none of the individual environmental areas reach the threshold of unacceptable, the totality of these effects would not result in them being cumulatively unacceptable nor in combination.

1.3.12. Consequently, it is considered that the potential for cumulative air quality impacts have been adequately addressed as part of the works undertaken for the planning application. Cumulative impact discussions will therefore not feature any further as part of this study.

[5] Durham County Council Planning Services, Committee Report for Planning Application DM/21/01500/WAS. Available online via: https://publicaccess.durham.gov.uk/online-applications/files/B99C2613A342B15E3E58C342BCFB8A5F/pdf/DM_21_01500_WAS-COMMITTEE_REPORT-3060188.pdf

2. METHOD STATEMENT

2.1. Choice of Model

2.1.1. The UK-ADMS model was developed jointly by Cambridge Environmental Research Consultants ("CERC"), Her Majesty's Inspectorate of Pollution (the EA's predecessor body), the Meteorological Office and National Power, with sponsorship from the UK Government and a number of commercial organisations. UK-ADMS is a computer-based model of dispersion from both point and non-point sources in the atmosphere and is one of the modelling packages that are suitable for this type of study. The current version is ADMS 6.0.

2.1.2. ADMS 6.0 has been validated against a number of data sets in order to assess various configurations of the model such as flat or complex terrain, line/area/volume sources, buildings, dry deposition fluctuations and visible plumes. The model results have been compared to observational data or other model results if available.

2.1.3. ADMS 6.0 is a new generation Gaussian plume air dispersion model, which means that the atmospheric boundary layer properties are characterised by two parameters:

- the boundary layer depth, and
- the Monin-Obukhov length,

rather than in terms of the single parameter Pasquill-Gifford class.

2.1.4. Dispersion under convective meteorological conditions uses a skewed Gaussian concentration distribution (shown by validation studies to be a better representation than a symmetrical Gaussian expression).

2.1.5. ADMS 6.0 is therefore considered to be suitable for use in this assessment.

2.2. Key Assumptions

2.2.1. The study will be undertaken on the basis of a worst-case scenario. Consequently, the following assumptions have been made:

- the release concentrations of the pollutants will be at the permitted ELVs on a 24-hourly basis, 365 days of the year; in practice, when the plant is operating, the release concentrations will be below the ELVs, and, for most pollutants, considerably so; furthermore, taking shutdowns for planned maintenance into account, the plant will not operate for 365 days;
- the highest predicted pollutant GLCs for the six years of meteorological data for each averaging period (annual mean, hourly, etc.) have been used;
- concentrations of NO_2 in the emissions have been calculated assuming a long-term 70% NO_X to NO_2 conversion rate, and a short-term 35% NO_X to NO_2 as referenced in AQTAG06[6];
- all of the particulate releases will be present as $PM_{2.5}$ and also as PM_{10}; this enables direct comparison with the particle AQSs, which are expressed in terms of $PM_{2.5}$

[6] AQTAG06 Technical guidance on detailed modelling approach for an appropriate assessment for emissions to air (April 2014);

and PM_{10}; in practice, this will not be the case as some of the particles present will be larger than PM_{10}; and

- maximum predicted GLCs at any location, irrespective of whether a sensitive receptor is characteristic of public exposure, are compared against the relevant AQSs for each pollutant; in addition, the predicted maximum sensitive receptor GLC has also been assessed.

2.3. Sensitive Human Receptors

2.3.1. In addition to predicting concentrations over a 4km by 4km grid, there are eighteen potentially sensitive human receptors considered in the assessment. Details of these receptors are provided in Table 1 and a visual representation as Figure 2.

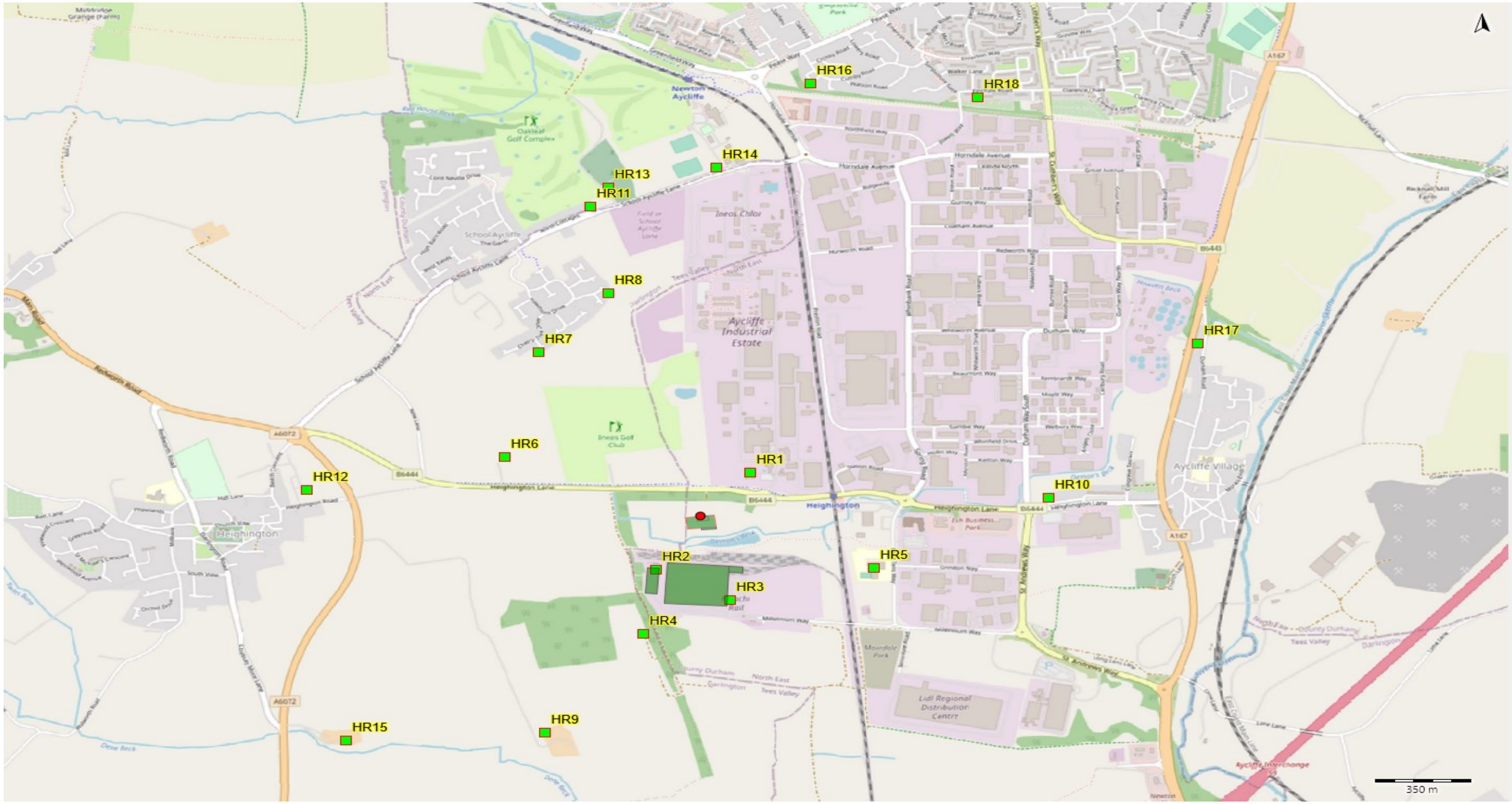
2.3.2. It should be noted that, with the exception of elevated receptor HR2 – Hitachi Rail Intake Vents (specified at a height of 14m from ground level in the model), all remaining receptors are assumed to be at ground level.

Table 1: Potentially Sensitive Human Receptors

ADMS Ref.	Name	Easting (X)	Northing (Y)	Distance from Source (m)	Heading (°)
HR1	Industrial	426818	522628	262	43
HR2	Hitachi Rail Intake Vents (14m from ground level)	426479	522196	289	214
HR3	Hitachi Rail (Ground level)	426746	522065	386	164
HR4	Clay Pigeon Shooting	426431	521913	563	202
HR5	College	427269	522205	670	110
HR6	East Field Lane	425930	522696	756	290
HR7	Cherry Tree Drive	426052	523161	933	321
HR8	Magnolia Close	426306	523424	1,043	341
HR9	Bracks Farm	426076	521477	1,113	210
HR10	Heighington Road	427904	522516	1,267	86
HR11	North Cottages	426239	523806	1,427	344
HR12	Kieran Maxwell Lane	425211	522549	1,433	275
HR13	West Cemetery	426307	523891	1,493	347
HR14	Sports Ground	426697	523979	1,544	2
HR15	Dene Bridge Farm	425352	521443	1,626	232
HR16	Cumby Road	427037	524352	1,957	12
HR17	Durham Road	428443	523200	1,958	67
HR18	Finchale Road	427645	524291	2,110	28

Notes to Table 1
(a) Distances are measured as the crow flies from the receptor to the stack coordinates.

Figure 2: Location of the Potentially Sensitive Human Receptors Considered for the Assessment



Notes to Figure 2

The red circle is the approximate location of the proposed HTI emission point;

The neon green squares with the red outline and yellow highlighted annotations are the locations of the potentially sensitive human receptor locations specified in Table 1; and

The darker green shapes represent the buildings layout considered in the modelling assessment (refer to Section 2.16., for further details).

2.4. Sensitive Ecological Receptors

2.4.1. The impact of emissions to air on vegetation and ecosystems from the Installation has been assessed for the following sensitive environmental receptors within 10km of the proposed discharge stack:

- Special Areas of Conservation ("SACs") and candidate SACs ("cSACs") designated under the EC Habitats Directive[7];
- Special Protection Areas ("SPAs") and potential SPAs designated under the EC Birds Directive[8];
- SACs and SPAs are included in an EU-wide network of protected sites called Natura 2000[9]. The EC Habitats Directive and Wild Birds Directive have been transposed into UK law by the Habitats Regulations[10]; and
- Ramsar Sites designated under the Convention on Wetlands of International Importance[11].

2.4.2. In addition, the impact of emissions to air on vegetation and ecosystems from the Installation has been assessed for the following sensitive environmental receptors within 2km of the discharge stack:

- Sites of Special Scientific Interest ("SSSI") established by the 1981 Wildlife and Countryside Act;
- Ancient woodland; and
- local nature sites (ancient woodland, local wildlife sites ("LWS") and national and local nature reserves).

2.4.3. Based on the 10km and 2km ecological searches outlined above, only LWSs were identified. The details of the habitat sites are provided in Table 2, and a visual representation provided in Figure 3. For dispersion modelling purposes, the specified habitat coordinates are a precautionary approach, and are those located at the boundary of the protected site / priority habitat approximately closest in distance to the proposed Installation. All receptors are assumed to be at ground level.

Table 2: Ecological Receptors Considered for the Assessment

ADMS Ref.	Name	Designation(s)	Easting (X)	Northing (Y)	Distance from Site [a] (m)	Heading (°)
ER1	Cumby Pond	LWS	426813	522322	207	123
ER2	Aycliffe Quarry		428139	522057	1,546	104
ER3	School Aycliffe		425850	524061	1,807	334
ER4	Aycliffe Nature Park		428310	523988	2,280	47

Notes to Table 2

(a) The ecological sites included were identified using the Multi-Agency Geographic Information System for the Countryside ("MAGIC") portal.

(b) Distances are measured as the crow flies from the approximate nearest point of the boundary of the ecological receptor to the stack coordinates.

[7] Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora

[8] Council Directive 79/409/EEC on the conservation of wild birds

[9] www.natura.org

[10] The Conservation (Natural Habitats, &c.) Regulations 1994. The Conservation (Natural Habitats, &c.) (Amendment) Regulations 1997 (Statutory Instrument 1997 No. 3055), The Conservation (Natural Habitats, &c.) (Amendment) (England) Regulations 2000 (Statutory Instrument 2000 No. 192)

[11] The Convention of Wetlands of International Importance especially as Waterfowl Habitat (Ramsar, Iran,1971)

Figure 3: Location of the Potentially Sensitive Ecological Receptors Considered for the Assessment

Notes to Figure 3

The red circle is the approximate location of the proposed HTI emission point;

The neon green squares with the red outline and yellow highlighted annotations are the locations of the ecological receptor locations specified in Table 2; and

The darker green shapes represent the buildings layout considered in the modelling assessment (refer to Section 2.16., for further details)

2.5. Air Quality Standards for the Protection of Human Health

2.5.1. The Air Quality Strategy for England, Scotland, Wales and Northern Ireland[12] details Air Quality Strategy Objectives for a range of pollutants, including a number that are directly relevant to this study. In addition, the Regulatory Authorities must ensure that the proposals do not exceed Ambient Air Direction ("AAD") limit values.

2.5.2. The 4th Air Quality Daughter Directive[13] ("AQDD") details Target Values for arsenic, cadmium and nickel. The Expert Panel on Air Quality Standards ("EPAQS"), which advises the UK Government on air quality, has set recommended Guideline Values for arsenic, chromium VI and nickel; the EPAQS Guideline Value for nickel is the same as the AQDD Target Value, but the EPAQS Guideline Value for arsenic is half that of the AQDD value. The lowest of these values have been taken into account in this study.

2.5.3. In the case of hydrogen chloride, hydrogen fluoride, chromium (VI) and arsenic, EPAQS has set recommended Guideline Values which have been taken into account in this study. Environmental Quality Standards ("EQSs") have been assigned by the EA (by the use of the EA's EQS) to a number of the other pollutants assessed in the modelling study; these are detailed (where assigned) in the EA's online guidance; these have been derived from a variety of published UK and international sources (including the World Health Organisation ("WHO")).

2.5.4. In this report, the generic term Air Quality Standard ("AQS") is used to refer to any of the above values. The various AQSs - Air Quality Objectives, Target Values, EPAQS Guideline Values and EALs - are intended to be used as guidelines for the protection of human health and the management of local air quality. The values relevant to this study are detailed in Table 3.

[12] The Air Quality Strategy for England, Scotland, Wales and Northern Ireland (Volume 1), July 2007

[13] Directive 2004/107/EC of the European Parliament and of the Council of 15 December 2004 relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air, 15th December 2004.

Table 3: Air Quality Standards for the Protection of Human Health

Pollutant	Averaging Period	AQS ($\mu g/m^3$)	Comments
Nitrogen Dioxide (NO_2)	annual	40	UK AQO
	1-hour	200	UK AQO, not to be exceeded more than 18 times per annum, equivalent to the 99.79th percentile of 1-hour means
Sulphur Dioxide (SO_2)	24-hour	125	UK AQO, not to be exceeded more than 3 times per annum, equivalent to the 99.18th percentile of 24-hour means
	1-hour	350	UK AQO, not to be exceeded more than 24 times per annum, equivalent to the 99.73rd percentile of 1-hour means
	15-minute	266	UK AQO, not to be exceeded more than 35 times per annum, equivalent to the 99.90th percentile of 15-minute means
Particulate Matter as PM_{10}	annual	40	UK AQO
	24-hour	50	UK AQO, not to be exceeded more than 7 times per annum, equivalent to the 98.08th percentile of 24 hour means
Particulate Matter as $PM_{2.5}$	annual	20	EU Limit Value
Carbon Monoxide (CO)	8-hour	10,000	UK AQO
VOC (as benzene)	annual	5	UK -AQO
	24-hour	30	
Ammonia (NH_3)	annual	180	EAL derived from long-term occupational exposure limits
	1-hour	2,500	EAL derived from long-term occupational exposure limits as no short-term limit exists
Hydrogen Chloride (HCl)	1-hour	750	EPAQS Guideline Value
Hydrogen Fluoride (HF)	Annual	16	EPAQS Guideline Values
	1-hour	160	
Antimony (Sb)	annual	5	EAL derived from long-term occupational exposure limits
	1-hour	150	EAL derived from long-term occupational exposure limits as no short-term limit exists
Arsenic (As)	annual	0.003	`EPAQS Guideline Value
Cadmium (Cd)	annual	0.005	AQDD Target Value/EPAQS Guideline Value
Chromium III (CrIII)	annual	5	EAL derived from long-term occupational exposure limits
	1-hour	150	EAL derived from long-term occupational exposure limits as no short-term limit exists

Table 3: Air Quality Standards for the Protection of Human Health (cont.)

Pollutant	Averaging Period	AQS ($\mu g/m^3$)	Comments
Chromium VI (CrVI)	annual	0.0002	EPAQS Guideline Value
Cobalt (Co)	annual	0.2	EAL derived from long-term occupational exposure limits
	1-hour	6	EAL derived from short-term occupational exposure limits
Copper (Cu)	annual	10	EAL derived from long-term occupational exposure limits
	1-hour	200	EAL derived from short-term occupational exposure limits
Lead (Pb)	annual	0.25	UK AQO
Manganese (Mn)	annual	1	WHO Guideline Value
	1-hour	1500	EAL derived from long-term occupational exposure limits as no short-term limit exists
Mercury (Hg)	annual	0.25	EAL derived from long-term occupational exposure limits
	1-hour	7.5	EAL derived from long-term occupational exposure limits as no short-term limit exists
Nickel (Ni)	annual	0.02	AQDD Target Value/EPAQS Guideline Value
Thallium (Tl)	Annual	1	EAL derived from long-term occupational exposure limits
	1-hour	30	EAL derived from short-term occupational exposure limits
Vanadium (V)	annual	5	EAL derived from long-term occupational exposure limits
	24-hour	1	WHO Guideline Value
Benzo[a]pyrene	annual	0.00025	UK AQO
PCBs	annual	0.2	EAL
	1-hour	6	EAL
Dioxins and Furans	No Standard Applies		

Notes to Table 3

(a) WHO (2000) Air Quality Guidelines for Europe; 2nd Edition. WHO Regional Publications, European Series, No. 91.

(b) UN Economic & Social Council, Executive Body for the Convention on Long-Range Transboundary Air Pollution, ECE/EB.AIR/WG.5/2007/3.

(c) Mc Cune, DC (1969a): Fluoride criteria for vegetation reflect the diversity of the plant kingdom. In a symposium: The technical significance of air quality standards. Environmental Science & Technology. 3: 720-735.

2.6. Assessment Criteria for the Protection of Sensitive Habitat Sites and Ecosystems - Critical Levels

2.6.1. Critical levels are thresholds of airborne pollutant concentrations above which damage may be sustained to sensitive plants and animals. High concentrations of pollutants in ambient air directly cause harm to leaves and needles of forests and other plant communities. Oxidised nitrogen can have both a toxic effect on vegetation and an impact on nutrient nitrogen.

2.6.2. The 2008 Air Quality Directive[14] set limit values for the protection of vegetation and ecosystems and these have been adopted by the Air Quality Strategy but are not currently set in Regulations. The current objectives are summarised in Table 4.

Table 4: Assessment Criteria for the Protection of Sensitive Habitats and Ecosystems

Pollutant	Averaging Period	Critical Level (µg/m³)	Comments
Nitrogen Oxides (as NO_2)	annual	30	Air Quality Objective
	daily	75	(a)
Sulphur Dioxide (SO_2)	annual	10	Sensitive lichen communities & bryophytes and ecosystems where lichens & bryophytes are an important part of the ecosystem's integrity (a)
	annual	20	Air Quality Objective
	winter mean	20	Air Quality Objective
Ammonia (NH_3)	annual	1	Sensitive lichen communities & bryophytes and ecosystems where lichens & bryophytes are an important part of the ecosystem's integrity (b)
	annual	3	All other ecosystems (b)
Hydrogen Fluoride (HF)	daily	5	(c)
	weekly	0.5	(c)

Notes to Table 4
(a) WHO (2000) Air Quality Guidelines for Europe; 2nd Edition. WHO Regional Publications, European Series, No. 91.
(b) UN Economic & Social Council, Executive Body for the Convention on Long-Range Transboundary Air Pollution, ECE/EB.AIR/WG.5/2007/3.
(c) Mc Cune, DC (1969a): Fluoride criteria for vegetation reflect the diversity of the plant kingdom. In a symposium: The technical significance of air quality standards. Environmental Science & Technology. 3: 720-735.

[14] Directive 2008/50/EC on Ambient Air Quality and Cleaner Air for Europe, 21st May 2008

2.7. Assessment Criteria for the Protection of Sensitive Habitat Sites and Ecosystems - Critical Loads

2.7.1. Critical Loads are defined as:

"a quantitative estimate of exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge"[15].

2.7.2. Critical loads for nutrient nitrogen are set under the Convention on Long-Range Transboundary Air Pollution based on empirical evidence, mainly observations from experiments and gradient studies. Critical loads[16] are assigned to habitat classes of the European Nature Information System[17] in units of kgN/ha/yr.

2.7.3. Predicted NO_x deposition rates in units of µg m^{-2} s^{-1} are converted to units of kg/ha/yr as nitrogen for direct comparison with critical loads as follows:

$$kgN/ha/yr = \mu g/m^2/s \times (14/46)^{18} \times 315.36^{19}$$

2.7.4. Exceedance of critical loads for nitrogen deposition can result in significant terrestrial and freshwater impacts due to changes in species composition, reduction in species richness, increase in nitrate leaching, increases in plant production, changes in algal productivity and increases in the rate of succession[20].

2.7.5. In the UK, an empirical approach is applied to critical loads for acidity for non-woodland habitats; and the simple mass balance equation is applied to both managed and unmanaged woodland habitats. For freshwater ecosystems, national critical load maps are currently based on the First-order Acidity Balance model. All of these methods provide critical loads for systems at steady-state[16] in units of keq/ha/yr.

2.7.6. The unit kiloequivalent (keq) is the molar equivalent of potential acidity resulting from sulphur or oxidised and reduced nitrogen. Predicted acid deposition rates in units of µg/m^2/s are converted to units of keq/ha/yr) as hydrogen for direct comparison with critical loads as follows:

- nitrogen from NO_x (keq) =([NO_x]µg/m^2/s × (14/46) × 315.36) ÷ 14[21]
- sulphur (keq) =([SO_2]µg/m^2/s × (32/64) × 315.36) ÷ 16[22].

2.7.7. Emissions of ammonia (“NH_3”) and hydrogen chloride (“HCl”) from the Installation will also contribute to the total acidification rate.

2.7.8. Exceedance of the critical loads for acid deposition can result in significant terrestrial and freshwater impacts due to leaching and subsequent increase in availability of potentially toxic metal ions.

[15] From http://www.unece.org/env/lrtap/WorkingGroups/wge/definitions.htm
[16] From http://www.apis.ac.uk/overview/issues/overview_Cloadslevels.htm
[17] See http://eunis.eea.europa.eu/ for details
[18] Ratio of atomic weight of nitrogen to molecular weight of nitrogen dioxide
[19] Conversion factor from µg/m^2 to kg/ha.
[20] From http://www.apis.ac.uk/overview/issues/overview_Cloadslevels.htm#_Toc279788052
[21] 14kg nitrogen/ha$^{/yr}$ = 1keq nitrogen/ha/yr
[22] 16kg sulphur/ha/yr= 1keq sulphur/ha/yr

2.7.9. Table 5 list the site-specific critical loads for nutrient nitrogen deposition and acid deposition. As the Air Pollution Information System ("APIS") does not provide any information for local nature sites, an equivalent feature was used to derive (where possible) critical loads, as indicated in the Habitats Table on the APIS website[23].

[23] http:/www.apis.ac.uk/habitat_table.html

Table 5: Critical Loads for Deposition

ADMS Receptor Reference	Site Name and Designation	Habitat Interest and Habitat Feature	Nutrient Nitrogen (kgN/ha/yr)		Acid Deposition (keq/ha/yr)		
			Lower Critical Load (N)	Upper Critical Load (N)	CL MinN	CL MaxN	CL MaxS
ER1	Cumby Pond – LWS	Fen, marsh, and swamp	15	30	Habitat not sensitive to acidification		
ER2	Aycliffe Quarry – LWS	Dwarf shrub heath	10	20	0.714	2.274	1.56
ER3	School Aycliffe – LWS	Fen, marsh, and swamp	15	30	Habitat not sensitive to acidification		
ER4	Aycliffe Nature Park – LWS	Calcareous Grassland	15	25	0.856	4.856	4

2.8. Habitat Site Specific Baseline Concentrations and Deposition Rates

2.8.1. Airborne NO_X, SO_2 and NH_3 Concentrations

2.8.1.1. A summary of site-specific baseline concentrations of NO_X, SO_2 and NH_3, as provided by APIS, is presented in Table 6. Background concentrations for each ecological receptor have been obtained at the same point as listed in Table 2 i.e., the closest grid square to the point of the site used in the assessment.

Table 6: Baseline Concentrations of NO_X, SO_2 and NH_3

ADMS Receptor Reference	Name and Designation(s)	Background Concentration [(a)]			
		NO_X (µg/m³)		SO_2 (µg/m³)	NH_3 (µg/m³)
		Annual Mean	24 Hour Mean [(b)]	Annual Mean	Annual Mean
ER1	Cumby Pond – LWS	10.74	12.67	1.95	1.89
ER2	Aycliffe Quarry – LWS	11.84	13.97	1.47	1.96
ER3	School Aycliffe – LWS	6.97	8.22	1.01	1.77
ER4	Aycliffe Nature Park – LWS	14.7	17.35	1.72	1.93

Notes to Table 6
(a) Background concentrations have been taken from the APIS website for the closest grid square to the site (data year: 2019-2021).
(b) The 24-hour mean baseline concentration is twice the annual mean multiplied by a factor of 0.59, in accordance with the H1 guidance.

2.8.2. Nutrient Nitrogen and Acid Deposition

1.8.2.3. A summary of site-specific baseline nutrient nitrogen and acid deposition rates, as obtained from APIS, is presented in Table 7. Again, the specific deposition rates for each ecological receptor have been obtained from the same point as listed in Table 2, i.e., the closest grid square to the point of the site used in the assessment.

Table 7: Background Nutrient Nitrogen and Acid Deposition

ADMS Receptor Reference	Name and Designation(s)	Nutrient Nitrogen Background (kgN/ha/yr) [(a)]	Acid Deposition Background - (keq/ha/yr) [(a)]		
			Total	Nitrogen	Sulphur
ER1	Cumby Pond – LWS	16.3	1.23	1.16	0.11
ER2	Aycliffe Quarry – LWS	16.51	1.25	1.18	0.11
ER3	School Aycliffe – LWS	15.88	1.21	1.13	0.12
ER4	Aycliffe Nature Park – LWS	16.33	1.24	1.17	0.11

Notes to Table 7
(a) Background concentrations have been taken from the APIS website for the closest grid square to the site (data year: 2019-2021).

2.9. Deposition Parameters - Sensitive Habitats

2.9.1. Deposition of nitrogen and acids at designated habitats sites was also included in the assessment. This focused on sites within 10km of the Installation as detailed in Section 2.4.3. The pollutant deposition rates are presented in Table 8. These parameters are detailed in AQTAG06. Since woodland sites have a greater surface area, higher deposition velocities are adopted for these sites.

2.9.2. For acidification impacts, the deposition of oxides of nitrogen, ammonia, sulphur dioxide and hydrogen chloride are considered. For nutrient nitrogen, the deposition of the oxides of nitrogen and ammonia are included.

Table 8: Acid/Nitrogen Dry Deposition Velocities [a]

Pollutant	Grassland (m/s)	Woodland (m/s)
Sulphur Dioxide	0.012	0.024
Oxides of Nitrogen (as NO_2)	0.0015	0.003
Ammonia	0.02	0.03
Hydrogen Chloride	0.025	0.06

2.10. Background Air Quality

2.10.1. Background air quality data has been obtained for all pollutants, where relevant, so that the PECs can be calculated. Where background concentrations were needed, the source and concentrations used are discussed in the relevant sections of this report.

2.11. Stack Emission Parameters

2.11.1. The stack emission parameters used in the study are presented in Table 9.

Table 9: Stack Emission Parameters

Parameter	HTI Stack (A1)
Stack Height (m)	30
Stack Exit Diameter (m)	0.70
Stack Gas Discharge Velocity (actual) (m/s)	18.03
Stack Gas Discharge Temperature (°C)	200
Stack Centre Coordinates	426640 (X), 522436 (Y)
Oxygen Concentration in Stack Emission (%)	11
Moisture Concentration in Stack Emission (%)	8.4
Actual Volumetric Flowrate (m^3/s)	6.94
Normalised Volumetric Flowrate (Nm^3/s) [a]	3.67

Notes to Table 9
(a) Referenced to 273K, 1 atm, dry and 11% O_2.

2.11.2. The ELVs assumed for each pollutant and the pollutant mass emission rate for the study are presented in Table 10a for the daily ELVs. Similarly, Tables 10b and 10c display the pollutants where ELVs have been assigned for abnormal emissions – both for half-hourly emission limits and for abnormal operating conditions, respectively. These are the assumed ELVs used for the modelling assessment.

Table 10a: Pollutant Emission Rates – Daily ELVs

Pollutant	ELV (a) (b) (mg/Nm^3)	HTI Stack – A1 (g/s)
NO_x as NO_2	120	0.440
SO_2	30	0.110
CO	50	0.183
PM_{10} (c)	5	0.0183
$PM_{2.5}$ (c)	5	0.0183
VOCs (as Benzene)	10	0.0367
HCl	6	0.0220
HF	1	0.00367
Cd/Tl	0.02	0.0000734
Hg – long-term sampling period	0.01	0.0367
Hg – daily average	0.02	0.0734
Sb, As, Pb, Cr, Co, Cu, Mn, Ni, V	0.3	0.00110
NH_3	10	0.0367
Dioxins and Furans	0.00000006	0.000000000220
PAH (as benzo[a]pyrene) (d)	0.00009	0.000000330
PCBs (d)	0.0000000036	0.0000000000132

Notes to Table 10a

(a) Concentrations are at reference conditions i.e., 273K, 1 atmosphere, 11% oxygen, dry.
(b) Unless stated otherwise, the BAT-AELs have been used (new plant, high end).
(c) It has been assumed that all particulate matter can be present as PM_{10} or $PM_{2.5}$.
(d) The specified ELVs have been assumed based on the DEFRA report on emissions from waste management facilities (*WR0608 Emissions from Waste Management Facilities, ERM Report on Behalf of DEFRA (July 2011)*)

Table 10b: Pollutant Emission Rates – Half-Hourly Emission Limits

Pollutant	ELV (a) (b) (mg/Nm^3)	HTI Stack – A1 (g/s)
NO_x as NO_2	400	1.47
SO_2	200	0.734
PM_{10}	30	0.110
VOCs (as Benzene)	20	0.0734
HCl	60	0.220
HF	4	0.0147

Notes to Table 10b

(a) Concentrations are at reference conditions i.e., 273K, 1 atmosphere, 11% oxygen, dry.
(b) Half-hourly emission limits as prescribed in Annex VI of the IED.

Table 10c: Pollutant Emission Rates – Abnormal Releases

Pollutant	ELV [(a) (b)] (mg/Nm^3)	HTI Stack – A1 (g/s)
NOx as NO_2 – Long-term	121.9	0.447
NOx as NO_2 – Short-term	400	1.47
SO_2	200	0.734
CO	100	0.367
PM_{10} – Long-term	5.99	0.0220
PM_{10} – Short-term	29.2	0.107
HCl	60	0.220
HF (annual)	1.02	0.00374
HF – Short-term	4	0.0147

Notes to Table 10c

(a) Concentrations are at reference conditions i.e., 273K, 1 atmosphere, 11% oxygen, dry.

(b) ELVs as per Article (6) of the IED – when taking account of short-term abnormal operating conditions.

2.12. Meteorological (Met) Data

2.12.1. ADMS has a meteorological pre-processing capability, which calculates the required boundary layer parameters from a variety of data. Meteorological data (“met data”) can be utilised in its sequentially analysed form, which estimates the pattern of dispersion through 10° sectors from the source or as raw data.

2.12.2. The nearest suitable met data available from the Meteorological Office (“Met Office”) is from Durham recording station with missing cloud and wind data from Leeming recording station. These weather stations are located approximately 19km north and 33.5km south, respectively, from the Installation.

2.12.3. Consequently, the assessment utilises five years (2017 – 2021, inclusive) of hourly sequentially analysed data in sectors of 10° from Durham recording station, with cloud and wind data from Leeming recording station.

2.12.4. Over the five years (43,824 hours) of meteorological data used, ADMS reported that 124 hours were inadequate, 19 hours were calm and 905 hours were non-calm met data lines with a wind speed less than the minimum value (0.75 m/s). These represent 0.28%, 0.04% and 2.07% of the data, respectively.

2.12.5. Wind roses for the data are presented as Figure 4; these show that the prevailing winds are predominantly south easterly, with observable westerly and northerly components.

Figure 4: Wind Roses

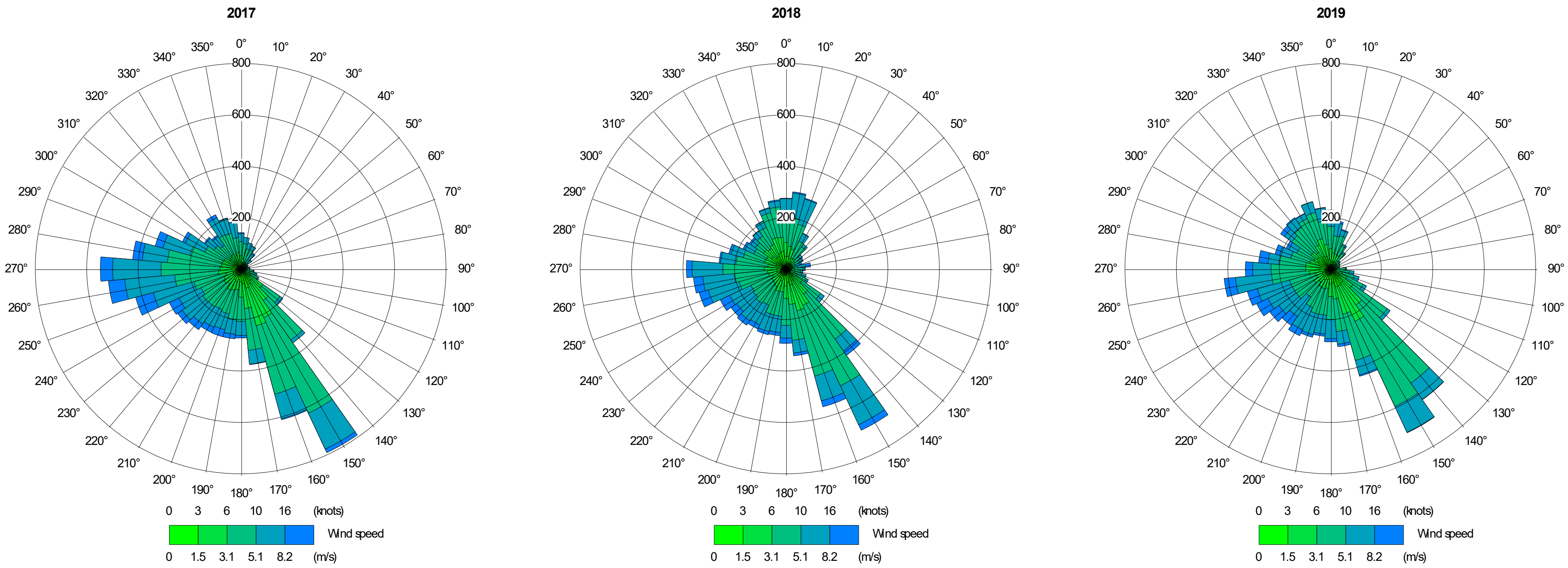
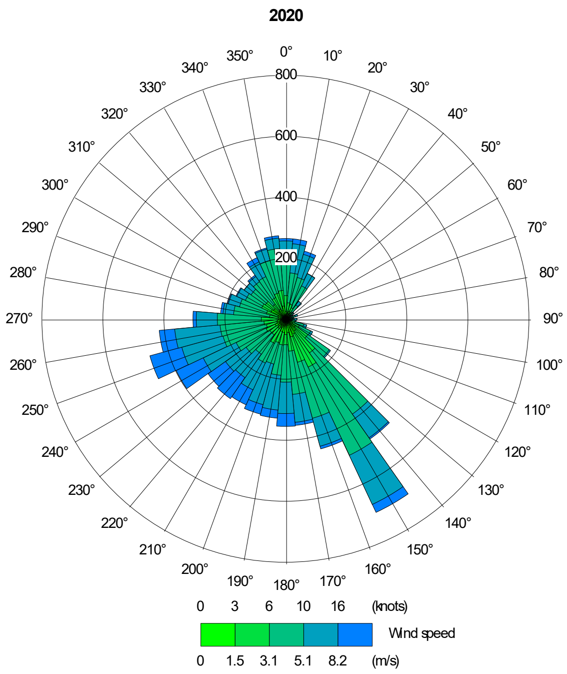
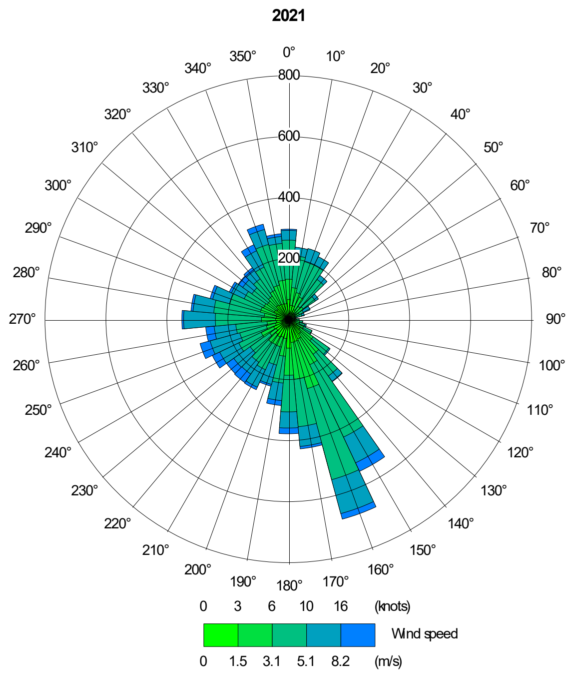


Figure 4: Wind Roses (cont.)





2.13. Surface Albedo

2.13.1. The surface albedo is the ratio of reflected to incident shortwave solar radiation at the surface of the earth[24]. ADMS allows the user to set this value between 0 and 1. A value of 0.40-0.95 would be considered representative of snow-covered ground where a large proportion of the light is reflected, soils from 0.05-0.40, agricultural crops 0.18-0.25, and grass would be 0.16 – 0.26 depending on length[25]. A value of 0.23 is an average value for non-snow-covered surfaces and is the default value used in the model. This value is considered appropriate for the rural setting of the dispersion site.

2.14. Priestley-Taylor Parameter

2.14.1. The Priestly Taylor parameter is a parameter representing the surface moisture available for evaporation[27]. This parameter must be set between 0 and 3 where 0 would be classed as dry bare earth, 0.45 as dry grassland, 1 as moist grassland and a value of 3 is suggested for a saturated forest surrounded by forest[26]. The value of 1 was considered to be appropriate for the rural setting of the dispersion site.

2.15. Minimum Monin-Obukhov Length

2.15.1. The Monin-Obukhov length provides a measure of the stability of the atmosphere. For example, in urban areas the air is affected by heat generated from buildings and traffic which prevents the atmosphere from becoming stable. In rural areas the atmosphere would be more stable. The minimum Monin-Obukhov length can be set between 1 and 200m. Typical values would be[27]:

- large conurbations >1 million = 100m;
- mixed urban/industrial = 30m;
- small towns <50,000 = 10m; and
- rural areas = 1m.

2.15.2. Based on the surrounding land use, and in the interest of a conservative assessment, a value of 30m was used for the dispersion site and a value of 10m was used to represent the met measurement sites.

2.16. Buildings Data

2.16.1. The building parameters utilised for the study are detailed in Table 11 and a visual representation is provided as Figure 5.

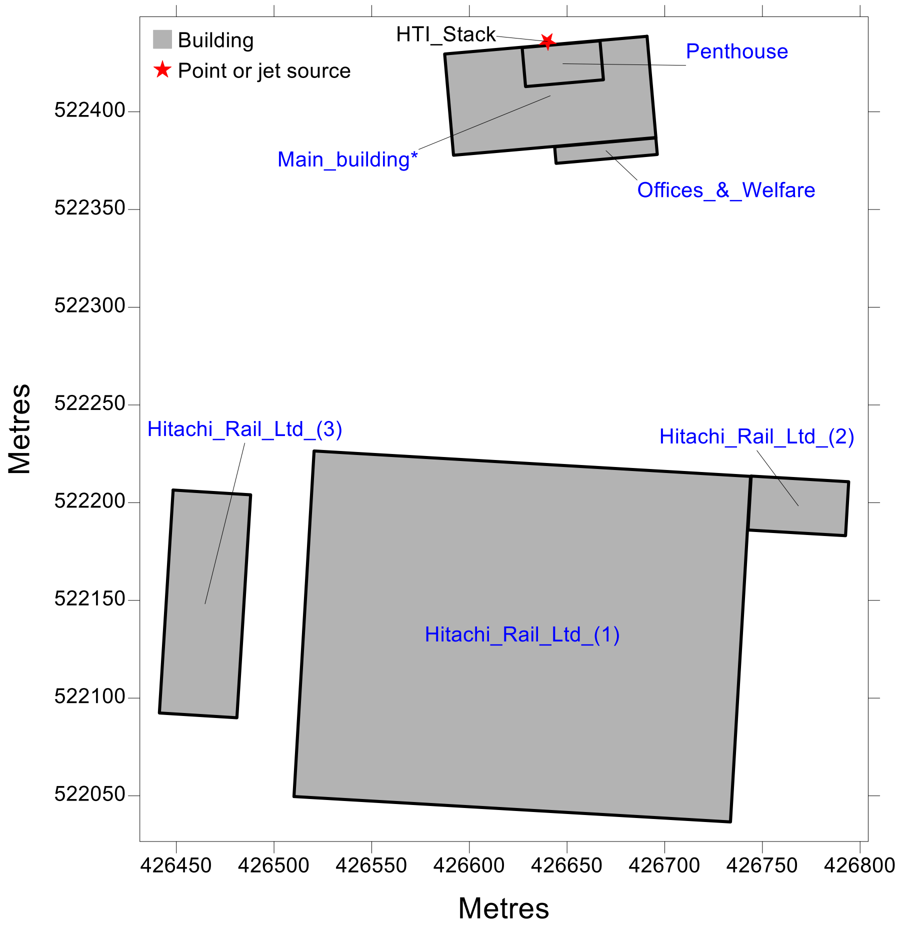
[24] ADMS5 User Guide, CERC, V5, Nov 2012
[25] TR Oke, Buondary Layer Climates, 2nd Edition 1987
[26] J P Lhomme, A Theorestivl Basis for the Priestley-Taylor Coefficient, February 1997.

Table 11: Building Parameters

Building	X [a]	Y [a]	Length (m) [b]	Width (m) [b]	Height (m) [b]	Angle (°) [c]
Main Building	426641	522408	52	104	14.8	175
Penthouse	426648	522425	20	40	16.7	175
Offices & Welfare	426670	522380	8.5	52	7.8	175
Hitachi Rail Ltd (1)	426627	522132	177.12	223.8	13.5	3.33
Hitachi Rail Ltd (2)	426768	522198	50	27.65	13.5	93.33
Hitachi Rail Ltd (3)	426465	522148	39.75	114.3	13.5	93.53

Notes to Table 11
(a) X(m), Y(m) denote the grid reference coordinates of the centre of the building.
(b) Building dimensions were obtained using a combination of Site drawings, Google Earth, the model's Mapper and LiDAR data.
(c) Angle denotes the angle between north and the side designated as length in the ADMS model.

Figure 5: Buildings Layout



2.17. Roughness Length

2.17.1. The surface nature of the terrain is defined in terms of Roughness Length (Z_o). The roughness length is dependent on the type of terrain and its physical properties. The ADMS model gives values to various types of terrain, for example, agricultural areas are classed as 0.2-0.3m, parkland and open suburbia is classed as 0.5m and cities and woodlands are classed as 1.0m.

2.17.2. Based on a review of the terrain, a surface roughness value of 0.5m and was used for the dispersion site and the met measurement sites. The surface roughness value chosen was considered suitable to reflect the mixture of industrial buildings, residential housing, open green space and agricultural land in the wider site settings. Following previous discussions with CERC, reasonable model verification results were found when using a very similar surface roughness value for similar land use.

2.18. Model Output Parameters

2.18.1. The ADMS model calculates the likely pollutant GLCs at locations within a definable grid system pre-determined by a user. Output grids may be determined in terms of a Cartesian or Polar coordinate system. For the purposes of this study the Cartesian system was used.

2.18.2. A Cartesian grid is constructed with reference to an initial origin, which is taken to be the bottom left corner of the grid. The lines of the grid are inserted at regular pre-defined increments in both northerly and easterly directions. Pollutant GLCs are calculated at the intersection of these grid lines; they are calculated in this manner primarily to aid in the generation of pollutant contours.

2.18.3. For assessing the maximum point of impact from the Installation, a grid sizing of 4km x 4km was utilised in order to capture values of the predicted pollutant GLCs arising from the model. The grid coordinates were X = 424640 to 428640 and Y = 520436 to 524436, with 101 nodes along each axis i.e., a grid spacing of 40m.

2.18.4. For assessing the impact of emissions on human health the grid references of each were included as specified points within the ADMS model. Also, for assessing ecological sites, the grid reference of the ecological sites' boundary closest to the stack location was used.

2.19. Scenarios Modelled

2.19.1. The modelling study assessed the following scenarios:

- emissions from the Installation for all pollutants at the maximum GLC;
- emissions from the Installation for all pollutants at the potentially sensitive human receptor locations;
- emissions from the Installation for NO_x, SO_2, NH_3 and HF at the ecological habitat sites;
- modelled deposition rates (acid and nitrogen) at the ecological habitat sites;
- plume visibility from the Installation;
- abnormal emissions from the Installation, as detailed in IED.

2.20. Assessment of Significance of Impact Guidelines – Maximum GLC and Human Receptors

2.20.1. Both the EA online guidance and IAQM[27] guidance has been used for the purposes of significance assessment, and this guidance details the guidelines upon which the assessment of the significance of impact can be established.

2.20.2. In the first instance, the EA online guidance indicates that PCs can be considered insignificant if:

- the long-term PC is <1% of the long-term environmental standard; and
- the short-term PC is <10% of the short-term environmental standard.

2.20.3. As outlined in the EA online guidance, there are no criteria to determine whether:

- PCs are significant; and
- PECs are insignificant or significant.

2.20.4. Consequently, significance will be judged based on the site-specific circumstances and on the EPUK and IAQM methodology as described in the ensuing sections for long-term and short-term impacts.

Long-Term Impacts

2.20.5. If the PCs exceed the long-term criteria outlined in the EA online guidance, the potential long-term effects on human receptors from the operation of the two scrubber stacks will be assessed in accordance with the latest guidance produced by EPUK and IAQM in January 2017.

2.20.6. The guidance provides a basis for a consistent approach that could be used by all parties to professionally judge the overall significance of the air quality effects based on the severity of air quality impacts.

2.20.7. The following rationale is used in determining the severity of the air quality impacts at individual human receptors:

- the effects are provided as a percentage of the AQAL;
- the absolute concentrations are also considered in terms of the AQAL and are divided into categories for long-term concentrations. The categories are based on the sensitivity of the individual receptor in terms of harmful potential. The degree of potential to change increases as absolute concentrations are close to or above the AQAL;
- severity of the effect is described as qualitative descriptors; negligible, slight, moderate or substantial by taking into account in combination the harm potential and air quality effect. This means that a small increase at a receptor which is already close to or above the AQAL will have higher severity compared to a relatively large change at a receptor which is significantly below the AQAL, >75% AQAL;
- the effects can be adverse when the air quality concentration increases or beneficial when the concentration decreases as a result of development; and

[27] IAQM guidance, January 2017 (Land-Use Planning & Development Control: Planning for Air Quality')

- the judgement of overall significance of the effects is then based on severity of effects on all the individual receptors considered.

2.20.8. The impact descriptors for individual receptors are presented in Table 12.

Table 12: Impact Descriptors for Individual Receptors – Long-Term Concentrations

Long-term average concentration at receptor in assessment year	% Change in concentration relative to AQAL			
	1	2-5	6-10	>10
≤75% of AQAL	Negligible	Negligible	Slight	Moderate
76-94% of AQAL	Negligible	Slight	Moderate	Moderate
95-102% of AQAL	Slight	Moderate	Moderate	Substantial
103-109% of AQAL	Moderate	Moderate	Substantial	Substantial
≥ 110% of AQAL	Moderate	Substantial	Substantial	Substantial

Short-Term Impacts

2.20.9. As stated in EPUK / IAQM guidance, January 2017 (Land-Use Planning & Development Control: Planning for Air Quality') in Section 6.36, Page 27: *"For any point source, some consideration must also be given to the impacts resulting from short term, peak concentrations of those pollutants that can affect health through inhalation. The Environment Agency uses a threshold criterion of 10% of the short term AQAL as a screening criterion for the maximum short-term impact. This is a reasonable value to take and this guidance also adopts this as a basis for defining an impact that is sufficiently small in magnitude to be regarded as having an insignificant effect. Background concentrations are less important in determining the severity of impact for short term concentrations, not least because the peak concentrations attributable to the source and the background are not additive."*

2.20.10. Short-term concentrations, in the context laid out in the IAQM guidance, are those averaged over periods of an hour or less. These exposures would be regarded as acute and occur when a plume from an elevated source affects airborne concentrations experienced by a receptor over an hour or less.

2.20.11. The IAQM guidance offers the following severity of impact descriptors for peak short-term concentrations from an elevated source:

- 11-20% of the relevant AQAL – the magnitude can be regarded as 'small';
- 21-50% of the relevant AQAL – the magnitude can be regarded as 'medium'; and
- 51% or more of the relevant AQAL – the magnitude can be regarded as 'large'.

2.20.12. It is argued that this approach is intended to be a streamlined and pragmatic assessment procedure that avoids undue complexity.

2.21. Assessment of Significance of Impact Guidelines – Ecological Receptors, Critical Levels and/or Loads

2.21.1. EA Operational Instruction 67_12[28] states that a detailed assessment is required where modelling predicts that the long-term PC is greater than:

- 1% for European sites and SSSIs; or
- 100% for NNR, LNR, LWS and ancient woodlands.

And, the PEC is greater than:

- 70% for European sites and SSSIs; or
- 100% for NNR, LNR, LWS and ancient woodlands.

2.21.2. For short-term emissions, modelling is required at European site and SSSI's where the PC is greater than 10% of the critical level, or 100% for NNR, LNR, LWS and ancient woodland.

2.21.3. Following detailed assessment, if the PEC is less than 100% of the appropriate environmental criterion, then it can be assumed there will be no adverse effect for European Sites and SSSI's.

2.21.4. However, for NNR, LNR, LWS or ancient woodland, if the PC is less than 100% of the appropriate environmental criterion, then it can be assumed there will be no significant pollution.

2.22. Assessment of Significance Guidelines for Trace Metals

2.22.1. For the Group 3 metals there is an additional guideline indicated in the EA Guidance for Group 3 metals (see below) that states that the environmental standard is unlikely to be exceeded if:

- the long-term and short-term PEC is <100% of the long-term and short-term environmental standard (as appropriate)

(where the short-term PEC is the sum of the short-term PC and twice the long-term pollutant background concentration).

2.22.2. For trace metals, Annex VI of the IED assigns ELVs for three groups. Group 1 comprises cadmium (Cd) and thallium (Tl), Group 2 comprises mercury (Hg) and Group 3 comprises antimony (Sb), arsenic (As), chromium (Cr), cobalt (Co), copper (Cu), manganese (Mn), lead (Pb), nickel (Ni) and vanadium (V). The ELVs are the total for the combined emissions, and it would not be reasonable to assume that each metal emits at the maximum ELV for the group. In this regard, the EA has provided guidance on the steps required for assessing the impact of such metal emissions, namely Releases from Waste Incinerators[29].

2.22.3. Step 1 of the guidance is to assume that all emissions are at the maximum ELV for the group. For example, all of the Group 3 metals would be assumed to be emitted at a concentration of 0.3mg/Nm^3 (i.e., as per the BAT-AEL).

[28] EA Operational Instruction 67_12 Detailed assessment of the impact of aerial emissions from new or expanding IPPC regulated industry for impacts on nature conservation, V2, 27.3.15
[29] Releases from Waste Incinerators, Environment Agency, V4

2.22.4. Where the release is considered potentially significant, Step 2 of the guidance allows the applicant to use the maximum emissions data listed in Appendix A of the guidance to revise predictions and consider each pollutant as a percentage of the Group 3 ELVs.

2.23. NO_x to NO_2 conversion Rates

2.23.1. EA online guidance states that emissions of NO_x should be recorded as NO_2 as follows:

- for the long-term PCs and PECs, assume 100% of the emissions of NO_x convert to NO_2; and
- for the short-term PCs and PECs assume 50% of the emissions of NO_x convert to NO_2.

2.23.2. However, further to detailed discussion with the EA on previous studies, a long-term 70% NO to NO_2 conversion rate, and a short-term 35% NO to NO_2 as required by guidance on NO_X and NO_2 Conversion Ratios as referenced in AQTAG06 should be used in all detailed modelling assessments. The conversion rates, as provided in Section 2.23.1., should only be used for screening assessments.

3. ASSESSMENT OF AIR QUALITY IMPACTS AT THE MAXIMUM GROUND LEVEL CONCENTRATIONS

3.1. Comparison of Maximum Predicted Pollutant Ground Level Concentrations with Air Quality Standards

3.1.1. The predicted PCs for each of the pollutants considered in the assessment at the maximum point of impact have been extracted and are presented in Table 13. The data is based on the worst case met data year. It should be noted that the location of the maximum impact may not be in an area where there is a relevant public exposure.

3.1.2. Maximum concentrations are considered potentially significant if the long-term prediction is greater than 1% of the long-term AQS. For short-term predictions, a potentially significant concentration would be greater than 10% of the short-term AQS. In Table 13, any PCs that are above these significance criteria are indicated in bold type.

Table 13: Comparison of Predicted Maximum Ground Level PCs with AQSs

Pollutant	Worst Case Met Year	Maximum PC ($\mu g/m^3$)	AQS ($\mu g/m^3$)	PC as a % of AQS
NO_2 (annual mean)	2017	**0.908**	40	**2.27%**
NO_2 (1 hour, 99.79th percentile)	2021	4.38	200	2.19%
SO_2 (24 hour, 99.18th percentile)	2018	1.92	125	1.53%
SO_2 (1 hour, (99.73rd percentile)	2021	2.77	350	0.79%
SO_2 (15min, 99.90th Percentile)	2021	4.41	266	1.66%
PM_{10} (annual mean)	2017	0.0540	40	0.14%
PM_{10} (24 hour, 90.41st Percentile)	2018	0.179	50	0.36%
$PM_{2.5}$ (annual mean)	2017	0.0540	20	0.27%
CO (8 hour, 100th percentile)	2020	3.96	10,000	0.04%
VOC (annual mean)	2017	**0.108**	5	**2.16%**
VOC (24-hour mean)	2018	0.694	30	2.31%

Table 13: Comparison of Predicted Maximum Ground Level PCs with AQSs (cont.)

Pollutant	Worst Case Met Year	Maximum PC ($\mu g/m^3$)	AQS ($\mu g/m^3$)	PC as a % of AQS
NH_3 (annual mean)	2017	0.108	180	0.06%
NH_3 (1-hour)	2021	2.27	2,500	0.09%
HCl (1-hour)	2021	1.36	750	0.18%
HF (annual mean)	2017	0.0108	16	0.07%
HF (1-hour)	2021	0.227	160	0.14%
Sb (annual mean)	2017	0.00324	5	0.06%
Sb (1-hour)	2021	0.0680	150	0.05%
As (annual mean)	2017	**0.00324**	0.003	**108.07%**
Cd (annual mean)	2017	**0.000216**	0.005	**4.32%**
Cr (annual mean)	2017	0.00324	5	0.06%
Cr (1-hour)	2021	0.0680	150	0.05%
Cr(VI) (annual mean)	2017	**0.00324**	0.00025	**1,296.83%**
Co (annual mean)	2017	**0.00324**	0.2	**1.62%**
Co (1-hour)	2021	0.0680	6	1.13%
Cu (annual mean)	2017	0.00324	10	0.03%
Cu (1-hour)	2021	0.0680	200	0.03%
Pb (annual mean)	2017	**0.00324**	0.25	**1.30%**
Mn (annual mean)	2017	0.00324	1	0.32%
Mn (1-hour)	2021	0.0680	1,500	0.005%
Hg (annual mean)	2017	0.000108	0.25	0.04%
Hg (1-hour)	2021	0.00453	7.5	0.06%

Table 13: Comparison of Predicted Maximum Ground Level PCs with AQSs (cont.)

Pollutant	Worst Case Met Year	Maximum PC ($\mu g/m^3$)	AQS ($\mu g/m^3$)	PC as a % of AQS
Ni (annual mean)	2017	**0.00324**	0.02	**16.21%**
Tl (annual mean)	2017	0.000216	1	0.02%
Tl (1-hour)	2021	0.00453	30	0.02%
V (annual mean)	2017	0.00324	5	0.06%
V (24-hour)	2018	0.0208	1	2.08%
PAH (as B[a]P) (annual mean)	2017	0.000000973	0.00025	0.39%
PCBs (annual mean)	2017	0.0000000000389	0.2	0.00000002%
PCBs (1-hour)	2021	0.000000000816	6	0.00000001%
Dioxins and Furans	2017	0.000000000648	No Standard Applies	

3.1.3. It can be seen from the data in Table 13, that the impact of the Installation varies depending on the pollutant considered. The potentially significant impacts are for long-term (annual):

- NO_2;
- VOC (as benzene);
- As;
- Cd;
- Cr(VI);
- Co;
- Pb; and
- Ni.

3.1.4. It is important to note that the metals, at this step of the assessment, have each been modelled at their respective ELVs (see Section 2.11. of this report).

3.1.5. However, it would not be reasonable to assume that each Group 3 metal emits at the maximum ELV for the group. In this regard, the EA has provided guidance on the steps required for assessing the impact of metals emissions (see Section 2.22. of this report). If any of the Group 3 metals exceed 1% of a long-term standard, then the PEC should be compared against the AQS. If the PEC is greater than 100% of the AQS then case specific screening is required. Although not directly applicable to Group 1 metals, the Group 3 further screening guidance has also been adopted for Cd. Consequently, background concentrations for As, Cd, Cr(VI), Co, Pb, Hg and Ni are required.

3.2. Background Air Concentrations of Group 3 Metals and Cadmium

3.2.1. Monitoring of trace elements has been undertaken by DEFRA since 1976. Currently, monitoring of twelve metals is carried out at locations throughout the UK, predominantly in urban locations. In addition, concentrations of As and Ni are monitored at a further ten rural locations.

3.2.2. The nearest monitoring locations to the Installation are:

- the urban industrial site at Scunthorpe Town (490338 (X), 410836 (Y)), located approximately 128.5km to the south-southeast of the Installation;
- the urban industrial site at Scunthorpe Low Santon (492936 (X), 411943 (Y)), located approximately 129km to the south-southeast of the Installation; and
- the rural background site at Eskdalemuir (323551 (X), 603022 (Y)), located approximately 131km to the northwest of the Installation.

3.2.3. A summary of background concentrations for 2022 are provided in Table 14 for all three sites. For Cr(VI), it has been assumed that the background concentration is 20% of the total Cr concentration (as indicated in the EPAQS report *Guidelines for metals and metalloids in ambient air for the protection of human health*, May 2009).

Table 14: Annual Mean Trace Metal Concentrations

	Annual Mean Concentration ($\mu g/m^3$)		
Metal	Scunthorpe Town	Scunthorpe Low Santon	Eskdalemuir
As	0.000753	0.000897	0.000149
Cd	0.000263	0.000637	0.0000207
Cr	0.00193	0.00439	0.000336
Cr(VI)	0.000386	0.000877	0.0000671
Co	0.000129	0.000257	0.0000179
Pb	0.0104	0.0222	0.000655
Ni	0.000951	0.00136	0.000325

3.2.4. It should be noted that all monitoring sites are a considerable distance from the Installation and possess surrounding land uses that are unlikely to be representative of the ambient air quality in the vicinity of the Installation. For example, based on the rural location of the Eskdalemuir monitoring site and the proximity of steel and metal works to the Scunthorpe monitoring site – it is therefore considered that the measured heavy metals data will be either an underestimate (i.e., Eskdalemuir site) or overestimate (i.e., Scunthorpe sites) of ambient background concentrations at the Installation.

3.2.5. Consequently, in the interest of a conservative assessment, the monitoring site with the highest background concentrations (i.e., Scunthorpe Low Santon) will be used for the purposes of calculating the PECs.

3.3. Step 1 and 2 Screening of Group 3 Metals

3.3.1. Using the background concentrations in Table 14 (for Scunthorpe Low Santon), PECs for the potentially significant Group 3 metals and Cd are provided in Table 15. Any PECs greater than 100% of the AQS are highlighted in bold.

Table 15: PECs of Group 3 Metals – Step 1 Screening

Pollutant	Worst Case Met Year	Maximum PC ($\mu g/m^3$)	AQS ($\mu g/m^3$)	PC as a % of AQS	Background Concentration ($\mu g/m^3$)	Maximum PEC ($\mu g/m^3$)	PEC as a % of AQS
As (annual mean)	2017	**0.00324**	0.003	**108.07%**	0.000897	0.00414	**138%**
Cd (annual mean)	2017	**0.000216**	0.005	**4.32%**	0.000637	0.000853	17%
Cr(VI) (annual mean)	2017	**0.00324**	0.00025	**1,296.83%**	0.000877	0.00412	**1,648%**
Co (annual mean)	2017	**0.00324**	0.2	**1.62%**	0.000257	0.00350	1.7%
Pb (annual mean)	2017	**0.00324**	0.25	**1.30%**	0.0222	0.0254	10.2%
Ni (annual mean)	2017	**0.00324**	0.02	**16.21%**	0.00136	0.00460	23%

3.3.2. The data in Table 15 indicates that, although for the majority of pollutants the PECs can be screened out, further screening is required for long-term As and Cr(VI).

3.3.3. Step 2 screening indicates that where the PC exceeds 1% of the long-term standard, the maximum emissions data in Appendix A of the EA's Group 3 metals assessment guidance can be used to revise the predictions, and the PEC then compared against the AQS. The guidance states that As comprises 5% of the Group 3 metals, and Cr(VI) 0.03%. Consequently, the emission rates for each have been recalculated based on these percentages. The results of the assessment may be found in Table 16.

Table 16: PECs of Group 3 Metals – Step 2 Screening

Pollutant	Worst Case Met Year	Maximum PC (µg/m^3)	AQS (µg/m^3)	PC as a % of AQS	Background Concentration (µg/m^3)	Maximum PEC (µg/m^3)	PEC as a % of AQS
As (annual mean)	2017	0.000162	0.003	**5.40%**	0.000897	0.00106	35%
Cr(VI) (annual mean)	2017	0.000000973	0.00025	0.39%	N/A – PC screens out (i.e., it is less than 1% of the AQS)		

3.3.4. The data in Table 16 indicates that the PEC for As can be screened out. In addition, the PC for Cr(VI) now screens out. Consequently, no further assessment is required for the metals.

3.3.5. The long-term impacts of NO_2 and VOC, as shown in Table 13, still require further assessment. The next stage of the Step 2 impact significance screening process is to compare the long-term pollutant PECs with the criteria outlined in Section 2.21. of this report. Consequently, the background concentrations of the pollutants are required.

3.4. Background Concentrations of NO_2 and VOC

3.4.1. DCC and DBC undertake monitoring for NO_2 throughout the counties. However, there are no monitoring sites within Newton Aycliffe, with the nearest diffusion tube ("DT") based NO_2 monitoring undertaken on the outskirts of Darlington – approximately 5.8km south-southeast of the Installation. Neither DCC or DBC currently undertake any monitoring for VOC.

3.4.2. Background NO_2, and VOC (as benzene) data is available from the Department for Environment, Food and Rural Affairs ("DEFRA"). These background pollution maps are at a resolution of 1x1km and are modelled each year under DEFRA's Modelling of Ambient Air Quality contract.

3.4.3. The nearest mapped modelled annual NO_2 and VOC (as benzene) concentrations to the Installation are displayed in Table 17 for the year 2021 (the latest available year at the time of writing). In the interest of a conservative assessment, for the purposes of calculating PECs the highest DEFRA background concentration will be used for each pollutant.

Table 17: Nearest Background DEFRA Data to Site – 2021 Concentrations

ECL Ref.	UK Grid Code	Annual Concentration ($\mu g/m^3$) [a]		(X) [a]	(Y) [a]	Distance from Site (m) [c]	Heading (°)
		NO_2	VOC [b]				
DEFRA1	536567	8.05	0.228	426500	522500	161	298
DEFRA2	536568	9.23	0.273	427500	522500	860	85
DEFRA3	537257	5.52	0.204	426500	521500	936	189
DEFRA4	537258	7.85	0.222	427500	521500	1,261	137

Notes to Table 17
(a) Information obtained from DEFRA's background pollution maps, available from: https://uk-air.defra.gov.uk/data/pcm-data.
(b) As benzene.
(c) Distances are measured as the crow flies from the background source to the stack coordinates.

3.5. Step 2 Screening of Remaining Pollutants

3.5.1. Using the background data discussed in section 3.4., PECs will now be calculated for the long-term impacts of NO_2 and VOC. The criteria used to determine the significance of the impact of PECs is provided in Section 2.20 of this report. Table 18 displays the PEC assessment, with any potentially significant PCs indicated in bold.

Table 18: Long-term impacts of NO_2 and VOC – Step 2 Screening

Pollutant	Worst Case Met Year	Maximum PC (µg/m^3)	AQS (µg/m^3)	PC as a % of AQS	Background Concentration (µg/m^3)	Maximum PEC (µg/m^3)	PEC as a % of AQS	Impact Descriptor
NO_2 (annual mean)	2020	**0.908**	40	**2.27%**	9.23	10.14	25%	Negligible
VOC (annual mean)	2020	**0.108**	5	**2.16%**	0.273	0.381	8%	Negligible

3.5.2. The data in Table 18 indicates that, following further screening, the impact on the environment can be classed as ‘negligible’ for both annual NO_2 and VOC (as benzene). Consequently, no further assessment is required.

3.6. Isopleths

3.6.1. Isopleths have been prepared for every pollutant with an AQS (with the exception of annual and 1-hour PCBs, as it has been considered that the predicted PCs for these pollutants are infinitesimal (refer to Table 13 for details) for the worst-case met year. These are provided as Figures 6 - 26.

3.6.2. The blue contour line (as shown in Figure 6 for annual NO_2) represents the extent to which the predicted PCs are 1% of the AQS.

Figure 6: NO_2 - Annual Mean – Met Year 2017

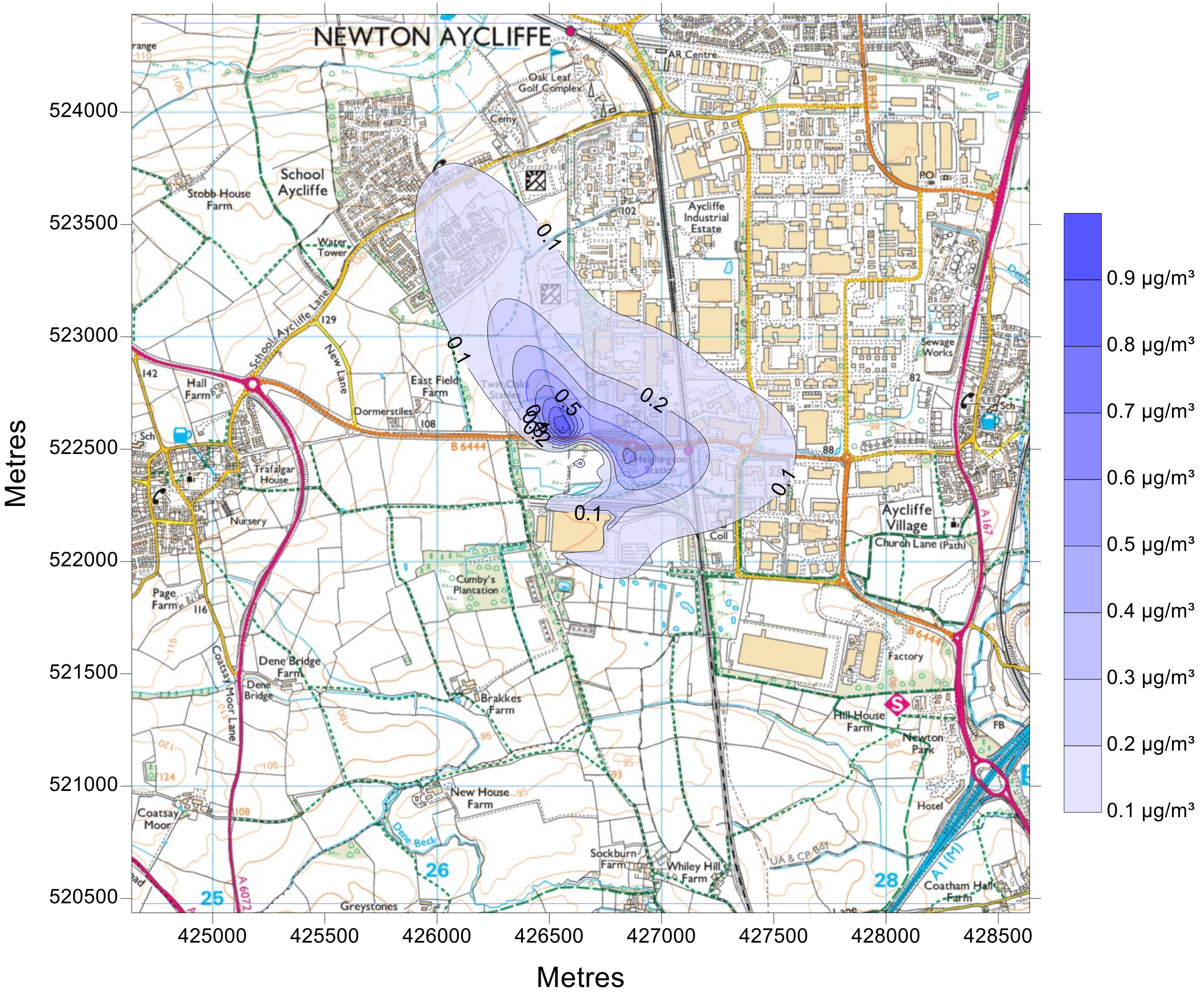


Figure 7: NO_2 - 99.79th Percentile – Met Year 2021

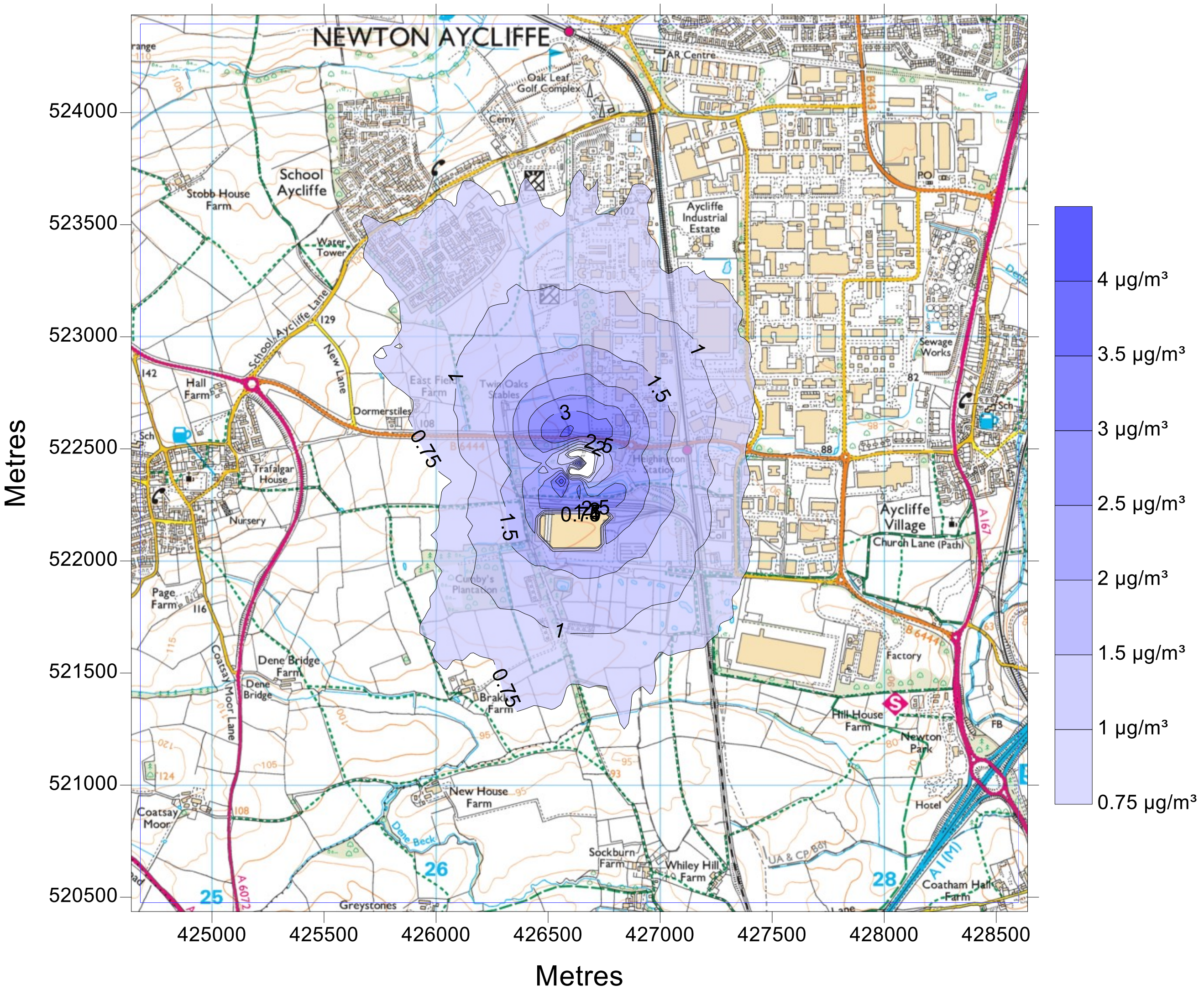


Figure 8: SO_2 - 99.18th Percentile – Met Year 2018

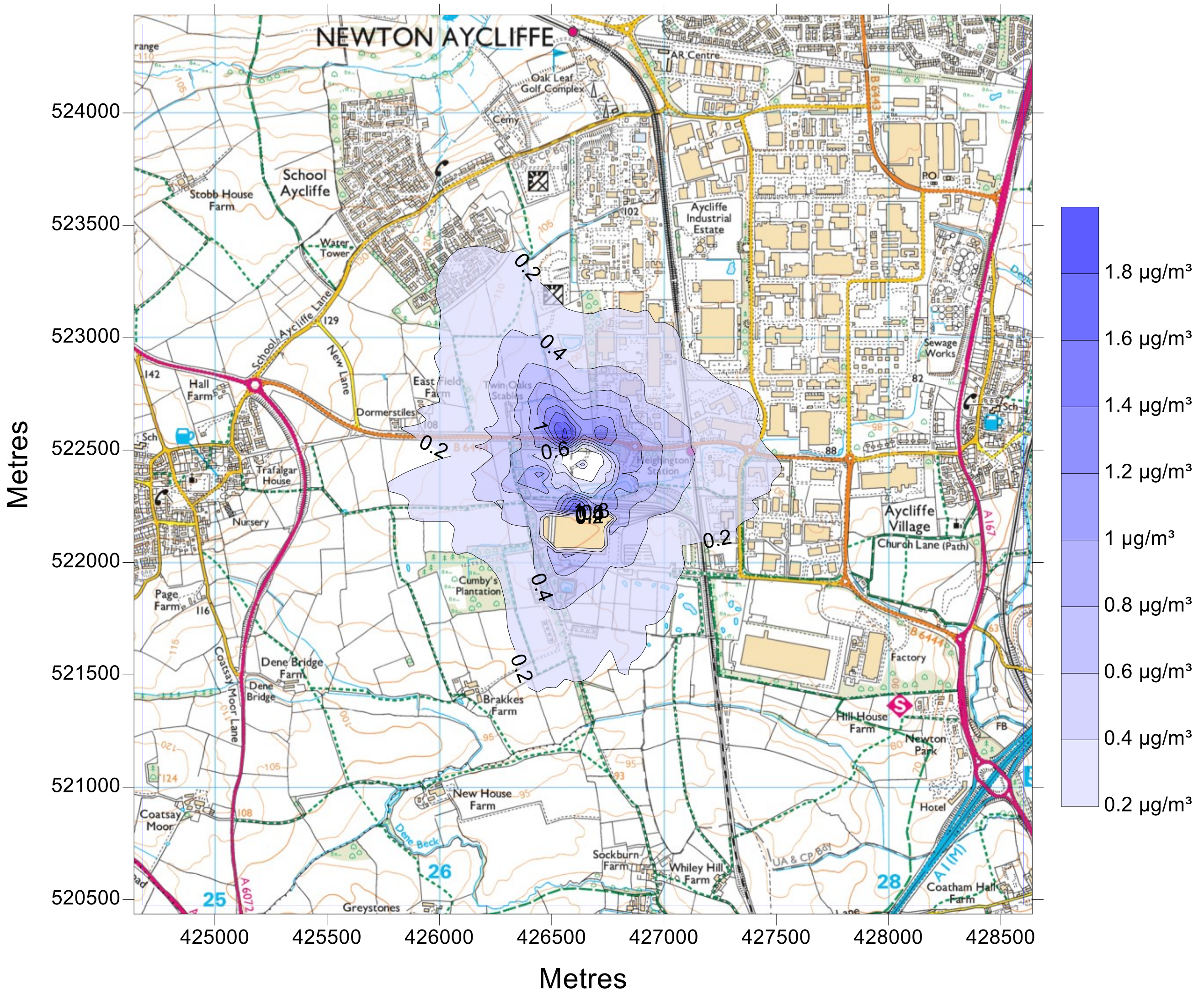


Figure 9: SO_2 - 99.73rd Percentile – Met Year 2021

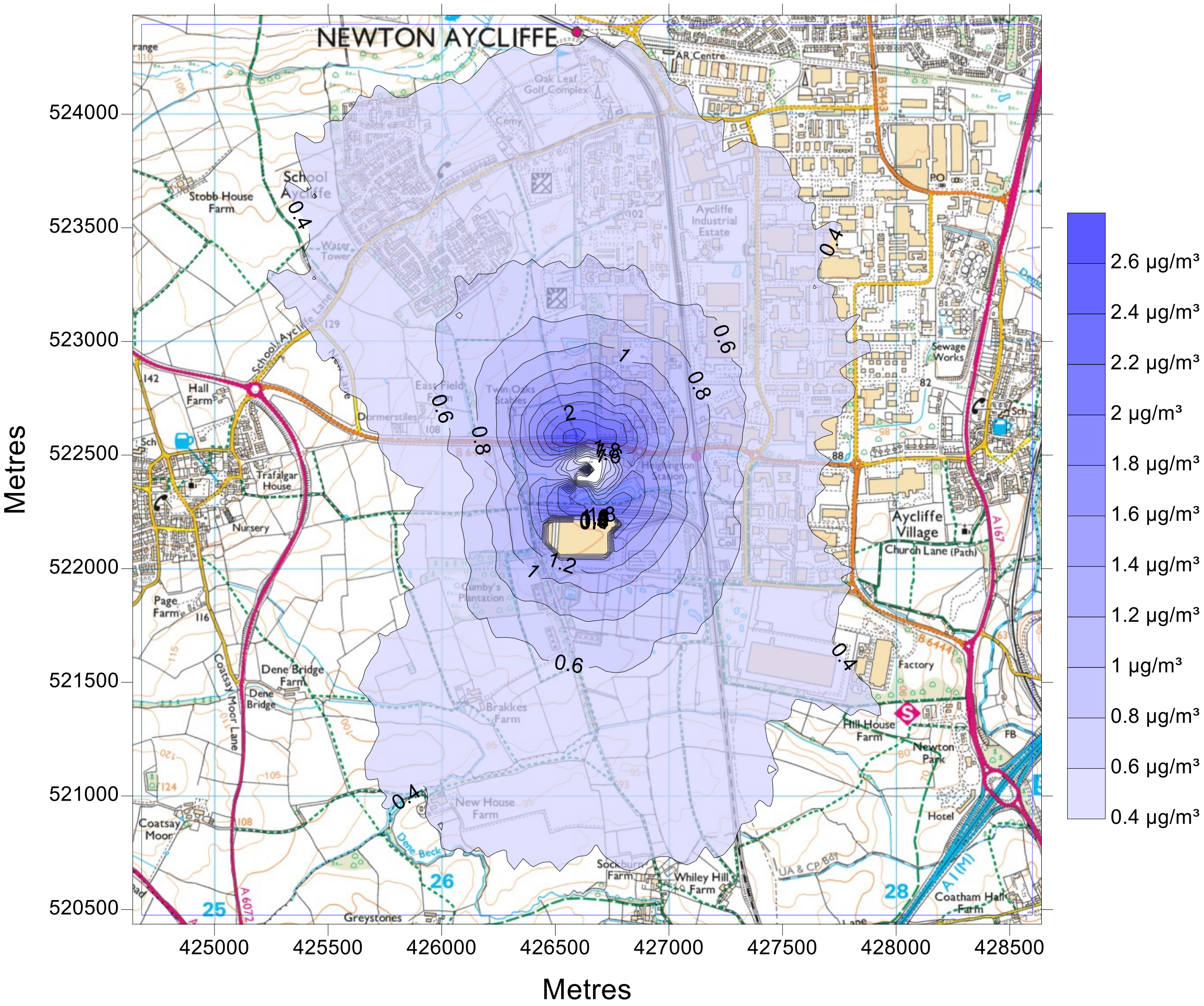


Figure 10: SO_2 - 99.90th Percentile – Met Year 2021

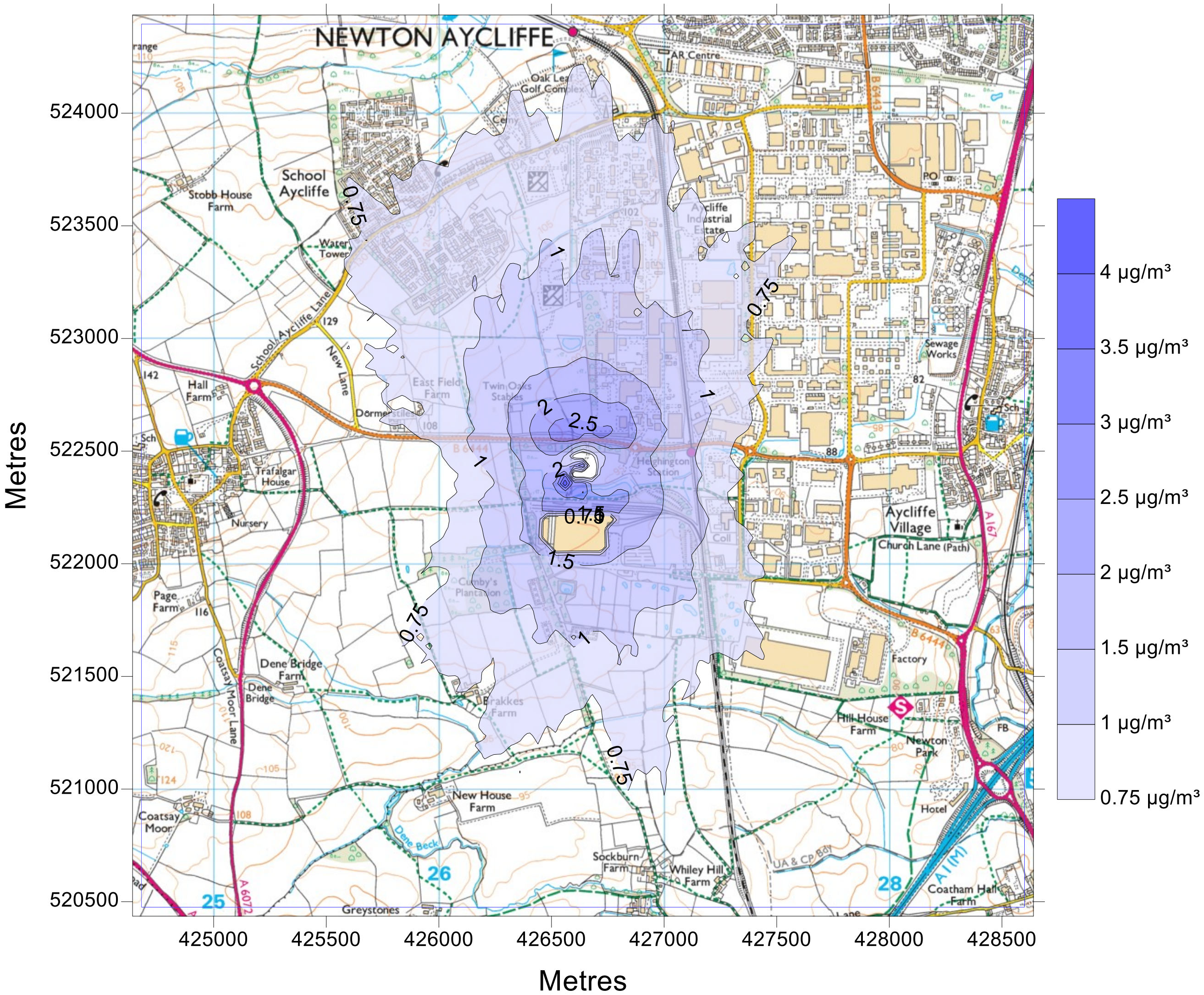


Figure 11: PM_{10} and $PM_{2.5}$ - Annual Mean – Met Year 2017

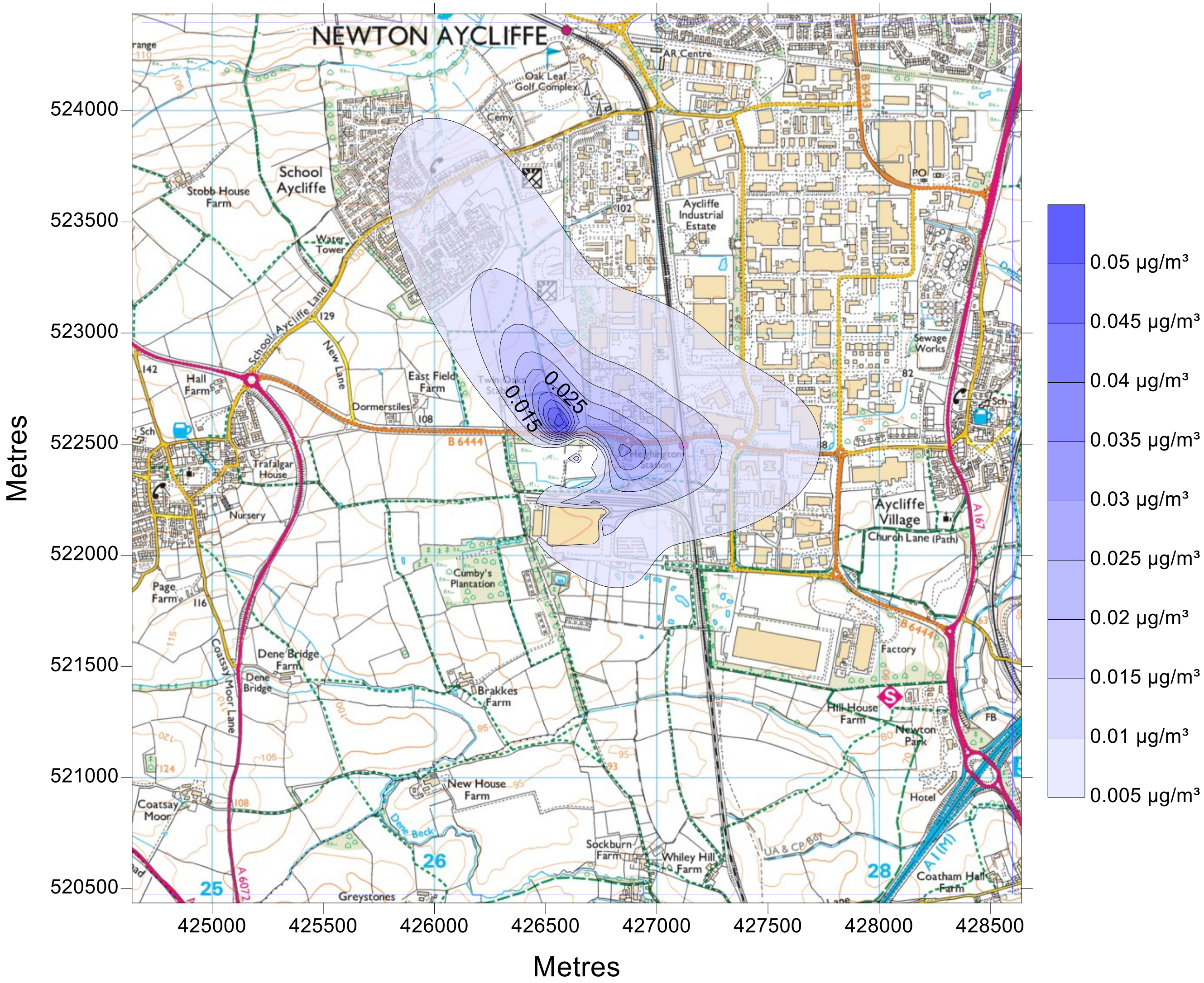


Figure 12: PM_{10} - 90.41st Percentile – Met Year 2018

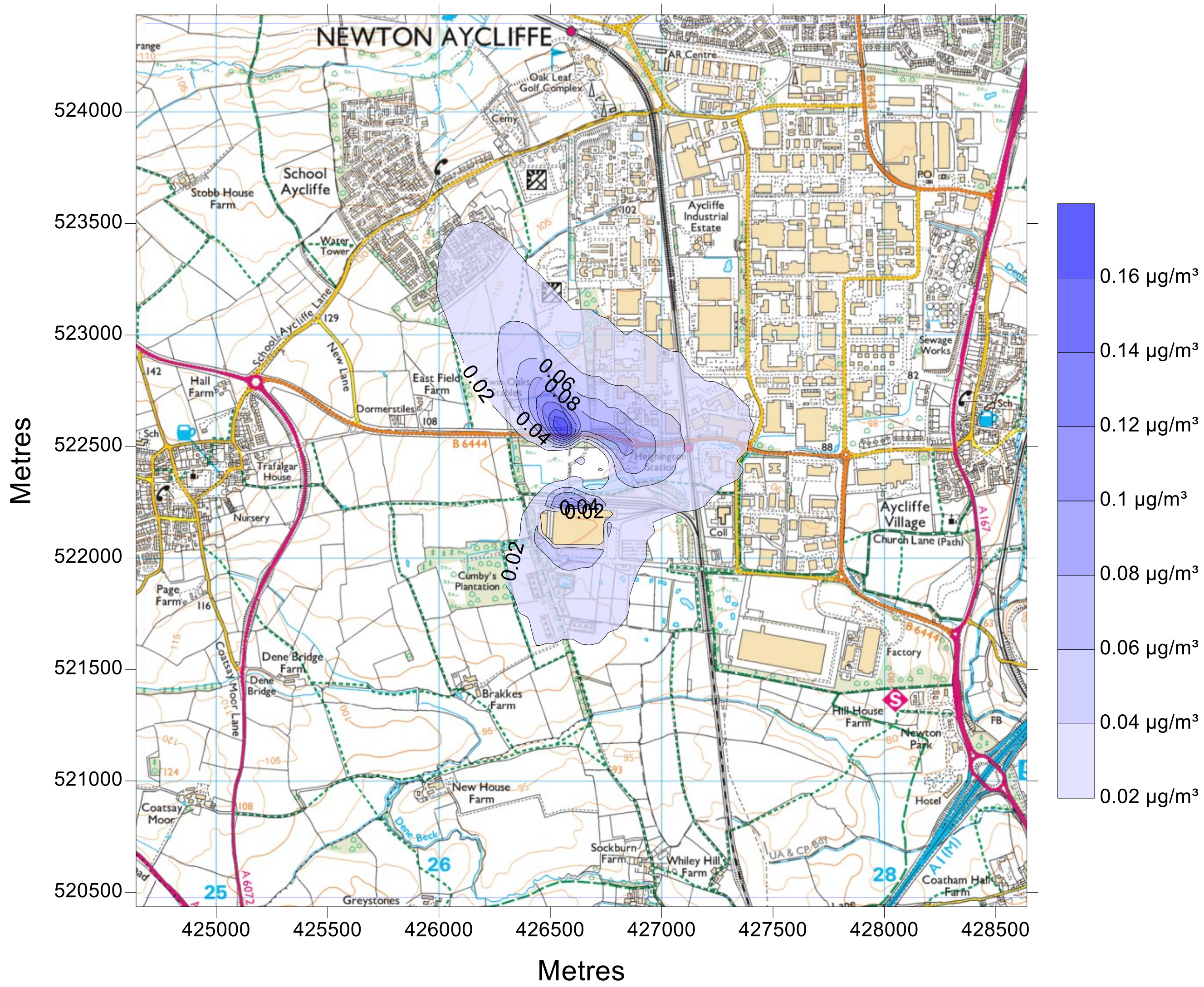


Figure 13: CO - 100th Percentile – Met Year 2020

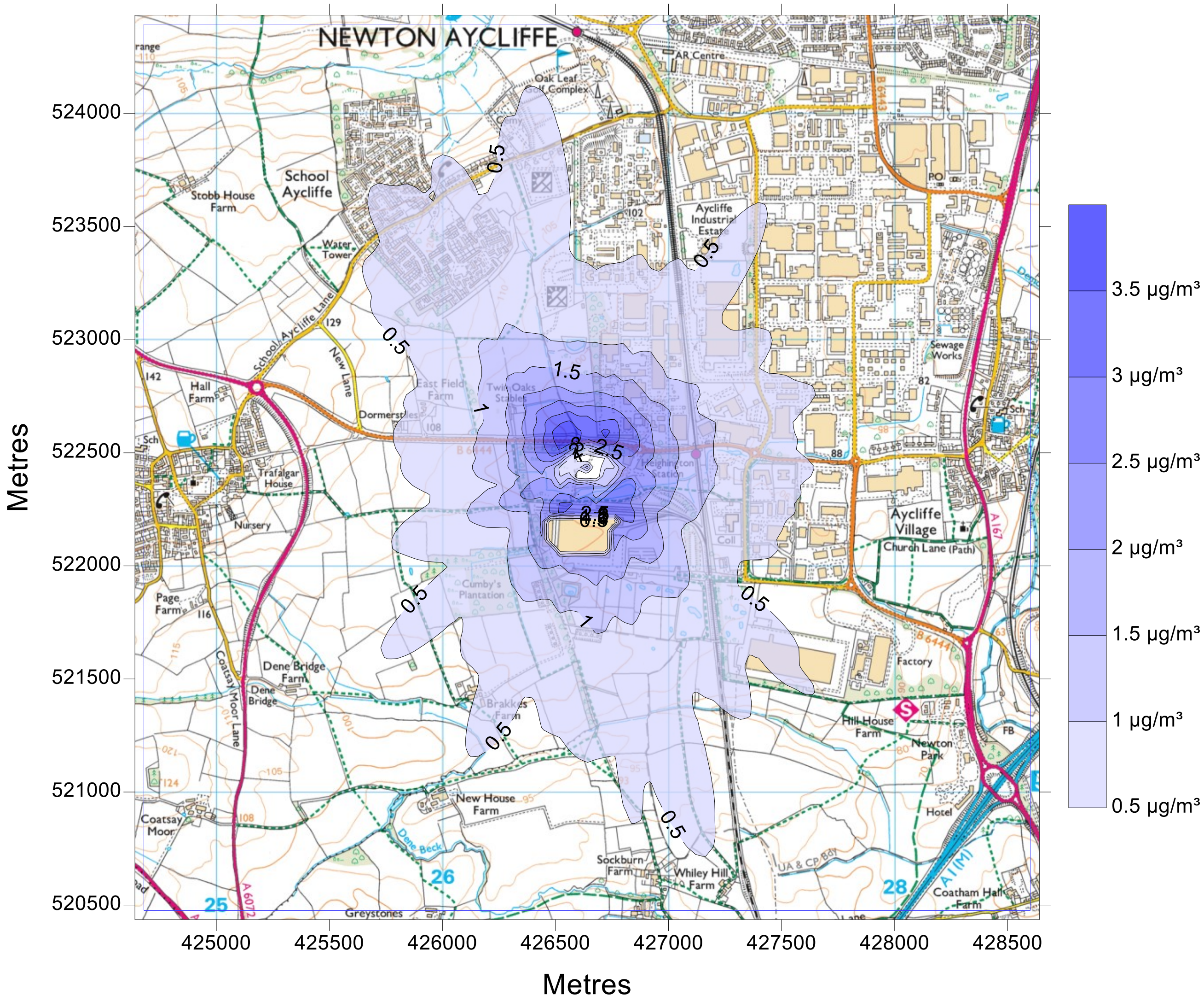


Figure 14: VOC and NH_3 - Annual Mean – Met Year 2017

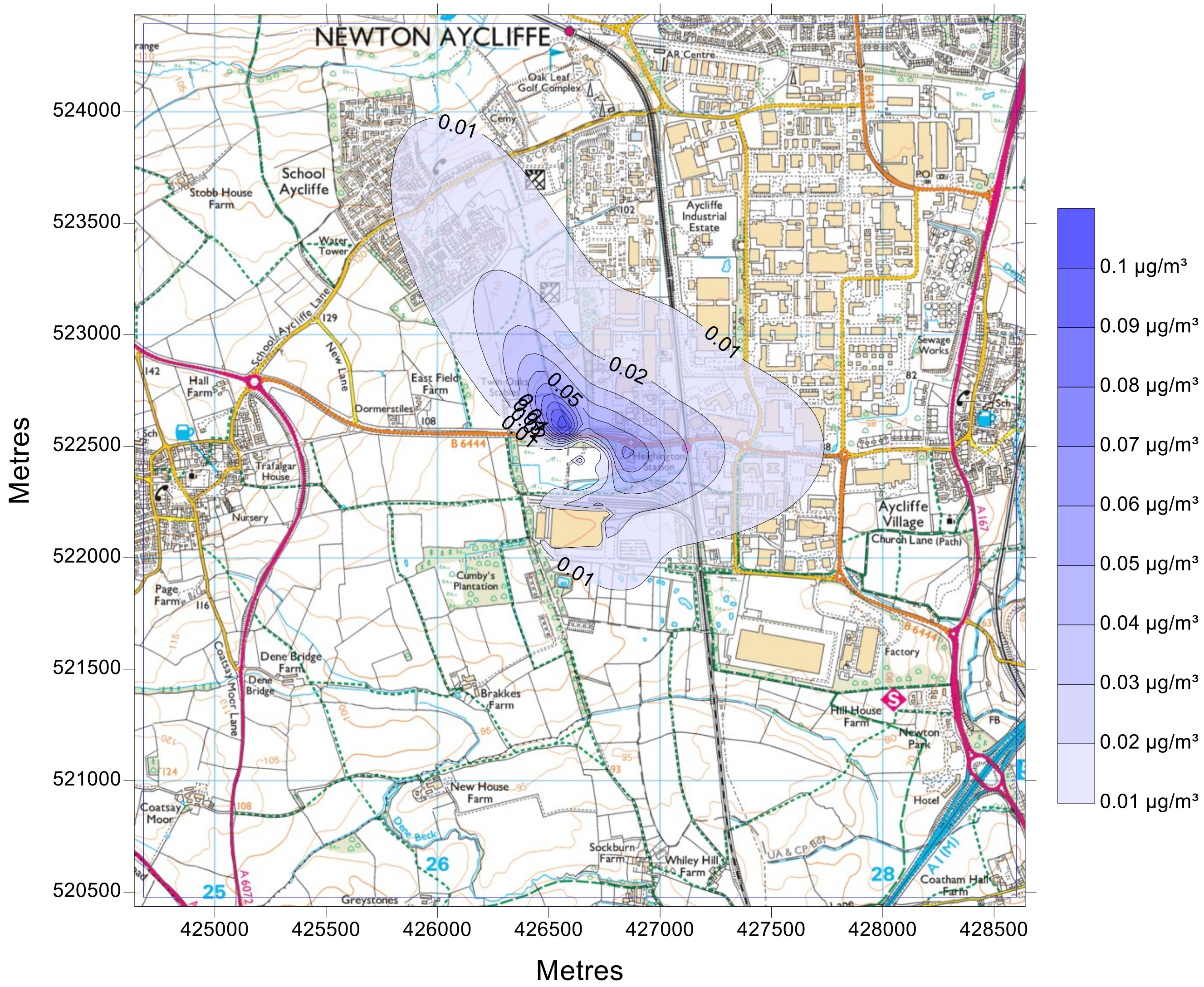


Figure 15: VOC – 24-Hour 100th Percentile – Met Year 2018

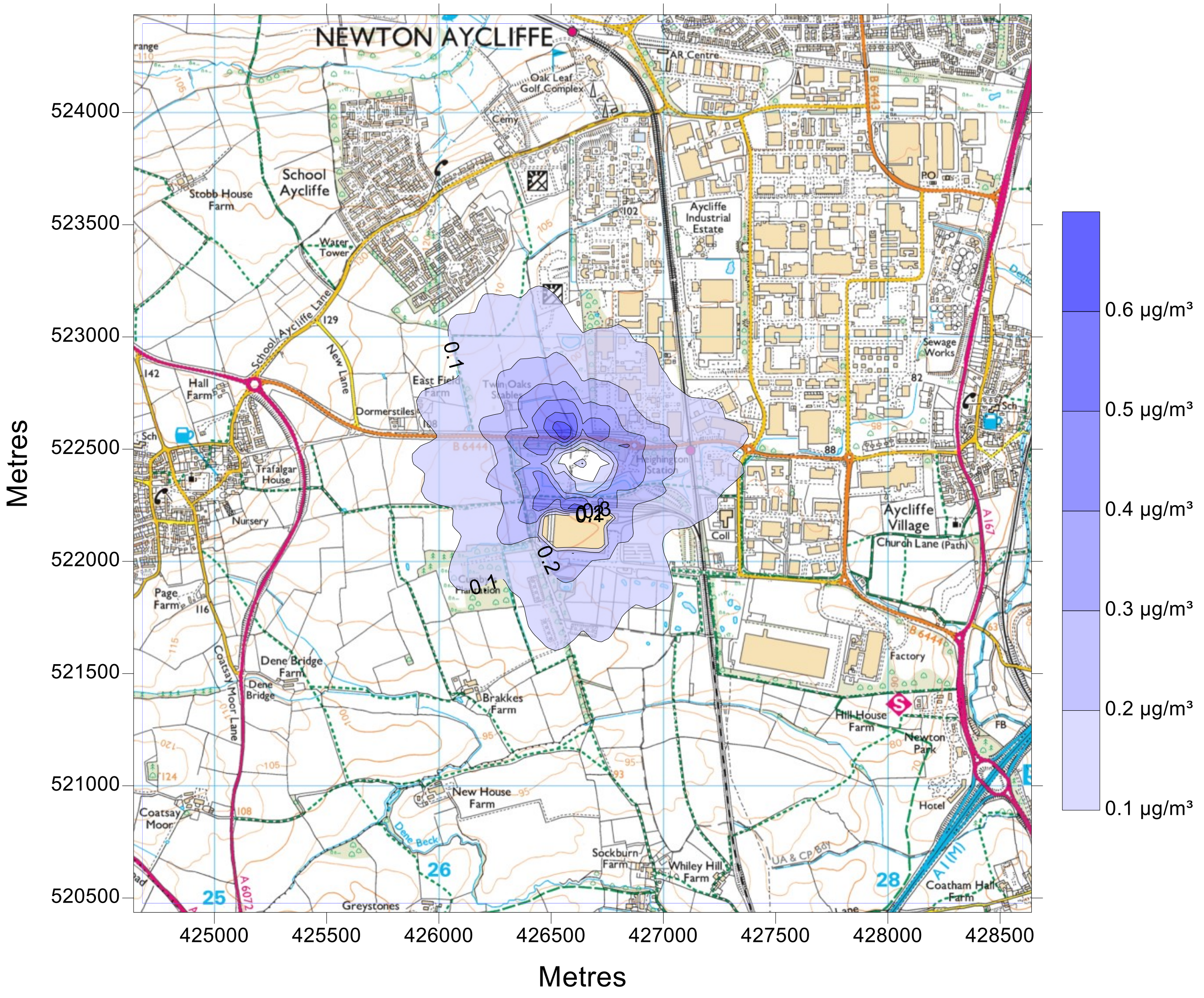


Figure 16: NH_3 – 100th Percentile – Met Year 2021

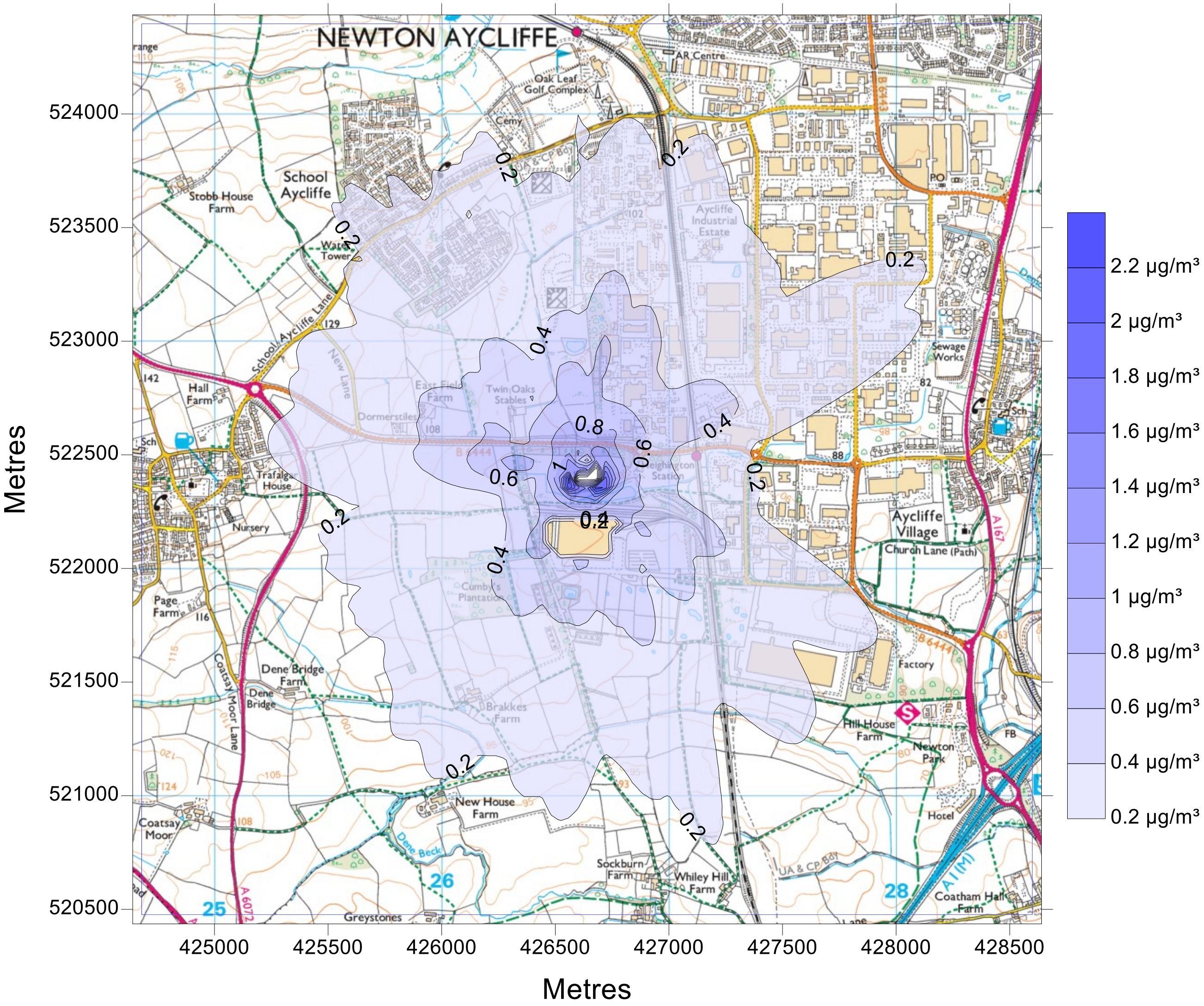


Figure 17: HCl – 100th Percentile – Met Year 2021

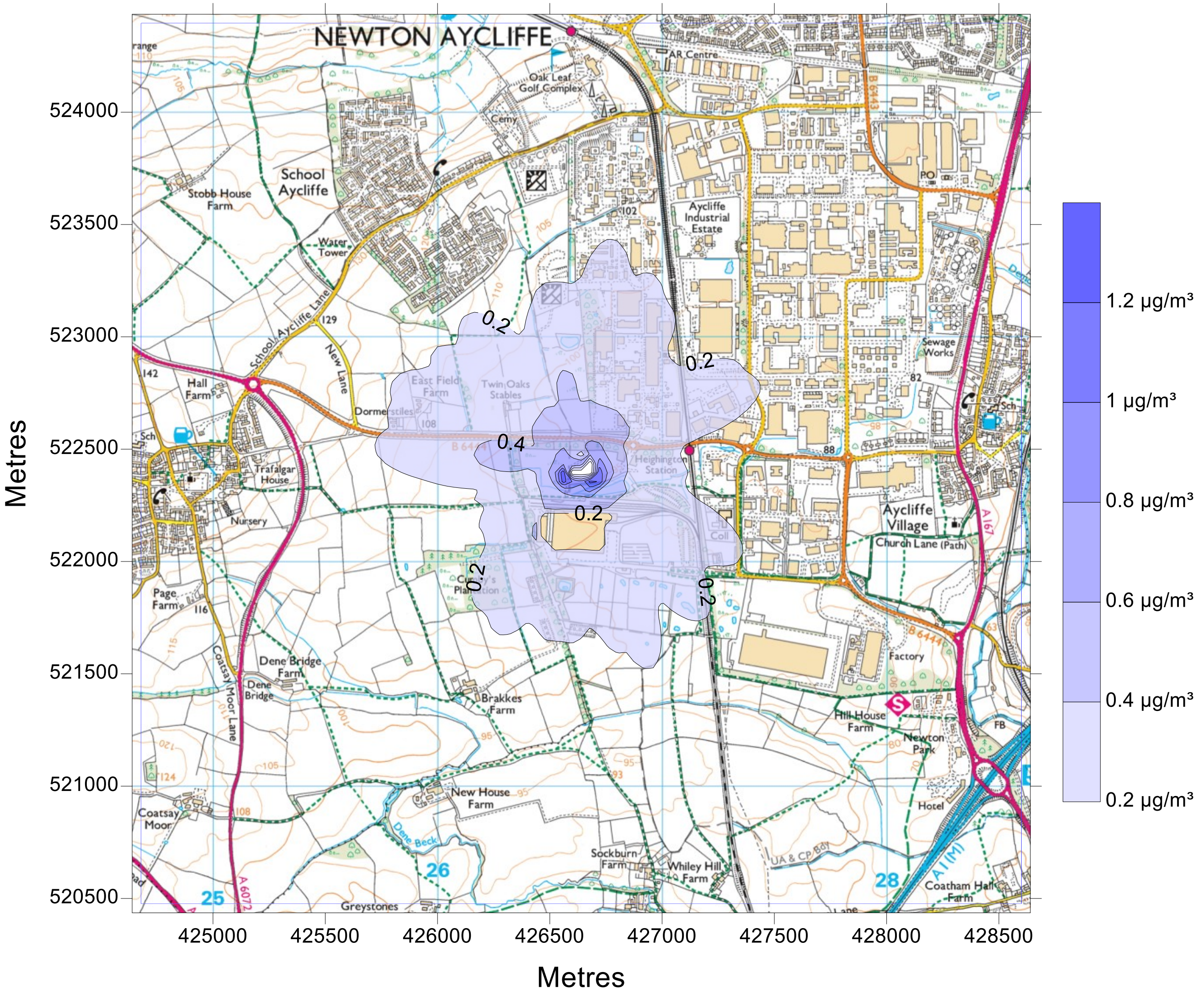


Figure 18: HF – Annual Mean – Met Year 2017

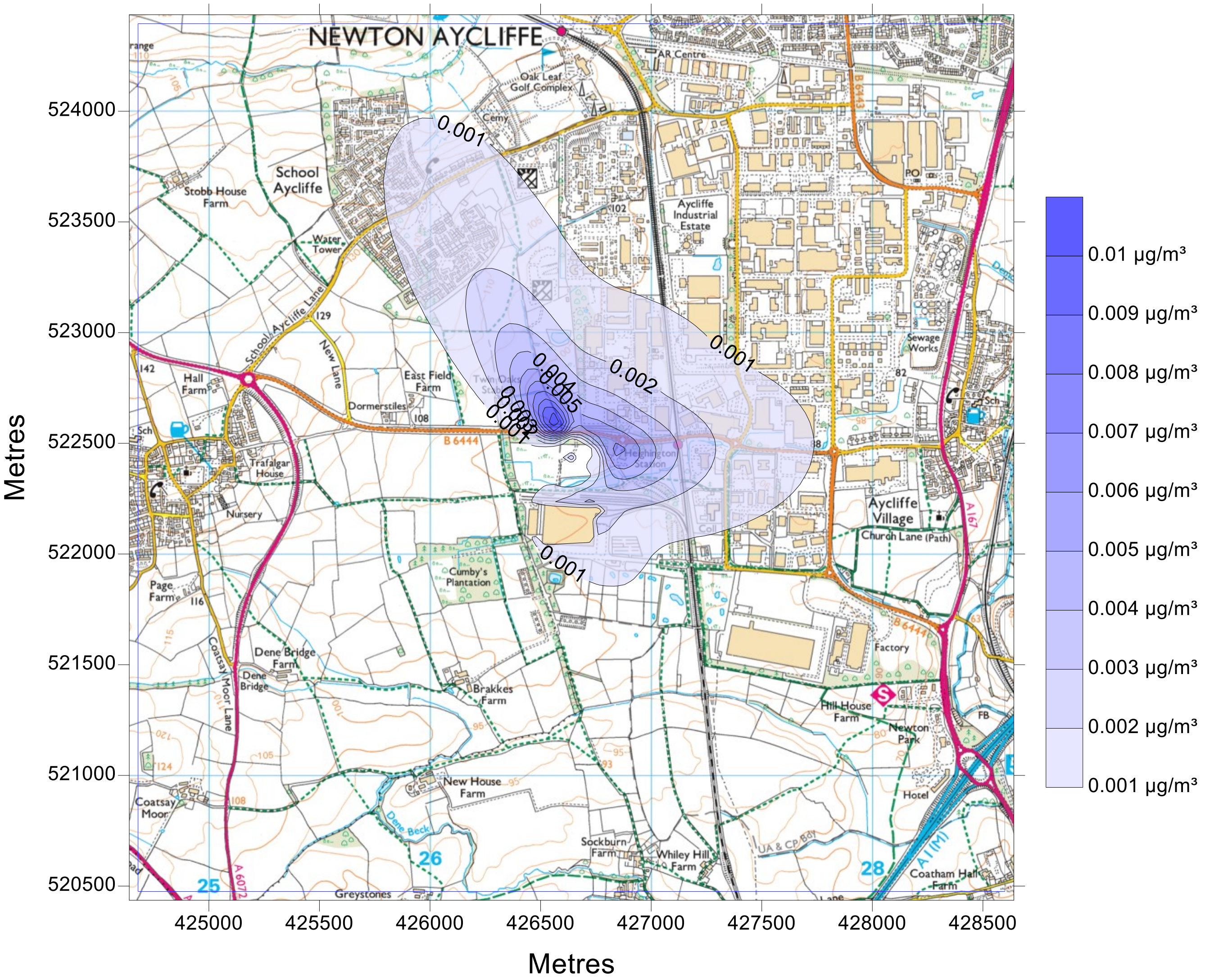


Figure 19: HF – 100th Percentile – Met Year 2021

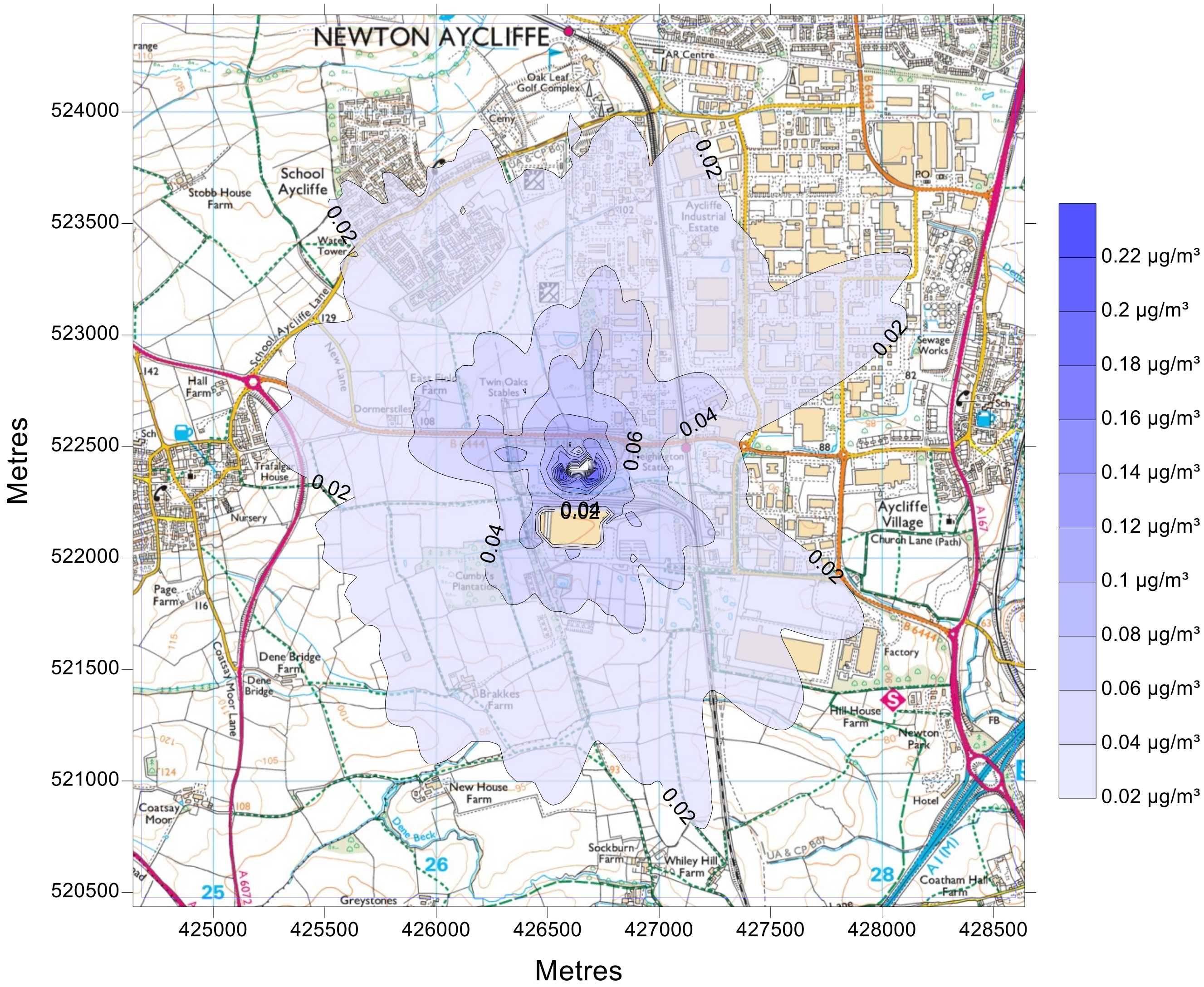


Figure 20: Sb, As, Pb, Cr, Co, Cu, Mn, Ni, V – Annual Mean – Met Year 2017

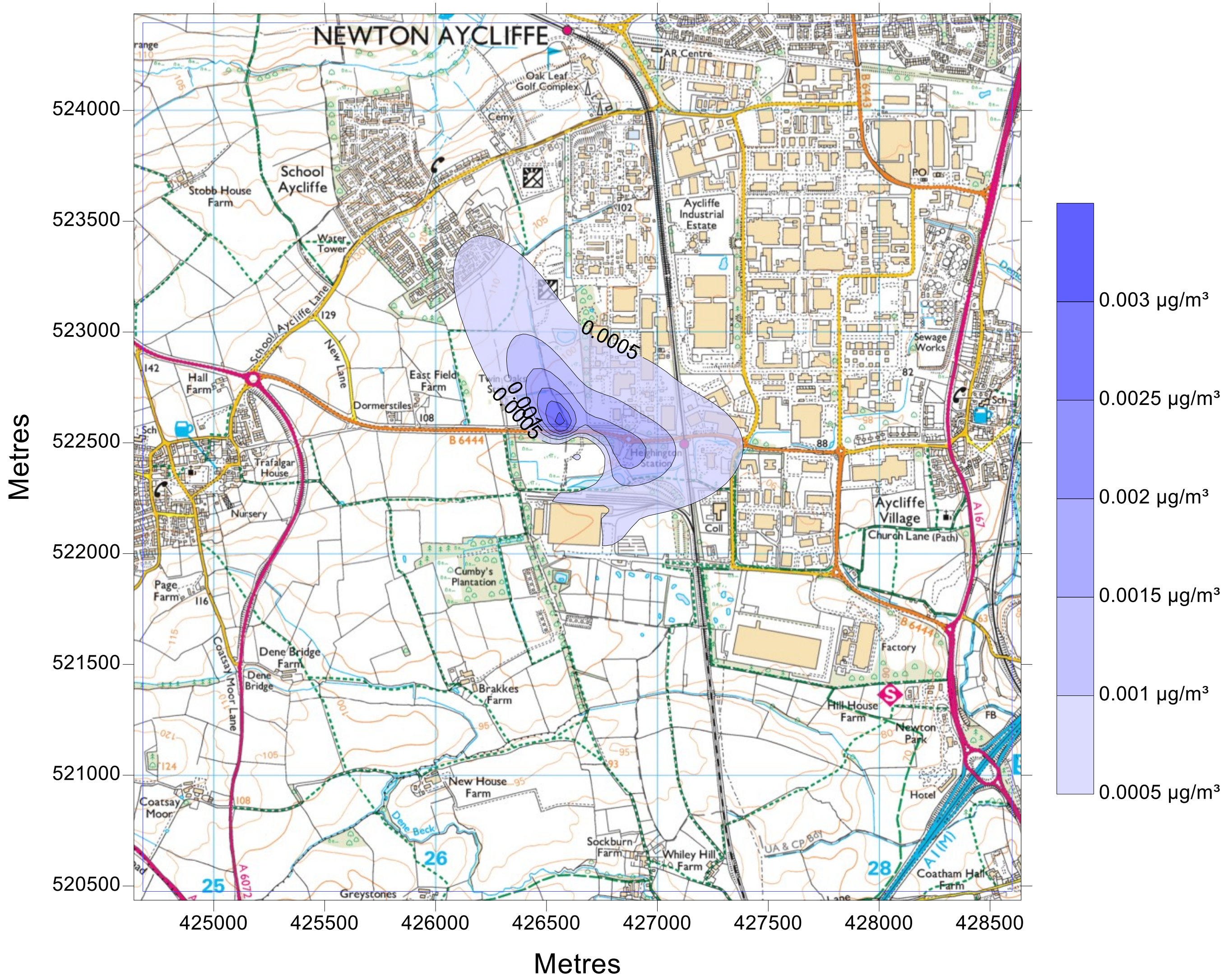


Figure 21: V – 24-Hour 100th Percentile – Met Year 2018

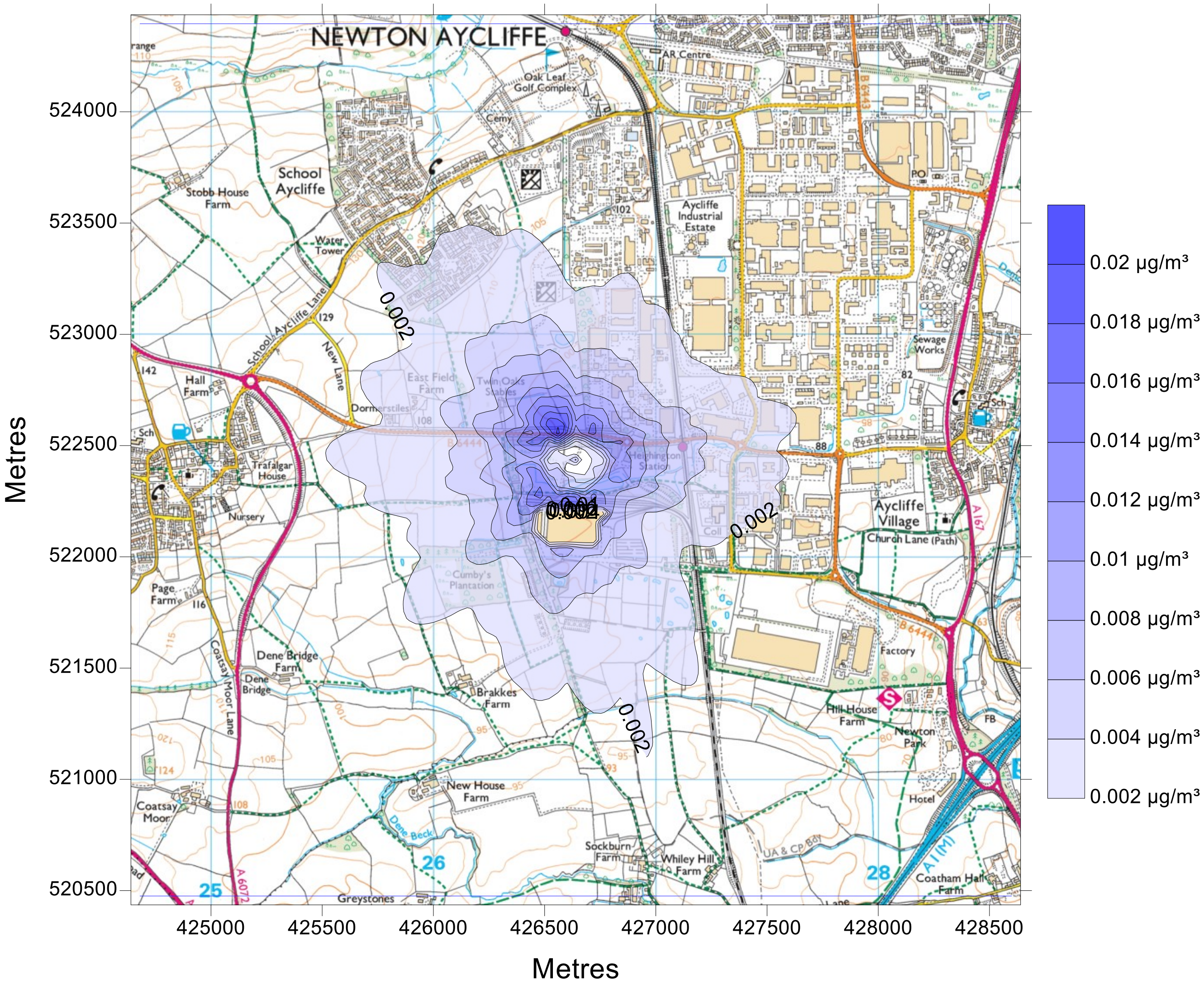


Figure 22: Sb, Cr, Co, Cu, Mn - 100th Percentile – Met Year 2021

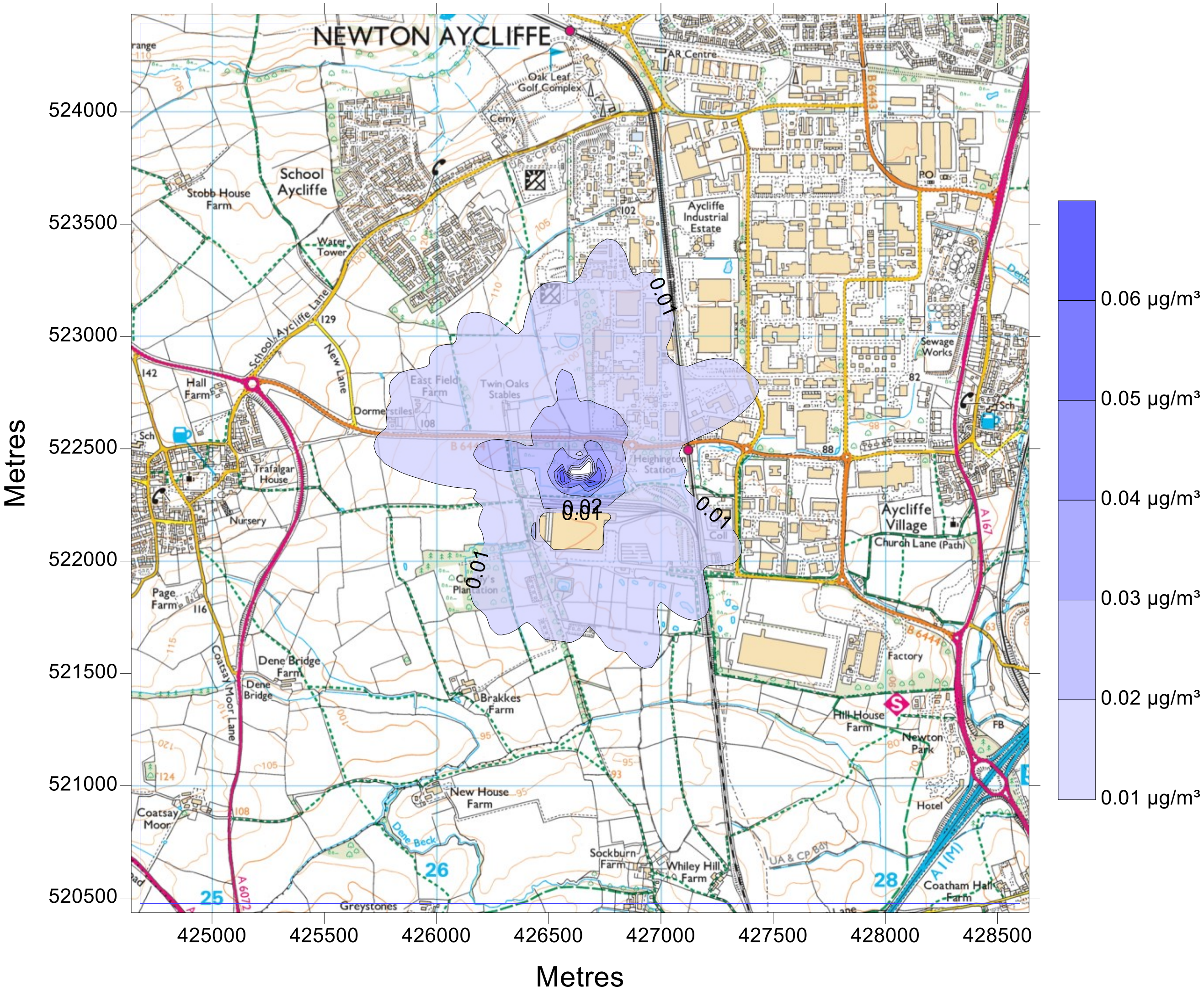


Figure 23: Cd and Tl – Annual Mean – Met Year 2017

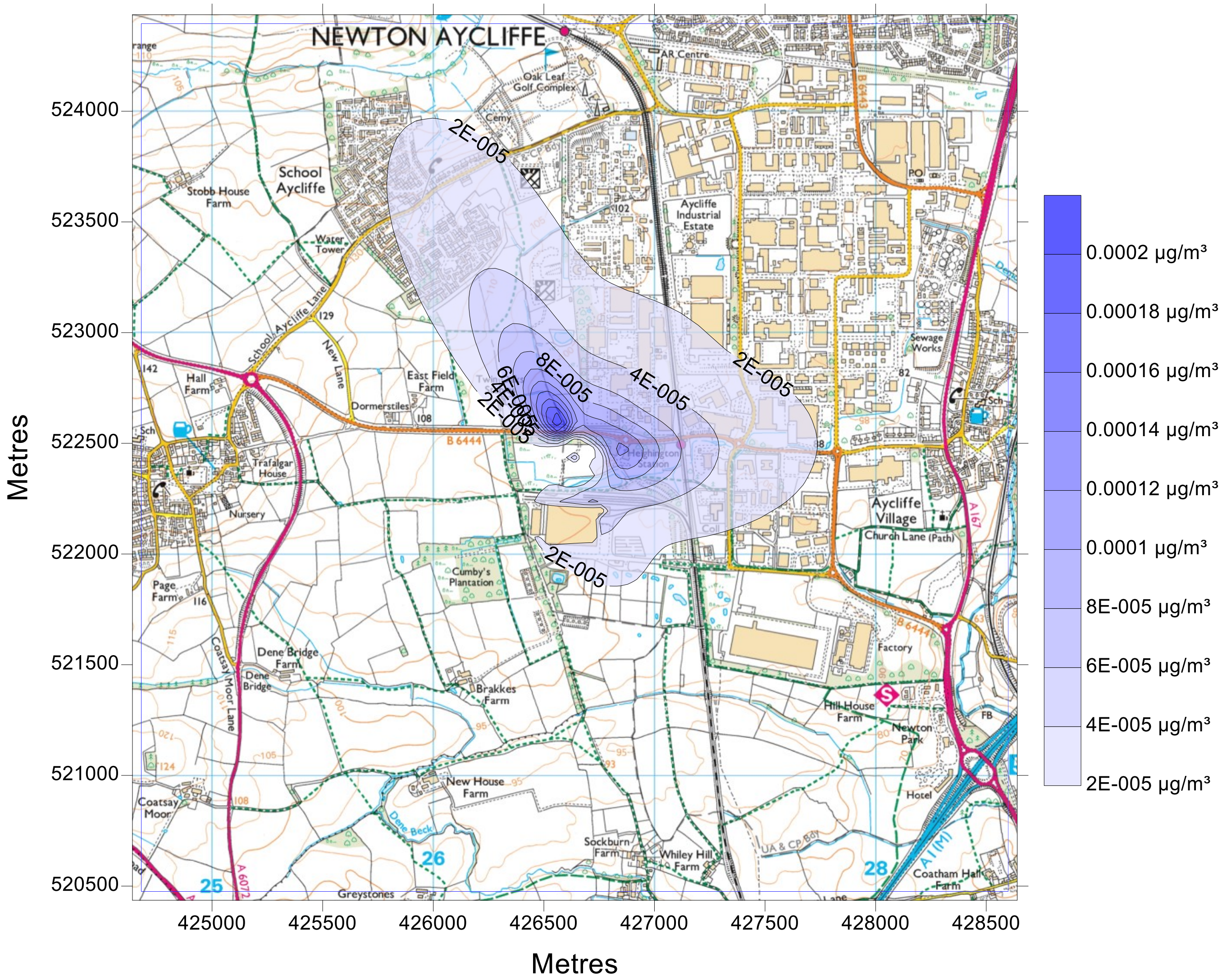


Figure 24: Hg – Annual Mean – Met Year 2017

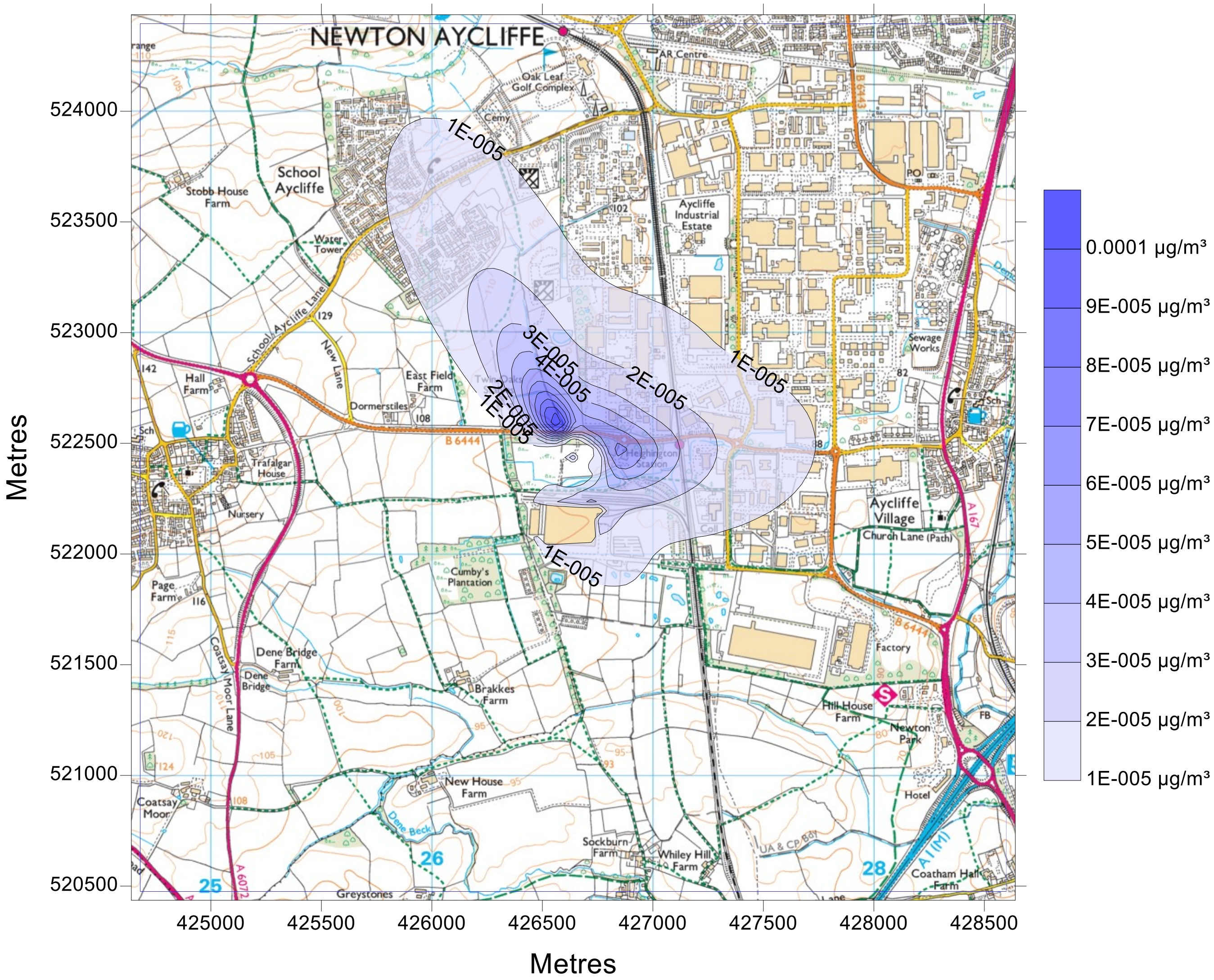


Figure 25: Hg and Tl – 1-Hour 100th Percentile – Met Year 2021

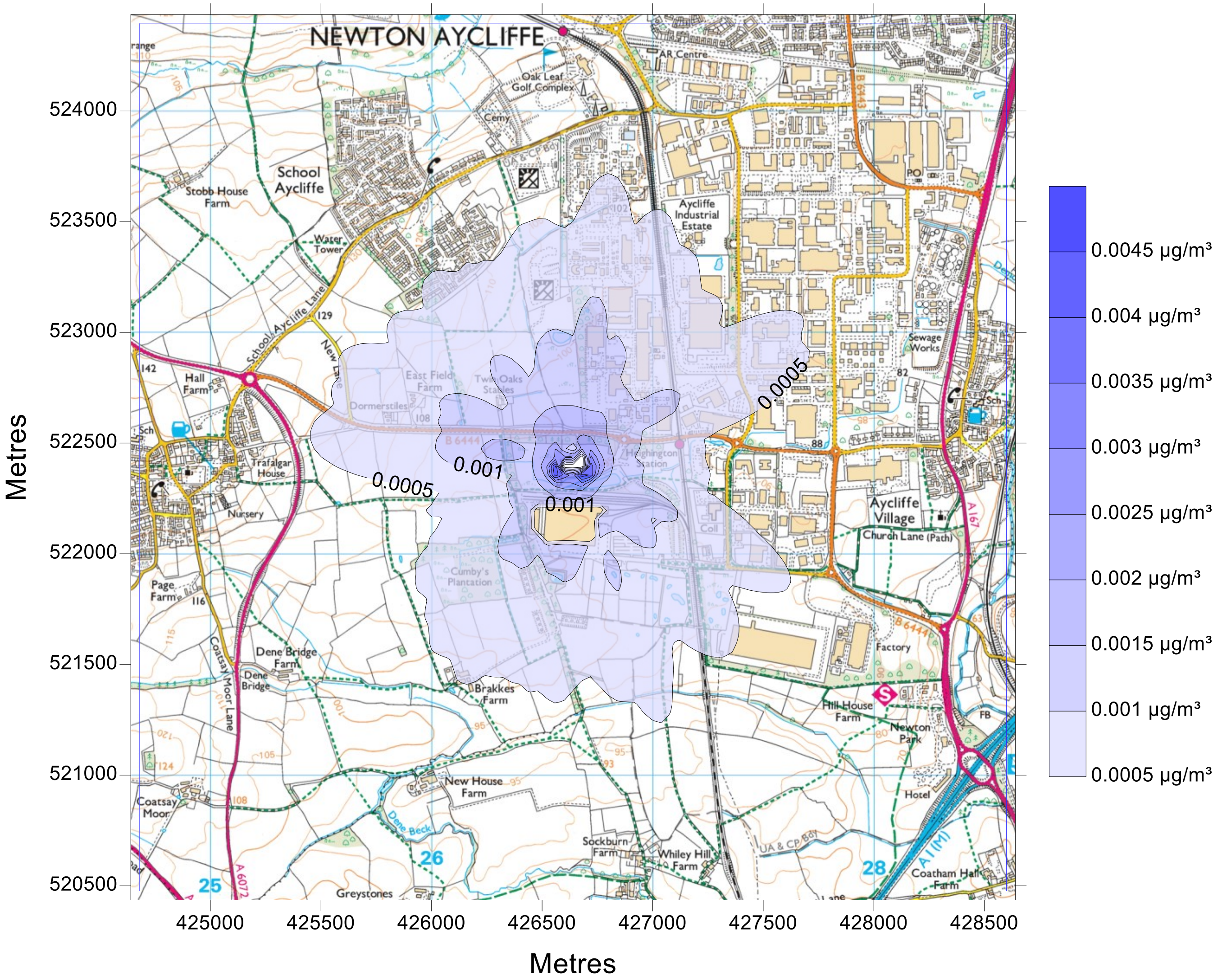
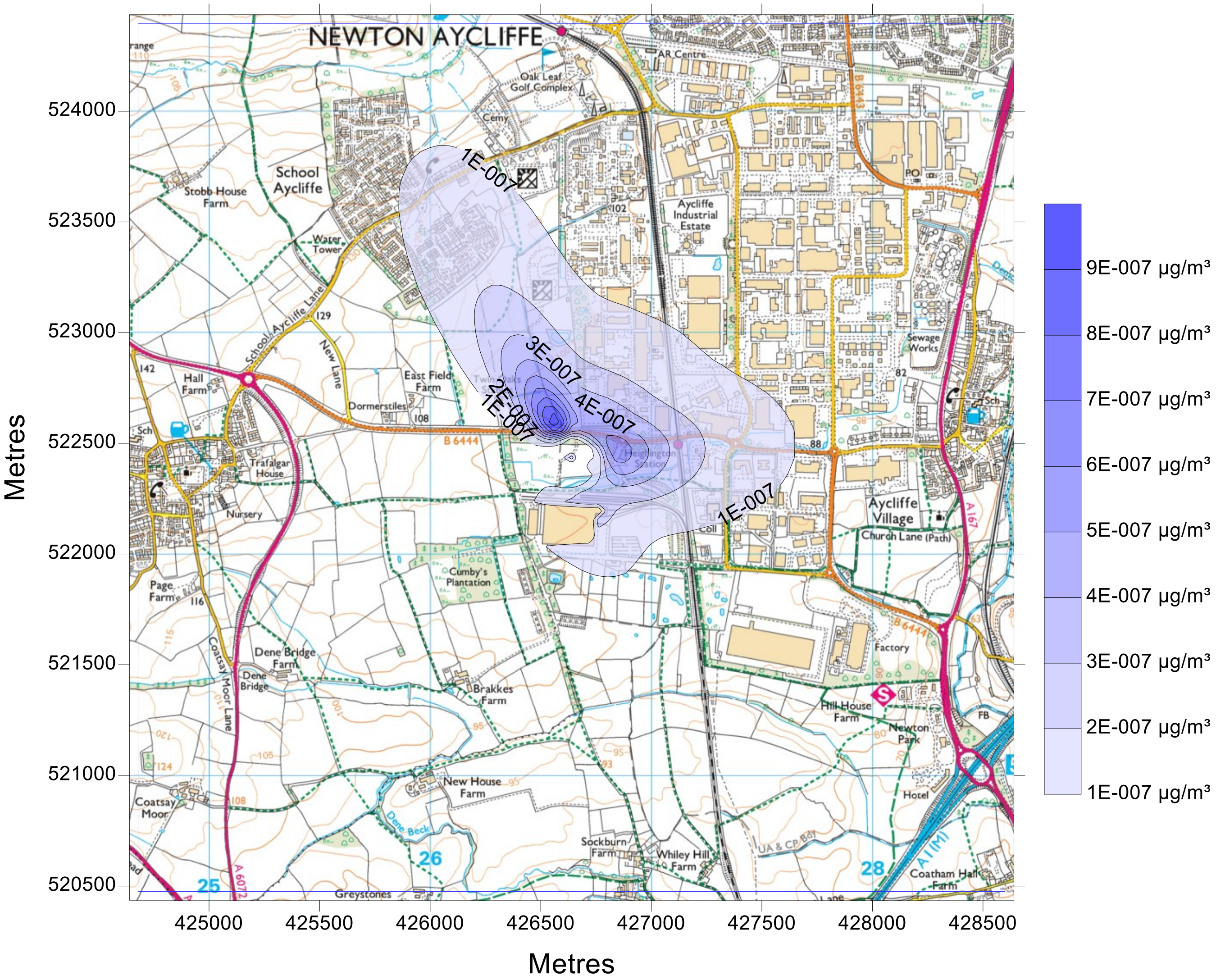


Figure 26: PAH (as B[a]P) – Annual Mean – Met Year 2017



4. ASSESSMENT OF AIR QUALITY IMPACTS – POTENTIALLY SENSITIVE HUMAN RECEPTOR LOCATIONS

4.1.1. The following assessments (outlined in Sections 4.2. and 4.3.) consider the effects of emissions from the Installation on the potentially sensitive human receptors identified in Table 1.

4.2. Results – Group 1, 2 and 3 Metals

4.2.1. Due to the number of potentially sensitive human receptors, and the varying screening methodology, the results have been split into two sections. This section focuses on Group 1, 2 and 3 metals only, the remaining pollutants are discussed in Section 4.3.

4.2.2. The results of the assessment can be found in Table 19 to follow. Based on Stage 1 screening (i.e., long-term PCs greater than 1% of their AQS are potentially significant and short-term PCs greater than 10% of their AQS are potentially significant), all metals with short-term averaging periods screened out. The metals with potentially significant long-term impacts were As, Cd, Cr(VI) and Ni (all annual mean). Consequently, PECs were considered for these metals. All other long-term metals screened out.

4.2.3. Following calculation of the PECs, all metals with the exception of Cr(VI) screened out (i.e., the PECs were all less than 100% of their respective AQSs). Step 2 screening indicates that where the PC exceeds 1% of the long standard, the maximum emissions data in Appendix A of the EA's Group 3 metals assessment guidance can be used to revise the predictions, and the PEC then compared against the AQS (see Section 2.22). The guidance states that Cr(VI) comprises 0.03% of the Group 3 metals. Consequently, the emission rate for Cr(VI) has been recalculated based on these percentages.

4.2.4. Following Step 2 screening for Cr(VI), all Group 1, 2 and 3 metals screen out as being not significant at all potentially sensitive human receptors.

4.2.5. The results of the screening assessments for Group 1, 2 and 3 metals may be found in Table 19, with any potentially significant impacts, that required further assessment as described above, highlighted in bold.

Table 19: Predicted Maximum GLCs at Potentially Sensitive Human Receptors for Group 1, 2 and 3 Metals

	Pollutant	Sb (annual)	Sb (1-hour)	As (annual)	Cd (annual)	Cr (annual)	Cr (1-hour)	Cr VI (annual) [a]	Co (annual)	Co (1-hour)	Cu (annual)	Cu (1-hour)
	AQS (µg/m³)	5	150	0.003	0.005	5	150	0.00025	0.2	6	10	200
	Maximum PC (µg/m³)	0.00134	0.0220	**0.00134**	**0.0000892**	0.00134	0.0220	0.000000401	0.00134	0.0220	0.00134	0.0220
	Max PC as % of AQS	0.03%	0.01%	**44.61%**	**1.78%**	0.03%	0.01%	0.16%	0.67%	0.37%	0.01%	0.01%
	Background Concentration (µg/m³)	n/a	n/a	0.000897 [c]	0.000637 [c]	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Maximum PEC (µg/m³)	n/a	n/a	0.00224	0.000726	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Max PEC as % of AQS	n/a	n/a	75%	15%	n/a	n/a	n/a	n/a	n/a	n/a	n/a
HR1	Industrial	0.00134	0.0212	**0.00134**	**0.0000892**	0.00134	0.0212	0.000000401	0.00134	0.0212	0.00134	0.0212
HR2	Hitachi Rail Intake Vents (14m from ground level)	0.000909	0.0220	**0.000909**	**0.0000606**	0.000909	0.0220	0.000000273	0.000909	0.0220	0.000909	0.0220
HR3	Hitachi Rail (Ground level)	0.000837	0.0161	**0.000837**	**0.0000558**	0.000837	0.0161	0.000000251	0.000837	0.0161	0.000837	0.0161
HR4	Clay Pigeon Shooting	0.000437	0.0160	**0.000437**	0.0000291	0.000437	0.0160	0.000000131	0.000437	0.0160	0.000437	0.0160
HR5	College	0.000410	0.0130	**0.000410**	0.0000273	0.000410	0.0130	0.000000123	0.000410	0.0130	0.000410	0.0130
HR6	East Field Lane	0.000151	0.0126	**0.000151**	0.0000101	0.000151	0.0126	0.0000000454	0.000151	0.0126	0.000151	0.0126
HR7	Cherry Tree Drive	0.000549	0.00931	**0.000549**	0.0000366	0.000549	0.00931	0.000000165	0.000549	0.00931	0.000549	0.00931
HR8	Magnolia Close	0.000488	0.00771	**0.000488**	0.0000325	0.000488	0.00771	0.000000146	0.000488	0.00771	0.000488	0.00771
HR9	Bracks Farm	0.000174	0.00729	**0.000174**	0.0000116	0.000174	0.00729	0.0000000522	0.000174	0.00729	0.000174	0.00729
HR10	Heighington Road	0.000249	0.00755	**0.000249**	0.0000166	0.000249	0.00755	0.0000000747	0.000249	0.00755	0.000249	0.00755
HR11	North Cottages	0.000323	0.00651	**0.000323**	0.0000216	0.000323	0.00651	0.0000000970	0.000323	0.00651	0.000323	0.00651
HR12	Kieran Maxwell Lane	0.0000439	0.00588	**0.0000439**	0.00000292	0.0000439	0.00588	0.0000000132	0.0000439	0.00588	0.0000439	0.00588
HR13	West Cemetery	0.000289	0.00572	**0.000289**	0.0000193	0.000289	0.00572	0.0000000867	0.000289	0.00572	0.000289	0.00572
HR14	Sports Ground	0.000207	0.00592	**0.000207**	0.0000138	0.000207	0.00592	0.0000000621	0.000207	0.00592	0.000207	0.00592
HR15	Dene Bridge Farm	0.0000583	0.00512	**0.0000583**	0.00000389	0.0000583	0.00512	0.0000000175	0.0000583	0.00512	0.0000583	0.00512
HR16	Cumby Road	0.000127	0.00482	**0.000127**	0.00000848	0.000127	0.00482	0.0000000381	0.000127	0.00482	0.000127	0.00482
HR17	Durham Road	0.000119	0.00553	**0.000119**	0.00000792	0.000119	0.00553	0.0000000356	0.000119	0.00553	0.000119	0.00553
HR18	Finchale Road	0.0000983	0.00430	**0.0000983**	0.00000655	0.0000983	0.00430	0.0000000295	0.0000983	0.00430	0.0000983	0.00430

Table 19: Predicted Maximum GLCs at Potentially Sensitive Human Receptors for Group 1, 2 and 3 Metals (cont.)

	Pollutant	Pb (annual)	Mn (annual)	Mn (1-hour)	Hg (annual)	Hg (1-hour)	Ni (annual)	Tl (annual)	Tl (1-hour)	V (annual)	V (24-hour)
	AQS (µg/m³)	0.25	1	1,500	0.25	7.5	0.02	1	30	5	1
	Maximum PC (µg/m³)	0.00134	0.00134	0.0220	0.0000446	0.00147	**0.00134**	0.0000892	0.00147	0.00134	0.0111
	Max PC as % of AQS	0.54%	0.13%	0.0011%	0.02%	0.02%	**6.69%**	0.009%	0.005%	0.03%	1.11%
	Background Concentration (µg/m³)	n/a	n/a	n/a	n/a	n/a	0.00136 (c)	n/a	n/a	n/a	n/a
	Maximum PEC (µg/m³)	n/a	n/a	n/a	n/a	n/a	0.00270	n/a	n/a	n/a	n/a
	Max PEC as % of AQS	n/a	n/a	n/a	n/a	n/a	13%	n/a	n/a	n/a	n/a
HR1	Industrial	0.00134	0.00134	0.0212	0.0000446	0.00141	0.00134	0.0000892	0.00141	0.00134	0.0111
HR2	Hitachi Rail Intake Vents (14m from ground level)	0.000909	0.000909	0.0220	0.0000303	0.00147	0.000909	0.0000606	0.00147	0.000909	0.00974
HR3	Hitachi Rail (Ground level)	0.000837	0.000837	0.0161	0.0000279	0.00107	0.000837	0.0000558	0.00107	0.000837	0.00917
HR4	Clay Pigeon Shooting	0.000437	0.000437	0.0160	0.0000146	0.00107	0.000437	0.0000291	0.00107	0.000437	0.00477
HR5	College	0.000410	0.000410	0.0130	0.0000137	0.000869	0.000410	0.0000273	0.000869	0.000410	0.00302
HR6	East Field Lane	0.000151	0.000151	0.0126	0.00000504	0.000843	0.000151	0.0000101	0.000843	0.000151	0.00320
HR7	Cherry Tree Drive	0.000549	0.000549	0.00931	0.0000183	0.000621	0.000549	0.0000366	0.000621	0.000549	0.00311
HR8	Magnolia Close	0.000488	0.000488	0.00771	0.0000163	0.000514	0.000488	0.0000325	0.000514	0.000488	0.00253
HR9	Bracks Farm	0.000174	0.000174	0.00729	0.00000580	0.000486	0.000174	0.0000116	0.000486	0.000174	0.00167
HR10	Heighington Road	0.000249	0.000249	0.00755	0.00000830	0.000503	0.000249	0.0000166	0.000503	0.000249	0.00140
HR11	North Cottages	0.000323	0.000323	0.00651	0.0000108	0.000434	0.000323	0.0000216	0.000434	0.000323	0.00187
HR12	Kieran Maxwell Lane	0.0000439	0.0000439	0.00588	0.00000146	0.000392	0.0000439	0.00000292	0.000392	0.0000439	0.00149
HR13	West Cemetery	0.000289	0.000289	0.00572	0.00000963	0.000381	0.000289	0.0000193	0.000381	0.000289	0.00168
HR14	Sports Ground	0.000207	0.000207	0.00592	0.00000690	0.000394	0.000207	0.0000138	0.000394	0.000207	0.00137
HR15	Dene Bridge Farm	0.0000583	0.0000583	0.00512	0.00000194	0.000341	0.0000583	0.00000389	0.000341	0.0000583	0.000952
HR16	Cumby Road	0.000127	0.000127	0.00482	0.00000424	0.000322	0.000127	0.00000848	0.000322	0.000127	0.000983
HR17	Durham Road	0.000119	0.000119	0.00553	0.00000396	0.000369	0.000119	0.00000792	0.000369	0.000119	0.000954
HR18	Finchale Road	0.0000983	0.0000983	0.00430	0.00000328	0.000287	0.0000983	0.00000655	0.000287	0.0000983	0.000676

Notes to Table 19

(a) Modelled in accordance with the Step 2 screening guidance (i.e., at the revised emission rate calculated with Cr(VI) comprising 0.03% of the Group 3 metals).

(b) It is worth noting that the maximum predicted PC for As occurs in the vicinity of an industrial estate building north of site (i.e., HR1) and is therefore not necessarily a receptor representative of public exposure. Furthermore, As comprises 5% of the Group 3 metals (which, in line with the Step 2 screening guidance, would give a revised maximum GLC of 0.0000669µg/m³ (i.e., a PC and PEC of 2.23% and 32% of the AQS, respectively)).

(c) Background concentrations taken from the urban industrial site at Scunthorpe Low Santon, 2022 data (refer to Section 3.2., for further details on this monitoring station).

4.3. Results – Remaining Pollutants

4.3.1. This section focuses on all pollutants excluding the Group 1, 2 and 3 Metals which are discussed in Section 4.2.

4.3.2. Based on Stage 1 screening (i.e., long-term PCs greater than 1% of their AQS are potentially significant and short-term PCs greater than 10% of their AQS are potentially significant), all pollutants screened out all locations.

4.3.3. The results of this assessment may be found in Table 20, with any potentially significant impacts highlighted in bold.

Table 20: Predicted Maximum GLCs at Potentially Sensitive Human Receptors for All Remaining Pollutants

	Pollutant	NO_2 (annual mean)	NO_2 (99.79th %ile)	SO_2 (99.18th %ile)	SO_2 (99.73rd %ile)	SO_2 (99.90th %ile)	PM_{10} (annual)	PM_{10} (90.41st %ile)	$PM_{2.5}$ (annual)	CO (8-hour)	VOC (annual)
	AQS (µg/m^3)	40	200	125	350	266	40	50	20	10,000	5
	Maximum PC (µg/m^3)	0.375	2.78	0.908	1.97	2.26	0.0223	0.0719	0.0223	2.87	0.0446
	Max PC as % of AQS	0.94%	1.39%	0.73%	0.56%	0.85%	0.06%	0.14%	0.11%	0.03%	0.89%
HR1	Industrial	0.375	2.78	0.883	1.97	2.26	0.0223	0.0719	0.0223	2.74	0.0446
HR2	Hitachi Rail Intake Vents (14m from ground level)	0.254	2.56	0.908	1.82	2.13	0.0151	0.0645	0.0151	2.87	0.0303
HR3	Hitachi Rail (Ground level)	0.234	1.98	0.758	1.39	1.69	0.0139	0.0519	0.0139	2.22	0.0279
HR4	Clay Pigeon Shooting	0.122	1.29	0.387	0.898	1.18	0.00729	0.0298	0.00729	1.20	0.0146
HR5	College	0.115	0.963	0.242	0.663	0.873	0.00683	0.0229	0.00683	0.899	0.0137
HR6	East Field Lane	0.042	0.784	0.201	0.557	0.756	0.00252	0.00965	0.00252	0.641	0.00504
HR7	Cherry Tree Drive	0.154	0.912	0.304	0.631	1.04	0.00915	0.0265	0.00915	0.927	0.0183
HR8	Magnolia Close	0.137	0.874	0.212	0.584	0.952	0.00813	0.0216	0.00813	0.762	0.0163
HR9	Bracks Farm	0.049	0.720	0.127	0.457	0.736	0.00290	0.0110	0.00290	0.456	0.00580
HR10	Heighington Road	0.0697	0.534	0.118	0.362	0.544	0.00415	0.0116	0.00415	0.410	0.00830
HR11	North Cottages	0.0906	0.698	0.155	0.495	0.841	0.00539	0.0151	0.00539	0.618	0.0108
HR12	Kieran Maxwell Lane	0.0123	0.471	0.0764	0.304	0.637	0.000731	0.00266	0.000731	0.417	0.00146
HR13	West Cemetery	0.0809	0.683	0.134	0.479	0.758	0.00482	0.0133	0.00482	0.548	0.00963
HR14	Sports Ground	0.0580	0.705	0.108	0.482	0.784	0.00345	0.0102	0.00345	0.665	0.00690
HR15	Dene Bridge Farm	0.0163	0.536	0.0860	0.332	0.603	0.000972	0.00308	0.000972	0.430	0.00194
HR16	Cumby Road	0.0356	0.528	0.0745	0.370	0.636	0.00212	0.00624	0.00212	0.346	0.00424
HR17	Durham Road	0.0333	0.458	0.0675	0.321	0.499	0.00198	0.00587	0.00198	0.312	0.00396
HR18	Finchale Road	0.0275	0.494	0.0498	0.339	0.540	0.00164	0.00469	0.00164	0.312	0.00328

Table 20: Predicted Maximum GLCs at Potentially Sensitive Human Receptors for All Remaining Pollutants (cont.)

	Pollutant	VOC (24-hour)	NH_3 (annual)	NH_3 (1-hour)	HCl (1 hour)	HF (annual)	HF (1-hour)	PAH (as B[a]P) (annual)	PCB (annual)	PCB (1-hour)	Dioxins & Furans (annual)
	AQS (µg/m³)	30	180	2,500	750	16	160	0.00025	0.2	6	n/a
	Maximum PC (µg/m³)	0.369	0.0446	0.734	0.440	0.00446	0.0734	0.000000401	1.61E-11	2.64E-10	2.68E-10
	Max PC as % of AQS	1.23%	0.02%	0.03%	0.06%	0.03%	0.05%	0.16%	0.000000008%	0.000000004%	n/a
HR1	Industrial	0.369	0.0446	0.707	0.424	0.00446	0.0707	0.000000401	1.61E-11	2.55E-10	2.68E-10
HR2	Hitachi Rail Intake Vents (14m from ground level)	0.325	0.0303	0.734	0.440	0.00303	0.0734	0.000000273	1.09E-11	2.64E-10	1.82E-10
HR3	Hitachi Rail (Ground level)	0.306	0.0279	0.535	0.321	0.00279	0.0535	0.000000251	1.00E-11	1.93E-10	1.67E-10
HR4	Clay Pigeon Shooting	0.159	0.0146	0.535	0.321	0.00146	0.0535	0.000000131	5.25E-12	1.93E-10	8.74E-11
HR5	College	0.101	0.0137	0.435	0.261	0.00137	0.0435	0.000000123	4.92E-12	1.56E-10	8.19E-11
HR6	East Field Lane	0.107	0.00504	0.421	0.253	0.000504	0.0421	0.0000000454	1.82E-12	1.52E-10	3.03E-11
HR7	Cherry Tree Drive	0.104	0.0183	0.310	0.186	0.00183	0.0310	0.000000165	6.59E-12	1.12E-10	1.10E-10
HR8	Magnolia Close	0.0844	0.0163	0.257	0.154	0.00163	0.0257	0.000000146	5.85E-12	9.25E-11	9.76E-11
HR9	Bracks Farm	0.0558	0.00580	0.243	0.146	0.000580	0.0243	0.0000000522	2.09E-12	8.75E-11	3.48E-11
HR10	Heighington Road	0.0467	0.00830	0.252	0.151	0.000830	0.0252	0.0000000747	2.99E-12	9.06E-11	4.98E-11
HR11	North Cottages	0.0622	0.0108	0.217	0.130	0.00108	0.0217	0.0000000970	3.88E-12	7.81E-11	6.47E-11
HR12	Kieran Maxwell Lane	0.0497	0.00146	0.196	0.118	0.000146	0.0196	0.0000000132	5.26E-13	7.05E-11	8.77E-12
HR13	West Cemetery	0.0561	0.00963	0.191	0.114	0.000963	0.0191	0.0000000867	3.47E-12	6.86E-11	5.78E-11
HR14	Sports Ground	0.0458	0.00690	0.197	0.118	0.000690	0.0197	0.0000000621	2.48E-12	7.10E-11	4.14E-11
HR15	Dene Bridge Farm	0.0317	0.00194	0.171	0.102	0.000194	0.0171	0.0000000175	7.00E-13	6.14E-11	1.17E-11
HR16	Cumby Road	0.0328	0.00424	0.161	0.0965	0.000424	0.0161	0.0000000381	1.53E-12	5.79E-11	2.54E-11
HR17	Durham Road	0.0318	0.00396	0.184	0.111	0.000396	0.0184	0.0000000356	1.43E-12	6.64E-11	2.38E-11
HR18	Finchale Road	0.0225	0.00328	0.143	0.0861	0.000328	0.0143	0.0000000295	1.18E-12	5.17E-11	1.97E-11

5. ASSESSMENT OF AIR QUALITY IMPACTS - IMPACT ON HABITAT SITES – CRITICAL LEVELS

5.1.1. The following assessments (outlined in Sections 5.2. – 5.5.) consider the effect of emissions from the Installation on critical levels for the habitat sites identified in Table 2.

5.1.2. In accordance with the EA guidance, the significance of the impacts has been determined using the 100% criteria for long and short-term predictions for local nature sites (see Section 2.21. of this document).

5.2. Comparison of Maximum Predicted Pollutant Ground Level Concentrations with Critical Levels for the Protection of Vegetation and Ecosystems - Oxides of Nitrogen

5.2.1. A summary of maximum predicted GLCs of oxides of nitrogen at the identified sensitive habitat sites is presented in Table 21. Any significant impacts are highlighted in bold.

Table 21: Comparison of Maximum Predicted Oxides of Nitrogen Ground Level Concentrations (PCs) with Critical Levels at Sensitive Habitat Sites – SPAs, SACs, Ramsars and SSSIs

	Pollutant	**NO_X (annual mean)**	**NO_X (24-hour mean)**
	Critical Level	30	75
	Maximum PC ($\mu g/m^3$)	0.397	4.20
	Max PC as % of Critical Level	1.32%	5.59%
ER1	Cumby Pond – LWS	0.397	4.20
ER2	Aycliffe Quarry – LWS	0.0640	0.548
ER3	School Aycliffe – LWS	0.110	0.672
ER4	Aycliffe Nature Park – LWS	0.0334	0.294

5.2.2. It can be seen from the data in Table 21 that the annual and daily mean oxides of nitrogen PCs are all less 100% of the respective critical level and therefore, are not significant at all habitat sites considered.

5.3. Comparison of Maximum Predicted Pollutant Ground Level Concentrations with Critical Levels for the Protection of Vegetation and Ecosystems - Sulphur Dioxide

5.3.1. A summary of maximum predicted GLCs of sulphur dioxide at the identified sensitive habitat sites are presented in Table 22. Any significant impacts are highlighted in bold.

Table 22: Comparison of Maximum Predicted Sulphur Dioxide Ground Level Concentrations (PCs) with Critical Levels at Sensitive Habitat Sites

	Pollutant	SO_2 (annual mean)
	Critical Level (µg/m^3)	10 [(a)]
	Maximum PC (µg/m^3)	0.0993
	Max PC as % of Critical Level	0.99%
ER1	Cumby Pond – LWS	0.0993
ER2	Aycliffe Quarry – LWS	0.0160
ER3	School Aycliffe – LWS	0.0275
ER4	Aycliffe Nature Park – LWS	0.00836

Notes to Table 22

(a) In the interest of a conservative assessment, the strictest critical level (i.e., when lichens and bryophytes are present) has been used (see Table 4 of Section 2.6.).

5.3.2. It can be seen from the data in Table 22 that the annual mean sulphur dioxide PCs are all less than 100% of the critical level and therefore are not significant at all habitat sites considered.

5.4. Comparison of Maximum Predicted Pollutant Ground Level Concentrations with Critical Levels for the Protection of Vegetation and Ecosystems - Ammonia

5.4.1. A summary of maximum predicted GLCs of ammonia at the identified sensitive habitat sites are presented in Table in Table 23. Any significant impacts are highlighted in bold.

Table 23: Comparison of Maximum Predicted Ammonia Ground Level Concentrations (PCs) with Critical Levels at Sensitive Habitat Sites

	Pollutant	NH_3 (annual mean) - Other Vegetation
	Critical Level (µg/m^3)	1 [(a)]
	Maximum PC (µg/m^3)	0.0331
	Max PC as % of Critical Level	3.31%
ER1	Cumby Pond – LWS	0.0331
ER2	Aycliffe Quarry – LWS	0.00533
ER3	School Aycliffe – LWS	0.00916
ER4	Aycliffe Nature Park – LWS	0.00279

Notes to Table 23

(a) In the interest of a conservative assessment, the strictest critical level (i.e., when lichens and bryophytes are present) has been used (see Table 4 of Section 2.6.).

5.4.2. It can be seen from the data in Table 23 that the annual and daily mean ammonia PCs are all less than 100% of the respective critical level and therefore are not significant at all habitat sites considered.

5.5. Comparison of Maximum Predicted Pollutant Ground Level Concentrations with Critical Levels for the Protection of Vegetation and Ecosystems - Hydrogen Fluoride

5.5.1. A summary of maximum predicted GLCs of hydrogen fluoride at the identified sensitive habitat sites are presented in Table 24. Any significant impacts are highlighted in bold.

Table 24: Comparison of Maximum Predicted Hydrogen Fluoride Ground Level Concentrations (PCs) with Critical Levels at Sensitive Habitat Sites

	Pollutant	HF (weekly mean)	HF (daily mean)
	Critical Level (µg/m³)	0.5	5
	Maximum PC (µg/m³)	0.0164	0.0350
	Max PC as % of Critical Level	3.27%	0.70%
ER1	Cumby Pond – LWS	0.0164	0.0350
ER2	Aycliffe Quarry – LWS	0.00172	0.00457
ER3	School Aycliffe – LWS	0.00341	0.00560
ER4	Aycliffe Nature Park – LWS	0.000762	0.00245

5.5.2. It can be seen from the data in Table 24 that the annual and daily mean HF PCs are all less than 100% of the respective critical level and therefore are not significant at all habitat sites considered.

6. ASSESSMENT OF AIR QUALITY IMPACTS - IMPACT ON HABITAT SITES - DEPOSITION

6.1.1. The following assessments (outlined in Sections 6.2. and 6.3.) consider the effect of emissions from the Installation on critical loads for the habitat sites identified in Table 2.

6.2. Comparison of Maximum Predicted Nutrient Nitrogen Deposition Rates with Critical Loads – European Sites and SSSIs

6.2.1. A summary of maximum predicted nutrient nitrogen deposition rates at the identified ecological sites are presented in Table 25. Habitat Interests considered are as specified in Table 5 of Section 2.7., with the deposition velocities for grassland (as outlined in Table 8 of Section 2.9.) utilised for all ecological sites assessed.

6.2.2. In Table 25, any PCs less than 100% of the critical load can be screened out (i.e., it can be assumed there will be no significant pollution – as per the EA guidance detailed in Section 2.21.). Any PCs greater than 100% of the critical load will be highlighted in bold.

Table 25: Comparison of Maximum Predicted Nutrient Nitrogen Deposition Rates with Critical Loads at Sensitive Habitat Sites

ADMS Ref.	Site Details	Lower Critical Load (kgN/ha/yr)	Upper Critical Load (kgN/ha/yr)	Nutrient Nitrogen Deposition Rate [(a)] (kgN/ha/yr)	PC as a % of Lower Critical Load	PC as a % of Upper Critical Load
ER1	Cumby Pond – LWS	15	30	4.44	29.61%	14.80%
ER2	Aycliffe Quarry – LWS	10	20	0.605	6.05%	3.02%
ER3	School Aycliffe – LWS	15	30	0.923	6.15%	3.08%
ER4	Aycliffe Nature Park – LWS	15	25	0.277	1.84%	1.11%

Notes to Table 25

(a) Total PC to nutrient nitrogen deposition is derived from the sum of the contribution from Nitrogen and Ammonia (dry deposition only).

6.2.3. It can be seen from the data in Table 25 that there are no predicted exceedances for nitrogen deposition at any of the modelled points. Consequently, no further assessment is required.

6.3. Comparison of Maximum Predicted Acid Deposition Rates with Critical Loads

6.3.1. A summary of maximum predicted acid deposition rates at the identified ecological sites are presented in Table 26. Habitat Interests considered are as specified in Table 5 of Section 2.7., with the deposition velocities for grassland (as outlined in Table 8 of Section 2.9.) utilised for all ecological sites assessed.

6.3.2. In Table 26, any PCs less than 100% of the critical load can be screened out (i.e., it can be assumed there will be no significant pollution – as per the EA guidance detailed in Section 2.21.). Any PCs greater than 100% of the critical load will be highlighted in bold.

Table 26: Comparison of Maximum Predicted Acid Deposition Rates with Critical Loads at Sensitive Habitat Sites

ADMS Ref.	Site Details	PC N (keq/Ha/yr)	BG N (keq/ha/yr)	PC S (keq/Ha/yr)	BG S (keq/ha/yr)	CL MinN (keq/ha/yr)	CLMaxN (keq/ha/yr)	CLMaxS (keq/ha/yr)	PEC N (keq/ha/yr)	PEC S (keq/ha/yr)	PC as % of CL
ER1	Cumby Pond - LWS	0.0232	1.16	0.288	0.11	Habitat not sensitive to acidification					
ER2	Aycliffe Quarry - LWS	0.00328	1.18	0.0394	0.11	0.714	2.274	1.560	1.18	0.149	1.88%
ER3	School Aycliffe - LWS	0.00516	1.13	0.0593	0.12	Habitat not sensitive to acidification					
ER4	Aycliffe Nature Park - LWS	0.00155	1.17	0.0178	0.11	0.856	4.856	4.000	1.17	0.128	0.40%

Notes to Table 26

PC N = Process contribution from Nitrogen and Ammonia (dry deposition only)

PC S = Process contribution from Sulphur (dry deposition) and Hydrogen Chloride (wet and dry deposition)

PEC = Predicted environmental concentration

BG = Background concentration

CL = Critical Load

6.3.3. It can be seen from the data in Table 26 that there are no predicted exceedances for acid deposition at any of the modelled points. Consequently, no further assessment is required.

7. ASSESSMENT OF AIR QUALITY IMPACTS - PLUME VISIBILITY

7.1. Forecast Visible Plumes

7.1.1. This section of the report describes the potential visible plume impacts from the HTI stack. A plume will become visible when water vapour in the plume condenses to form small particles in the form of water droplets. A plume is defined as "visible" if the liquid water content of the plume at the centreline exceeds 0.000015 kg/kg and is defined to have grounded if the vertical spread of the plume is larger than the plume centreline height.

7.1.2. In addition to the input parameters for the model used thus far, the initial mixing ration of the plume in kg/kg (i.e. the mass of water vapour per unit mass of dry release at the source) is also required. This value was provided by the technology provider and is 0.116 kg/kg.

7.1.3. Plume visibility for the main stack was assessed for the 5 years of observed met data. All met files include the relative humidity and temperature required for plume visibility calculation.

7.1.4. The modelled lengths of visible vapour plumes are provided in Table 27 for all hours – daytime and night-time. No visible groundings were observed for any of the met years.

Table 27: Predicted Visible Plumes

	2017	2018	2019	2020	2021
Number of Met Lines Used	8423	7633	8568	8580	8401
Number of Visible Plumes	0	0	0	0	4
Percentage of Visible Plumes	0.00%	0.00%	0.00%	0.00%	0.05%
Average length of visible plumes (m)	0.00	0.00	0.00	0.00	1.41
Max Length of visible plume (m)	0.00	0.00	0.00	0.00	2.07

7.1.5. The results of the plume visibility assessment concluded that visible plumes would occur approximately 0.05% of the hours in a year; with 2021 the only met year assessed resulting in visible plumes. The maximum length of a visible plume from the Installation is approximately 2.1m. Consequently, as the approximate closest point of the Installation's boundary to the proposed HTI stack is circa 60m, the worst-case visible plume would remain well within the Installation's boundary. It should be noted that this assessment also included night-time hours.

7.1.6. In the absence of EA specific guidance on plume visibility, Scottish Environment Protection Agency's ("SEPA") H1 guidance[30], has been used to assess the impact of plume visibility. The screening criteria used is provided in Table 28.

[30] IPPC Environmental Assessment and Appraisal of BAT, V6, July 2003

Table 28: Screening Criteria for Plume Visibility

Impact	Quantitative Description
Zero	• No visible impacts resulting from operation of process
Insignificant	• Regular small impact from operation of process • Plume length exceeds boundary less than 5% of daylight hours per year • No sensitive local receptors
Low	• Regular small impact from operation of process • Plume length exceeds boundary less than 5% of daylight hours per year • Sensitive local receptors
Medium	• Regular large impact from operation of process • Plume length exceeds boundary for more than 5% of daylight hours per year • Sensitive local receptors
High	• Continuous large impact from operation of process • Plume length exceeds boundary more than 25% of daylight hours per year • Local sensitive receptors

7.1.7. As the SEPA criteria references daylight hours, the model was re-run excluding hours from 10pm to 4am.

7.1.8. Following the assessment of daylight hours only, the results were very similar to those displayed in Tables 27. The plume is forecast to extend to a length of up to 2.07m for the 100^{th} Percentile and the visible plume would remain in close proximity to the stack and well with the Installation's boundary.

7.1.9. The nearest potentially sensitive human receptor considered in the assessment would be HR1, an industrial activity 262m to the northeast of the HTI stack. Consequently, the predicted visible plume would not extend to the closest potentially sensitive human receptor.

7.1.10. Consequently, based on the SEPA criteria, the impact of the visible plume for daylight hours would be classed as 'zero' for met years 2017 – 2020 and 'insignificant' for met year 2021.

8. ASSESSMENT OF AIR QUALITY IMPACTS - ABNORMAL EMISSIONS

8.1. Scenarios Considered

8.1.1. In order to assess the impact of the plant under abnormal operating conditions, two scenarios have been considered:

- with emissions at the half-hourly emission limits prescribed in Annex VI of the IED,
- and to take account of short-term abnormal conditions permitted under Article 46(6) of the IED.

8.2. Emissions at Half-hourly Emission Limit Values

8.2.1. The dispersion modelling results presented below are based on the Installation operating for all hours in the year with the pollutant concentrations at the daily ELVs prescribed by Annex VI of the IED. This is an extreme assumption, especially for long term predictions since the Installation could never operate with release rates as high as this in practice. Annex VI of the IED also prescribes short-term ELVs for some pollutants based on half hourly average concentrations. However, the frequency with which these limits can be applied are very limited (i.e., for the majority of pollutants with half hourly limits the daily limit value must be complied with for 97% of the time).

8.2.2. Half-hourly limit values apply to total dust (30mg/Nm^3), volatile organic compounds (as benzene) (20mg/Nm^3), hydrogen chloride (60mg/Nm^3), hydrogen fluoride (4mg/Nm^3), sulphur dioxide (200mg/Nm^3) and oxides of nitrogen (as nitrogen dioxide) (400mg/Nm^3). The emission rates for the Installation operating at these half-hourly limits are as displayed in Table 10b of Section 2.11.

8.2.3. Short-term peak concentrations may arise if the Installation emits some pollutants that are at concentrations within the half hourly limit values prescribed in Annex VI of the IED but greater than the daily limit values used for the dispersion modelling. The probability of such occasions occurring at the same time as the meteorological conditions that produce the highest one-hour mean GLCs is remote. However, in the event that this does occur, then the maximum one-hour mean GLCs for these pollutants would be as provided in Table 29, with any potentially significant PCs shown in bold.

Table 29: Maximum Predicted One-hour Concentrations (PCs) for Emissions at the Half- hourly IED Emission Limit Values

Pollutant	Maximum Predicted Hourly Mean GLC (PC) (µg/m^3) [(b)]	Short-term AQS (µg/m^3)	PC as a %age of Short-term AQS
Particulate Matter (as PM_{10})	6.80	No hourly standard	n/a
VOCs (as Benzene)	4.53	No hourly standard	n/a
Hydrogen Chloride	13.6	750	1.81%
Hydrogen Fluoride	0.907	160	0.57%
Sulphur Dioxide	**45.3**	350	**12.95%**
Nitrogen Dioxide [(a)]	**31.7**	200	**15.86%**

Notes to Table 29

(a) Assuming 35% of NO_x is oxidised to NO_2 (see Section 2.23. of this document).

(b) Maximum predicted hourly concentration for all hours of the meteorological data set.

8.2.4. With the exception of SO_2 and NO_2, predicted PCs under these worst-case conditions are all less than 10% of their respective AQSs and, in accordance with the short-term significance criterion detailed in Section 2.20. of this document, would be assessed as being not significant.

8.2.5. For SO_2 and NO_2, the maximum predicted short term concentrations are approximately 13% and 16%, respectively. This represents the very worst-case conditions (i.e., these are the highest PCs predicted assuming the Installation emits at the half-hourly average for the entire year and therefore, combines the maximum emission with the worst-case hour of meteorological data). Furthermore, these are the maximum concentrations predicted at any location within the model area. Accordingly, it is considered that, in practice, releases of short-term SO_2 and NO_2 will not be significant. However, even at these concentrations, using the IAQM methodology (as outlined in Section 2.20.), the severity of the impact would be described as 'small' (i.e., the predicted PCs for SO_2 and NO_2 are both between 11-20% of their respective AQSs).

8.2.6. Predicted concentrations at the sensitive human receptors will be substantially lower than this, and, accordingly, will not be significant.

8.3. Emissions Under Abnormal Operating Conditions

8.3.1. Article 46(6) of the IED allows abnormal operation, this is where the ELVs can be exceeded for certain periods, without being in contravention of the Environmental Permit. This part of the assessment quantifies the impacts on air quality as a result of changes in emissions during abnormal events.

8.3.2. In the event of any process disruption or mechanical failure, the operator would assess the situation to determine if these abnormal conditions can be remedied without resulting in elevated emissions; this would avoid shutting down the process unnecessarily. Where this is not the case, the operator would reduce/cease fuel loading and commence a controlled shutdown of the combustion plant.

8.3.3. The dispersion modelling assessment for abnormal emissions has been adapted to consider short-term impacts during periods of abnormal operation, assuming abatement plant failure. Article 46(6) of the IED specifies that abatement plant or monitoring failure may not occur for longer than four hours whilst the plant is operating. Therefore, if it is likely that the problem cannot be rectified within four hours then a controlled shut down would be implemented as soon as possible. In addition, the total allowable period in a year for abnormal releases must not exceed sixty hours.

8.3.4. Accordingly, the maximum time period for which a failure can occur is four hours. Carbon monoxide and total organic carbon - VOCs (pollutant indicators of poor combustion conditions) are not allowed to exceed their respective ELVs. Therefore, a four-hour exceedance of the ELVs only applies to total dust (maximum concentration of 150mg/Nm^3, expressed as a half-hourly average), hydrogen chloride, hydrogen fluoride, sulphur dioxide and oxides of nitrogen.

8.3.5. For assessing short-term air quality impacts resulting from abnormal operation, it has been assumed that the plant operates for four hours continuously at the maximum emission concentration (i.e., half-hourly limit or abnormal emission limit). Abnormal emission limits apply to carbon monoxide (100mg/Nm^3) and to total dust (150mg/Nm^3).

8.3.6. For assessing long-term air quality impacts resulting from abnormal operation, it has been assumed that the plant operates for sixty hours continuously at the maximum emission concentration and for the remainder of the time at the daily emission limit. On this basis an annual average emission limit has been derived to determine annual average concentrations (refer to Table 10c of Section 2.11., for details).

8.3.7. Emission concentrations for the assessment of abnormal emissions on short-term and long-term predicted concentrations are presented in Table 30. Predicted maximum GLCs are compared to the relevant AQSs in Table 31.

Table 30: Short-term and Long-term Emission Concentrations for Abnormal Releases

Pollutant	Half Hour Limit (mg/Nm^3)	Normal Emission Concentration (mg/Nm^3)	Maximum Emission Concentration (mg/Nm^3)	Assumed Short-term Abnormal Emission Concentration (mg/Nm^3)	Assumed Long-term Abnormal Emission Concentration (mg/Nm^3)
Particulate Matter, as PM_{10}	30	5	150	29.2 [(a)]	5.99 [(b)]
Hydrogen Chloride	60	6	-	60	No Long-term AQS
Hydrogen Fluoride	4	1	-	4	1.02 [(c)]

Table 30: Short-term and Long-term Emission Concentrations for Abnormal Releases (cont.)

Pollutant	Half Hour Limit (mg/Nm^3)	Normal Emission Concentration (mg/Nm^3)	Maximum Emission Concentration (mg/Nm^3)	Assumed Short-term Abnormal Emission Concentration (mg/Nm^3)	Assumed Long-term Abnormal Emission Concentration (mg/Nm^3)
Sulphur Dioxide	200	30	-	200	No Long-term AQS
Nitrogen Dioxide	400	120	-	400	121.09 [(c)]
Carbon Monoxide	100	50	150 [(d)]	100	No Long-term AQS

Notes to Table 30

(a) 4 hours at 150mg/Nm^3 and 20 hours at the normal emissions concentration (5mg/Nm^3) for comparison with daily mean AQS.

(b) 60 hours at 150mg/Nm^3 and the remainder of hours at the normal emission concentration of 5mg/Nm^3.

(c) 60 hours at half hour limit and the remainder at the normal emissions concentration of 120 mg/Nm^3.

(d) Ten-minute average.

Table 31: Comparison of Maximum Predicted Pollutant Ground Level Concentrations (PCs) with Air Quality Standards for Abnormal Emissions

Pollutant	Averaging Period	Maximum Predicted GLC (PC) (µg/m^3)	AQS (µg/m^3)	PC as a %age of AQS
Particulate Matter, as PM_{10}	annual	0.0648	40	0.16%
	24-hour	1.05	50	2.09%
Hydrogen Chloride	1-hour	13.6	750	1.81%
Hydrogen Fluoride	annual	0.0110	16	0.07%
	1-hour	0.907	160	0.57%
Sulphur Dioxide	24-hour	**12.8**	125	**10.23%**
	1-hour	18.5	350	5.27%
	15-minute	**29.4**	266	**11.06%**
Nitrogen Dioxide	annual	**0.922**	40	**2.31%**
	1-hour	14.6	200	7.30%
Carbon Monoxide	8-hour	**7.91**	10,000	0.08%

8.3.8. It is evident from the data in Table 31, that PCs of PM_{10}, HCl, HF, 1-hour SO_2, 1-hour NO_2 and CO can be considered to be not significant as long term GLCs are less than 1% of the long-term AQS and short term GLCs are less than 10% of the short-term AQS.

8.3.9. For annual NO_2, the maximum predicted annual mean GLC is in excess of 1% of the long-term AQS. For 24-hour and 15-minute SO_2 the short-term PCs are in excess of 10% of the short-term AQSs. Stage 2 screening has, therefore, also been undertaken for these pollutants.

8.3.10. The PEC for annual NO_2 (when using DEFRA2 (2021 data) as the background air quality source – refer to Table 17 in Section 3.4., for details) would be 10.16μg/m^3 (or 25% of the AQS). Under the IAQM methodology the impact of the maximum predicted annual NO_2 PC, under abnormal operating conditions, would therefore be described as 'negligible'.

8.3.11. The potentially significant short-term concentrations (i.e., for 24-hour and 15-minute SO_2 and 1-hour NO_2), are all within 11% - 20% of their AQSs and therefore the severity of the impact would be described as 'small' in accordance with the IAQM methodology.

8.3.12. For SO_2 and NO_2, the potentially significant impacts are all only just above the significance criterion and represent the very worst-case conditions. Furthermore, these are the maximum concentrations predicted at any location within the model area. Accordingly, it is considered that, in practice, releases of SO_2 and NO_2 will not be significant.

9. CONCLUSIONS

9.1.1. An assessment has been carried out to determine the local air quality impacts associated with the emissions from the proposed HTI.

9.1.2. Detailed air quality modelling using the ADMS dispersion model has been undertaken to predict the impacts associated with stack emissions from the Installation. As a worst-case, emissions have been assumed to be released at the maximum ELVs twenty-four hours a day, 365 days of the year. This represents a conservative assessment of the impact since the actual emissions from the site are likely to be significantly lower during normal operation.

9.1.3. Predicted maximum GLCs ("PCs") are within the long-term and short-term air quality objectives and are assessed as not significant for most pollutants assessed. For pollutants with potentially significant impacts, further screening has demonstrated that it is unlikely that any AQSs will be exceeded as a result of emissions from the proposed Installation at the maximum point of GLC or at any of the potentially significant human receptors.

9.1.4. For the sensitive habitat sites assessed there are no predicted exceedances for either the critical levels or critical loads.

9.1.5. An assessment of plume visibility was also undertaken which included daytime and night-time hours. Visible plumes would remain well within the Installation's boundary 100% of the time – with a maximum visible plume length of approximately 2m and an impact regarded as 'insignificant'.

9.1.6. An assessment was also made of the impact of the proposed plant when operating under the abnormal conditions permitted under Article 46(6) of the IED. The results of the assessment indicated that it would be unlikely that any AQSs would be exceeded under such abnormal operating conditions.

9.1.7. In summary, therefore, it can be concluded that the proposed HTI plant will not have a detrimental impact on local air quality, human health or sensitive habitat sites.