Redmore environmental

Air Quality Assessment

The Green Hub, Herefordshire

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Executive Summary

Redmore Environmental Ltd was commissioned by Onnu Ltd to undertake an Air Quality Assessment in support of an Environmental Permit Application for a pyrolysis plant referred to as The Green Hub on land off Hereford Road, Herefordshire.

Combustion emissions from the proposed plant have the potential to cause air quality impacts during normal operation. As such, an Air Quality Assessment was undertaken in order to determine baseline conditions and consider potential effects.

Dispersion modelling was undertaken in order to predict pollutant concentrations at sensitive locations as a result of emissions from the facility. The results indicated that impacts on pollutant concentrations were not predicted to be significant at any human receptor location in the vicinity of the site.

It should be noted that the modelled emissions were based on a feedstock made up entirely of compost oversize. Daily operations are likely to consist of a blended feedstock containing a significant amount of woody biomass. As such, modelling concentrations are likely to overestimate actual emissions.

The results also indicated that impacts on pollutant concentrations were not predicted to be significant at any ecological designation in the vicinity of the site.

Table of Contents

1.0 INTRODUCTION

1.1 Background

1.1.1 Redmore Environmental Ltd was commissioned by Onnu Ltd to undertake an Air Quality Assessment in support of an Environmental Permit Application for a pyrolysis plant referred to as the Green Hub on land off Hereford Road, Herefordshire.

1.1.2 Combustion emissions from the plant have the potential to cause air quality impacts at sensitive locations during normal operation. An Air Quality Assessment was therefore undertaken in order to determine baseline conditions and consider potential effects.

1.2 Site Location and Context

1.2.1 The Green Hub is located on land off Hereford Road, Herefordshire, at approximate National Grid Reference (NGR): 351080, 254120. Reference should be made to Figure 1 for a map of the site and surrounding area.

1.2.2 It is proposed to construct and operate a plant comprising four C1000 pyrolysis units each with a thermal input of 1.3MW. The plant will be installed within a dedicated building and process emissions will be treated using a wet scrubber prior to exhaust to atmosphere through two 10m dispersion stacks located on the roof. The site will operate in accordance with Schedule 13A of the Environmental Permitting Regulations and as such will be authorised as a Small Waste Incineration Plant (SWIP).

1.2.3 The operation of the plant will result in atmospheric emissions of combustion gases. These have the potential to cause air quality impacts at sensitive locations within the vicinity of the site. As such, potential effects have been assessed within the following report.

2.0 LEGISLATION

2.1 Legislation

2.1.1 The Air Quality Standards Regulations (2010) and subsequent amendments include Air Quality Limit Values (AQLVs) for the following pollutants:

- Nitrogen dioxide (NO_2);
- Sulphur dioxide (SO2);
- Lead (Pb);
- Particulate matter with an aerodynamic diameter of less than 10µm (PM_{10});
- Particulate matter with an aerodynamic diameter of less than 2.5µm ($PM_{2.5}$);
- Benzene; and,
- Carbon monoxide (CO).

2.1.2 Air Quality Target Values (AQTVs) were also provided for an additional five pollutants. These include:

- Ozone;
- Arsenic (As);
- Cadmium (Cd);
- Nickel (Ni); and,
- Benzo(a)pyrene.

2.1.3 It should be noted that the AQLV for $PM_{2.5}$ stated in the Air Quality Standards Regulations (2010) was amended in the Environment (Miscellaneous Amendments) (EU Exit) Regulations (2020).

2.1.4 The Environmental Improvement Plan 2023[1] was published in January 2023, providing long term and Interim Targets in order to reduce population exposure to $PM_{2.5}$. The concentration target for 2040 was subsequently adopted in the Environmental Targets (Fine Particulate Matter) (England) Regulations (2023).

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1 The Environmental Improvement Plan 2023, DEFRA, 2023.

2.1.5 The Air Quality Strategy (AQS) was produced by the Department for Environment, Food and Rural Affairs (DEFRA) and published in April 2023[2]. The document contains standards, objectives and measures for improving ambient air quality, including a number of Air Quality Objectives (AQOs). These are maximum ambient pollutant concentrations that are not to be exceeded either without exception or with a permitted number of exceedences over a specified timescale. These are generally in line with the AQLVs, although the requirements for the determination of compliance vary.

2.1.6 Table 1 presents the AQOs and Interim Target for pollutants considered within this assessment.

Table 1 Air Quality Objectives and Interim Target

Pollutant	Air Quality Objective/ Interim Target	
	Concentration (μg/m³)	Averaging Period
NO_2	40	Annual mean
	200	1-hour mean, not to be exceeded on more than 18 occasions per annum
PM_{10}	40	Annual mean
	50	24-hour mean, not to be exceeded on more than 35 occasions per annum
$PM_{2.5}$	12[a]	Annual mean
CO	10,000	8-hour running mean

Note: (a) Interim Target to be achieved by end of January 2028.

2.1.7 Table 2 presents the AQTVs for pollutants considered within this assessment.

Table 2 Air Quality Target Values

Pollutant	Air Quality Objective/ Interim Target	
	Concentration (μg/m³)	Averaging Period
As	0.006	Annual mean
Cd	0.005	Annual mean

2 AQS: Framework for Local Authority Delivery, DEFRA, 2023.

Pollutant	Air Quality Objective/ Interim Target	
	Concentration (μg/m³)	Averaging Period
Ni	0.020	Annual mean

2.1.8 Table 3 summarises the advice provided in DEFRA guidance[3] on where the AQOs for pollutants considered within this report apply.

Table 3 Examples of Where the Air Quality Objectives Apply

Averaging Period	Objective Should Apply At	Objective Should Not Apply At
Annual mean	All locations where members of the public might be regularly exposed Building façades of residential properties, schools, hospitals, care homes etc.	Building façades of offices or other places of work where members of the public do not have regular access Hotels, unless people live there as their permanent residence Gardens of residential properties Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term
24-hour mean and 8-hour mean	All locations where the annual mean objective would apply, together with hotels. Gardens of residential properties.	Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term.
1-hour mean	All locations where the annual mean and 24 and 8-hour mean objectives apply. Kerbside sites (for example, pavements of busy shopping streets) Those parts of car parks, bus stations and railway stations etc which are not fully enclosed, where members of the public might reasonably be expected to spend one hour or more Any outdoor locations where members of the public might reasonably be expected to spend one hour or longer	Kerbside sites where the public would not be expected to have regular access

3 Local Air Quality Management Technical Guidance (TG22), DEFRA, 2022.

2.2 Industrial Pollution Control Legislation

2.2.1 Atmospheric emissions from industry are controlled in the UK through the Environmental Permitting (England and Wales) Regulations (2016) and subsequent amendments. The plant will require an Environmental Permit prior to operation. Conditions of operation will include specific Emission Limit Values (ELVs) for various pollutants produced by the process. Compliance with these conditions must be demonstrated through periodic monitoring requirements, which have been set in order to limit potential impacts in the surrounding area.

2.3 Local Air Quality Management

2.3.1 Local Authorities (LAs) are required to periodically review and assess air quality within their area of jurisdiction under the system of Local Air Quality Management (LAQM). This review and assessment of air quality involves comparing present and likely future pollutant concentrations against the AQOs. If it is predicted that levels at locations of relevant exposure, as summarised in Table 2, are likely to be exceeded, the LA is required to declare an Air Quality Management Area (AQMA). For each AQMA the LA is required to produce an Air Quality Action Plan, the objective of which is to reduce pollutant concentrations in pursuit of the AQOs.

2.4 Environmental Assessment Levels

2.4.1 An Environmental Assessment Level (EAL) is the concentration of a substance, which, in a particular environmental medium, the regulators regard as an appropriate comparator value. This enables comparison between the environmental effects of different substances in that medium and between environmental effects in different media, enabling the summation of those effects.

2.4.2 Ideally EALs to fulfil this objective would be defined for each pollutant:

- Based on the sensitivity of particular habitats or receptors (in particular three main types of receptor should be considered, protection of human health, protection of natural ecosystems and protection of specific sensitive receptors, e.g. materials, commercial activities requiring a particular environmental quality);

- Be produced according to a standardised protocol to ensure that they are consistent, reproducible and readily understood;
- Provide similar measure of protection for different receptors both within and between media; and,
- Take account of habitat specific environmental factors such as pH, nutrient status, bioaccumulation, transfer and transformation processes where necessary.

2.4.3 EALs used in this assessment were obtained from Environment Agency (EA) guidance 'Air emissions risk assessment for your environmental permit'[4] and are summarised in Table 4.

Table 4 Environmental Assessment Levels

Pollutant	Environmental Assessment Level (μg/m³)		
	Long Term (Annual)	Short Term	
		24-hour	1-hour
$PM_{2.5}$	20	-	-
Hg	-	0.06	0.6
Antimony (Sb)	5	-	150
Cd	-	0.03	-
Chromium (Cr) (III) compounds (as Cr)	-	2.0	-
Cr (VI)	0.00025	-	-
Copper (Cu)	-	0.05	-
Manganese (Mn)	0.15	-	1,500
Vanadium (V)		1	-
Hydrogen chloride (HCl)	-	-	750
Hydrogen fluoride (HF)	-	-	160

2.4.4 It should be noted that the Interim Target for $PM_{2.5}$ was used in order to provide a conservative assessment of potential impacts as it is lower than the EAL of 20 μg/m³.

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

2.5 Critical Loads and Levels

2.5.1 A critical load is defined by the UK Air Pollution Information System (APIS)[5] 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."

2.5.2 A critical level is defined as:

> "Concentrations of pollutants in the atmosphere above which direct adverse effects on receptors, such as human beings, plants, ecosystems or materials, may occur according to present knowledge."

2.5.3 A critical load refers to deposition of a pollutant, while a critical level refers to pollutant concentrations in the atmosphere (which usually have direct effects on vegetation or human health).

2.5.4 When pollutant loads (or concentrations) exceed the critical load or level it is considered that there is a risk of harmful effects. The excess over the critical load or level is termed the exceedence. A larger exceedence is often considered to represent a greater risk of damage.

2.5.5 Maps of critical loads and levels and their exceedences have been used to show the potential extent of pollution damage and aid in developing strategies for reducing pollution. Decreasing deposition below the critical load is seen as means for preventing the risk of damage. However, even a decrease in the exceedence may infer that less damage will occur.

2.5.6 Table 5 presents the critical levels for the protection of vegetation for pollutants considered within this assessment.

5 UK Air Pollution Information System, www.apis.ac.uk.

Table 5 Critical Levels for the Protection of Vegetation

Pollutant	Critical Level	
	Concentration (μg/m³)	Averaging Period
Oxides of nitrogen (NO_x)	30	Annual mean
	75	24-hour mean
HF	0.5	Weekly mean
	5.0	Daily mean

2.5.7 Critical loads have been designated within the UK based on the sensitivity of the receiving habitat and have been reviewed for the purpose of this assessment. These are summarised in Section 3.5.

3.0 BASELINE

3.1 Introduction

3.1.1 Existing air quality conditions in the vicinity of the site were identified in order to provide a baseline for assessment. These are detailed in the following Sections.

3.2 Local Air Quality Management

3.2.1 As required by the Environment Act (1995), Herefordshire Council (HC) has undertaken Review and Assessment of air quality within their area of jurisdiction. This process has indicated that annual mean concentrations of NO_2 are above the AQO within the area. As such, two AQMAs have been declared. The closest of these to the development is described as follows:

> "An area encompassing the junction between the A44 Bargates and B4361 Dishley Street/Cursneh Road in Leominster."

3.2.2 The site is located approximately 5.1km north of the AQMA. It is considered highly unlikely that the proposals would affect air quality over a distance of this magnitude. As such, the AQMA has not been considered further in the context of this assessment.

3.3 Air Quality Monitoring

Local Authority Monitoring

3.3.1 Monitoring of pollutant concentrations is undertaken by HC throughout their area of jurisdiction. However, the closest survey location to the facility is approximately 5.1km north of the site. Due to the distance between the two locations, it is not considered likely that similar pollution levels would occur. As such, this source of data has not been considered further in the context of the assessment.

3.3.2 HC do not undertake monitoring of PM_{10}, $PM_{2.5}$ or CO concentrations within the vicinity of the site.

Heavy Metals Monitoring

3.3.3 Monitoring of heavy metals is carried out by DEFRA at 24 industrial sites and 10 rural locations throughout the UK The closest site to the facility is Walsall Pleck at NGR: 399832, 296868, approximately 64.9km north-east of the facility. The most recent data available from Walsall Pleck is from 2023, as summarised in Table 6. It should be noted that monitoring of Hg is not undertaken at Walsall Pleck. As such, data for the pollutant was obtained from Walsall Bilston which is located at 397197, 298370, approximately 63.9km north-east of the facility.

Table 6 Heavy Metals Monitoring Results

Species	Annual Mean Concentration (ng/m^3)
As	0.83
Cd	0.22
Cr	0.49
Cu	14.30
Hg	2.30
Mn	7.09
Ni	0.75
Pb	7.74
V	0.67

Acid Gas Monitoring

3.3.4 Concentrations of HCl are monitored in the UK through the UK Eutrophying and Acidifying Pollutants (UKEAP) network. The closest site to the facility is Rosemaund at NGR: 356535, 247200, approximately 8.8km south-east of the facility. The most recent data available for HCl from the monitoring station is from 2013 which is summarised in Table 7.

Table 7 Acid Gas Monitoring Results

Species	Annual Mean Concentration (µg/m3)
HCl	0.32

3.3.5 Baseline concentrations of HF are not measured locally or nationally, since these are not generally of concern in terms of local air quality. However, the Expert Panel on Air Quality Standards (EPAQS) report "Guidelines for halogens and hydrogen halides in ambient air for protecting human health against acute irritancy effects"[6] contains some estimates of baseline levels. This indicates that measured concentrations have been in the range of 0.036μg/m^3 to 2.35μg/m^3.

3.3.6 In lieu of local monitoring, the maximum measured baseline HF concentration has been used for the purpose of this assessment.

Dioxins and Furans Monitoring

3.3.7 Monitoring of dioxins and furans is undertaken throughout the UK through the Toxic Organic Micro Pollutants (TOMPs) network. Throughout this report, the term 'dioxins' is taken to mean the family of 210 compounds or congeners comprising polychlorinated dibenzodioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs). If both PCDDs and PCDFs are present, these have been referred to as PCDD/Fs. The summation of the concentrations of 17 toxic PCDD and PCDF congeners, weighted relative to the toxicity of 2,3,7,8-TCDD, is given in the form of Toxic Equivalents (TEQ).

3.3.8 The closest TOMPS monitor is Manchester Law Courts at NGR: 383375, 398260 approximately 147km north of the facility. The most recent data available from this site is from 2016 and is summarised in Table 8.

Table 8 Dioxins and Furans Monitoring Results

Species	Annual Mean Concentration (TEQ fg/m^3)
PCDD/ F	23

3.4 Background Pollutant Concentrations

3.4.1 Predictions of background pollutant concentrations on a 1km by 1km grid basis have been produced by DEFRA for the entire of the UK to assist Local Authorities in their Review

6 EPAQS Guidelines for halogens and hydrogen halides in ambient air for protecting human health against acute irritancy effects, DEFRA, Scottish Executive, National Assembly of Wales, Department of the Environment in Northern Ireland, 2006.

and Assessment of air quality. The site is located in grid square NGR: 351500, 254500. Data for this location was downloaded from the DEFRA website[7] for the purpose of the assessment and is summarised in Table 9.

Table 9 Background Pollutant Concentration Predictions

Pollutant	Predicted Background Pollutant Concentration (μg/m³)
NO_2	3.94
PM_{10}	11.30
$PM_{2.5}$	6.67
CO	193

3.4.2 It should be noted that concentrations of NO_2, PM_{10} and $PM_{2.5}$ are predicted for 2024 and CO for 2001. These are the most recent predictions available from DEFRA and are therefore considered to provide a reasonable representation of background concentrations in the vicinity of the site.

3.5 Sensitive Receptors

3.5.1 A sensitive receptor is defined as any location which may be affected by changes in air quality. These have been defined for human and ecological receptors in the following Sections.

Human Receptors

3.5.2 A desk-top study was undertaken in order to identify any sensitive human receptor locations in the vicinity of the site that required specific consideration during the assessment. These are summarised in in Table 10.

7 http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html.

Table 10 Sensitive Human Receptor Locations

Receptor		NGR (m)	
		X	Y
R1	Residential - Newton Lane	350914.3	253967.8
R2	Residential - Marlbrook Cottages	350567.0	254537.1
R3	Residential - Marlbrook Cottages	350943.7	254554.3
R4	Residential - A49	351246.8	253764.1
R5	Residential - Newton Lane	350747.8	253715.5

3.5.3 Reference should be made to Figure 2 for a map of the sensitive human receptor locations.

Ecological Receptors

3.5.4 Atmospheric emissions from the facility also have the potential to impact on receptors of ecological sensitivity within the vicinity of the site. The Conservation of Habitats and Species Regulations (2010) and subsequent amendments require competent authorities to review applications and consents that have the potential to impact on ecological designations. A pre-application request was therefore submitted to the EA in order to identify any sites of ecological or nature conservation importance that required consideration within the assessment. The response indicated the following should be included:

- River Lugg Special Areas of Conservation (SAC) and Sites of Special Scientific Interest (SSSI);
- River Wye SAC;
- Hill Hole Dingle SSSI and Ancient Woodland (AW);
- Dinmore Hill Woods SSSI and AW;
- The Bury Farm SSSI;
- Fords Coppice AW;
- Stone Coppice AW;
- Lewis's Plantation AW;
- Old Nash Coppice AW;
- Upper Miles's Rough AW;

- Lower Miles's Rough AW;
- Spendle's Green AW;
- Draycott Wood AW; and,
- Marlbrook Wood AW.

3.5.5 For the purpose of the modelling assessment discrete receptors were placed at the closest point of each designation to the site to ensure the maximum potential impact was predicted. These are summarised in Table 11.

Table 11 Ecological Receptor Locations

Receptor		NGR (m)	
		X	Y
E1	River Lugg SSSI	351000.7	254931.7
E2	River Lugg SSSI	351319.3	254508.2
E3	River Lugg SSSI	351479.3	254167.2
E4	River Lugg SSSI	351501.7	253898.9
E5	River Lugg SSSI	351427.7	253075.4
E6	River Lugg SSSI / River Wye SAC	351436.4	252854.8
E7	Hill Hole Dingle SSSI	352631.2	254101.6
E8	Dinmore Hill Woods SSSI / AW	350903.3	252678.8
E9	Dinmore Hill Woods SSSI	350807.8	252396.5
E10	The Bury Farm SSSI	350676.9	252779.5
E11	Fords Coppice AW	351507.9	255578.9
E12	Stone Coppice AW	351641.4	255839.9
E13	Lewis's Plantation AW	351528.2	254088.0
E14	Hill Hole Dingle AW	352936.2	253762.2
E15	Dinmore Hill AW	350833.2	252119.3
E16	Old Nash Coppice AW	350240.2	252227.9
E17	Upper Miles's Rough AW	350307.5	253291.6
E18	Lower Miles's Rough AW	350654.6	253475.5

Receptor		NGR (m)	
		X	Y
E19	Spendle's Green AW	350270.2	254124.1
E20	Draycott Wood AW	349624.4	253927.7
E21	Marlbrook Wood AW	349283.0	254566.8
E22	Marlbrook Wood AW	349415.6	254816.2
E23	Marlbrook Wood AW	349787.6	255225.8

3.5.6 Reference should be made to Figure 3 for a map of the ecological receptors.

3.5.7 Critical loads have been designated within the UK based on the sensitivity and relevant features of the receiving habitat. A review of the APIS[8] and MAGIC[9] websites, as well as the relevant site designations and publicly available information, was undertaken in order to identify the most suitable habitat description and associated critical load for the area of each designation considered within the assessment.

3.5.8 The relevant nitrogen deposition critical loads are presented in Table 12.

Table 12 Critical Loads for Nitrogen Deposition

Receptor	Feature	APIS Habitat	Nitrogen Critical Load (kgN/ha/yr)	
			Low	High
River Lugg SSSI	Clay river displaying a transition from nutrient poor to naturally nutrient rich water chemistry	No comparable habitat with established critical load estimate available	-[a]	-[a]
River Wye SAC	Bog woodland	Raised and blanket bogs	5	10
Hill Hole Dingle SSSI	Alnus glutinosa - Urtica dioica Woodland	Broadleaved deciduous woodland	10	15

8 http://www.apis.ac.uk/.

9 Multi-Agency Geographic Information for the Countryside, www.magic.gov.uk.

Receptor	Feature	APIS Habitat	Nitrogen Critical Load (kgN/ha/yr)	
			Low	High
Dinmore Hill Woods SSSI	Fraxinus Excelsior - Acer Campestre - Mercurialis Perennis Woodland	Carpinus and Quercus mesic deciduous forest	15	20
The Bury Farm SSSI	Cynosurus Cristatus - Centaurea Nigra Grassland	Low and medium altitude hay meadows	10	20
Fords Coppice AW	Broadleaved, Mixed and Yew Woodland	Broadleaved deciduous woodland	10	15
Stone Coppice AW	Broadleaved, Mixed and Yew Woodland	Broadleaved deciduous woodland	10	15
Lewis's Plantation AW	Broadleaved, Mixed and Yew Woodland	Broadleaved deciduous woodland	10	15
Hill Hole Dingle AW	Coniferous woodland	Coniferous woodland	3	15
Dinmore Hill AW	Broadleaved, Mixed and Yew Woodland	Broadleaved deciduous woodland	10	15
Old Nash Coppice AW	Broadleaved, Mixed and Yew Woodland	Broadleaved deciduous woodland	10	15
Upper Miles's Rough AW	Broadleaved, Mixed and Yew Woodland	Broadleaved deciduous woodland	10	15
Lower Miles's Rough AW	Broadleaved, Mixed and Yew Woodland	Broadleaved deciduous woodland	10	15
Spendle's Green AW	Broadleaved, Mixed and Yew Woodland	Broadleaved deciduous woodland	10	15
Draycott Wood AW	Broadleaved, Mixed and Yew Woodland	Broadleaved deciduous woodland	10	15
Marlbrook Wood AW	Coniferous woodland	Coniferous woodland	3	15

NOTE: (a) Critical load not available.

3.5.9 The site features were also reviewed to identify the habitat types most sensitive to acid deposition. These are summarised in Table 13.

Table 13 Critical Loads for Acid Deposition

Receptor	Feature	APIS Habitat	Acid Critical Load (keq/ha/yr)		
			CLMinN	CLMaxS	CLMaxN
River Lugg SSSI	Clay river displaying a transition from nutrient poor to naturally nutrient rich water chemistry	Freshwater	-[a]	-[a]	-[a]
River Wye SAC	Bog Woodland	Bogs	0.166	0.321	0.487
Hill Hole Dingle SSSI	Alnus glutinosa - Urtica dioica Woodland	Unmanaged Broadleafed/ Coniferous Woodland	1.426	0.142	1.568
Dinmore Hill Woods SSSI	Fraxinus Excelsior - Acer Campestre - Mercurialis Perennis Woodland	Unmanaged Broadleafed/ Coniferous Woodland	1.428	0.142	1.57
The Bury Farm SSSI	Cynosurus Cristatus - Centaurea Nigra Grassland	Calcareous grassland	4.000	0.856	4.856
Fords Coppice AW	Broadleaved, Mixed and Yew Woodland	Broadleafed/ Coniferous unmanaged woodland	1.477	0.142	1.619
Stone Coppice AW	Broadleaved, Mixed and Yew Woodland	Broadleafed/ Coniferous unmanaged woodland	1.477	0.142	1.619
Lewis's Plantation AW	Broadleaved, Mixed and Yew Woodland	Broadleafed/ Coniferous unmanaged woodland	1.432	0.142	1.574
Hill Hole Dingle AW	Broadleaved, Mixed and Yew Woodland	Broadleafed/ Coniferous unmanaged woodland	1.426	0.142	1.568
Dinmore Hill AW	Broadleaved, Mixed and Yew Woodland	Broadleafed/ Coniferous unmanaged woodland	1.436	0.142	1.578

Receptor	Feature	APIS Habitat	Acid Critical Load (keq/ha/yr)		
			CLMinN	CLMaxS	CLMaxN
Old Nash Coppice AW	Broadleaved, Mixed and Yew Woodland	Broadleafed/ Coniferous unmanaged woodland	1.436	0.142	1.578
Upper Miles's Rough AW	Broadleaved, Mixed and Yew Woodland	Broadleafed/ Coniferous unmanaged woodland	1.437	0.142	1.579
Lower Miles's Rough AW	Broadleaved, Mixed and Yew Woodland	Broadleafed/ Coniferous unmanaged woodland	1.437	0.142	1.579
Spendle's Green AW	Broadleaved, Mixed and Yew Woodland	Broadleafed/ Coniferous unmanaged woodland	1.437	0.142	1.579
Draycott Wood AW	Broadleaved, Mixed and Yew Woodland	Broadleafed/ Coniferous unmanaged woodland	1.456	0.142	1.598
Marlbrook Wood AW	Broadleaved, Mixed and Yew Woodland	Broadleafed/ Coniferous unmanaged woodland	1.455	0.142	1.597

NOTE: (a) Critical load not available.

3.5.10 Baseline pollutant concentrations and deposition rates at each ecological receptor were obtained from the APIS[10] website and are summarised in Table 14.

Table 14 Baseline Pollution Levels at Ecological Receptors

Receptor		Annual Mean NO_x Conc. (μg/m³)	Baseline Deposition Rate	
			Nitrogen (kgN/ha/yr)	Acid (keq/ha/yr)
E1	River Lugg SSSI	5.53	19.83	1.47
E2	River Lugg SSSI	5.53	19.83	1.47
E3	River Lugg SSSI	5.53	19.83	1.47

10 http://www.apis.ac.uk/.

Receptor		Annual Mean NO_x Conc. (µg/m^3)	Baseline Deposition Rate	
			Nitrogen (kgN/ha/yr)	Acid (keq/ha/yr)
E4	River Lugg SSSI	7.46	19.66	1.46
E5	River Lugg SSSI	7.46	19.66	1.46
E6	River Lugg SSSI / River Wye SAC	5.29	19.49	1.45
E7	Hill Hole Dingle SSSI	5.28	33.37	2.45
E8	Dinmore Hill Woods SSSI	5.41	33.04	2.43
E9	Dinmore Hill Woods SSSI	5.41	33.04	2.43
E10	The Bury Farm SSSI	5.41	19.73	2.43
E11	Fords Coppice AW	4.71	33.89	2.49
E12	Stone Coppice AW	4.71	33.89	2.49
E13	Lewis's Plantation AW	5.53	33.56	2.47
E14	Hill Hole Dingle AW	5.11	33.05	2.43
E15	Dinmore Hill AW	5.41	33.04	2.43
E16	Old Nash Coppice AW	5.41	33.04	2.43
E17	Upper Miles's Rough AW	4.93	33.39	2.46
E18	Lower Miles's Rough AW	4.93	33.39	2.46
E19	Spendle's Green AW	4.81	33.74	2.48
E20	Draycott Wood AW	4.43	33.56	2.47
E21	Marlbrook Wood AW	4.43	33.93	2.49
E22	Marlbrook Wood AW	4.43	33.93	2.49
E23	Marlbrook Wood AW	4.61	34.29	2.52

4.0 METHODOLOGY

4.1 Introduction

4.1.1 Combustion emissions from the SWIP have the potential to cause air quality impacts at sensitive locations in the vicinity of the site. These have been quantified through dispersion modelling in accordance with the methodology outlined in the following Sections.

4.2 Dispersion Model

4.2.1 Dispersion modelling was undertaken using ADMS-6 (v6.0.2.0), which is developed by Cambridge Environmental Research Consultants (CERC) Ltd. ADMS-6 is a short-range dispersion modelling software package that simulates a wide range of buoyant and passive releases to atmosphere. It is a new generation model utilising boundary layer height and Monin-Obukhov length to describe the atmospheric boundary layer and a skewed Gaussian concentration distribution to calculate dispersion under convective conditions.

4.2.2 The model utilises hourly meteorological data to define conditions for plume rise, transport and diffusion. It estimates the concentration for each source and receptor combination for each hour of input meteorology and calculates user-selected long-term and short-term averages.

4.3 Modelling Scenarios

4.3.1 The scenarios considered in the modelling assessment for human receptors are summarised in Table 15.

Table 15 Human Receptor Assessment Scenarios

Parameter	Modelled As	
	Short Term	Long Term
NO_2	99.8th percentile (%ile) 1-hour mean	Annual mean
PM_{10}	90.4th %ile 24-hour mean	Annual mean

Parameter	Modelled As	
	Short Term	Long Term
$PM_{2.5}$	-	Annual mean
HCl	1-hour mean	-
HF	1-hour mean	-
CO	8-hour rolling mean	-
Cd and Tl (as Cd)	24-hour mean	Annual Mean
Hg	1-hour mean and 24-hour mean	-
Metals (total Sb, As, Pb, Cr, Cobalt (Co), Cu, Mn, Ni, V and their compounds)	1-hour mean and 24-hour mean	Annual Mean

4.3.2 Some short-term air quality criteria are framed in terms of the number of occasions in a calendar year on which the concentration should not be exceeded. As such, the %iles shown in Table 15 were selected to represent the relationship between the permitted number of exceedences of short-period concentrations and the number of periods within a calendar year.

4.3.3 The scenarios considered for ecological receptors in the modelling assessment are summarised in Table 16.

Table 16 Ecological Receptor Assessment Scenarios

Parameter	Modelled As	
	Short Term	Long Term
NO_x	24-hour mean	Annual mean
HF	24-hour mean	-
	Weekly mean	-
Nitrogen deposition	-	Annual deposition
Acid deposition	-	Annual deposition

4.3.4 Predicted pollutant concentrations were summarised in the following formats:

- Process Contribution (PC) - Predicted pollutant concentration as a result of emissions from the facility only; and,
- Predicted Environmental Concentration (PEC) - Total predicted pollutant concentration as a result of emissions from the facility and existing baseline levels.

4.3.5 Predicted ground level pollutant concentrations and deposition rates were compared with the relevant AQOs, Interim Target, EALs, critical levels and critical loads. These criteria are collectively referred to as Environmental Quality Standards (EQSs).

4.4 Assessment Area

4.4.1 The assessment area was defined based on the facility location, anticipated pollutant dispersion patterns and the positioning of sensitive receptors. Ambient concentrations were predicted over NGR: 350300, 253300 to 351800, 254800. One Cartesian grid with a resolution of 10m was used within the model to produce data suitable for contour plotting using the Surfer software package.

4.4.2 Reference should be made to Figure 4 for a graphical representation of the assessment grid extents.

4.5 Process Conditions

4.5.1 A summary of the inputs used in the assessment is provided in Table 17. These were provided by the equipment supplier (Woodtek). It should be noted that each stack will serve two C1000 pyrolysis units. Each stack will also include a wet scrubber in order to provide treatment of emissions prior to discharge to atmosphere.

Table 17 Stack Parameters

Parameter	Unit	Stack 1	Stack 2
Stack position	NGR	351074.4, 254136	351076.8, 254122.1
Stack height	m	10.0	10.0
Stack diameter	m	0.4	0.4
Exhaust gas temperature	°C	242	242
Exhaust stack oxygen	%	7.8	7.8

Parameter	Unit	Stack 1	Stack 2
Exhaust gas flow rate	m^3/s	1.49	1.49
Exhaust gas flow rate	Nm^3/s	0.70	0.70
Exhaust gas efflux velocity	m/s	19.7	19.7

NOTE: (a) Stated at 6% oxygen, dry gas, 273K.

4.5.2 Reference should be made to Figure 4 for a visual representation of the emission point location.

4.6 Emissions

4.6.1 The anticipated pollutant concentrations in the exhaust gas streams were obtained from the results of monitoring undertaken at a research and development pyrolysis facility which at the time of monitoring was using compost oversize as a feedstock, as provided by Woodtek. During the monitoring the feedstock was compost oversize, however the facility can operate using a wide range of feedstocks. It should be noted that the Industrial Emissions Directive[11] specifies a number of ELVs for pollutants that were not assessed as part of the monitoring undertaken at the research and development facility that are applicable to the operation of a SWIP. As such, these were utilised where relevant in order to ensure a comprehensive assessment of potential impacts as a result of emissions from the facility. A summary of the pollutant concentrations is provided in Table 18.

4.6.2 It should be noted that concentrations of SO_2 and Volatile Organic Compounds (VOCs) measured as part of the monitoring undertaken at the research and development facility were below the limit of detection for the analysis procedures and were therefore not assessed further.

Table 18 Pollutant Emission Concentration

Pollutant	Pollutant Concentration (mg/m^3)[(a)]
NO_x	225.0
Particulate matter (PM)	0.3

11 Directive 2010/75/EU Of The European Parliament And Of The Council, November 2010.

Pollutant	Pollutant Concentration (mg/m^3)[(a)]	
CO	85.5	
HCl	1.7	
HF[(b)]	6.0 (half-hour mean)	1.5 (24-hour mean)
Cd and Tl[(b)]	0.08	
Hg[(b)]	0.08	
Metals (total Sb, As, Pb, Cr, Co, Cu, Mn, Ni, V and their compounds) [(b)]	0.8	
PCDD/Fs[(b)]	0.0000001	

NOTE: (a) Stated at 6% oxygen, dry gas, 273K.
(b) Emission Limit Value.

4.6.3 The pollutant mass emission rates for use in the assessment were derived from the concentrations shown in Table 18 and the flow rate shown in Table 17. The results are summarised in Table 19.

Table 19 Pollutant Mass Emission Rate

Pollutant	Pollutant Mass Emission Rate (g/s) - Per Stack	
NO_x	0.1569	
PM	0.0002	
CO	0.0596	
HCl	0.0012	
HF	0.0042 (half-hour mean)	0.0010 (24-hour mean)
Cd	2.1×10^{-6}	
Hg	0.0001	
Metals (total Sb, As, Pb, Cr, Co, Cu, Mn, Ni, V and their compounds)	0.0001	
PCDD/Fs	1.05×10^{-10}	

4.6.4 The emission rate for PM is stated as total dust. However, for the purposes of dispersion modelling it was considered that the entire PM emission consisted of only PM_{10} or $PM_{2.5}$. This allowed the maximum ground level impacts to be assessed with respect to the EQSs.

Actual emissions of PM are unlikely to only consist of only one PM fraction, resulting in a worst-case assessment.

4.6.5 The emission concentration provided for Cd and Tl is stated as the total permitted level for both species in combination. However, Tl does not have an associated EQS and was therefore not considered as part of the assessment. As such, the purpose of the dispersion modelling it was assumed that 50% of the emission consisted of Cd.

4.6.6 The ELV for Sb, As, Pb, Cr, Co, Cu, Mn, Ni and V is stated as total Group 3 metals. Due to the low EQSs that have been designated for Cr (VI), As and Ni, the EA have issued guidance on the modelling of Group 3 metals[12]. This was reviewed for the purpose of the assessment and the following staged approach adopted:

- Potential impacts on annual mean Cr (VI), As and Ni and 1-hour mean V concentrations were assessed as these represent the lowest EQSs;
- Stage 1 - The full metal emission was considered to consist of only one species. Any species with predicted exceedences of the EQSs or that could not be screened out in accordance with the EA criteria were progressed to Stage 2;
- Stage 2 - The emission was apportioned equally between the relevant species. This resulted in 11% of the ELV being apportioned to each metal. Any species with predicted exceedences of the EQSs or that could not be screened out in accordance with the EA criteria were progressed to Stage 3; and,
- Stage 3 - Review EA data for specific species.

4.6.7 Emissions from the proposed plant were modelled for 8200-hours per year in accordance with the proposed operational schedule for the facility.

4.7 NO_x to NO_2 Conversion

4.7.1 Emissions of total NO_x from combustion processes are predominantly in the form of nitric oxide (NO). Excess oxygen in the combustion gases and further atmospheric reactions cause the oxidation of NO to NO_2. Comparisons of ambient NO and NO_2 concentrations in the vicinity of point sources in recent years has indicated that it is unlikely that more than 30% of the NO_x is present at ground level as NO_2.

12 Guidance to Applicants on Impact Assessment for Group 3 Metals Stack, EA, 2012.

4.7.2 Ambient NO_x concentrations were predicted through dispersion modelling. Concentrations of NO_2 shown in the results section assume 70% conversion from NO_x to NO_2 for annual means and 35% conversion for 1-hour concentrations, based upon EA guidance[13].

4.8 Building Effects

4.8.1 The dispersion of substances released from elevated sources can be influenced by the presence of buildings close to the emission point. Structures can interrupt the wind flows and cause significantly higher ground-level concentrations close to the source than would arise in the absence of the buildings.

4.8.2 Analysis of the site layout indicated that a number of structures should be included within the model in order to take account of effects on pollutant dispersion. Input geometries are shown in Table 20.

Table 20 Building Geometries

Building	NGR (m)		Height (m)	Length (m)	Width (m)	Angle (°)
	X	Y				
Main Building	351071.3	254121.8	8.5	42.5	26.5	170.5
Biochar Storage	351092.9	254139.5	3.5	15.5	14.3	260.5
Office	351094.1	254106.1	4.7	9.3	11.3	170.5
Woodchip storage	351071.9	254174.9	8.0	8.4	44.1	205.6

4.9 Meteorological Data

4.9.1 Meteorological data used in the assessment was taken from Hereford Credenhill meteorological station over the period 1st January 2018 to 31st December 2022 (inclusive). This observation station is located at NGR: 344997, 242664, which is approximately 12.8km south-west of the facility. It is anticipated that conditions would be reasonably similar over a distance of this magnitude. The data was therefore considered suitable for an assessment of this nature.

13 https://www.gov.uk/guidance/environmental-permitting-air-dispersion-modelling-reports.

4.9.2 All meteorological files used in the assessment were provided by Atmospheric Dispersion Modelling Ltd, which is an established distributor of data within the UK. Reference should be made to Figure 5 for wind roses of utilised meteorological records.

4.10 Roughness Length

4.10.1 A roughness length (z_0) of 0.3m was used within the model to describe both the modelling extents and meteorological site. This value is considered appropriate for the morphology of both areas and is suggested within ADMS-6 as being suitable for 'agricultural areas (max)'.

4.11 Monin-Obukhov Length

4.11.1 The Monin-Obukhov length provides a measure of the stability of the atmosphere. A minimum Monin-Obukhov length of 1m was used to describe the modelling extents and the meteorological site. This is considered appropriate for the nature of both areas and is suggested within ADMS-6 as being suitable for 'rural areas'.

4.12 Terrain Data

4.12.1 Ordnance Survey OS Terrain 50 data was included in the model for the site and surrounding area in order to take account of the specific flow field produced by variations in ground height throughout the assessment extents. This was pre-processed using the method suggested by CERC[14].

4.13 Nitrogen Deposition

4.13.1 Nitrogen deposition rates were calculated using the conversion factors provided within EA document 'Technical Guidance on Detailed Modelling approach for an Appropriate Assessment for Emissions to Air AQTAG 06'[15]. Predicted pollutant concentrations were multiplied by the relevant deposition velocity and conversion factor to calculate the

14 Note 105: Setting up Terrain Data for Input to CERC Models, CERC, 2016.

15 Technical Guidance on Detailed Modelling approach for an Appropriate Assessment for Emissions to Air AQTAG 06, EA, 2014.

speciated dry deposition flux. The conversion factors used for the determination of nitrogen deposition are presented within Table 21.

Table 21 Conversion Factors to Determine Dry Deposition Flux for Nitrogen Deposition

Pollutant	Deposition Velocity (m/s)		Conversion Factor (µg/m²/s to kg/ha/yr of pollutant species)
	Grassland	Forest	
NO_2	0.0015	0.003	95.9

4.13.2 The relevant deposition velocity for each ecological receptor was selected from Table 21 based on the vegetation type present within the designation.

4.14 Acid Deposition

4.14.1 Acid deposition occurs as a result of NO_2 and HCl. Predicted ground level pollutant concentrations of all these species were converted to kilo-equivalent ion depositions (keq/ha/yr) for comparison with the critical load for acid deposition at each of the identified ecological receptors. The conversion to units of equivalents, a measure of the potential acidifying effect of a species, was undertaken using the standard conversion factors shown in Table 22.

Table 22 Conversion Factors to Determine Dry Deposition Flux for Acid Deposition

Pollutant	Deposition Velocity (m/s)		Conversion Factor (µg/m²/s to keq/ha/yr of pollutant species)
	Grassland	Forest	
NO_2	0.0015	0.003	6.84
HCl	0.025	0.06	8.63

4.14.2 The following formula was used to calculate predicted PCs as a proportion of the critical load function where PECs were identified to be greater than the CLminN value:

PC as %CL function = ((PC of deposition)/CLmaxN) x 100

4.14.3 The above formula was obtained from the APIS website[16].

4.14.4 It should be noted that in accordance with the AQTAG 06 guidance[17], the PC of HCl was added to the PC of nitrogen and treated as N in the above formula.

4.15 Background Concentrations

4.15.1 Review of existing data in the vicinity of the site was undertaken in Section 3.0 in order to identify suitable background values for use in the assessment. These were subsequently utilised to represent existing concentrations at sensitive human receptors in the vicinity of the site. A summary of the relevant values is provided in Table 23.

Table 23 Background Pollutant Concentrations - Sensitive Human Receptors

Pollutant	Background Pollutant Concentration Used in Model	Unit	Source
NO_2	3.94	µg/m³	DEFRA mapping
PM_{10}	11.30	µg/m³	DEFRA mapping
$PM_{2.5}$	6.67	µg/m³	DEFRA mapping
HCl	0.32	µg/m³	UKEAP Network (Rosemaund)
HF	2.35	µg/m³	EPAQS report
CO	193	µg/m³	DEFRA mapping
Cd	0.22	ng/m³	DEFRA (Walsall Pleck)
Hg	2.30	ng/m³	DEFRA (Walsall Bilston Lane)
PCDD/F	23.00	fg/m³	TOMPS Network (Manchester Law Courts)
As	0.83	ng/m³	DEFRA (Walsall Pleck)
Cr (VI)	0.47	ng/m³	DEFRA (Walsall Pleck)
Ni	0.75	ng/m³	DEFRA (Walsall Pleck)
V	0.67	ng/m³	DEFRA (Walsall Pleck)

16 http://www.apis.ac.uk/.

17 Technical Guidance on Detailed Modelling approach for an Appropriate Assessment for Emissions to Air AQTAG 06, EA, 2014.

4.15.2 Baseline pollutant levels at the sensitive ecological receptors were obtained from the APIS website, as summarised in Table 14.

4.15.3 It is not possible to add short-term peak baseline and process concentrations. This is because the conditions which give rise to peak ground-level concentrations of substances emitted from an elevated source at a particular location and time are likely to be different to the conditions which give rise to peak concentrations due to emissions from other sources. This point is addressed in in EA guidance 'Air emissions risk assessment for your environmental permit'[18], which advises that an estimate of the maximum combined pollutant concentration can be obtained by adding the maximum predicted short-term concentration due to emissions from the source to twice the annual mean baseline concentration. This approach was adopted throughout the assessment.

4.16 Assessment Criteria

Human Receptors

4.16.1 EA guidance 'Air emissions risk assessment for your environmental permit'[19] states that PCs can be screened as insignificant if they meet the following criteria:

- The short-term PC is less than 10% of the short-term environmental standard; and,
- The long-term PC is less than 1% of the long-term environmental standard.

4.16.2 If these criteria are exceeded the following guidance is provided on when whether PECs can be screened as insignificant:

- The short-term PC is less than 20% of the short-term environmental standards minus twice the long-term background concentration; and,
- The long-term PEC is less than 70% of the long-term environmental standards.

4.16.3 Should these criteria be exceeded then additional consideration to potential impacts should be provided.

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

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

Ecological Receptors

4.16.4 EA guidance 'Air emissions risk assessment for your environmental permit'[20] states that PCs at SSSIs and SACs can be screened as insignificant if they meet the following criteria:

- The short-term PC is less than 10% of the short-term environmental standard for protected conservation areas;
- The long-term PC is less than 1% of the long-term environmental standard for protected conservation areas; or,
- The long-term PC is greater than 1% and the long term PEC is less than 70% of the long term environmental standard.

4.16.5 PCs at AWs can be screened as insignificant if they meet the following criteria:

- The short-term PC is less than 100% of the short-term environmental standard for protected conservation areas; and,
- The long-term PC is less than 100% of the long-term environmental standard for protected conservation areas.

4.16.6 Predicted PCs have been compared to the relevant EQSs and the criteria stated above. Where the impact is within these parameters, the EA concludes that impacts associated with an installation are acceptable.

4.17 Modelling Uncertainty

4.17.1 Uncertainty in dispersion modelling predictions can be associated with a variety of factors, including:

- Model uncertainty - due to model limitations;
- Data uncertainty - due to errors in input data, including emission estimates, operational procedures, land use characteristics and meteorology; and,
- Variability - randomness of measurements used.

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

4.17.2 Potential uncertainties in the model results were minimised as far as practicable and worst-case inputs used in order to provide a robust assessment. This included the following:

- Choice of model - ADMS-6 is a commonly used atmospheric dispersion model and results have been verified through a number of studies to ensure predictions are as accurate as possible;
- Meteorological data - Modelling was undertaken using five annual meteorological data sets from an observation station local to the site. The analysis was based on the worst-case year for each averaging period to ensure maximum concentrations were considered;
- Surface characteristics - The z_0 and Monin-Obukhov length were determined for both the dispersion and meteorological sites based on the surrounding land uses and guidance provided by CERC;
- Plant operating conditions - Operational parameters were obtained from Onnu Ltd. As such, input parameters are considered to be representative of normal operating conditions;
- Emission rates - Emission rates were derived from monitored data or the relevant ELVs and are therefore considered to provide a robust representation of the anticipated pollutant releases associated with the plant;
- Background concentrations - Background pollutant levels were obtained from the DEFRA mapping study, APIS and the relevant national monitoring networks. These are considered representative of baseline air quality conditions at sensitive locations within the vicinity of the site;
- Receptor locations - A Cartesian Grid was included in the model in order to provide suitable data for contour plotting. Receptor points were also included at sensitive locations to provide additional consideration of these areas; and,
- Variability - All model inputs were as accurate as possible and worst-case conditions were considered as necessary in order to ensure a robust assessment of potential pollutant concentrations.

4.17.3 Results were considered in the context of the relevant EQSs and EA significance criteria. It is considered that the use of the stated measures to reduce uncertainty and the use of worst-case assumptions when necessary has resulted in model accuracy of an acceptable level.

5.0 RESULTS

5.1 Introduction

5.1.1 Dispersion modelling was undertaken with the inputs described in Section 4.0. The results are outlined in the following Sections.

5.1.2 Reference should be made to Figure 6 to Figure 22 for graphical representations of predicted PECs, inclusive of background levels, throughout the assessment extents. It should be noted that the values shown in the Figures are predictions from the meteorological data set which resulted in the maximum pollutant concentration for that averaging period. For example, the maximum annual mean NO_2 concentration was predicted using the 2021 meteorological data set. As such, the contours shown in Figure 6 were produced from the 2021 model outputs.

5.2 Maximum Pollutant Concentrations

5.2.1 The maximum predicted pollutant concentrations at any point within the modelling extents for any meteorological data set are summarised in Table 24.

Table 24 Maximum Predicted Pollutant Concentrations

Pollutant	Averaging Period	Units	EQS	PC	PC Proportion of EQS (%)	PEC	PEC Proportion of EQS (%)
NO_2	Annual	μg/m^3	40	3.25	8.1	7.19	18.0
	99.8th %ile 1-hour	μg/m^3	200	25.10	12.5	32.98	16.5
PM_{10}	Annual	μg/m^3	40	0.01	0.0	11.31	28.3
	90.4th %ile 24-hour	μg/m^3	50	0.02	0.0	22.62	45.2
$PM_{2.5}$	Annual	μg/m^3	12	0.01	0.0	6.68	33.4
HCl	1-hour	μg/m^3	750	750	0.65	0.1	1.29
HF	1-hour	μg/m^3	160	160	2.29	1.4	6.99
CO	Rolling 8-hour	μg/m^3	10,000	25.79	0.3	411.79	4.1

Pollutant	Averaging Period	Units	EQS	PC	PC Proportion of EQS (%)	PEC	PEC Proportion of EQS (%)
Cd	Annual	ng/m^3	5	5.95	119.0	6.17	123.4
	24-hour	ng/m^3	30	46.28	154.3	46.72	155.7
Hg	24-hour	ng/m^3	60	43.32	72.2	45.62	76.0
	1-hour	ng/m^3	600	118.16	19.7	122.76	20.5
PCDD/Fs	Annual	fg/m^3	n/a	0.003	-	23.00	-
	1-hour	fg/m^3	n/a	0.057	-	46.06	-

5.2.2 As shown in Table 24, there were no predicted exceedences of any EQS at any location for any pollutant or averaging period of interest with the exception of Cd. However, as shown in Figure 15 and Figure 16, predicted exceedences of the annual EQS are restricted to within the site boundary and exceedences of the 24-hour EQS are located on the B4361. As shown in Table 3, the roadside location is not considered to be a location of relevant exposure in accordance with the DEFRA guidance.

5.3 Metal Concentrations

5.3.1 A staged assessment methodology was utilised for the prediction of grouped metal concentrations as outlined previously. Potential impacts on annual mean Cr(VI), As and Ni and 24-hour mean V concentrations were assessed as these represent the lowest EQSs. The results are outlined below.

Stage 1

5.3.2 Predicted concentrations with the full metal emission considered to consist of only one species are summarised in Table 25.

Table 25 Predicted Metal Concentrations - Stage 1

Pollutant	Averaging Period	Units	EQS	PC	PC Proportion of EQS (%)	PEC	PEC Proportion of EQS (%)
As	Annual	ng/m^3	6	27.85	464.1	28.68	478.0

Pollutant	Averaging Period	Units	EQS	PC	PC Proportion of EQS (%)	PEC	PEC Proportion of EQS (%)
Cr (VI)	Annual	ng/m^3	0.25	27.85	11,139.5	28.32	11,326.7
Ni	Annual	ng/m^3	20	27.85	139.2	28.60	143.0
V	24-hour	ng/m^3	1,000	590.82	59.1	592.16	59.2

5.3.3 As indicated in Table 25, the PEC proportion of the EQS was below 100% for V and therefore wasn't considered further within the assessment. The EA criteria were exceeded for predicted PCs of As, Cr (VI) and Ni. As such, these were progressed to the Stage 2 Assessment.

Stage 2

5.3.4 Predicted concentrations with the metal emission distributed equally between all species are summarised in Table 26.

Table 26 Predicted Metal Concentrations - Stage 2

Pollutant	Averaging Period	Units	EQS	PC	PC Proportion of EQS (%)	PEC	PEC Proportion of EQS (%)
As	Annual	ng/m^3	6	3.06	51.1	3.89	64.9
Cr (VI)	Annual	ng/m^3	0.25	3.06	1,225.3	3.53	1,412.5
Ni	Annual	ng/m^3	20	3.06	15.3	3.81	19.1

5.3.5 As indicated in Table 26, the EA criteria was exceeded for the PEC proportion of the EQS for Cr (VI) only. As such, Cr (VI) was progressed to the Stage 3 Assessment.

5.3.6 Due to the low PECs of Ni and As, it is considered unlikely that exceedences of the relevant EQSs would occur. As such, the second EA criteria was achieved and there was no requirement to proceed to a Stage 3 Assessment for Ni and As.

Stage 3

5.3.7 The EA metals guidance[21] provides a range of emission concentrations (corresponding fractions of the total metals emission) measured at twenty waste incineration facilities in the UK. The data suggests that, on average, Cr comprises 2.2% of the total metals emission and provides a mean Cr(VI) emission rate of 3.5 x 10-5mg/Nm^3. The predicted maximum PCs and PECs utilising this data is summarised in Table 27.

Table 27 Predicted Metal Concentrations - Stage 3

Pollutant	Averaging Period	Units	EQS	PC	PC Proportion of EQS (%)	PEC	PEC Proportion of EQS (%)
Cr (VI)	Annual	ng/m^3	0.2	0.002	0.8	0.470	188.0

5.3.8 It should be noted that the background Cr (VI) concentration exceedes the EQS as a baseline. As shown in Table 27, the Cr (VI) PC is less than 1% of the relevant EQS. As such, impacts are not predicted to be significant at any location within the modelling extents.

5.4 Human Receptors

5.4.1 Predicted concentrations of each pollutant at the sensitive human receptor locations identified in Table 10 are summarised in the following Sections.

Nitrogen Dioxide

5.4.2 Predicted annual mean NO_2 PECs at the sensitive human receptors, inclusive of background levels, are summarised in Table 28.

Table 28 Predicted Annual Mean NO_2 Concentrations

Receptor		Predicted Annual Mean NO_2 PEC (µg/m^3)				
		2018	2019	2020	2021	2022
R1	Residential - Newton Lane	4.54	4.34	4.43	4.45	4.33
R2	Residential - Marlbrook Cottages	4.00	4.01	3.99	3.99	4.00
R3	Residential - Marlbrook Cottages	4.09	4.07	4.08	4.09	4.08

21 Guidance to Applicants on Impact Assessment for Group 3 Metals Stack, EA, 2012.

Receptor		Predicted Annual Mean NO_2 PEC (µg/m^3)				
		2018	2019	2020	2021	2022
R4	Residential - A49	4.06	4.08	4.05	4.07	4.07
R5	Residential - Newton Lane	4.11	4.05	4.08	4.09	4.05

5.4.3 As indicated in Table 28, NO_2 PECs were below the annual mean EQS of 40µg/m^3 at all sensitive receptor locations for all meteorological data sets.

5.4.4 Maximum predicted annual mean NO_2 concentrations at the receptor locations are summarised in Table 29. Reference should be made to Figure 6 for a graphical representation of predicted concentrations throughout the assessment extents.

Table 29 Maximum Predicted Annual Mean NO_2 Concentrations

Receptor		Predicted Annual Mean NO_2 Concentration (µg/m^3)		Proportion of EQS (%)	
		PC	PEC	PC	PEC
R1	Residential - Newton Lane	0.60	4.54	1.5	11.4
R2	Residential - Marlbrook Cottages	0.07	4.01	0.2	10.0
R3	Residential - Marlbrook Cottages	0.15	4.09	0.4	10.2
R4	Residential - A49	0.14	4.08	0.4	10.2
R5	Residential - Newton Lane	0.17	4.11	0.4	10.3

5.4.5 As indicated in Table 29, all PCs were below 1% of the EQS with the exception of R1. However, the PEC was below 70% of the EQS at this location. As such, predicted effects on annual mean NO_2 concentrations are not considered to be significant, in accordance with the EA criteria.

5.4.6 Predicted 99.8th %ile 1-hour mean NO_2 PECs, inclusive of background levels, are summarised in Table 30.

Table 30 Predicted 99.8th %ile 1-hour Mean NO_2 Concentrations

Receptor		Predicted 99.8th %ile 1-hour Mean NO_2 PEC (µg/m³)				
		2018	2019	2020	2021	2022
R1	Residential - Newton Lane	12.41	12.47	12.39	12.55	12.40
R2	Residential - Marlbrook Cottages	9.00	8.96	9.01	8.96	9.03
R3	Residential - Marlbrook Cottages	9.95	9.79	9.94	9.94	9.81
R4	Residential - A49	10.29	10.24	10.27	10.27	10.19
R5	Residential - Newton Lane	9.44	9.36	9.40	9.39	9.41

5.4.7 As indicated in Table 30, 1-hour mean NO_2 PECs were below the EQS of 200µg/m³ at all sensitive human receptor locations for all meteorological data sets.

5.4.8 Maximum predicted 99.8th %ile 1-hour mean NO_2 concentrations at the human receptor locations are summarised in Table 31. Reference should be made to Figure 7 for a graphical representation of predicted concentrations throughout the assessment extents.

Table 31 Maximum Predicted 99.8th %ile 1-hour Mean NO_2 Concentrations

Receptor		Maximum Predicted 99.8th %ile 1-hour Mean NO_2 Concentration (µg/m³)		PC Proportion of EQS (%)	PC Proportion of EQS Headroom (%)(a)
		PC	PEC		
R1	Residential - Newton Lane	4.67	12.55	2.3	2.4
R2	Residential - Marlbrook Cottages	1.15	9.03	0.6	0.6
R3	Residential - Marlbrook Cottages	2.07	9.95	1.0	1.1
R4	Residential - A49	2.41	10.29	1.2	1.3
R5	Residential - Newton Lane	1.56	9.44	0.8	0.8

Note: (a) PC proportion of the EQS minus twice the long-term background concentration.

5.4.9 As indicated in Table 31, PCs were below 10% of the EQS at all human receptor locations. As such, predicted effects on 1-hour mean NO_2 concentrations are not considered to be significant, in accordance with the EA criteria.

Particulate Matter

5.4.10 Predicted annual mean PM_{10} PECs at the sensitive human receptors, inclusive of background levels, are summarised in Table 32.

Table 32 Predicted Annual Mean PM_{10} Concentrations

Receptor		Predicted Annual Mean PM_{10} PEC ($\mu g/m^3$)				
		2018	2019	2020	2021	2022
R1	Residential - Newton Lane	11.30	11.30	11.30	11.30	11.30
R2	Residential - Marlbrook Cottages	11.30	11.30	11.30	11.30	11.30
R3	Residential - Marlbrook Cottages	11.30	11.30	11.30	11.30	11.30
R4	Residential - A49	11.30	11.30	11.30	11.30	11.30
R5	Residential - Newton Lane	11.30	11.30	11.30	11.30	11.30

5.4.11 As indicated in Table 32, PM_{10} PECs were below the annual mean EQS of 40$\mu g/m^3$ at all human receptor locations for all meteorological data sets.

5.4.12 Maximum predicted annual mean PM_{10} concentrations at the receptor locations are summarised in Table 33. Reference should be made to Figure 8 for a graphical representation of predicted concentrations throughout the assessment extents.

Table 33 Maximum Predicted Annual Mean PM_{10} Concentrations

Receptor		Predicted Annual Mean PM_{10} Concentration ($\mu g/m^3$)		Proportion of EQS (%)	
		PC	PEC	PC	PEC
R1	Residential - Newton Lane	0.00	11.30	0.0	28.3
R2	Residential - Marlbrook Cottages	0.00	11.30	0.0	28.3
R3	Residential - Marlbrook Cottages	0.00	11.30	0.0	28.3
R4	Residential - A49	0.00	11.30	0.0	28.3
R5	Residential - Newton Lane	0.00	11.30	0.0	28.3

5.4.13 As indicated in Table 33, PCs were below 1% of the EQS at all human receptor locations. As such, predicted effects on annual mean PM_{10} concentrations are not considered to be significant, in accordance with the EA criteria.

5.4.14 Predicted 90.4th %ile 24-hour mean PM_{10} PECs, inclusive of background levels, are summarised in Table 34.

Table 34 Predicted 90.4th %ile 24-hour Mean PM_{10} Concentrations

Receptor		Predicted 90.4th %ile 24-hour Mean PM_{10} PEC (µg/m³)				
		2018	2019	2020	2021	2022
R1	Residential - Newton Lane	22.61	22.60	22.60	22.60	22.60
R2	Residential - Marlbrook Cottages	22.60	22.60	22.60	22.60	22.60
R3	Residential - Marlbrook Cottages	22.60	22.60	22.60	22.60	22.60
R4	Residential - A49	22.60	22.60	22.60	22.60	22.60
R5	Residential - Newton Lane	22.60	22.60	22.60	22.60	22.60

5.4.15 As indicated in Table 34, 24-hour mean PM_{10} PECs were below the EQS of 50µg/m³ at all human receptor locations for all meteorological data sets.

5.4.16 Maximum predicted 90.4th %ile 24-hour mean PM_{10} concentrations at the receptor locations are summarised in Table 35. Reference should be made to Figure 9 for a graphical representation of predicted concentrations throughout the assessment extents.

Table 35 Maximum Predicted 90.4th %ile 24-hour Mean PM_{10} Concentrations

Receptor		Maximum Predicted 90.4th %ile 24-hour Mean PM_{10} Concentration (µg/m³)		PC Proportion of EQS (%)	PC Proportion of EQS Headroom (%)[a]
		PC	PEC		
R1	Residential - Newton Lane	0.01	22.61	0.0	0.0
R2	Residential - Marlbrook Cottages	0.00	22.60	0.0	0.0
R3	Residential - Marlbrook Cottages	0.00	22.60	0.0	0.0

Receptor		Maximum Predicted 90.4th %ile 24-hour Mean PM_{10} Concentration (µg/m³)		PC Proportion of EQS (%)	PC Proportion of EQS Headroom (%)[(a)]
		PC	PEC		
R4	Residential - A49	0.00	22.60	0.0	0.0
R5	Residential - Newton Lane	0.00	22.60	0.0	0.0

NOTE (a) PC proportion of EQS minus twice the long-term background concentration.

5.4.17 As indicated in Table 35, PCs were below 10% of the EQS at all human receptor locations. As such, predicted effects on 24-hour mean PM_{10} concentrations are not considered to be significant in accordance with the EA criteria.

5.4.18 Predicted annual mean $PM_{2.5}$ PECs at the human receptors, inclusive of background levels, are summarised in Table 36.

Table 36 Predicted Annual Mean $PM_{2.5}$ Concentrations

Receptor		Predicted Annual Mean $PM_{2.5}$ PEC (µg/m³)				
		2018	2019	2020	2021	2022
R1	Residential - Newton Lane	6.67	6.67	6.67	6.67	6.67
R2	Residential - Marlbrook Cottages	6.67	6.67	6.67	6.67	6.67
R3	Residential - Marlbrook Cottages	6.67	6.67	6.67	6.67	6.67
R4	Residential - A49	6.67	6.67	6.67	6.67	6.67
R5	Residential - Newton Lane	6.67	6.67	6.67	6.67	6.67

5.4.19 As indicated in Table 36, $PM_{2.5}$ PECs were below the annual mean EQS of 12µg/m³ at all sensitive receptor locations for all meteorological data sets.

5.4.20 Maximum predicted annual mean $PM_{2.5}$ concentrations at the human receptor locations are summarised in Table 37. Reference should be made to Figure 10 for a graphical representation of predicted concentrations throughout the assessment extents.

Table 37 Maximum Predicted Annual Mean $PM_{2.5}$ Concentrations

Receptor		Predicted Annual Mean $PM_{2.5}$ Concentration (µg/m³)		Proportion of EQS (%)	
		PC	PEC	PC	PEC
R1	Residential - Newton Lane	0.00	6.67	0.0	55.6
R2	Residential - Marlbrook Cottages	0.00	6.67	0.0	55.6
R3	Residential - Marlbrook Cottages	0.00	6.67	0.0	55.6
R4	Residential - A49	0.00	6.67	0.0	55.6
R5	Residential - Newton Lane	0.00	6.67	0.0	55.6

5.4.21 As indicated in Table 33, PCs were below 1% of the EQS at all human receptor locations. As such, predicted effects on annual mean $PM_{2.5}$ concentrations are not considered to be significant, in accordance with the EA criteria.

Hydrogen Chloride

5.4.22 Predicted 1-hour mean HCl PECs, inclusive of background levels, are summarised in Table 38.

Table 38 Predicted 1-hour Mean HCl Concentrations

Receptor		Predicted 1-hour Mean HCl PEC (µg/m³)				
		2018	2019	2020	2021	2022
R1	Residential - Newton Lane	0.75	0.74	0.75	0.75	0.75
R2	Residential - Marlbrook Cottages	0.67	0.68	0.68	0.70	0.70
R3	Residential - Marlbrook Cottages	0.69	0.70	0.69	0.69	0.69
R4	Residential - A49	0.71	0.71	0.71	0.71	0.71
R5	Residential - Newton Lane	0.68	0.70	0.68	0.71	0.73

5.4.23 As indicated in Table 38, 1-hour mean HCl PECs were below the EQS of 750µg/m³ at all human receptor locations for all meteorological data sets.

5.4.24 Maximum predicted 1-hour mean HCl concentrations at the human receptor locations are summarised in Table 39. Reference should be made to Figure 11 for a graphical representation of predicted concentrations throughout the assessment extents.

Table 39 Maximum Predicted 1-hour Mean HCl Concentrations

Receptor		Predicted 1-hour Mean HCl Concentration (µg/m³)		PC Proportion of EQS (%)	PC Proportion of EQS Headroom (%)[a]
		PC	PEC		
R1	Residential - Newton Lane	0.11	0.75	0.0	0.0
R2	Residential - Marlbrook Cottages	0.06	0.70	0.0	0.0
R3	Residential - Marlbrook Cottages	0.06	0.70	0.0	0.0
R4	Residential - A49	0.07	0.71	0.0	0.0
R5	Residential - Newton Lane	0.09	0.73	0.0	0.0

NOTE (a) PC proportion of EQS minus twice the long-term background concentration.

5.4.25 As indicated in Table 39, PCs were below 10% of the EQS at all human receptor locations. As such, predicted effects on 1-hour mean HCl concentrations are not considered to be significant, in accordance with the EA criteria.

Hydrogen Fluoride

5.4.26 Predicted 1-hour mean HF PECs, inclusive of background levels, are summarised in Table 40.

Table 40 Predicted 1-hour Mean HF Concentrations

Receptor		Predicted 1-hour Mean HF PEC (µg/m³)				
		2018	2019	2020	2021	2022
R1	Residential - Newton Lane	5.084	5.067	5.083	5.087	5.092
R2	Residential - Marlbrook Cottages	4.812	4.830	4.847	4.894	4.914
R3	Residential - Marlbrook Cottages	4.890	4.898	4.888	4.885	4.892
R4	Residential - A49	4.955	4.932	4.959	4.933	4.952

Receptor		Predicted 1-hour Mean HF PEC (µg/m³)				
		2018	2019	2020	2021	2022
R5	Residential - Newton Lane	4.843	4.904	4.827	4.934	5.007

5.4.27 As indicated in Table 40, 1-hour mean HF PECs were below the EQS of 160µg/m³ at all human receptor locations for all meteorological data sets.

5.4.28 Maximum predicted 1-hour mean HF concentrations at the human receptor locations are summarised in Table 41. Reference should be made to Figure 13 for a graphical representation of predicted concentrations throughout the assessment extents.

Table 41 Maximum Predicted 1-hour Mean HF Concentrations

Receptor		Predicted 1-hour Mean HF Concentration (µg/m³)		PC Proportion of EQS (%)	PC Proportion of EQS Headroom (%)(a)
		PC	PEC		
R1	Residential - Newton Lane	0.392	5.092	0.25	0.25
R2	Residential - Marlbrook Cottages	0.214	4.914	0.13	0.14
R3	Residential - Marlbrook Cottages	0.198	4.898	0.12	0.13
R4	Residential - A49	0.259	4.959	0.16	0.17
R5	Residential - Newton Lane	0.307	5.007	0.19	0.20

NOTE (a) PC proportion of EQS minus twice the long-term background concentration.

5.4.29 As indicated in Table 41, PCs were below 10% of the EQS at all human receptor locations. As such, predicted effects on 1-hour mean HF concentrations are not considered to be significant, in accordance with the EA criteria.

Carbon Monoxide

5.4.30 Predicted 8-hour rolling mean CO PECs, inclusive of background levels, are summarised in Table 42.

Table 42 Predicted 8-hour Rolling Mean CO Concentrations

Receptor		Predicted 8-hour Rolling Mean CO PEC (µg/m³)				
		2018	2019	2020	2021	2022
R1	Residential - Newton Lane	390.43	390.74	390.28	389.69	390.07
R2	Residential - Marlbrook Cottages	387.02	386.89	386.88	386.88	386.92
R3	Residential - Marlbrook Cottages	387.95	387.39	387.78	387.82	387.79
R4	Residential - A49	388.19	388.06	388.07	388.18	388.53
R5	Residential - Newton Lane	387.30	387.36	387.31	387.17	387.26

5.4.31 As indicated in Table 42, 8-hour rolling mean CO PECs were below the EQS of 10,000µg/m³ at all human receptor locations for all meteorological data sets.

5.4.32 Maximum predicted 8-hour rolling mean CO concentrations at the human receptor locations are summarised in Table 43. Reference should be made to Figure 14 for a graphical representation of predicted concentrations throughout the assessment extents.

Table 43 Maximum Predicted 8-hour Rolling Mean CO Concentrations

Receptor		Maximum Predicted 8-hour Rolling Mean CO Concentration (µg/m³)		PC Proportion of EQS (%)	PC Proportion of EQS Headroom (%)(a)
		PC	PEC		
R1	Residential - Newton Lane	4.74	390.74	0.0	0.0
R2	Residential - Marlbrook Cottages	1.02	387.02	0.0	0.0
R3	Residential - Marlbrook Cottages	1.95	387.95	0.0	0.0
R4	Residential - A49	2.53	388.53	0.0	0.0
R5	Residential - Newton Lane	1.36	387.36	0.0	0.0

NOTE (a) PC proportion of EQS minus twice the long-term background concentration.

5.4.33 As indicated in Table 43, PCs were below 10% of the EQS at all human receptor locations. As such, predicted effects on 8-hour rolling mean CO concentrations are not considered to be significant, in accordance with the EA criteria.

Cadmium

5.4.34 Predicted annual mean Cd PECs at the human receptors, inclusive of background levels, are summarised in Table 44.

Table 44 Predicted Annual Mean Cd Concentrations

Receptor		Predicted Annual Mean Cd PEC (ng/m³)				
		2018	2019	2020	2021	2022
R1	Residential - Newton Lane	1.08	0.82	0.90	0.97	0.81
R2	Residential - Marlbrook Cottages	0.33	0.35	0.31	0.31	0.34
R3	Residential - Marlbrook Cottages	0.51	0.46	0.48	0.49	0.52
R4	Residential - A49	0.39	0.41	0.37	0.40	0.43
R5	Residential - Newton Lane	0.49	0.41	0.44	0.46	0.41

5.4.35 As indicated in Table 44, PECs were below the annual mean EQS of 5ng/m³ at all human receptor locations for all meteorological data sets.

5.4.36 Maximum predicted annual mean Cd concentrations at the receptor locations are summarised in Table 45. Reference should be made to Figure 15 for a graphical representation of predicted concentrations throughout the assessment extents.

Table 45 Maximum Predicted Annual Mean Cd Concentrations

Receptor		Predicted Annual Mean Cd Concentration (ng/m³)		Proportion of EQS (%)	
		PC	PEC	PC	PEC
R1	Residential - Newton Lane	0.86	1.08	17.3	21.7
R2	Residential - Marlbrook Cottages	0.13	0.35	2.6	7.0
R3	Residential - Marlbrook Cottages	0.30	0.52	5.9	10.3
R4	Residential - A49	0.21	0.43	4.2	8.6
R5	Residential - Newton Lane	0.27	0.49	5.4	9.8

5.4.37 As indicated in Table 45, PECs were below 70% of the EQS at all human receptor locations. As such, predicted effects on annual mean Cd concentrations are not considered to be significant, in accordance with the EA criteria.

5.4.38 Predicted 100th %ile 24-hour mean Cd PECs, inclusive of background levels, are summarised in Table 46.

Table 46 Predicted 100th %ile 24-hour Mean Cd Concentrations

Receptor		Predicted 100th %ile 24-hour Mean Cd PEC (ng/m³)				
		2018	2019	2020	2021	2022
R1	Residential - Newton Lane	7.20	7.87	7.50	7.54	6.66
R2	Residential - Marlbrook Cottages	2.03	1.41	1.45	1.23	1.76
R3	Residential - Marlbrook Cottages	2.87	2.92	2.63	3.12	2.89
R4	Residential - A49	3.02	3.45	3.50	3.04	3.20
R5	Residential - Newton Lane	2.50	2.49	1.91	2.32	2.12

5.4.39 As indicated in Table 46, 24-hour mean Cd PECs were below the EQS of 30ng/m³ at all human receptor locations for all meteorological data sets.

5.4.40 Maximum predicted 100th %ile 24-hour mean Cd concentrations at the receptor locations are summarised in Table 47. Reference should be made to Figure 16 for a graphical representation of predicted concentrations throughout the assessment extents.

Table 47 Maximum Predicted 100th %ile 24-hour Mean Cd Concentrations

Receptor		Maximum Predicted 100th %ile 24-hour Mean Cd Concentration (ng/m³)		PC Proportion of EQS (%)	PC Proportion of EQS Headroom (%)(a)
		PC	PEC		
R1	Residential - Newton Lane	7.43	7.87	24.8	33.6
R2	Residential - Marlbrook Cottages	1.81	2.03	6.0	8.2
R3	Residential - Marlbrook Cottages	2.90	3.12	9.7	13.1

Receptor		Maximum Predicted 100th %ile 24-hour Mean Cd Concentration (ng/m³)		PC Proportion of EQS (%)	PC Proportion of EQS Headroom (%)[(a)]
		PC	PEC		
R4	Residential - A49	3.28	3.50	10.9	14.8
R5	Residential - Newton Lane	2.28	2.50	7.6	10.3

NOTE (a) PC proportion of EQS minus twice the long-term background concentration.

5.4.41 As indicated in Table 47, the PC proportion of the EQS minus twice the long-term background concentration was below 20% at all human receptor locations with the exception of R1. However, PECs were below 100% of the EQS at the location. As such, predicted effects on 24-hour mean Cd concentrations are not considered to be significant.

Mercury

5.4.42 Predicted 100th %ile 24-hour mean Hg PECs, inclusive of background levels, are summarised in Table 48.

Table 48 Predicted 100th %ile 24-hour Mean Hg Concentrations

Receptor		Predicted 100th %ile 24-hour Mean Hg PEC (ng/m³)				
		2018	2019	2020	2021	2022
R1	Residential - Newton Lane	11.36	12.03	11.66	11.70	10.82
R2	Residential - Marlbrook Cottages	6.41	5.79	5.83	5.61	6.14
R3	Residential - Marlbrook Cottages	7.25	7.30	7.01	7.50	7.27
R4	Residential - A49	7.40	7.83	7.88	7.42	7.58
R5	Residential - Newton Lane	6.88	6.87	6.29	6.70	6.50

5.4.43 As indicated in Table 48, 24-hour mean Hg PECs were below the EQS of 60ng/m³ at all human receptor locations for all meteorological data sets.

5.4.44 Maximum predicted 100th %ile 24-hour mean Hg concentrations at the human receptor locations are summarised in Table 49. Reference should be made to Figure 17 for a graphical representation of predicted concentrations throughout the assessment extents.

Table 49 Maximum Predicted 100th %ile 24-hour Mean Hg Concentrations

Receptor		Maximum Predicted 100th %ile 24-hour Mean Hg Concentration (ng/m³)		PC Proportion of EQS (%)	PC Proportion of EQS Headroom (%)(a)
		PC	PEC		
R1	Residential - Newton Lane	7.43	12.03	12.38	13.41
R2	Residential - Marlbrook Cottages	1.81	6.41	3.02	3.27
R3	Residential - Marlbrook Cottages	2.90	7.50	4.83	5.23
R4	Residential - A49	3.28	7.88	5.46	5.92
R5	Residential - Newton Lane	2.28	6.88	3.80	4.11

NOTE (a) PC proportion of EQS minus twice the long-term background concentration.

5.4.45 As indicated in Table 49, the PC proportion of the EQS minus twice the long-term background concentration was below 20% at all human receptor locations. As such, predicted effects on 24-hour mean Hg concentrations are not considered to be significant, in accordance with the EA criteria.

5.4.46 Predicted 100th %ile 1-hour mean Hg PECs, inclusive of background levels, are summarised in Table 50.

Table 50 Predicted 100th %ile 1-hour Mean Hg Concentrations

Receptor		Predicted 100th %ile 1-hour Mean Hg PEC (μg/m³)				
		2018	2019	2020	2021	2022
R1	Residential - Newton Lane	20.01	22.74	22.54	18.21	22.24
R2	Residential - Marlbrook Cottages	9.21	9.91	9.58	10.34	10.74
R3	Residential - Marlbrook Cottages	17.20	17.57	17.40	16.09	17.62
R4	Residential - A49	14.13	14.76	14.21	13.81	15.94

Receptor		Predicted 100th %ile 1-hour Mean Hg PEC (µg/m³)				
		2018	2019	2020	2021	2022
R5	Residential - Newton Lane	11.94	13.10	11.47	10.86	14.89

5.4.47 As indicated in Table 50, 1-hour mean Hg PECs were below the EQS of 600ng/m³ at all human receptor locations for all meteorological data sets.

5.4.48 Maximum predicted 100th %ile 1-hour mean Hg concentrations at the human receptor locations are summarised in Table 51. Reference should be made to Figure 18 for a graphical representation of predicted concentrations throughout the assessment extents.

Table 51 Maximum Predicted 100th %ile 1-hour Mean Hg Concentrations

Receptor		Maximum Predicted 100th %ile 1-hour Mean Hg Concentration (µg/m³)		PC Proportion of EQS (%)	PC Proportion of EQS Headroom (%)(a)
		PC	PEC		
R1	Residential - Newton Lane	18.14	22.74	3.02	3.05
R2	Residential - Marlbrook Cottages	6.14	10.74	1.02	1.03
R3	Residential - Marlbrook Cottages	13.02	17.62	2.17	2.19
R4	Residential - A49	11.34	15.94	1.89	1.90
R5	Residential - Newton Lane	10.29	14.89	1.72	1.73

NOTE (a) PC proportion of EQS minus twice the long-term background concentration.

5.4.49 As indicated in Table 51, the PC proportion of the EQS 10% at all human receptor locations. As such, predicted effects on 1-hour mean Hg concentrations are not considered to be significant, in accordance with the EA guidance.

Dioxins and Furans

5.4.50 Predicted annual mean PCDD/Fs PECs at the sensitive human receptors, inclusive of background levels, are summarised in Table 52.

Table 52 Predicted Annual Mean PCDD/F Concentrations

Receptor		Predicted Annual Mean PCDD/F PEC (fg/m³)				
		2018	2019	2020	2021	2022
R1	Residential - Newton Lane	23.001	23.000	23.000	23.000	23.000
R2	Residential - Marlbrook Cottages	23.000	23.000	23.000	23.000	23.000
R3	Residential - Marlbrook Cottages	23.000	23.000	23.000	23.000	23.000
R4	Residential - A49	23.000	23.000	23.000	23.000	23.000
R5	Residential - Newton Lane	23.000	23.000	23.000	23.000	23.000

5.5 Ecological Receptors

Nitrogen Oxides

5.5.1 Predicted annual mean NO_x PECs at the ecological receptor locations, inclusive of background levels, are summarised in Table 53.

Table 53 Predicted Annual Mean NO_x Concentrations

Receptor		Predicted Annual Mean NO_x PEC (µg/m³)				
		2018	2019	2020	2021	2022
E1	River Lugg SSSI	5.62	5.61	5.63	5.62	5.61
E2	River Lugg SSSI	5.74	5.73	5.79	5.71	5.67
E3	River Lugg SSSI	6.08	6.16	6.16	6.08	6.08
E4	River Lugg SSSI	7.66	7.68	7.65	7.73	7.69
E5	River Lugg SSSI	7.51	7.51	7.50	7.51	7.54
E6	River Lugg SSSI / River Wye SAC	5.33	5.33	5.33	5.34	5.40
E7	Hill Hole Dingle SSSI	5.43	5.45	5.43	5.45	5.44
E8	Dinmore Hill Woods SSSI / AW	5.47	5.44	5.45	5.46	5.51
E9	Dinmore Hill Woods SSSI	5.45	5.43	5.44	5.45	5.47
E10	The Bury Farm SSSI	5.46	5.44	5.45	5.46	5.46
E11	Fords Coppice AW	4.76	4.75	4.76	4.75	4.75

Receptor		Predicted Annual Mean NO_x PEC ($\mu g/m^3$)				
		2018	2019	2020	2021	2022
E12	Stone Coppice AW	4.75	4.75	4.76	4.75	4.74
E13	Lewis's Plantation AW	5.93	6.00	5.95	5.97	5.94
E14	Hill Hole Dingle AW	5.29	5.29	5.27	5.31	5.30
E15	Dinmore Hill AW	5.44	5.43	5.43	5.44	5.47
E16	Old Nash Coppice AW	5.44	5.43	5.43	5.44	5.44
E17	Upper Miles's Rough AW	5.02	4.99	5.00	5.01	4.99
E18	Lower Miles's Rough AW	5.07	5.00	5.04	5.05	5.02
E19	Spendle's Green AW	4.87	4.88	4.85	4.87	4.87
E20	Draycott Wood AW	4.47	4.47	4.46	4.47	4.47
E21	Marlbrook Wood AW	4.45	4.45	4.44	4.44	4.45
E22	Marlbrook Wood AW	4.45	4.45	4.44	4.44	4.45
E23	Marlbrook Wood AW	4.65	4.66	4.64	4.64	4.66

5.5.2 As indicated in Table 53, annual mean NO_x PECs were below the EQS of $30\mu g/m^3$ at all ecological receptor locations.

5.5.3 Maximum predicted annual mean NO_x concentrations at the ecological receptor locations are summarised in Table 54.

Table 54 Maximum Predicted Annual Mean NO_x Concentrations

Receptor		Maximum Predicted Annual Mean NO_x Concentration ($\mu g/m^3$)		Proportion of EQS (%)	
		PC	PEC	PC	PEC
E1	River Lugg SSSI	0.10	5.63	0.3	18.8
E2	River Lugg SSSI	0.26	5.79	0.9	19.3
E3	River Lugg SSSI	0.63	6.16	2.1	20.5
E4	River Lugg SSSI	0.27	7.73	0.9	25.8

Receptor		Maximum Predicted Annual Mean NO_x Concentration (µg/m³)		Proportion of EQS (%)	
		PC	PEC	PC	PEC
E5	River Lugg SSSI	0.08	7.54	0.3	25.1
E6	River Lugg SSSI / River Wye SAC	0.11	5.40	0.4	18.0
E7	Hill Hole Dingle SSSI	0.17	5.45	0.6	18.2
E8	Dinmore Hill Woods SSSI / AW	0.10	5.51	0.3	18.4
E9	Dinmore Hill Woods SSSI	0.06	5.47	0.2	18.2
E10	The Bury Farm SSSI	0.05	5.46	0.2	18.2
E11	Fords Coppice AW	0.05	4.76	0.2	15.9
E12	Stone Coppice AW	0.05	4.76	0.2	15.9
E13	Lewis's Plantation AW	0.47	6.00	1.6	20.0
E14	Hill Hole Dingle AW	0.20	5.31	0.7	17.7
E15	Dinmore Hill AW	0.06	5.47	0.2	18.2
E16	Old Nash Coppice AW	0.03	5.44	0.1	18.1
E17	Upper Miles's Rough AW	0.09	5.02	0.3	16.7
E18	Lower Miles's Rough AW	0.14	5.07	0.5	16.9
E19	Spendle's Green AW	0.07	4.88	0.2	16.3
E20	Draycott Wood AW	0.04	4.47	0.1	14.9
E21	Marlbrook Wood AW	0.02	4.45	0.1	14.8
E22	Marlbrook Wood AW	0.02	4.45	0.1	14.8
E23	Marlbrook Wood AW	0.05	4.66	0.2	15.5

5.5.4 As shown in Table 54, PCs were below 100% of the EQS at all local designations. PCs were also below 1% of the EQS at all SACs and SSSIs with the exception of E3. However, PECs were below 70% of the EQS at the receptor. As such, predicted effects on annual mean NO_x concentrations are considered to be not significant, in accordance with the EA criteria.

5.5.5 Predicted 24-hour mean NO_x PECs at the ecological receptor locations, inclusive of background levels, are summarised in Table 55.

Table 55 Predicted 24-hour Mean NO_x Concentrations

Receptor		Predicted 24-hour Mean NO_x PEC (μg/m³)				
		2018	2019	2020	2021	2022
E1	River Lugg SSSI	12.26	11.92	12.83	12.21	12.22
E2	River Lugg SSSI	13.80	12.64	13.59	15.08	13.04
E3	River Lugg SSSI	14.91	14.70	14.54	14.56	14.38
E4	River Lugg SSSI	17.10	17.29	16.47	17.20	16.92
E5	River Lugg SSSI	15.64	16.03	15.77	15.76	15.67
E6	River Lugg SSSI / River Wye SAC	11.10	11.46	11.15	11.24	11.39
E7	Hill Hole Dingle SSSI	11.48	11.70	11.84	11.55	11.64
E8	Dinmore Hill Woods SSSI / AW	11.81	11.52	11.84	11.47	11.72
E9	Dinmore Hill Woods SSSI	11.53	11.30	11.49	11.25	11.31
E10	The Bury Farm SSSI	11.44	11.21	11.40	11.50	11.36
E11	Fords Coppice AW	9.91	9.79	9.99	9.90	9.82
E12	Stone Coppice AW	9.87	9.71	9.81	9.82	9.73
E13	Lewis's Plantation AW	13.92	13.60	13.40	13.95	13.82
E14	Hill Hole Dingle AW	11.78	11.43	11.44	11.32	11.44
E15	Dinmore Hill AW	11.49	11.36	11.40	11.23	11.39
E16	Old Nash Coppice AW	11.17	11.02	11.15	11.19	11.31
E17	Upper Miles's Rough AW	10.71	10.72	10.61	10.75	10.53
E18	Lower Miles's Rough AW	11.34	11.20	11.06	11.53	11.55
E19	Spendle's Green AW	10.68	10.29	10.16	10.50	10.64
E20	Draycott Wood AW	9.39	9.29	9.31	9.29	9.28
E21	Marlbrook Wood AW	9.30	9.15	9.10	9.16	9.12
E22	Marlbrook Wood AW	9.44	9.14	9.09	9.13	9.16
E23	Marlbrook Wood AW	12.26	11.92	12.83	12.21	12.22

5.5.6 As indicated in Table 55, 24-hour mean NO_x PECs were below the EQS of 75µg/m³ at all ecological receptor locations.

5.5.7 Maximum predicted 24-hour mean NO_x concentrations at the ecological receptor locations are summarised in Table 56.

Table 56 Maximum Predicted 24-hour Mean NO_x Concentrations

Receptor		Maximum Predicted 24-hour Mean NO_x Concentration (µg/m³)		Proportion of EQS (%)	
		PC	PEC	PC	PEC
E1	River Lugg SSSI	1.77	12.83	2.4	17.1
E2	River Lugg SSSI	4.02	15.08	5.4	20.1
E3	River Lugg SSSI	3.85	14.91	5.1	19.9
E4	River Lugg SSSI	2.37	17.29	3.2	23.0
E5	River Lugg SSSI	1.11	16.03	1.5	21.4
E6	River Lugg SSSI / River Wye SAC	0.88	11.46	1.2	15.3
E7	Hill Hole Dingle SSSI	1.28	11.84	1.7	15.8
E8	Dinmore Hill Woods SSSI / AW	1.02	11.84	1.4	15.8
E9	Dinmore Hill Woods SSSI	0.71	11.53	1.0	15.4
E10	The Bury Farm SSSI	0.68	11.50	0.9	15.3
E11	Fords Coppice AW	0.57	9.99	0.8	13.3
E12	Stone Coppice AW	0.45	9.87	0.6	13.2
E13	Lewis's Plantation AW	2.89	13.95	3.9	18.6
E14	Hill Hole Dingle AW	1.56	11.78	2.1	15.7
E15	Dinmore Hill AW	0.67	11.49	0.9	15.3
E16	Old Nash Coppice AW	0.49	11.31	0.7	15.1
E17	Upper Miles's Rough AW	0.89	10.75	1.2	14.3
E18	Lower Miles's Rough AW	1.69	11.55	2.3	15.4
E19	Spendle's Green AW	1.06	10.68	1.4	14.2

Receptor		Maximum Predicted 24-hour Mean NO_x Concentration (µg/m³)		Proportion of EQS (%)	
		PC	PEC	PC	PEC
E20	Draycott Wood AW	0.53	9.39	0.7	12.5
E21	Marlbrook Wood AW	0.44	9.30	0.6	12.4
E22	Marlbrook Wood AW	0.58	9.44	0.8	12.6
E23	Marlbrook Wood AW	0.68	9.90	0.9	13.2

5.5.8 As shown in Table 56, PCs were below 100% of the EQS at all local designations and below 10% of the EQS at the SAC and SSSI receptors. As such, predicted effects on 24-hour mean NO_x concentrations are considered to be not significant, in accordance with the EA criteria.

Hydrogen Fluoride

5.5.9 Predicted weekly mean HF PCs at the ecological receptor locations are summarised in Table 57.

Table 57 Predicted Weekly Mean HF Concentrations

Receptor		Predicted Weekly Mean HF PC (µg/m³)				
		2018	2019	2020	2021	2022
E1	River Lugg SSSI	0.003	0.003	0.004	0.002	0.003
E2	River Lugg SSSI	0.005	0.003	0.006	0.008	0.003
E3	River Lugg SSSI	0.014	0.013	0.011	0.009	0.011
E4	River Lugg SSSI	0.006	0.006	0.004	0.005	0.006
E5	River Lugg SSSI	0.001	0.002	0.002	0.002	0.002
E6	River Lugg SSSI / River Wye SAC	0.001	0.002	0.001	0.002	0.002
E7	Hill Hole Dingle SSSI	0.003	0.004	0.003	0.002	0.003
E8	Dinmore Hill Woods SSSI / AW	0.001	0.001	0.002	0.002	0.002
E9	Dinmore Hill Woods SSSI	0.001	0.001	0.001	0.001	0.001

Receptor		Predicted Weekly Mean HF PC (µg/m³)				
		2018	2019	2020	2021	2022
E10	The Bury Farm SSSI	0.001	0.001	0.001	0.002	0.002
E11	Fords Coppice AW	0.001	0.001	0.001	0.001	0.001
E12	Stone Coppice AW	0.001	0.001	0.001	0.001	0.001
E13	Lewis's Plantation AW	0.007	0.008	0.007	0.008	0.008
E14	Hill Hole Dingle AW	0.005	0.004	0.003	0.003	0.003
E15	Dinmore Hill AW	0.001	0.001	0.001	0.001	0.001
E16	Old Nash Coppice AW	0.001	0.000	0.001	0.001	0.001
E17	Upper Miles's Rough AW	0.003	0.002	0.003	0.003	0.002
E18	Lower Miles's Rough AW	0.006	0.002	0.004	0.006	0.005
E19	Spendle's Green AW	0.002	0.002	0.001	0.002	0.001
E20	Draycott Wood AW	0.001	0.001	0.001	0.001	0.001
E21	Marlbrook Wood AW	0.001	0.001	0.001	0.000	0.001
E22	Marlbrook Wood AW	0.002	0.001	0.001	0.000	0.001
E23	Marlbrook Wood AW	0.002	0.001	0.001	0.001	0.002

5.5.10 Maximum predicted weekly mean HF concentrations at the ecological receptor locations are summarised Table 58.

Table 58 Maximum Predicted Weekly Mean HF Concentrations

Receptor		Maximum Predicted Weekly Mean HF PC (µg/m³)	PC Proportion of EQS (%)
E1	River Lugg SSSI	0.004	0.7
E2	River Lugg SSSI	0.008	1.5
E3	River Lugg SSSI	0.014	2.8
E4	River Lugg SSSI	0.006	1.3
E5	River Lugg SSSI	0.002	0.4

Receptor		Maximum Predicted Weekly Mean HF PC (μg/m³)	PC Proportion of EQS (%)
E6	River Lugg SSSI / River Wye SAC	0.002	0.4
E7	Hill Hole Dingle SSSI	0.004	0.8
E8	Dinmore Hill Woods SSSI / AW	0.002	0.4
E9	Dinmore Hill Woods SSSI	0.001	0.2
E10	The Bury Farm SSSI	0.002	0.3
E11	Fords Coppice AW	0.001	0.3
E12	Stone Coppice AW	0.001	0.2
E13	Lewis's Plantation AW	0.008	1.7
E14	Hill Hole Dingle AW	0.005	0.9
E15	Dinmore Hill AW	0.001	0.2
E16	Old Nash Coppice AW	0.001	0.3
E17	Upper Miles's Rough AW	0.003	0.6
E18	Lower Miles's Rough AW	0.006	1.2
E19	Spendle's Green AW	0.002	0.4
E20	Draycott Wood AW	0.001	0.3
E21	Marlbrook Wood AW	0.001	0.3
E22	Marlbrook Wood AW	0.002	0.3
E23	Marlbrook Wood AW	0.002	0.4

5.5.11 As shown in Table 58, PCs were below 100% of the EQS at all local designations and below 10% of the EQS at the SAC and SSSI receptors. As such, predicted effects on weekly mean HF concentrations are considered to be not significant, in accordance with the EA criteria.

5.5.12 Predicted daily mean HF PCs at the ecological receptor locations are summarised in Table 59.

Table 59 Predicted Daily Mean HF Concentrations

Receptor		Predicted Daily Mean HF PC (μg/m³)				
		2018	2019	2020	2021	2022
E1	River Lugg SSSI	0.008	0.005	0.011	0.007	0.007
E2	River Lugg SSSI	0.017	0.010	0.016	0.026	0.013
E3	River Lugg SSSI	0.025	0.023	0.022	0.022	0.021
E4	River Lugg SSSI	0.014	0.015	0.010	0.015	0.013
E5	River Lugg SSSI	0.005	0.007	0.005	0.005	0.005
E6	River Lugg SSSI / River Wye SAC	0.003	0.006	0.004	0.004	0.005
E7	Hill Hole Dingle SSSI	0.006	0.007	0.008	0.006	0.007
E8	Dinmore Hill Woods SSSI / AW	0.006	0.004	0.007	0.004	0.006
E9	Dinmore Hill Woods SSSI	0.005	0.003	0.004	0.003	0.003
E10	The Bury Farm SSSI	0.004	0.002	0.004	0.004	0.003
E11	Fords Coppice AW	0.003	0.002	0.004	0.003	0.003
E12	Stone Coppice AW	0.003	0.002	0.002	0.003	0.002
E13	Lewis's Plantation AW	0.018	0.016	0.015	0.018	0.018
E14	Hill Hole Dingle AW	0.010	0.008	0.008	0.007	0.008
E15	Dinmore Hill AW	0.004	0.003	0.004	0.003	0.004
E16	Old Nash Coppice AW	0.002	0.001	0.002	0.002	0.003
E17	Upper Miles's Rough AW	0.005	0.005	0.005	0.006	0.004
E18	Lower Miles's Rough AW	0.009	0.009	0.008	0.011	0.011
E19	Spendle's Green AW	0.007	0.004	0.003	0.006	0.007
E20	Draycott Wood AW	0.003	0.003	0.003	0.003	0.003
E21	Marlbrook Wood AW	0.003	0.002	0.002	0.002	0.002
E22	Marlbrook Wood AW	0.004	0.002	0.001	0.002	0.002
E23	Marlbrook Wood AW	0.004	0.003	0.003	0.003	0.004

5.5.13 Maximum predicted daily mean HF concentrations at the ecological receptor locations are summarised in Table 60.

Table 60 Maximum Predicted Daily Mean HF Concentrations

Receptor		Maximum Predicted Daily Mean HF PC (μg/m³)	PC Proportion of EQS (%)
E1	River Lugg SSSI	0.011	0.2
E2	River Lugg SSSI	0.026	0.5
E3	River Lugg SSSI	0.025	0.5
E4	River Lugg SSSI	0.015	0.3
E5	River Lugg SSSI	0.007	0.1
E6	River Lugg SSSI / River Wye SAC	0.006	0.1
E7	Hill Hole Dingle SSSI	0.008	0.2
E8	Dinmore Hill Woods SSSI / AW	0.007	0.1
E9	Dinmore Hill Woods SSSI	0.005	0.1
E10	The Bury Farm SSSI	0.004	0.1
E11	Fords Coppice AW	0.004	0.1
E12	Stone Coppice AW	0.003	0.1
E13	Lewis's Plantation AW	0.018	0.4
E14	Hill Hole Dingle AW	0.010	0.2
E15	Dinmore Hill AW	0.004	0.1
E16	Old Nash Coppice AW	0.003	0.1
E17	Upper Miles's Rough AW	0.006	0.1
E18	Lower Miles's Rough AW	0.011	0.2
E19	Spendle's Green AW	0.007	0.1
E20	Draycott Wood AW	0.003	0.1
E21	Marlbrook Wood AW	0.003	0.1
E22	Marlbrook Wood AW	0.004	0.1
E23	Marlbrook Wood AW	0.004	0.1

5.5.14 As shown in PCs were below 100% of the EQS at all local designations and below 10% of the EQS at the SAC and SSSI receptors. As such, predicted effects on daily mean HF concentrations are considered to be not significant, in accordance with the EA criteria.

Nitrogen Deposition

5.5.15 Predicted annual nitrogen PC deposition rates at the ecological receptor locations are summarised in Table 61.

Table 61 Predicted Annual Nitrogen Deposition Rates

Receptor		Predicted Annual PC Nitrogen Deposition Rate (kgN/ha/yr)				
		2018	2019	2020	2021	2022
E1	River Lugg SSSI	0.009	0.008	0.010	0.009	0.008
E2	River Lugg SSSI	0.021	0.020	0.026	0.018	0.014
E3	River Lugg SSSI	0.055	0.063	0.064	0.055	0.055
E4	River Lugg SSSI	0.020	0.023	0.019	0.027	0.023
E5	River Lugg SSSI	0.005	0.005	0.004	0.005	0.008
E6	River Lugg SSSI / River Wye SAC	0.004	0.004	0.004	0.005	0.012
E7	Hill Hole Dingle SSSI	0.031	0.034	0.030	0.034	0.032
E8	Dinmore Hill Woods SSSI / AW	0.011	0.007	0.009	0.011	0.020
E9	Dinmore Hill Woods SSSI	0.008	0.005	0.006	0.008	0.012
E10	The Bury Farm SSSI	0.005	0.003	0.004	0.005	0.005
E11	Fords Coppice AW	0.009	0.008	0.011	0.009	0.008
E12	Stone Coppice AW	0.008	0.007	0.009	0.008	0.007
E13	Lewis's Plantation AW	0.081	0.094	0.084	0.088	0.082
E14	Hill Hole Dingle AW	0.036	0.037	0.032	0.040	0.037
E15	Dinmore Hill AW	0.007	0.004	0.005	0.007	0.011
E16	Old Nash Coppice AW	0.007	0.003	0.005	0.006	0.005
E17	Upper Miles's Rough AW	0.017	0.012	0.014	0.015	0.012

Receptor		Predicted Annual PC Nitrogen Deposition Rate (kgN/ha/yr)				
		2018	2019	2020	2021	2022
E18	Lower Miles's Rough AW	0.028	0.015	0.022	0.024	0.019
E19	Spendle's Green AW	0.012	0.013	0.008	0.012	0.012
E20	Draycott Wood AW	0.008	0.008	0.006	0.008	0.008
E21	Marlbrook Wood AW	0.004	0.004	0.002	0.003	0.003
E22	Marlbrook Wood AW	0.004	0.004	0.002	0.003	0.004
E23	Marlbrook Wood AW	0.008	0.010	0.007	0.006	0.009

5.5.16 Maximum predicted annual nitrogen deposition rates at the receptor locations are summarised in Table 62.

Table 62 Maximum Predicted Annual Nitrogen Deposition Rates

Receptor		Predicted Annual PC Nitrogen Deposition Rate (kgN/ha/yr)	PC Proportion of EQS (%)	
			Low EQS	High EQS
E1	River Lugg SSSI	0.010	-	-
E2	River Lugg SSSI	0.026	-	-
E3	River Lugg SSSI	0.064	-	-
E4	River Lugg SSSI	0.027	-	-
E5	River Lugg SSSI	0.008	-	-
E6	River Lugg SSSI / River Wye SAC	0.012	0.23	0.12
E7	Hill Hole Dingle SSSI	0.034	0.34	0.23
E8	Dinmore Hill Woods SSSI / AW	0.020	0.13	0.10
E9	Dinmore Hill Woods SSSI	0.012	0.08	0.06
E10	The Bury Farm SSSI	0.005	0.05	0.03
E11	Fords Coppice AW	0.011	0.11	0.07
E12	Stone Coppice AW	0.009	0.09	0.06
E13	Lewis's Plantation AW	0.094	0.94	0.63

Receptor		Predicted Annual PC Nitrogen Deposition Rate (kgN/ha/yr)	PC Proportion of EQS (%)	
			Low EQS	High EQS
E14	Hill Hole Dingle AW	0.040	1.34	0.27
E15	Dinmore Hill AW	0.011	0.11	0.07
E16	Old Nash Coppice AW	0.007	0.07	0.04
E17	Upper Miles's Rough AW	0.017	0.17	0.11
E18	Lower Miles's Rough AW	0.028	0.28	0.18
E19	Spendle's Green AW	0.013	0.13	0.09
E20	Draycott Wood AW	0.008	0.08	0.06
E21	Marlbrook Wood AW	0.004	0.14	0.03
E22	Marlbrook Wood AW	0.004	0.15	0.03
E23	Marlbrook Wood AW	0.010	0.33	0.07

5.5.17 As shown in Table 62, PCs were below 100% of the EQS at all local designations and below 1% of the EQS at the SAC and SSSI receptors. As such, predicted effects on annual nitrogen deposition are considered to be not significant, in accordance with the EA criteria.

Acid Deposition

5.5.18 Predicted annual acid PC deposition rates are summarised in Table 63.

Table 63 Predicted Annual PC Acid Deposition Rates

Receptor		Predicted Annual PC Acid Deposition Rate (keq/ha/yr)				
		2018	2019	2020	2021	2022
E1	River Lugg SSSI	0.0011	0.0010	0.0012	0.0011	0.0009
E2	River Lugg SSSI	0.0025	0.0024	0.0032	0.0022	0.0017
E3	River Lugg SSSI	0.0067	0.0076	0.0077	0.0066	0.0067
E4	River Lugg SSSI	0.0024	0.0027	0.0023	0.0032	0.0028

Receptor		Predicted Annual PC Acid Deposition Rate (keq/ha/yr)				
		2018	2019	2020	2021	2022
E5	River Lugg SSSI	0.0006	0.0006	0.0005	0.0006	0.0010
E6	River Lugg SSSI / River Wye SAC	0.0005	0.0005	0.0005	0.0006	0.0014
E7	Hill Hole Dingle SSSI	0.0041	0.0044	0.0040	0.0044	0.0042
E8	Dinmore Hill Woods SSSI / AW	0.0015	0.0009	0.0011	0.0014	0.0026
E9	Dinmore Hill Woods SSSI	0.0010	0.0006	0.0007	0.0010	0.0016
E10	The Bury Farm SSSI	0.0006	0.0003	0.0004	0.0006	0.0006
E11	Fords Coppice AW	0.0012	0.0011	0.0014	0.0012	0.0010
E12	Stone Coppice AW	0.0011	0.0010	0.0012	0.0010	0.0009
E13	Lewis's Plantation AW	0.0105	0.0123	0.0110	0.0115	0.0107
E14	Hill Hole Dingle AW	0.0047	0.0048	0.0041	0.0052	0.0049
E15	Dinmore Hill AW	0.0009	0.0005	0.0006	0.0009	0.0015
E16	Old Nash Coppice AW	0.0009	0.0005	0.0006	0.0007	0.0007
E17	Upper Miles's Rough AW	0.0022	0.0016	0.0018	0.0020	0.0015
E18	Lower Miles's Rough AW	0.0036	0.0020	0.0028	0.0031	0.0024
E19	Spendle's Green AW	0.0015	0.0018	0.0011	0.0015	0.0016
E20	Draycott Wood AW	0.0010	0.0011	0.0007	0.0010	0.0011
E21	Marlbrook Wood AW	0.0006	0.0005	0.0003	0.0004	0.0004
E22	Marlbrook Wood AW	0.0006	0.0005	0.0003	0.0004	0.0005
E23	Marlbrook Wood AW	0.0010	0.0013	0.0009	0.0008	0.0012

5.5.19 Maximum predicted annual acid deposition rates at the receptor locations are summarised in Table 64.

Table 64 Predicted Annual Acid Deposition Rates

Receptor		Maximum Predicted Annual Acid PC Deposition Rate (keq/ha/yr)	PC Proportion of EQS (%)
E1	River Lugg SSSI	0.000	-
E2	River Lugg SSSI	0.001	-
E3	River Lugg SSSI	0.003	-
E4	River Lugg SSSI	0.001	-
E5	River Lugg SSSI	0.000	-
E6	River Lugg SSSI / River Wye SAC	0.001	0.16
E7	Hill Hole Dingle SSSI	0.002	0.28
E8	Dinmore Hill Woods SSSI / AW	0.001	0.17
E9	Dinmore Hill Woods SSSI	0.001	0.10
E10	The Bury Farm SSSI	0.000	0.01
E11	Fords Coppice AW	0.001	0.09
E12	Stone Coppice AW	0.001	0.08
E13	Lewis's Plantation AW	0.006	0.78
E14	Hill Hole Dingle AW	0.002	0.33
E15	Dinmore Hill AW	0.001	0.09
E16	Old Nash Coppice AW	0.000	0.05
E17	Upper Miles's Rough AW	0.001	0.14
E18	Lower Miles's Rough AW	0.002	0.23
E19	Spendle's Green AW	0.001	0.11
E20	Draycott Wood AW	0.000	0.07
E21	Marlbrook Wood AW	0.000	0.03
E22	Marlbrook Wood AW	0.000	0.04
E23	Marlbrook Wood AW	0.001	0.08

5.5.20 As shown in Table 64, PCs were below 100% of the EQS at all local designations and below 1% of the EQS at the SAC and SSSI receptors. As such, predicted effects on annual acid deposition are considered to be not significant, in accordance with the EA criteria.

6.0 CONCLUSION

6.1.1 Redmore Environmental Ltd was commissioned by Onnu Ltd to undertake an Air Quality Assessment in support of an Environmental Permit Application for a pyrolysis plant referred to as the Green Hub on land off Hereford Road, Herefordshire.

6.1.2 Combustion emissions from the plant have the potential to cause air quality impacts at sensitive locations during normal operation. An Air Quality Assessment was therefore undertaken in order to determine baseline conditions and consider potential effects.

6.1.3 Dispersion modelling was undertaken in order to predict pollutant concentrations at sensitive locations as a result of emissions from the plant. Impacts at sensitive receptors were quantified and the results compared with the relevant EQSs and significance criteria.

6.1.4 The results of the assessment indicated that the operation of the facility is not predicted to result in exceedences of the relevant EQSs at any sensitive human receptor within the vicinity of the installation. Impacts were classified as not significant in accordance with the relevant methodology.

6.1.5 Impacts were also predicted at relevant ecological sites. The results indicated that emissions from the facility would not significantly affect existing conditions at any designation.

7.0 ABBREVIATIONS

APIS	Air Pollution Information System
AQLV	Air Quality Limit Value
AQMA	Air Quality Management Area
AQO	Air Quality Objective
AQS	Air Quality Strategy
AW	Ancient Woodland
CERC	Cambridge Environmental Research Consultants
CO	Carbon Monoxide
DEFRA	Department for Environment, Food and Rural Affairs
EA	Environment Agency
EQS	Environmental Quality Standard
EPAQS	Expert Panel on Air Quality Standards
HC	Herefordshire Council
HCl	Hydrogen chloride
HF	Hydrogen fluoride
Hg	Mercury
LAQM	Local Air Quality Management
MAGIC	Multi-Agency Geographic Information for the Countryside
NGR	National Grid Reference
NO	Nitric oxide
NO_2	Nitrogen dioxide
NO_x	Oxides of nitrogen
PC	Process Contribution
PEC	Predicted Environmental Concentration
PM	Particulate matter
PM_{10}	Particulate matter with an aerodynamic diameter of less than 10µm
$PM_{2.5}$	Particulate matter with an aerodynamic diameter of less than 10µm
SAC	Special Area of Conservation
SO_2	Sulphur dioxide
SWIP	Small Waste Incineration Plant
UKEAP	UK Eutrophying and Acidifying Pollutants
VOC	Volatile Organic Compound
z_0	Roughness length
%ile	Percentile

Figures

Legend

Site Boundary

Title

Figure 1 - Site Location Plan

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The Green Hub, Herefordshire

Project Reference

8125

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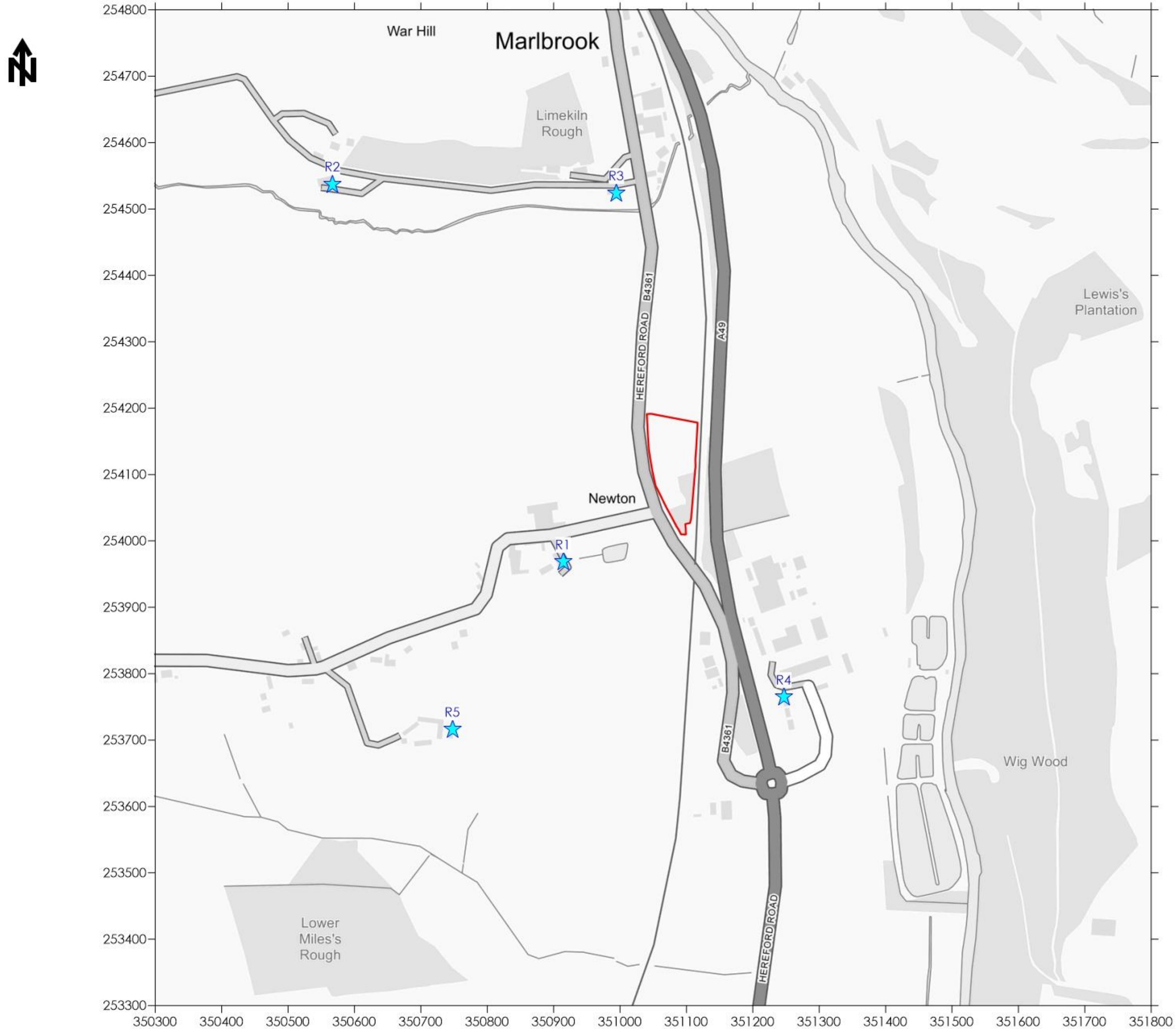

Legend

Site Boundary

Receptor

Title
Figure 2 - Human Receptor Locations

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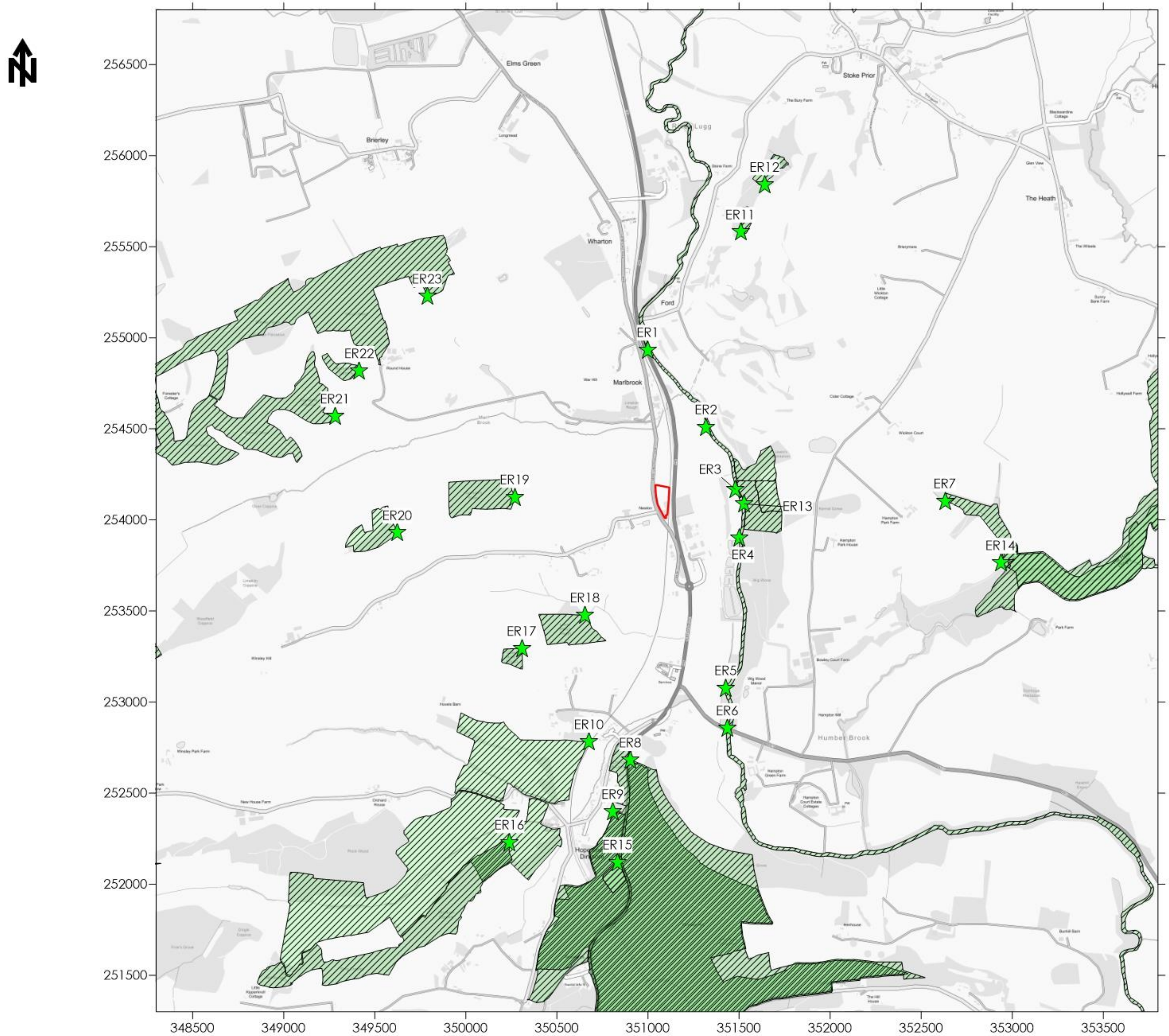

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Site Boundary

Receptor

Title

Figure 3 - Ecological Receptor Locations

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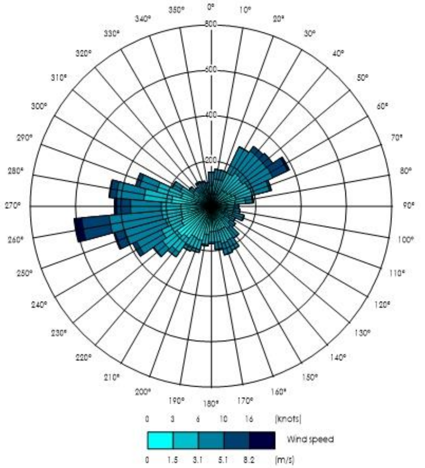
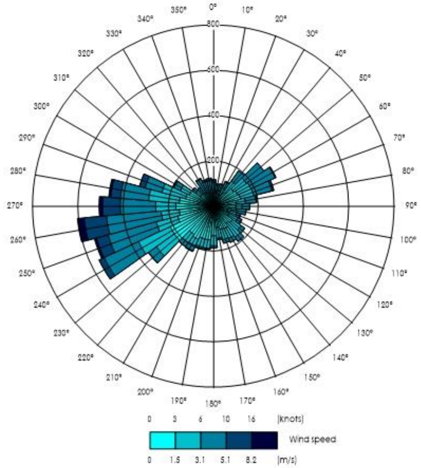
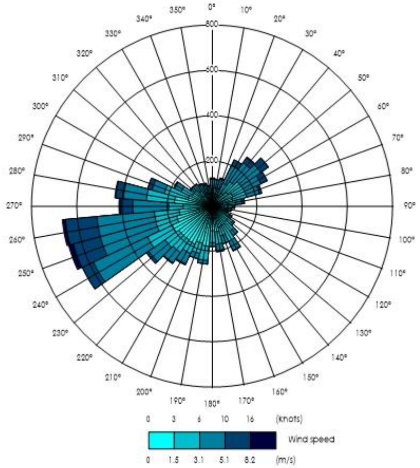


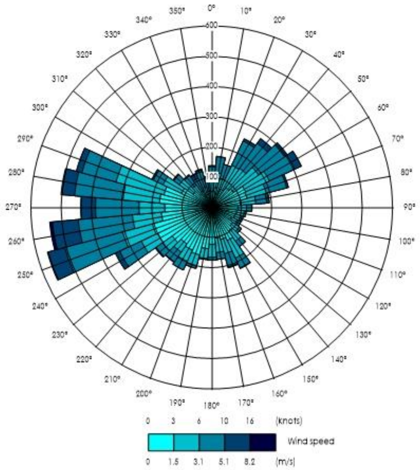
2018 Meteorological Data



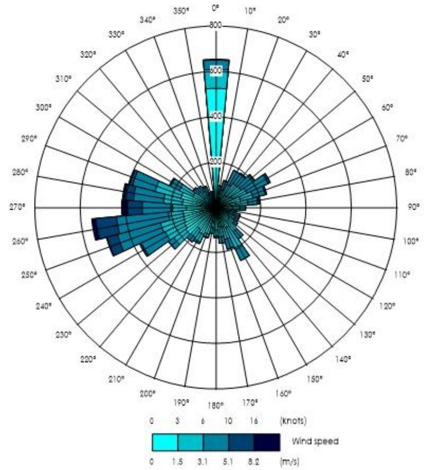
2019 Meteorological Data



2020 Meteorological Data



2021 Meteorological Data



2022 Meteorological Data

Legend

Title

Figure 5 - Wind Roses of 2018 to 2022 Hereford Credenhill Meteorological Data

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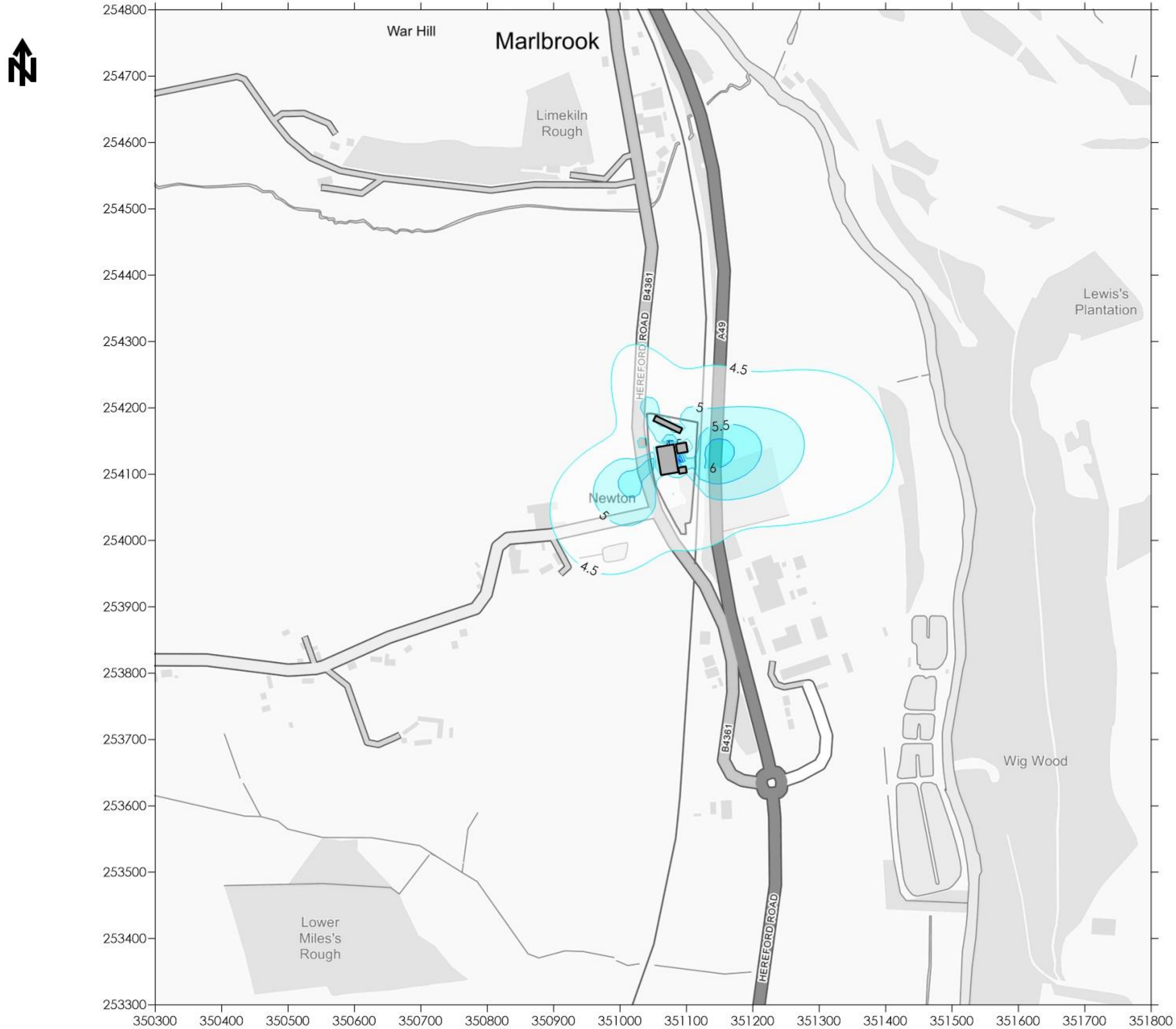

Legend

Site Boundary

Annual Mean NO_2 Concentration ($\mu g/m^3$)

7.5
7
6.5
6
5.5
5
4.5

Title

Figure 6 - Predicted Annual Mean NO_2 Concentration ($\mu g/m^3$) 2021 Meteorological Data

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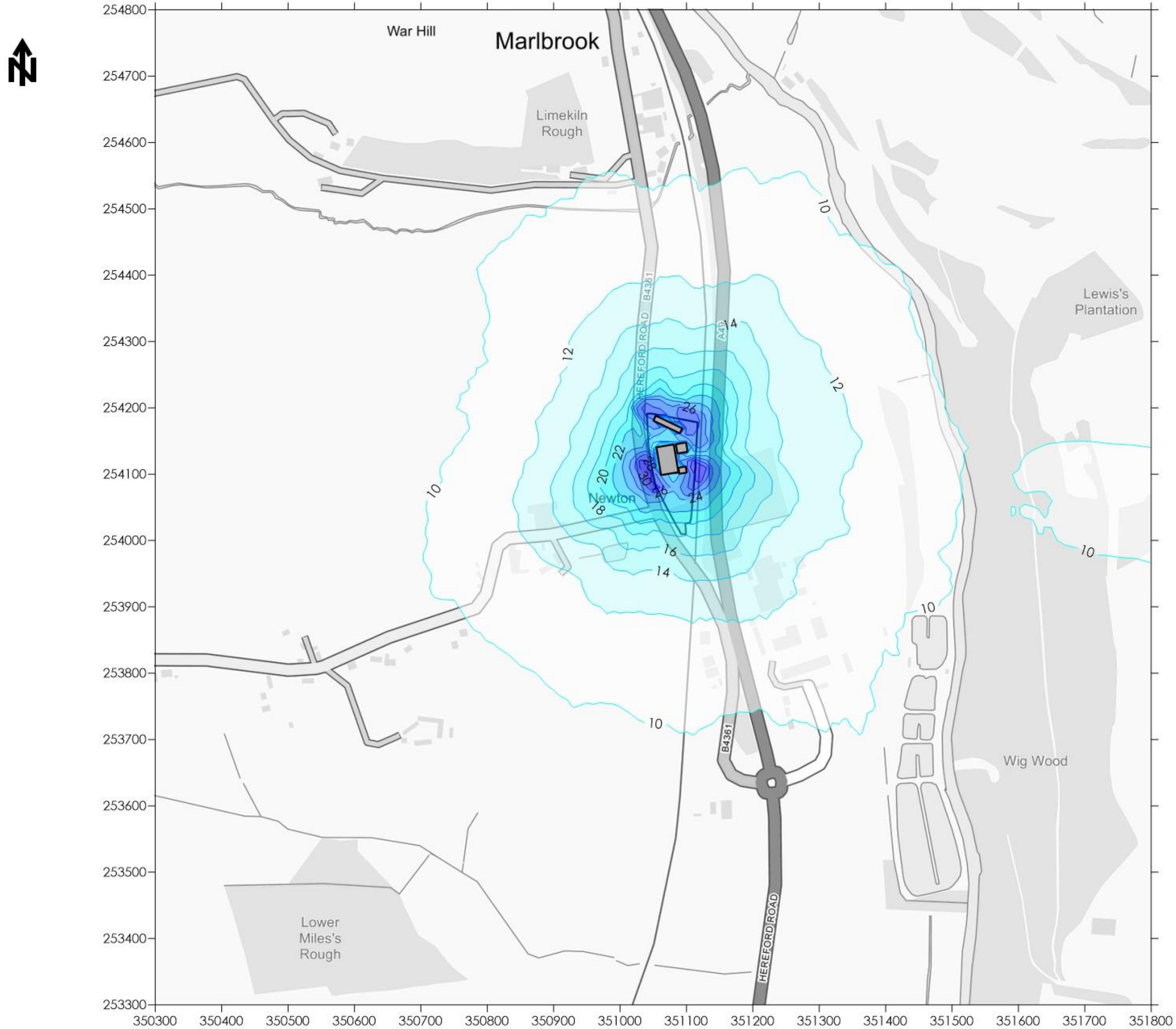

Legend

Site Boundary

30
28
26
24
22
20
18
16
14
12
10

99.8th %ile 1-hour Mean NO_2 Concentration ($\mu g/m^3$)

Title

Figure 7 - Predicted 99.8th %ile 1-hour Mean NO_2 Concentrations ($\mu g/m^3$)
2020 Meteorological Data

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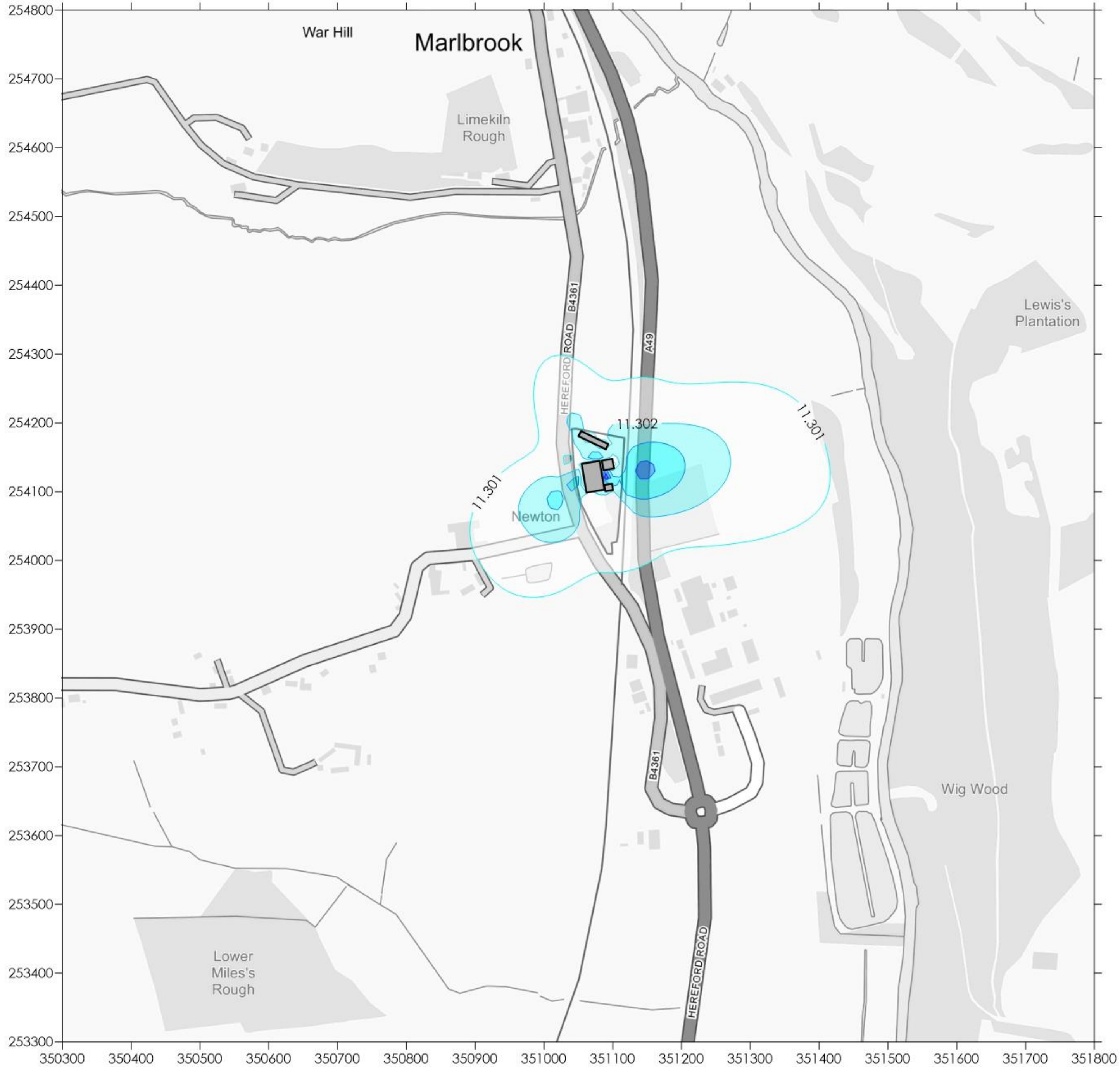

Legend

Site Boundary

Annual Mean PM_{10} Concentration (µg/m³)

11.305
11.304
11.303
11.302
11.301

Title

Figure 8 - Predicted Annual Mean PM_{10} Concentration (µg/m³) 2021 Meteorological Data

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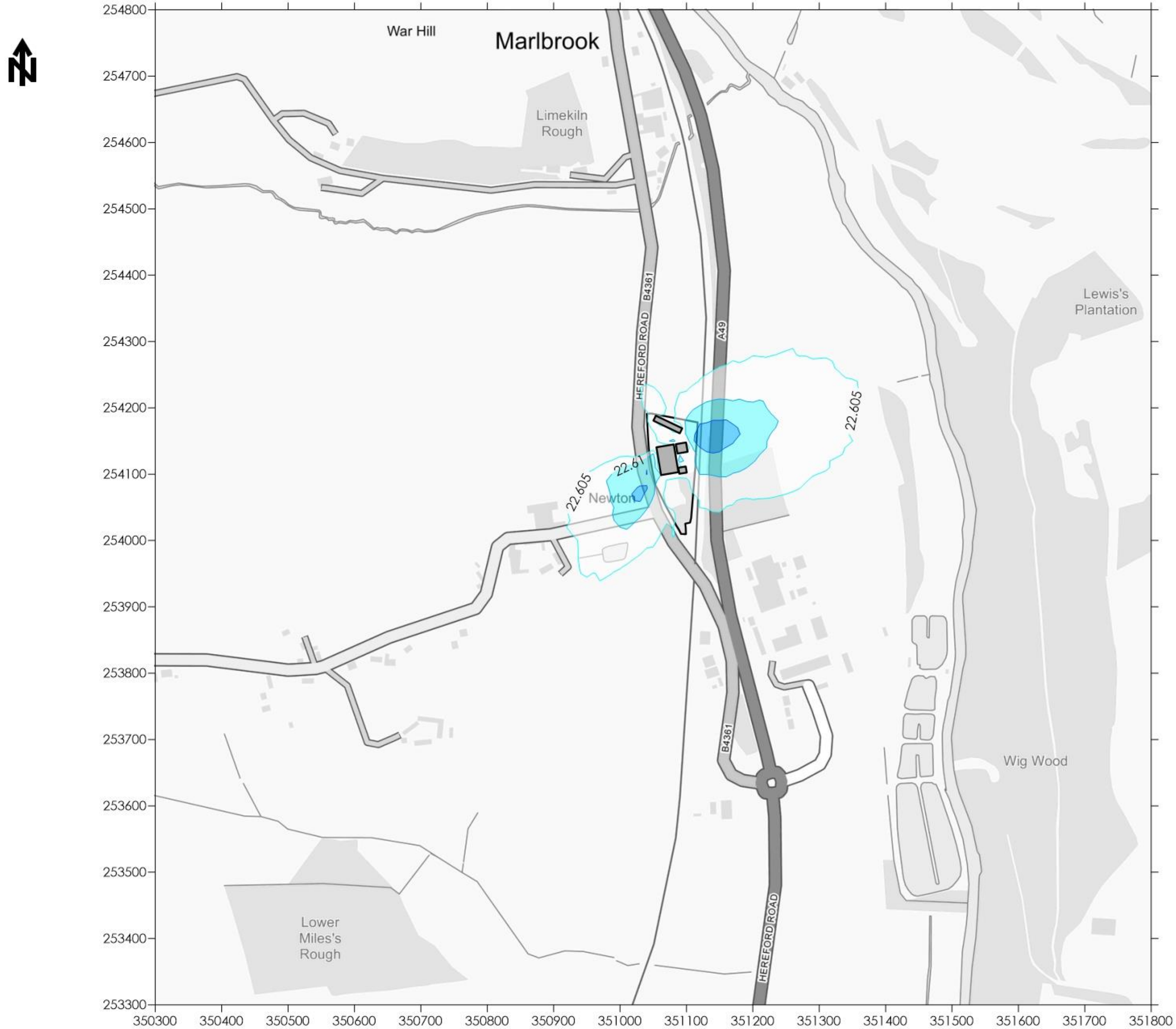

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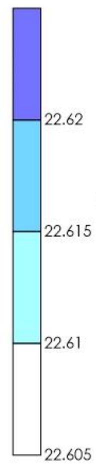
Site Boundary



90.4th %ile 24-hour Mean PM_{10} Concentration (µg/m³)

Title

Figure 9 - Predicted 90.4th %ile 24-hour Mean PM_{10} Concentrations (µg/m³)
2020 Meteorological Data

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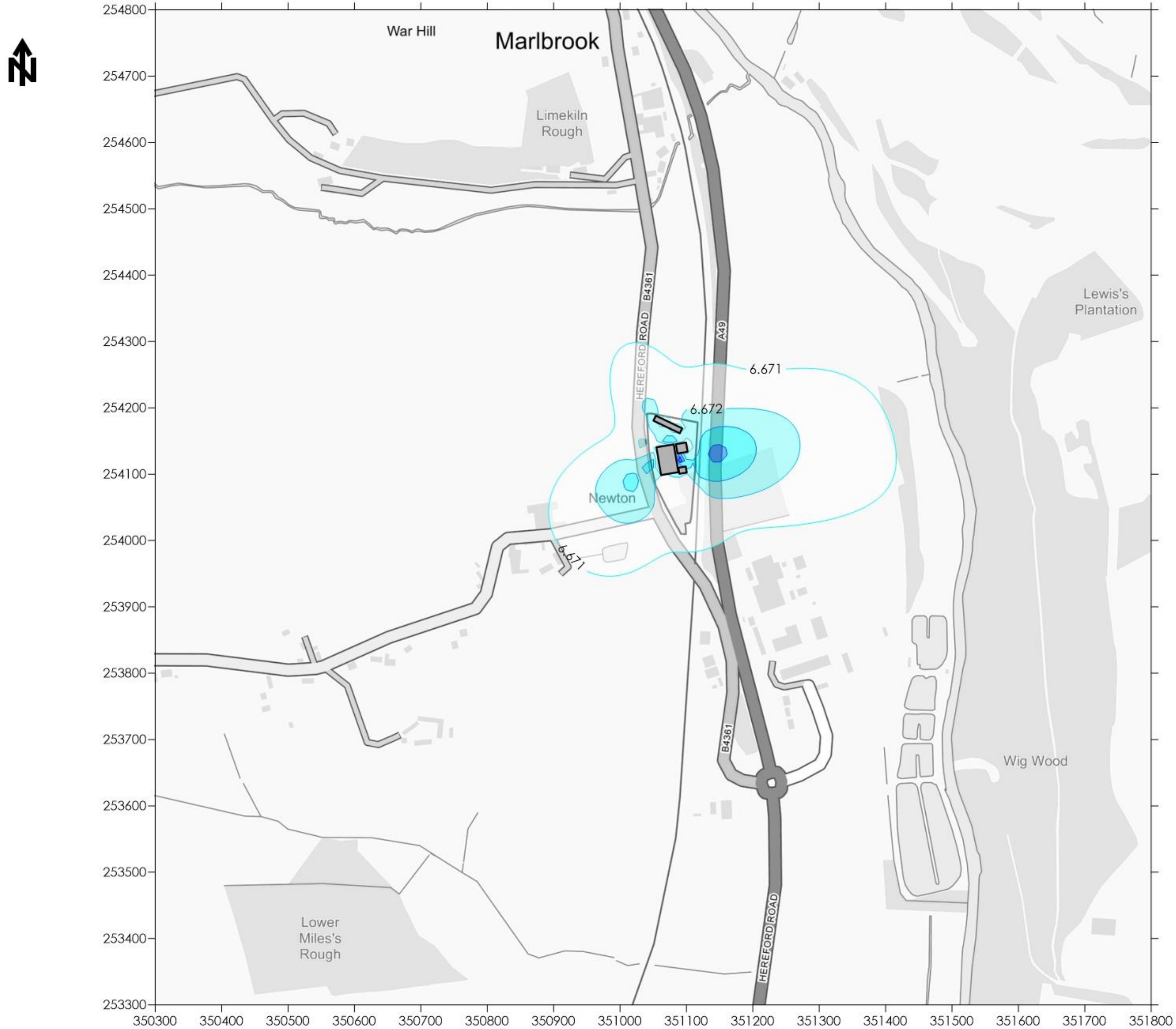

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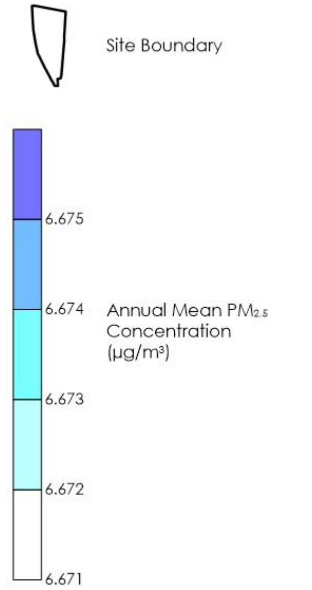

Title

Figure 10 - Predicted Annual Mean $PM_{2.5}$ Concentration (µg/m³) 2021 Meteorological Data

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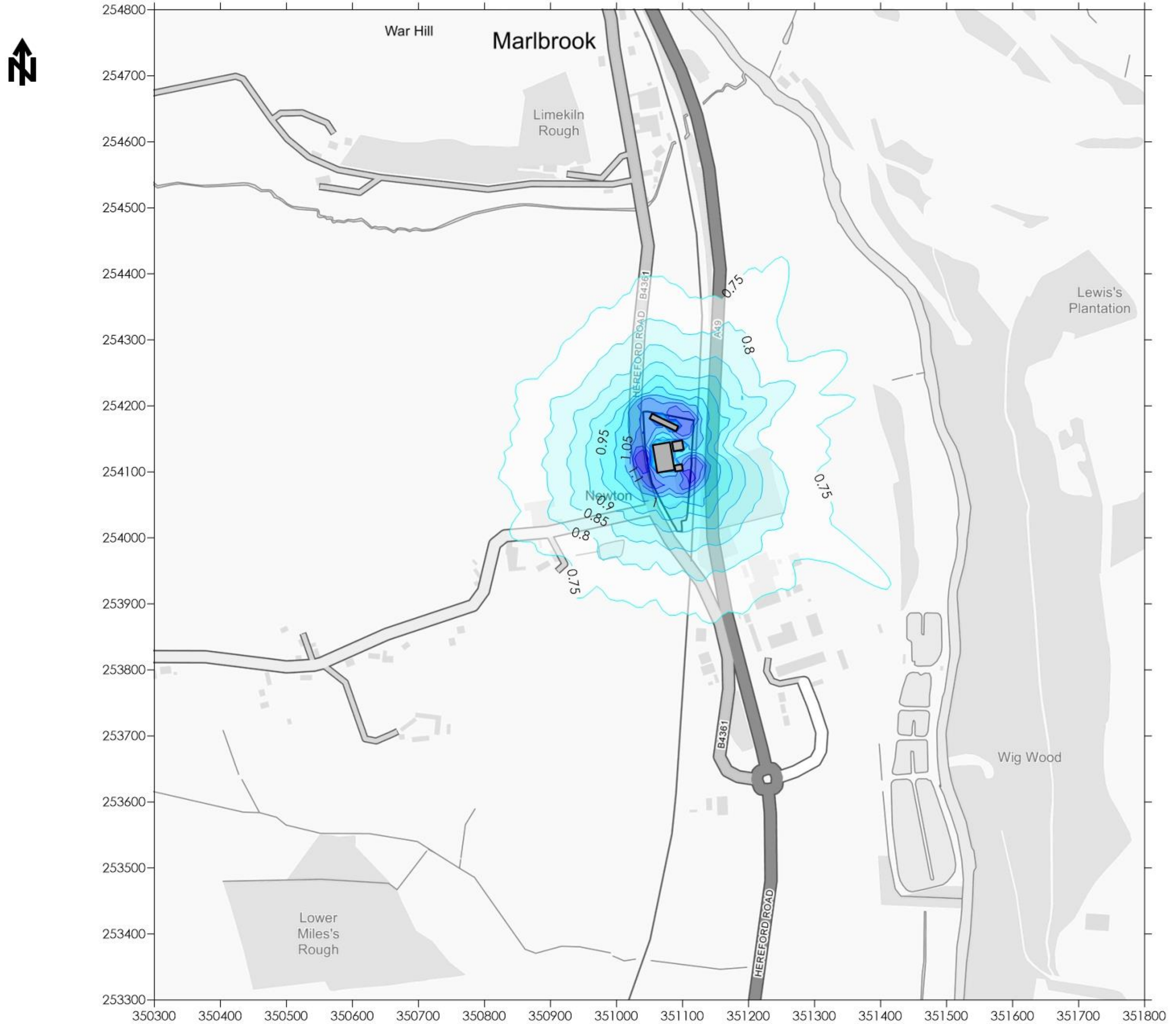

Legend

Site Boundary

1-hour Mean HCl Concentration (μg/m³)

1.2
1.15
1.1
1.05
1
0.95
0.9
0.85
0.8
0.75

Title

Figure 11 - 1-hour Mean HCl Concentrations (μg/m³) 2019 Meteorological Data

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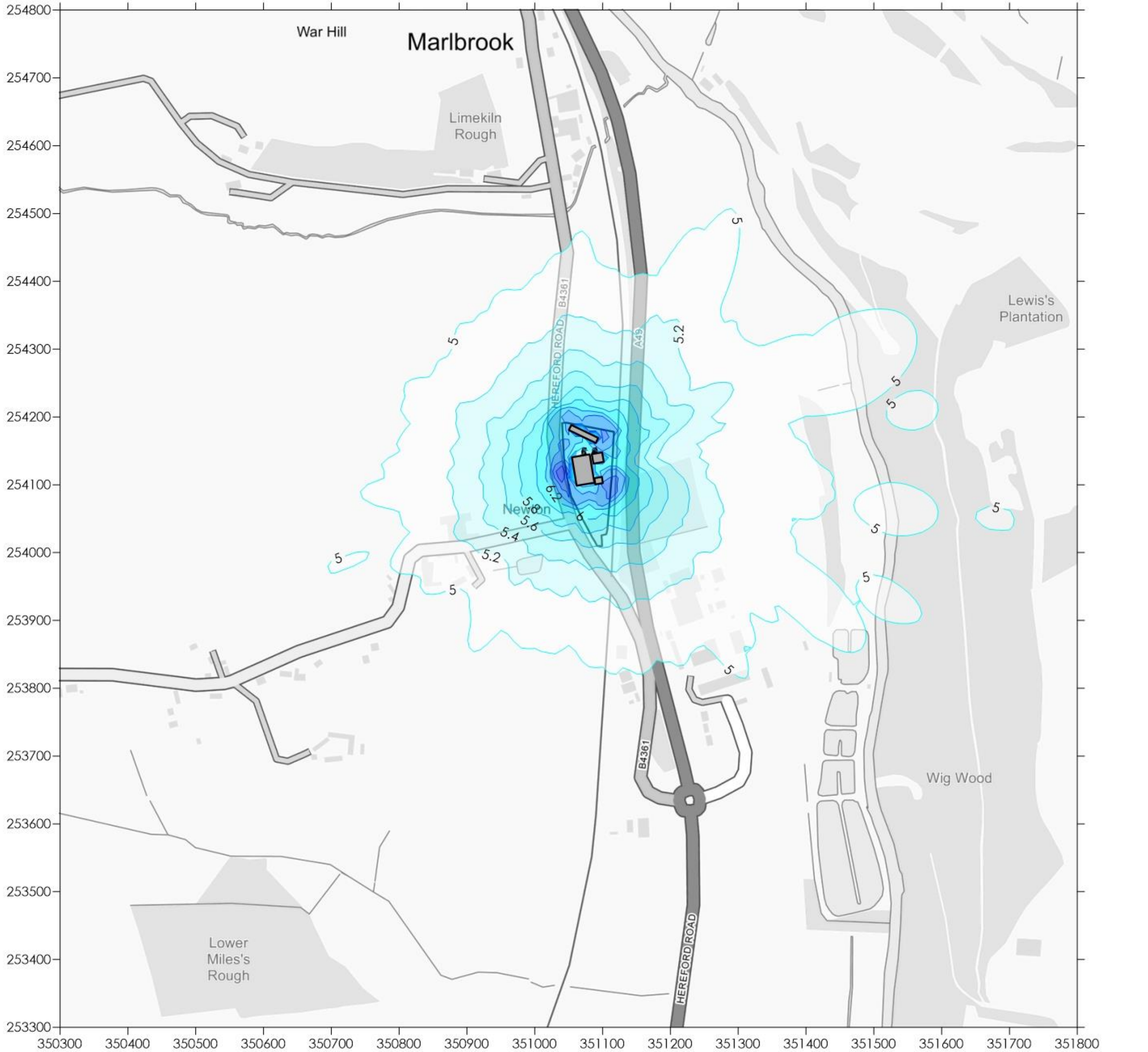

Title

Figure 12 - Predicted 1-hour Mean HF Concentrations (µg/m³)
2019 Meteorological Data

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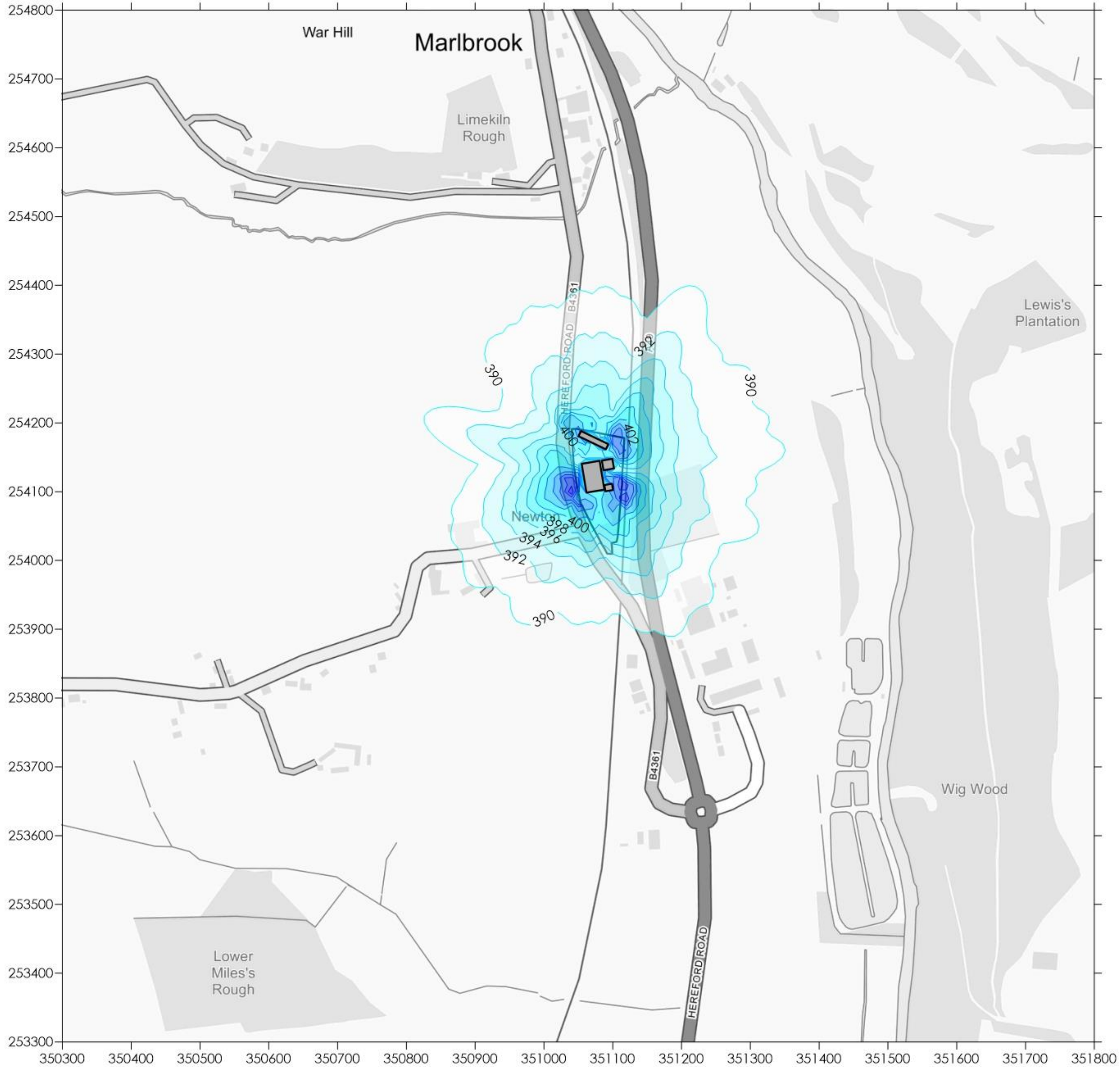

Legend

Site Boundary

8-hour Rolling Mean CO Concentration (µg/m³)

410, 408, 406, 404, 402, 400, 398, 396, 394, 392, 390

Title

Figure 13 - Predicted 8-hour Rolling Mean CO Concentrations (µg/m³)
2020 Meteorological Data

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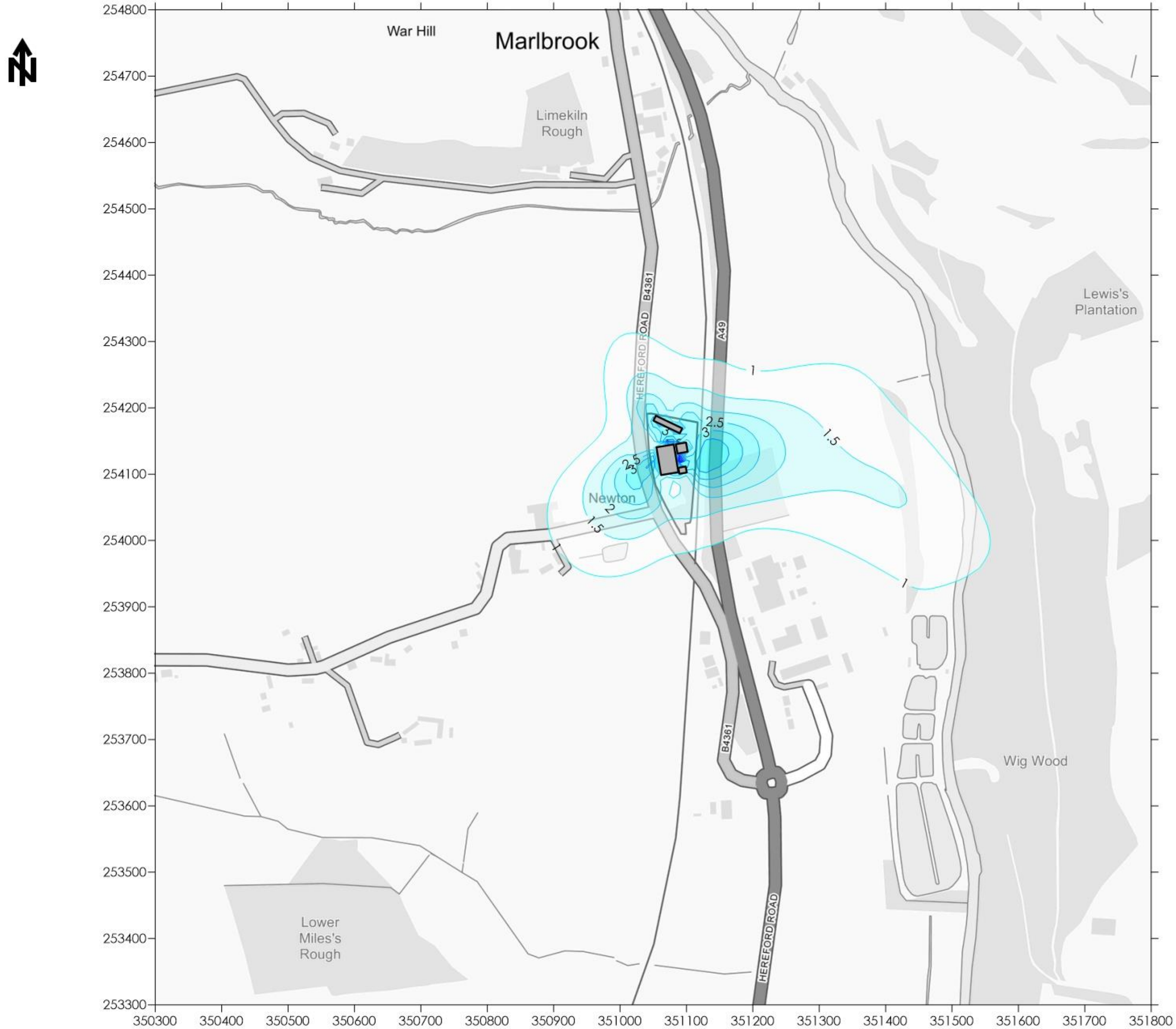

Legend

Site Boundary

Annual Mean Cd Concentration (ng/m³)

1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, 5, 5.5, 6

Title

Figure 14 - Predicted Annual Mean Cd Concentrations (ng/m³) 2021 Meteorological Data

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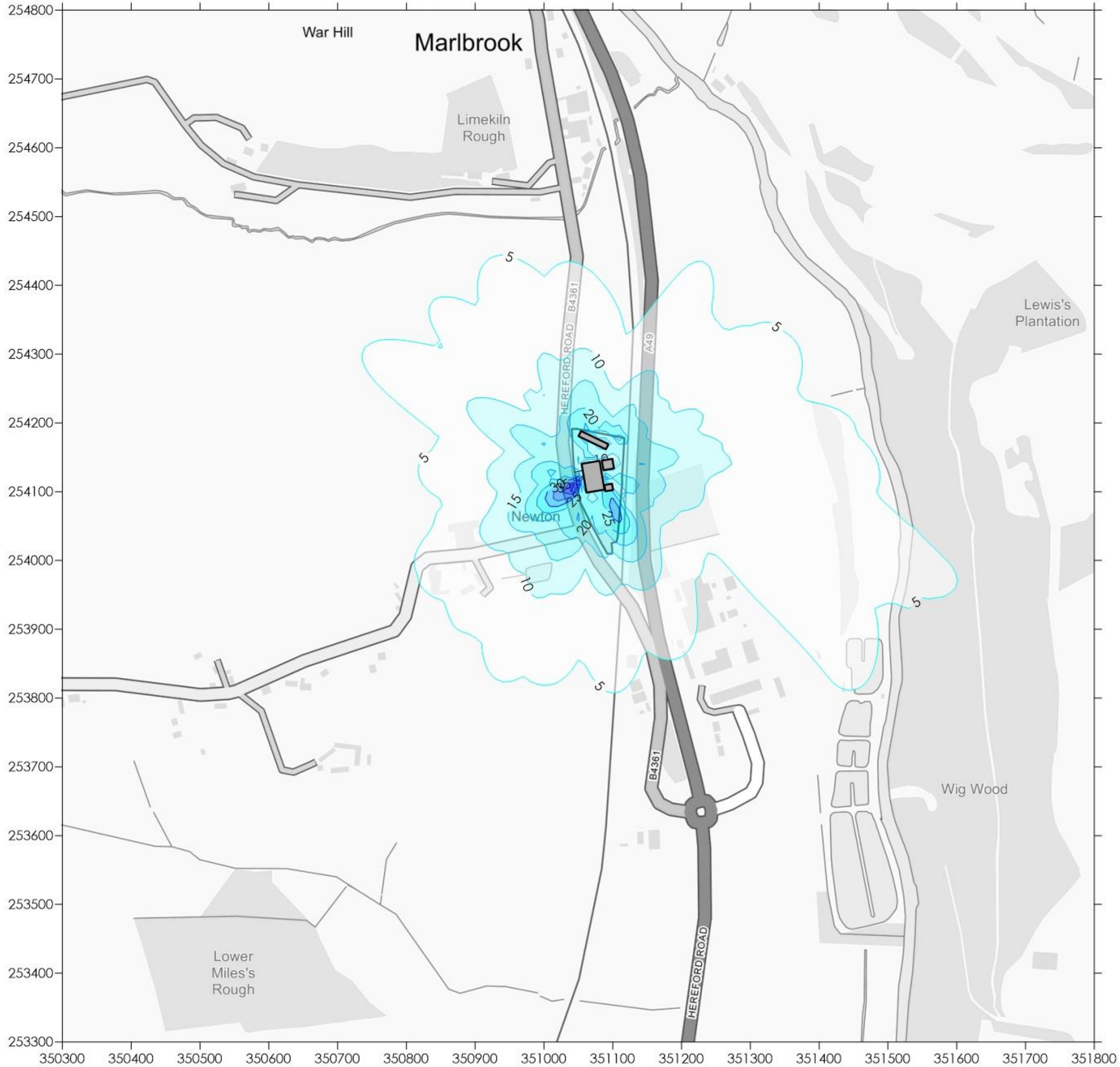

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Site Boundary

24-hour Mean Cd Concentration (ng/m³)

45, 40, 35, 30, 25, 20, 15, 10, 5

Title

Figure 15 - Predicted 24-hour Mean Cd Concentrations (ng/m³) 2018 Meteorological Data

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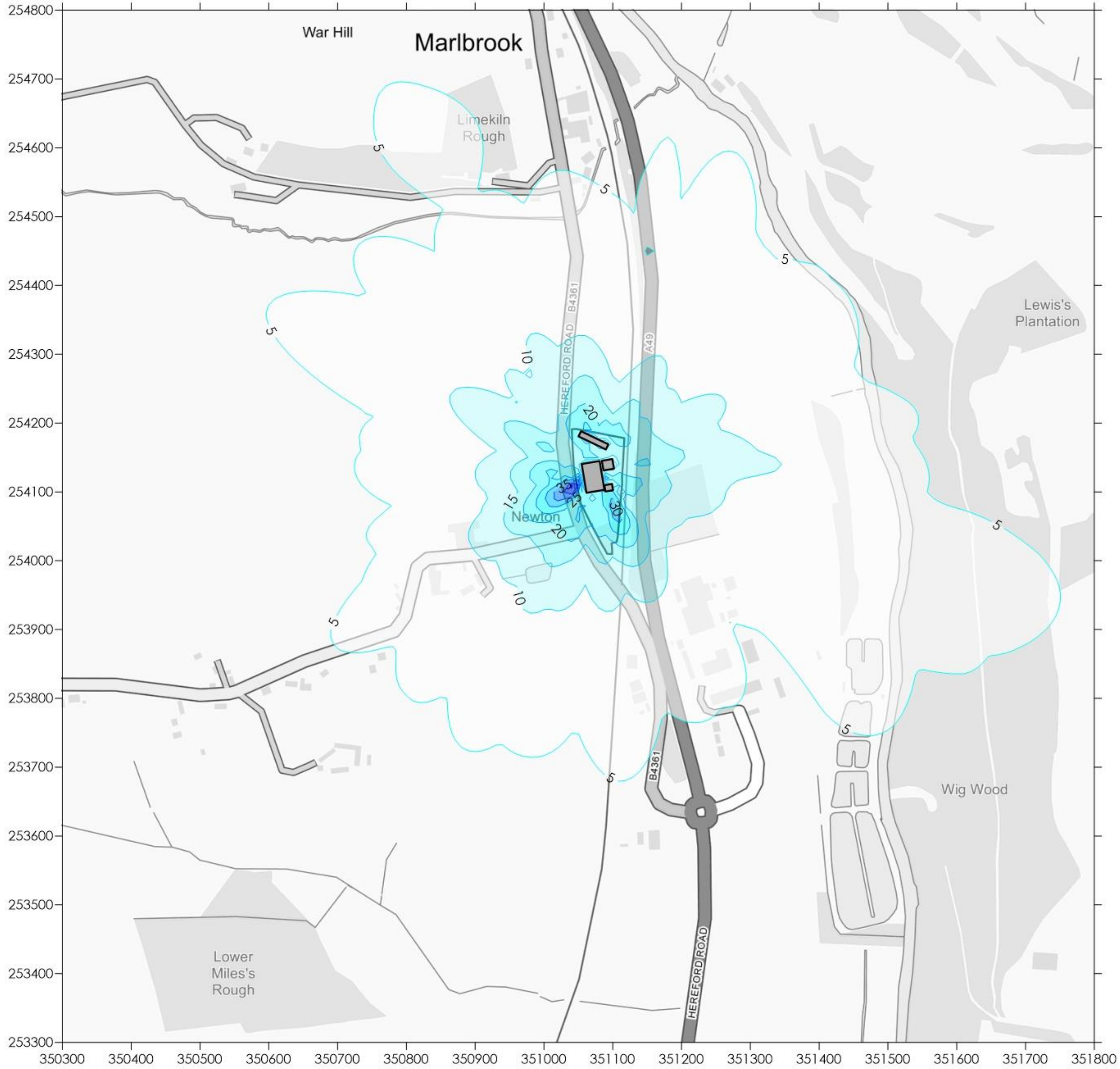

Legend

Site Boundary

24-hour Mean Hg Concentration (ng/m^3)

45, 40, 35, 30, 25, 20, 15, 10, 5

Title

Figure 16 - Predicted 24-hour Mean Hg Concentrations (ng/m^3) 2018 Meteorological Data

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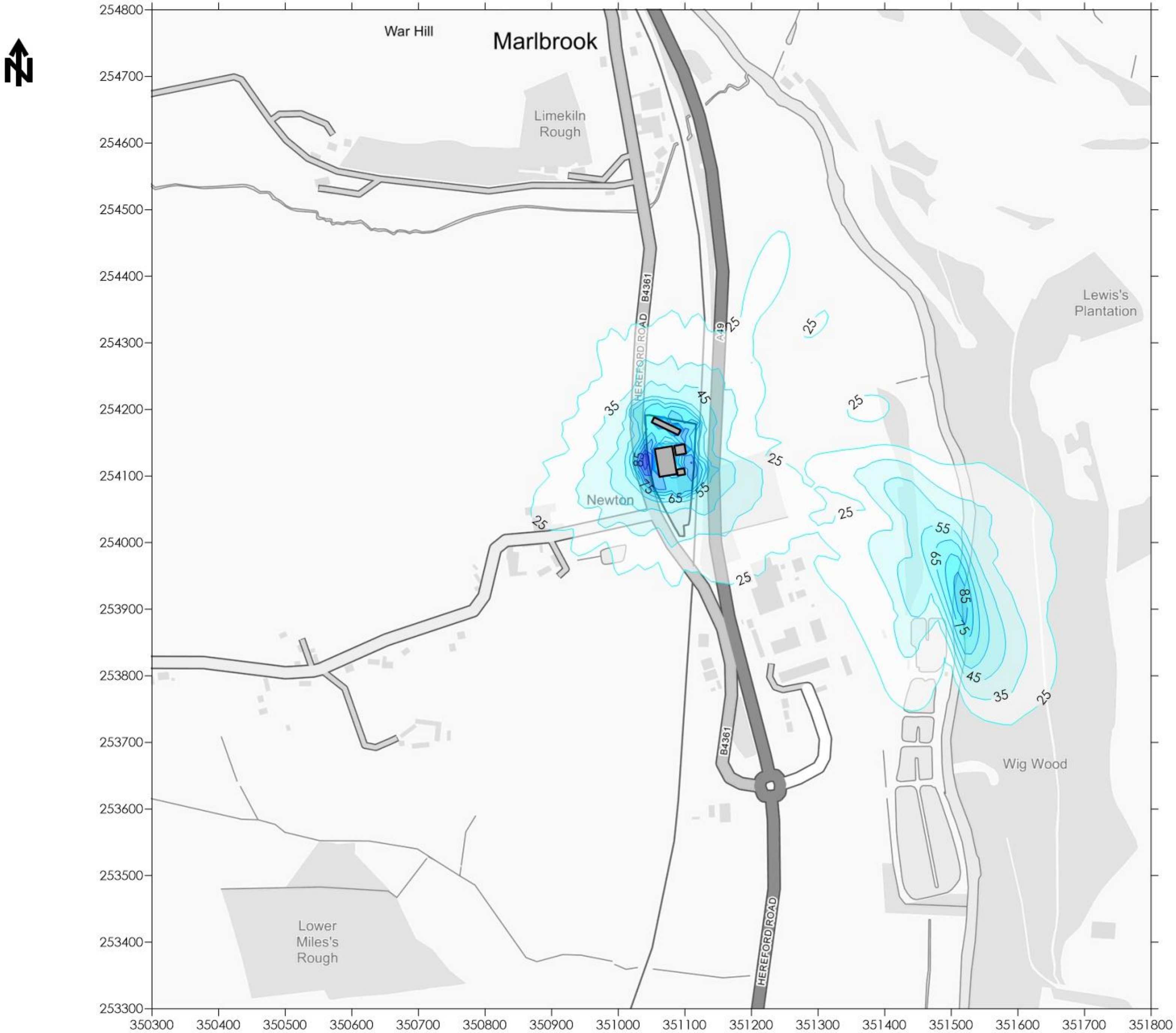

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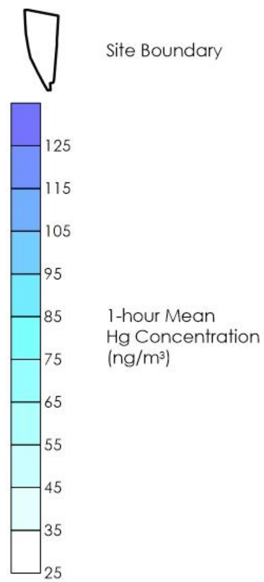

Title

Figure 17 - Predicted 1-hour Mean Hg Concentrations (ng/m³) 2020 Meteorological Data

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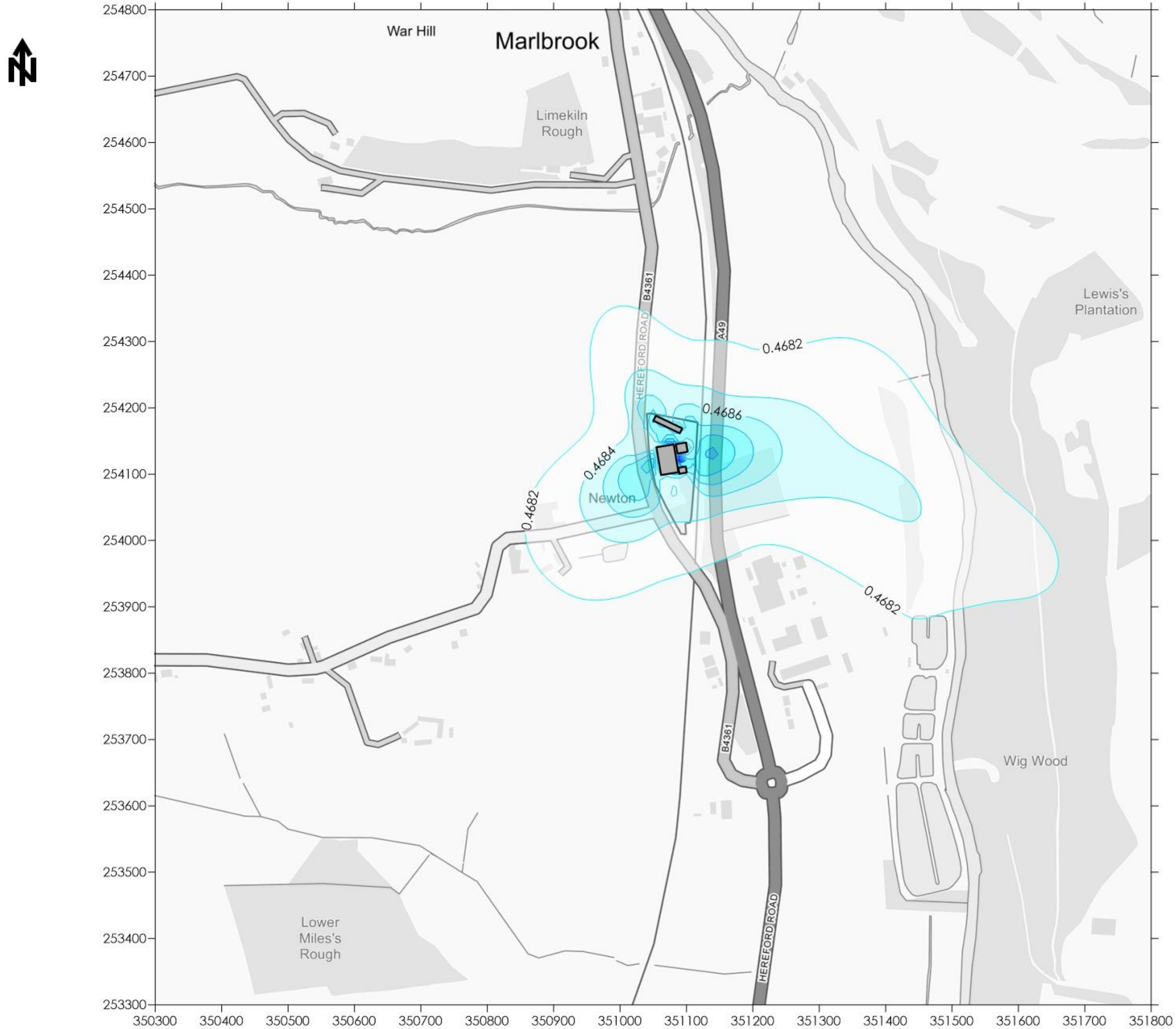

Title
Figure 18 - Predicted Annual Mean Cr(VI) Concentrations (ng/m³) 2021 Meteorological Data

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Legend

Site Boundary

Annual Mean As Concentration (ng/m³)

0.89
0.88
0.87
0.86
0.85
0.84

Title

Figure 19 - Predicted Annual Mean As Concentrations (ng/m³) 2021 Meteorological Data

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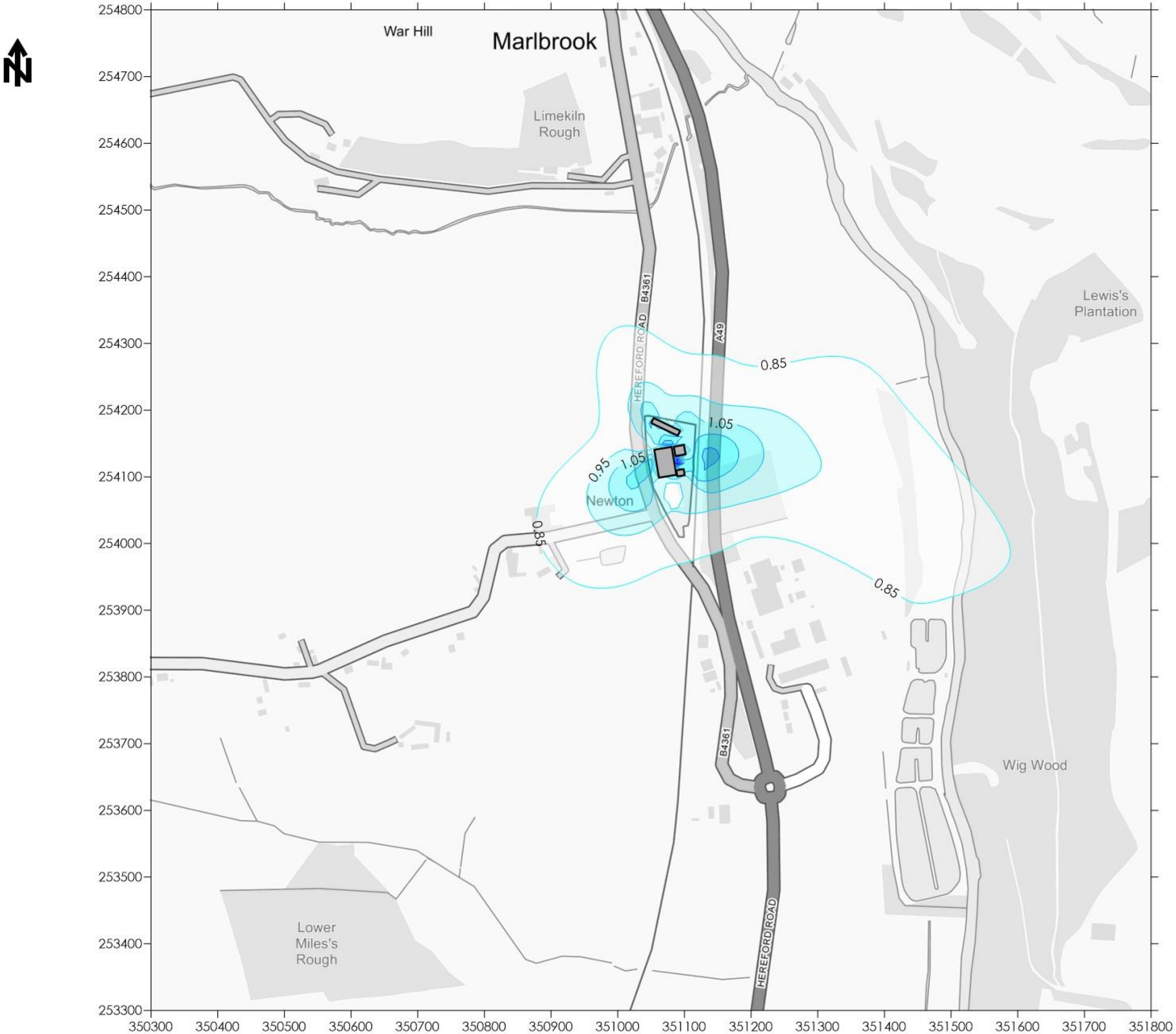

Legend

Site Boundary

1.55
1.45
1.35
1.25
1.15
1.05
0.95
0.85

Annual Mean Ni Concentration (ng/m³)

Title

Figure 20 - Predicted Annual Mean Ni Concentrations (ng/m³)
2021 Meteorological Data

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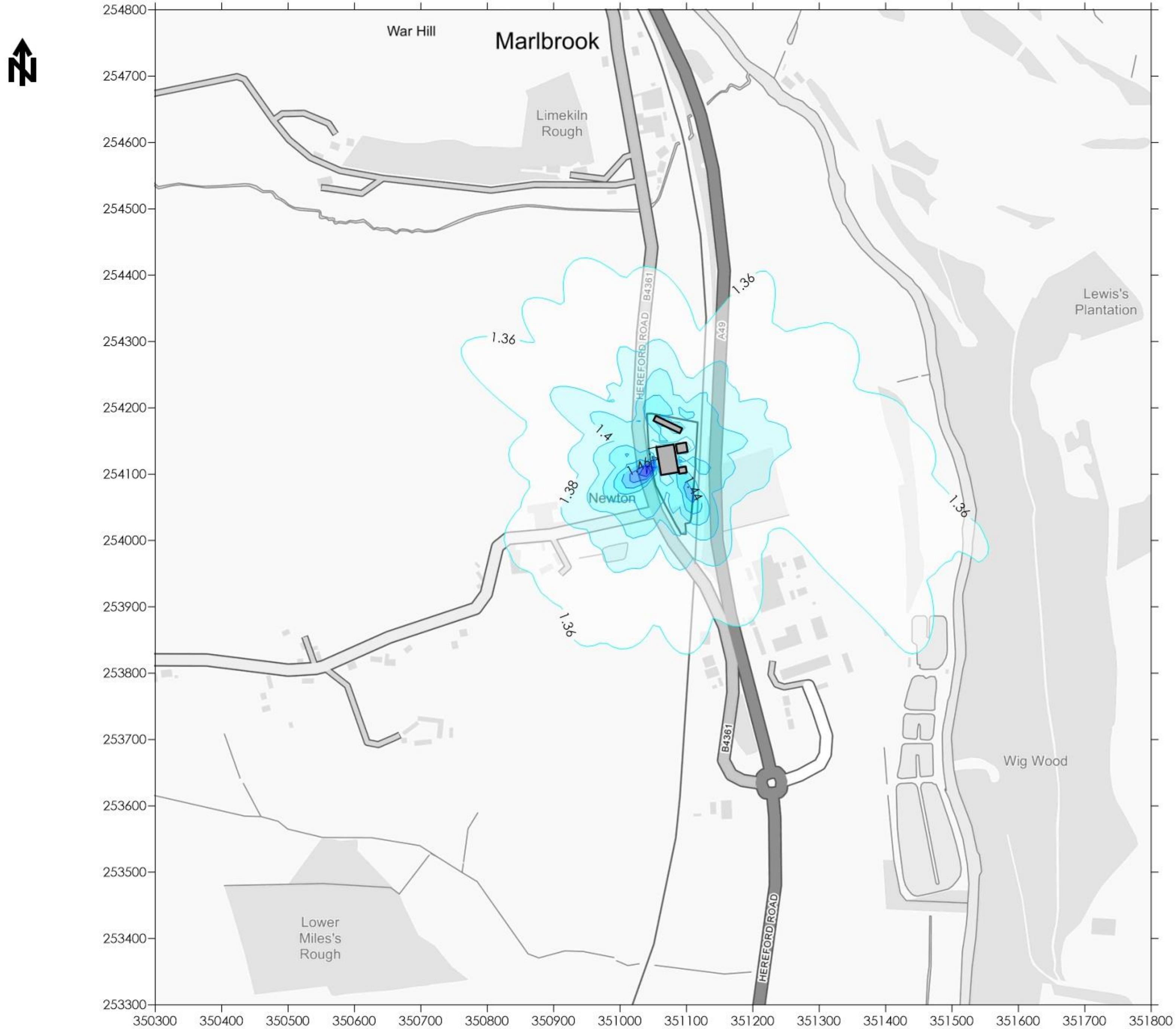

Legend

Site Boundary

24-hour Mean V Concentration (ng/m³)

1.52
1.5
1.48
1.46
1.44
1.42
1.4
1.38
1.36

Title

Figure 21 - Predicted 24-hour Mean V Concentrations (ng/m³) 2018 Meteorological Data

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