AIR EMISSIONS RISK ASSESSMENT

Buckden Landfill Gas Engines and Flares

Prepared for: Infinis Energy Services Ltd

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BASIS OF REPORT

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1.0 INTRODUCTION

SLR Consulting Limited has been commissioned by Infinis Energy Services Limited (Infinis) to undertake an Air Emissions Risk Assessment (AERA) in response to a Schedule 5 notice[1] from the Environment Agency (EA) relating to emissions from landfill gas engines and flares at Buckden Landfill, Brampton Road, Buckden, Cambridgeshire, PE19 5UH ('the Site').

1.1 Background and Proposed Changes

The Schedule 5 Notice relates to an application to vary Environmental Permit EPR/RP3732SZ/V005. A number of changes are proposed to the landfill gas utilisation (in gas engines) and treatment plant (destruction in flares) from the original Variation application. As such, the EA have requested an AERA to assess and compare the impacts of the originally permitted plant configuration, with the current configuration and the proposed configuration. The configurations can be summarised as follows:

Permitted Configuration (Scenario 0):

Engine 1 (unit 969 – CAT 3516) and Engine 2 (Perkins 4006) located in Gas Utilisation Plant (GUP) Compound with Flare 1 (1500m^3/hour capacity) as back-up. Plant feed is blended landfill gas.

Current Configuration (Scenario 1):

Changes to the Permitted configuration have been required as a result of high hydrogen sulphide (H_2S) concentrations in the landfill gas (LFG). The current configuration is:

- Flare 2 (2000m^3/hour capacity) flaring high H_2S gas feed with Flare 3 (2000m^3/hour capacity) as back-up, both located on the landfill north-west of the GUP Compound.
- Engine 1 (unit 969 – CAT 3516) located in the GUP Compound fuelled on low H_2S gas feed with Flare 1 (2000m^3/hour capacity) as back-up (Engine 2 has been removed).

Proposed Configuration (Scenario 2):

The proposed configuration involves filtering the H_2S (and other contaminants) from blended LFG in order to utilise a greater quantity of the gas and reduce flaring. All plant would be within the GUP Compound and include: existing Engine 1 (unit 969 – CAT 3516), Engine 3 (Cat 3512), with Main Flare 4 (2000m^3/hour capacity) and Flare 5 (2000m^3/hour capacity) as back up. The back-up flares would treat unfiltered LFG.

1.2 Scope and Objective

The scope of the assessment is limited to the consideration of point source combustion emissions to air at the Site. The pollutants of concern requiring consideration by the Schedule 5 notice are combustion emissions of nitrogen oxides (NOx) and sulphur dioxide (SO_2), and slippage of H_2S through the plant.

The objective of the study is to assess, using atmospheric dispersion modelling, the impact of NO_X, NO_2, SO_2 and H_2S emissions against relevant Air Quality Standards and Environmental Assessment Levels for the protection of human health and the relevant Critical Levels and Critical Loads for the protection of designated ecological receptors where present within the relevant screening distances.

This report presents the approach, detailed methodology and findings of the AERA.

[1] Reference EPR/RP3732SZ/V005 – Dated 12/12/2022

2.0 LEGISLATION AND RELEVANT GUIDANCE

2.1 Environmental Permitting Guidance

The key EP guidance referred to in this assessment is the '*Air emissions risk assessment for your environmental permit*'[2] (the AERA guidance). The purpose of the AERA guidance is to assist operators for all types of permitted facilities to assess risks to the environment and human health when applying for a permit under the EP Regulations. The AERA guidance provides Environmental Assessment Levels (EALs) for a suite of pollutants for which legislative air quality standards do not exist (such as hydrogen sulphide for human health).

2.2 Air Quality Legislation and Guidance

2.2.1 Air Quality Standards Regulations

The Air Quality Standards Regulations set Limit Values, Target Values, and Objectives for the protection of human health and the environment. These regulations were subsequently amended in 2019 to make them operable from 1 January 2021 despite the UK's withdrawal from the EU[3].

2.2.2 Air Quality Strategy

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

The AQS objectives apply at locations outside buildings or other natural or artificial structures above or below ground, where members of the public are regularly present and might reasonably be expected to be exposed to pollutant concentrations over the relevant averaging period – herein referred to as 'relevant exposure'. Table 2-1 provides an indication of those locations.

The ambient air quality objectives of relevance to human receptors in this assessment (collectively termed Air Quality Assessment Levels (AQALs) throughout this report) are provided in Table 2-2.

Table 2-1
Human Health Relevant Exposure

AQAL Averaging Period	AQALs Should Apply At	AQALs Should Not Apply At
Annual mean	Building facades of residential properties, schools, hospitals etc.	Facades of offices or other places of work Hotels Gardens of residences Kerbside sites
24-hour mean	As above together with hotels and gardens of residential properties	Kerbside sites or any other location where public exposure is expected to be short-term

[2] Air emissions risk assessment for your environmental permit. https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit
[3] The Air Quality (Amendment of Domestic Regulations) (EU Exit) Regulations 2019, Statutory Instrument 74.
[4] Defra, The Air Quality Strategy for England, Scotland, Wales and Northern Ireland, July 2007.

AQAL Averaging Period	AQALs Should Apply At	AQALs Should Not Apply At
1-hour mean	As above together with kerbside sites of regular access, car parks, bus stations etc. Any outdoor locations where members of the public might reasonably be expected to spend one hour or longer.	Kerbside sites where public would not be expected to have regular access
15-minute mean	All locations where members of the public might reasonably be exposed for a period of 15 minutes or longer.	-

2.2.3 Local Air Quality Management

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

Where any of the prescribed AQS objectives are not likely to be achieved, the authority must designate an Air Quality Management Area (AQMA). For each AQMA, the local authority is required to prepare an Air Quality Action Plan (AQAP), which details measures the authority intends to introduce to deliver improvements in local air quality in pursuit of the objective. Local authorities therefore have formal powers to control air quality through a combination of LAQM and through application of wider planning policies.

Defra has published technical guidance for use by local authorities in their LAQM work[5]. This guidance, referred to in this report as LAQM.TG(22), has been used where appropriate in the assessment presented here.

The EA's role in relation to LAQM is as follows[6]:

> *"The Environment Agency is committed to ensuring that any industrial installation or waste operation we regulate will not contribute significantly to breaches of an AQS objective.*
>
> *It is a mandatory requirement of EPR legislation that we ensure that no single industrial installation or waste operation we regulate will be the sole cause of a breach of an EU air quality limit value. Additionally we have committed that no installation or waste operation will contribute significantly to a breach of an EU air quality limit value."*

2.3 Air Quality Standards and EALs Applied in the Assessment

The standards (AQALs/EALs) applied in the assessment are provided in Table 2-2.

Table 2-2
Relevant Ambient AQALs

Pollutant	AQAL / EAL ($\mu g/m^3$)	Averaging Period
NO_2	40	Annual mean
	200	1-hour mean (not to be exceeded on more than 18 occasions per annum)
SO_2	266	15-minute mean (not to be exceeded on more than 35 occasions per annum)
	350	1-hour mean (not to be exceeded on more than 24 occasions per annum)

[5] Local Air Quality Management Technical Guidance (TG22), Published by Defra in partnership with the Scottish Government, Welsh Government and Department of Agriculture, Environment and Rural Affairs. August 2022.
[6] Regulating to Improve Air Quality. AQPG3, version 1, Environment Agency, 14 July 2008.

Pollutant	AQAL / EAL ($\mu g/m^3$)	Averaging Period
	125	24-hour mean (not to be exceeded on more than 3 occasions per annum)
H_2S	7	30-minute
	140	24-hour
	150	Annual

2.4 Protection of Nature Conservation Sites

Sites of nature conservation importance are provided environmental protection from developments, including from atmospheric emissions. AQALs for the protection of ecological receptors are known as Critical Levels (C_{Le}) for airborne concentrations and Critical Loads (C_{Lo}) for deposition to land from air.

The AERA guidance requires that designated ecological sites should be screened against relevant AQALs if they are located within the following set distances from the Site:

- Special Protection Areas (SPAs), Special Areas of Conservation (SACs) and Ramsar site within 10km; and
- Sites of Special Scientific Interest (SSSIs), ancient woods (AW), local wildlife sites (LWS) and national and local nature reserves (NNR and LNR) within 2km.

2.4.1 Critical Levels (C_{Le})

C_{Le} are a quantitative estimate of exposure to one or more airborne pollutants in gaseous form, below which significant harmful effects on sensitive elements of the environment do not occur, according to present knowledge. The relevant C_{Le} for the protection of vegetation and ecosystems is specified within the UK air quality regulations and AERA guidance (see Table 2-3).

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

Pollutant	Concentration ($\mu g/m^3$)	Habitat and Averaging Period	Ref
NO_X	30	Annual mean (all ecosystems)	AQSR
	75	Daily mean (all ecosystems)	AERA
SO_2	10	Annual mean (where lichens or bryophytes are present)	AERA
	20	Annual mean (all ecosystems)	AQSR

2.4.2 Critical Loads (C_{Lo})

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

Deposition of nitrogen and sulphur can cause eutrophication and acidification; the relevant C_{Lo} are presented in Section 5.3.

3.0 QUANTIFICATION OF EMISSIONS

The Schedule 5 Notice requires:

- impact assessment of H_2S emissions from engines and flares based on potential un-combusted H_2S (i.e. 'H_2S slip');
- confirmation of flare destruction efficiencies evidenced;
- confirmation of an upward or downward trend H_2S concentrations to inlet of flares and engines; and
- provision of all H_2S concentrations to inlet of flares and engines (see Appendix D).

This section sets out a review of the monitoring data used to inform the risk assessment.

3.1 Flare Destruction Efficiencies

Monitoring of H_2S in combustion emissions of engines and flares was completed on 21st December 2022. However, the H_2S in raw LFG sample was lost in transit. SO_2 monitoring was completed concurrently with H_2S monitoring enabling a mass balance approach to estimate raw H_2S and therefore destruction efficiency. The results are presented in Table 3-1 below, on the basis of which, as a precautionary approach, a 98% destruction efficiency (or 2% slip) has been assumed in the assessment. Trace gas monitoring reports (Appendix D) indicate that other sulphur compounds (dimethyl sulphide, carbon disulphide, and dimethyl disulphide) are not significant in the context of H_2S, with H_2S accounting for >99% of total S mols.

Table 3-1
Destruction Efficiency

Plant	SO_2 Exhaust Conc. (mg/m^3)	H_2S Exhaust Conc. (mg/m^3)	Flare / engine normalised Flow (m^3/hr)	Exhaust emission rate SO_2 (g/hr)	Exhaust emission rate H_2S (g/hr)	LFG flow (m^3/hr)	LFG H_2S (g/hr)[(a)]	D.E. %
Flare 2	362	3.35	8136	2945	27	1060	1594.1	98.3%
Flare 3	376	<1.14[b]	8136	3059	<9	1060	<1636.7	>99.4%
Engine 969	407	<0.52[b]	1827	744	<1	371	<396.5	>99.8%

Table notes:

a) Calculated from 'SO_2 exhaust emission rate' / 1.879 (ratio of SO_2 to H_2S) + 'H_2S exhaust emission rate'.

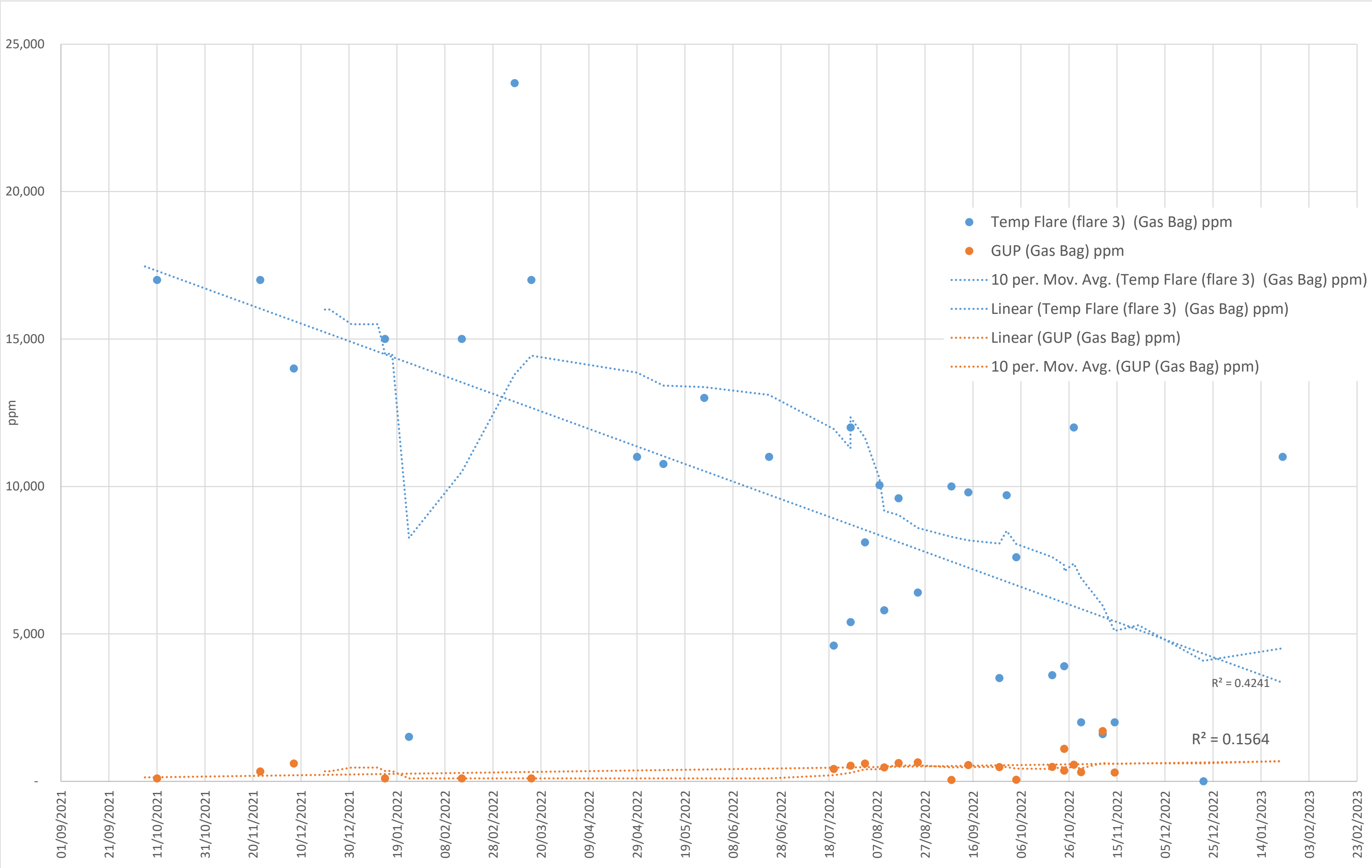
b) Below Limit of Detection

3.2 H_2S Concentrations to Inlet of Flares and Engines

H_2S monitoring since October 2021 has been reviewed, the dataset is presented in Appendix D. The Tedlar bag results are considered a more reliable dataset, given they are analysed to an accredited method, than the Velox analyser results which have been less reliable according to FCC (the Tedlar bag results are presented on Figure 3-2). The monitoring results indicate that:

- the LFG collected from the high H_2S areas of the landfill being passed to Temporary Flare 3 shows a downward trend from concentrations in excess of 15,000ppm 1 year ago to concentrations typically less than 10,000ppm, and frequently below 5,000ppm, in the latter half of 2022 to present; and
- the LFG collected from the low H_2S areas of the landfill being passed to the GUP compound show a relatively steady trend, typically less than 600ppm.

Figure 3-1 H_2S LFG Flare/Engine Feed Trend



The LFG collected from the high H_2S areas has had 2 readings removed from the trend analysis, they are 45,000ppm measured on 24/10/2022 and 87,000ppm measured on 24/11/2022. These values are considered potentially spurious and when viewed in the context of the wider dataset appear clear outliers; if these values are removed as outliers the dataset meets D'Agostino's test for normal distribution. Further, the SO_2 monitoring undertaken on the same day as the 87,000ppm was measured demonstrated concentrations toward the lower end of the normal range.

For the H_2S impact assessment a 2% slip through engines and flares will be adopted. Based on the review of monitoring data, and the broad downward trend, the 75%ile has been adopted for use across all assessment scenarios, i.e.: 12,250ppm for high H_2S gas feed; 580ppm for low H_2S gas feed, and a weighted average (based on gas collection rate 950m^3/hr from high H_2S area and 550m^3/hr from low H_2S area) for blended gas feeds.

3.3 Sulphur Dioxide Monitoring and Trends

SO_2 monitoring has been completed routinely on the flares since October 2021 and once on the landfill engine in December 2022. The full dataset is presented in Appendix D.

The monitoring results for the temporary flares indicate a downward trend. Measured concentrations have been typically below 10,000mg/Nm^3 since March 2022, and less than 5,000mg/Nm^3 since August 2022. For the comparative assessment of gas plant configuration scenarios, the 75% percentile of 9,158mg/Nm^3 has been adopted for flare emissions and is considered suitably precautionary on the basis of the trend in data and most recent results.

There is only a single measured value for SO_2 emissions from Engine 1 of 407mg/Nm^3 which has been applied to engines when fuelled on the low H_2S gas feed. As a precautionary approach this value has also been applied to the engines when fuelled on blended-filtered feed gas.

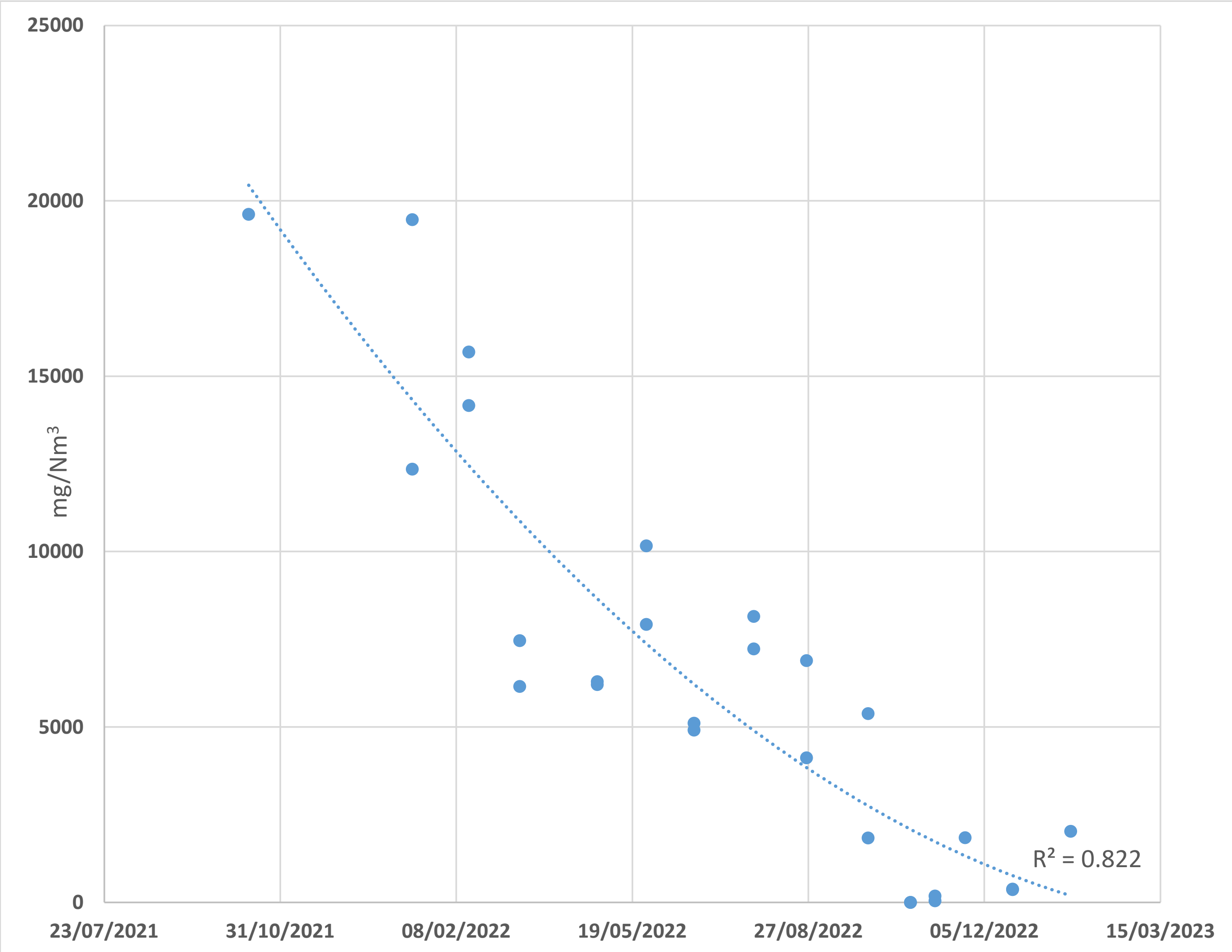


Figure 3-2
SO_2 Flare Emissions Trend

3.4 Modelled Engine and Flare Emissions

The emission parameters applied in the modelling are provided in Table 3-2. The emission parameters have been input on the basis of monitoring data and manufacturer's design specifications. Following data review and consultation with Infinis, the common assumptions applied across the scenarios for comparative purposes are as follows:

- 1500m^3/hr total LFG derived from 950m^3/hr from high H_2S gas feed and 550m^3/hr from low H_2S gas feed;
- LFG at 40% methane applied in calculation of engine gas utilisation volume rates to determine excess volumes rates for flaring;
- blended-filtered feed gas at 300ppm H_2S (filter will be changed at 300ppm and therefore this represents a precautionary assessment for consideration of peak short-term impacts); and
- NOx emissions have been input on the basis of the Permit ELVs (or ELV's appropriate to the commissioning date of proposed plant).

Table 3-2 Emission Parameters

Parameter / Source	Scenario 0			Scenario 1		Scenario 2		
	Engine 1	Engine 2	Flare 1	Engine 1	Flare 3	Engine 1	Engine 3	Flare 4
Unit	969 (Cat 3516)	Perkins 4006	GUP Compound (1500m^3/hr)	969 (Cat 3516)	Temporary Landfill Flare (2000m^3/hr)	969 (Cat 3516)	Cat 3512	GUP Compound (2000m^3/hr)
LFG feed rate (m^3/hr)	619	196	685	550	950	619	476	405
LFG source	Blended	Blended	Blended	Low H_2S	High H_2S	Blended-Filtered	Blended-Filtered	High H_2S
NGR x-coordinate	521475	521477	521497	521475	521426	521475	521480	521494
NGR y-coordinate	269166	269167	269161	269166	269222	269166	269163	269175
Stack Height (m)	7.3	4.3	5	7.3	6	7.3	7.4	9.5
Flow (Am^3/s)	3.62	1.13	8.80	3.62	12.20	3.62	2.67	5.20
Stack Diameter (m)	0.395	0.30	1.99	0.395	2.00	0.395	0.36	2.000
Velocity (m/s)	29.50	16.02	2.83	29.50	3.88	29.50	26.21	1.66
Emission Temperature (°C)	520	495	1000	520	1000	520	520	1000
Flow (Nm^3/s)	1.00[(a)]	0.32[(a)]	1.46[(b)]	1.00[(a)]	1.50[(c)]	1.00[(a)]	0.74[(a)]	0.86[(c)]
NO_x Concentration (mg/Nm^3)	650	650	150	650	150	650	650	150
NO_x Emission (g/s)	0.65	0.21	0.22	0.65	0.23	0.65	0.48	0.13
SO_2 Concentration (mg/Nm^3)	13875[(d)]	13875[(d)]	9158	407	9158	407	407	9158
SO_2 Emission (g/s)	13.86	4.48	13.37	0.41	13.77	0.41	0.30	7.91
H_2S Concentration (mg/Nm^3)	38.3	37.5	29.0	2.2	59.9	1.4	1.5	59.9
H_2S Emission (g/s)	0.038	0.012	0.042	0.002	0.090	0.001	0.001	0.038

Table notes:

a) Normalised to 273K, dry, 5% O_2 assuming in-stack oxygen concentration of 6.7% (dry) and moisture content 10% (monitoring report ERE-22514: Engine 969)

b) Normalised to 273K, dry, 3% O_2 assuming in-stack oxygen concentration of 6% (dry) and moisture content 7.1%. (monitoring report ERE-22514: Compound Flare)

c) Normalised to 273K, dry, 3% O_2 assuming in-stack oxygen concentration of 9.54% (dry) and moisture content 9.7%. (monitoring report ERE-22514: Temporary Flare 3)

d) Factored concentration for normalisation conditions to equate engine SO_2 release rate with flare SO_2 release rate based on LFG feed rate.

4.0 ASSESSMENT METHODOLOGY

Detailed atmospheric dispersion modelling has been undertaken with due consideration to the EA's AERA guidance. The modelling approach is based upon the following stages:

- review of pollutant emission rates and characteristics;
- identification of sensitive receptors, both human and ecological;
- compilation of the existing air quality baseline and review of LAQM status; and
- calculation of process contribution to ground level concentrations and evaluation against relevant AQALs for both human and ecological receptors.

4.1 Model Setup

For this assessment the AERMOD View model[7] (AERMOD) has been applied; this model is widely used and accepted by the EA for undertaking such assessments and its predictions have been validated against real-time monitoring data by the United States (US) Environmental Protection Agency (EPA). It is therefore considered a suitable model for this assessment.

4.1.1 Model Domain / Receptors

The modelling has been undertaken using a receptor grid across a map of the study area. Pollutant exposure isopleths are generated by interpolation between receptor points and superimposed onto the map. This method allows the maximum ground level concentration outside the Site boundary to be assessed (such as at local footpaths and other amenity areas).

A nested receptor grid extending 5km from the Site was applied as follows:

- 200m x 200m at 20m grid resolution;
- 500m x 500m at 50m grid resolution;
- 1000m x 1000m at 100m grid resolution;
- 2000m x 2000m at 200m grid resolution; and
- 5000m x 5000m at 500m grid resolution

In addition, the modelling of discrete sensitive receptor locations as described in Section 5.1 was undertaken to assess the impact at relevant exposure locations for annual mean impact and facilitate the discussion of results.

4.1.2 Building Downwash

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

The integrated Building Profile Input Programme (BPIP) module within AERMOD was used to assess the potential impact of building downwash upon predicted dispersion characteristics. Structures input to the model are represented in Figure 4-1 to Figure 4-3.

[7] Software used: Lakes AERMOD View.

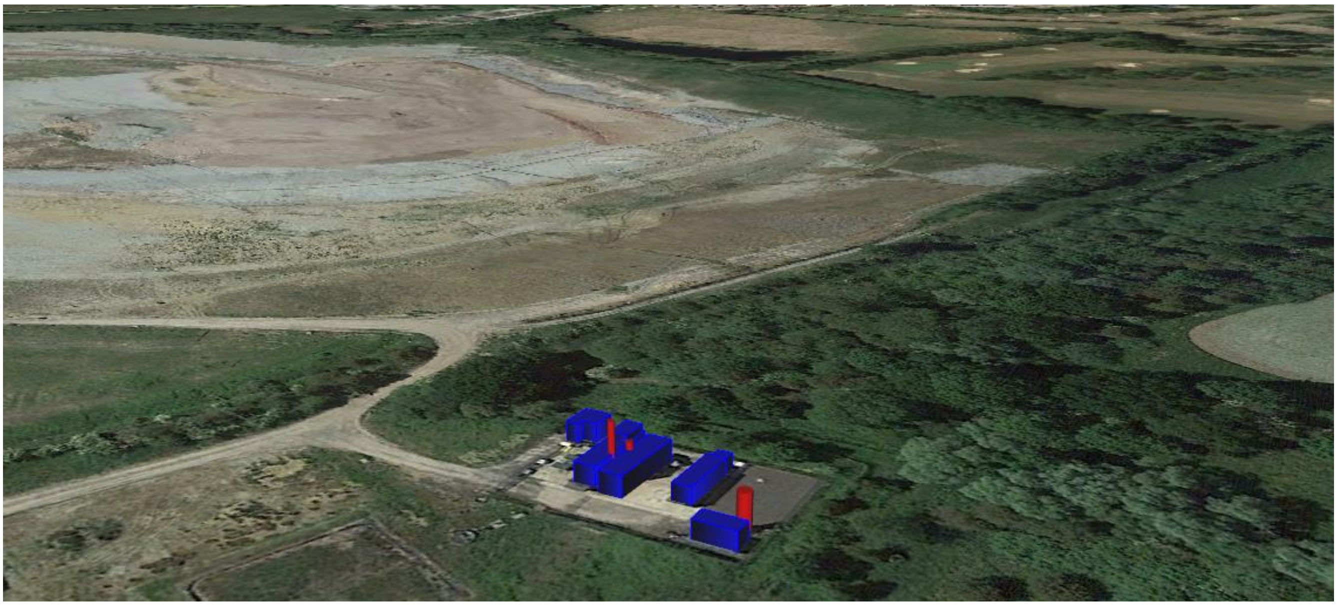


Figure 4-1
Modelled Buildings and Structures (Sc0)

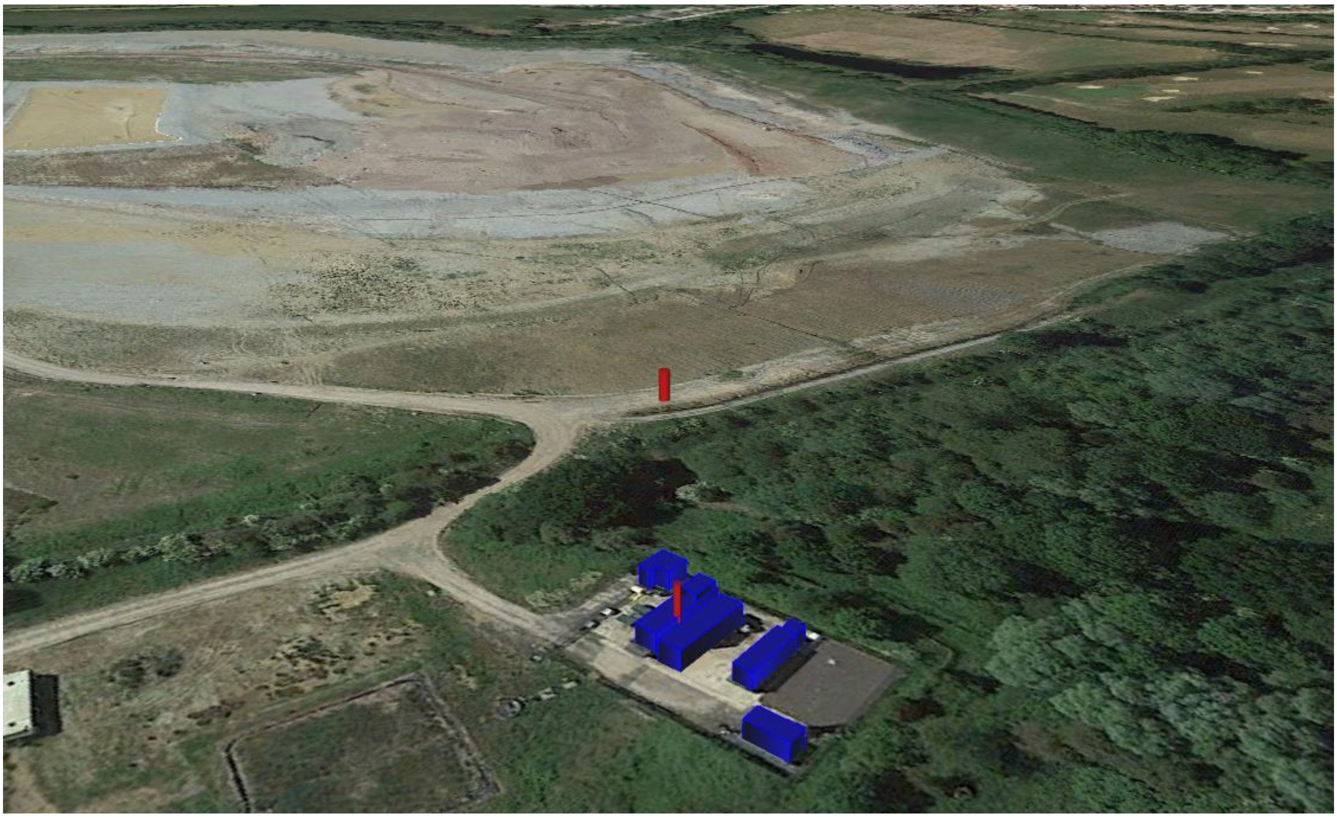


Figure 4-2
Modelled Buildings and Structures (Sc1)

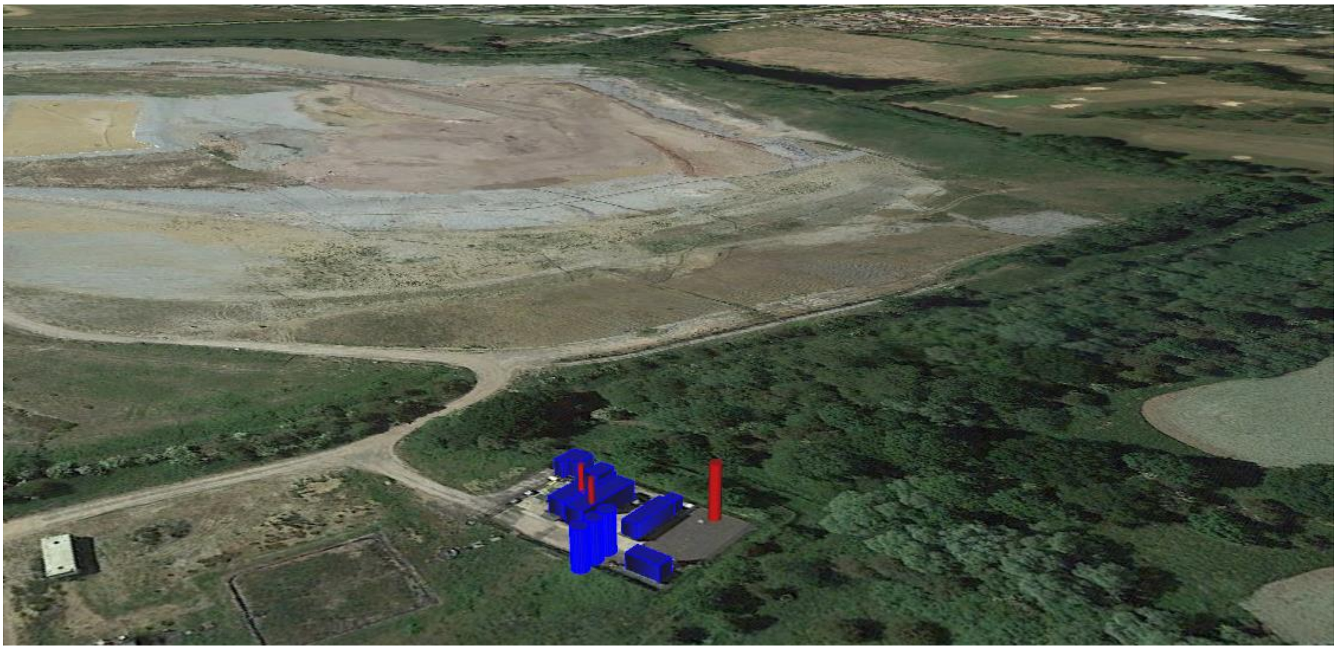


Figure 4-3
Modelled Buildings and Structures (Sc2)

4.1.3 Topography

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

AERMOD utilises digital elevation data to determine the impact of topography on dispersion from a source. Topography was incorporated within the modelling using Ordnance Survey Terrain 50 data. Data was processed by the AERMAP function within AERMOD to calculate terrain heights (see Figure 5-4).

4.1.4 Meteorological Data and Preparation

The observation site selected for use in this assessment was Bedford airport, located approximately 20km to the west of the Site. A windrose is presented in Figure 5-3.

The meteorological data (5 years of hourly sequential data for 2017 to 2021) was obtained in .met format from the data supplier and converted to the required surface and profile formats for use in AERMOD using AERMET View meteorological pre-processor. Details specific to the Site location were used to define the surface characteristics; albedo, bowen ratio, and surface roughness, applied in the conversion (see Table 4-1).

Table 4-1
Applied Surface Characteristics

Zone (Start)	Zone (End)	Albedo	Bowen Ratio	Surface Roughness (m)
0	30	0.18	0.65	0.022
30	60			0.024
60	90			0.015
90	120			0.015

Zone (Start)	Zone (End)	Albedo	Bowen Ratio	Surface Roughness (m)
120	150			0.033
150	180			0.049
180	210			0.033
210	240			0.017
240	270			0.015
270	300			0.015
300	330			0.015
330	360			0.016

4.1.5 Dispersion Coefficients

The 'rural' for dispersion coefficients was selected in accordance with AERMOD guidance[8].

4.1.6 Dispersion Model Uncertainty

Model validation studies[9] for AERMOD generally suggest that these dispersion models are for the vast majority of cases able to predict maximum short term high percentiles concentrations well within a factor of two and the latest evaluation studies for AERMOD show the composite (geometric mean) ratio of predicted to observed short-term averages from 'test sites' (where real-time monitoring data is available to validate model performance), to be between 0.96 and 1.2.

4.2 Assessment of Impacts on Air Quality

4.2.1 Treatment of Model Output

The assessment of impacts against the AQALs, as defined in Section 2.3 and 2.4, was undertaken using model output as described in Table 4-2.

As per the EA Air Quality Modelling and Assessment Unit (AQMAU) guidance[10] on conversion ratio for NO_x and NO_2, it has been assumed that 70% of NO_x is present as NO_2 in relation to long-term impacts and 35% of NO_x is present as NO_2 in relation to short-term impacts.

Table 4-2
Model Outputs

Averaging Period	Model Output – Process Contribution (PC)	Predicted Environmental Concentration (PEC)
NO_2 1-hour mean. Not to be exceeded more than 18 times a calendar year	99.79%ile of 1-hour means, factored by 0.35	PC + 2x annual mean background
SO_2 15-minute mean. Not to be exceeded more than 35 times a calendar year	99.9%ile of 1-hour means, multiplied by 1.34	PC + 2x annual mean background
SO_2 1-hour mean. Not to be exceeded more than 24 times a calendar year	99.73%ile of 1-hour means	PC + 2x annual mean background

[8] EPA, AERMOD Implementation Workgroup, Aermod Implementation Guide, EPA-454/B-22-008, (June 2022).
[9] AERMOD: Latest Features and Evaluation Results, EPA-454/R-03-003, June 2003 (United States Environmental Protection Agency).
[10] Environment Agency, Air Quality Modelling and Assessment Unit, 'Conversion Ratios for NOx and NO_2' (no date).

Averaging Period	Model Output – Process Contribution (PC)	Predicted Environmental Concentration (PEC)
SO_2 24-hour mean. Not to be exceeded more than 3 times a calendar year	99.18%ile of 24-hour means	PC + 2x annual mean background
30-minute H_2S EAL for odour	Maximum 1-hour mean, multiplied by 1.3	No background applied
NO_x 24-hour mean C_{Le} and H_2S EAL	Maximum 24-hour mean	PC + 2x annual mean background
Annual Mean NO_x	Annual mean	PC + annual mean background
Annual Mean NO_2	Annual mean, factored by 0.7	PC + annual mean background
Annual Mean SO_2	Annual mean	PC + annual mean background

4.2.2 Assessment of Impact and Significance

To assess the potential impact on air quality, the predicted exposure is compared to the AQALs, and the results of the dispersion modelling have been presented in the form of:

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

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

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

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

4.3 Assessment of Impacts on Vegetation and Ecosystems

4.3.1 Calculation of Contribution to Critical Loads

Deposition rates were calculated using empirical methods recommended by the EA AQTAG06[11]. Deposition flux was calculated using the following equation:

Deposition flux ($\mu g/m^2/s$) = ground level concentration ($\mu g/m^3$) x deposition velocity (m/s)

Wet deposition occurs via the incorporation of the pollutant into water droplets which are then removed in rain or snow and is not considered significant over short distances (AQTAG06) compared with dry deposition and therefore for the purposes of this assessment, wet deposition has not been considered. The applied deposition velocities are as shown in Table 4-3.

Table 4-3
Applied Deposition Velocities

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

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

Chemical Species	Recommended deposition velocity (m/s)	
	Woodland	0.0030
SO_2	Grassland	0.0120
	Woodland	0.0240

Critical Loads – Eutrophication

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

Critical Loads – Acidification

The predicted deposition rates are converted to units of equivalents (k_{eq}/ha/year), which is a measure of how acidifying the chemical species can be, by multiplying the dry deposition flux (µg/m^2/s) by the standard conversion factor of 6.84 for NO_2 and 9.84 for SO_2.

Calculation of PC as a Percentage of Acid Critical Load Function

The calculation of the process contribution of N and S to the acid C_{Lo} function has been carried out according to the guidance on APIS, which is as follows:

> *'The potential impacts of additional sulphur and/or nitrogen deposition from a source are partly determined by PEC, because only if PEC of nitrogen deposition is greater than CLminN will the additional nitrogen deposition from the source contribute to acidity. Consequently, if PEC is less that CLminN only the acidifying affects of sulphur from the process need to be considered:*
>
> *Where PEC N Deposition < CLminN*
>
> *PC as % CL function = (PC S deposition/CLmaxS)*100*
>
> *Where PEC is greater than CLminN (the majority of cases), the combined inputs of sulphur and nitrogen need to be considered. In such cases, the total acidity input should be calculated as a proportion of the CLmaxN.*
>
> *Where PEC N Deposition > CLminN*
>
> *PC as %CL function = (PC of S+N deposition)/CLmaxN)*100'*

4.3.2 Significance of Effect on Ecological Receptors

In addition to the AERA guidance, the EA's Operational Instruction 66_12[12] details how the air quality impacts on ecological sites should be assessed. This guidance provides risk-based screening criteria to determine whether impacts will have 'no likely significant effects (alone and in-combination)' for European sites, 'no likely damage' for SSSIs and 'no significant pollution' for other sites, as follows:

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

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

Where impacts cannot be classified as resulting in 'no likely significant effect', more detailed assessment may be required depending on the sensitivity of the feature in accordance with the EA's Operational Instruction 67_12[13]. This can require the consideration of the potential for in-combination effects, the actual distribution of sensitive features within the site, and local factors (such as the water table).

The guidance provides the following further criteria:

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

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

5.0 BASELINE ENVIRONMENT

5.1 Site Setting and Sensitive Receptors

The Site is located at Buckden Landfill, Brampton Road, Buckden, Cambridgeshire, PE19 5UH. The national grid reference (NGR) of the Site is x521475, y269165. The Site setting and assessed receptor locations are described in the following sections.

5.1.1 Human Receptors

According to LAQM.TG(22), AQALs should only apply to locations where members of the public may be reasonably likely to be exposed to air pollution for the duration of the relevant AQAL. As such, twelve locations surrounding the Site have been selected to inform the risk assessment in terms of relevant annual mean exposure (presented in Table 5-1 and Figure 5-1 as HR1 to HR12). Further, the dispersion modelling has been completed using a receptor grid to allow potential short-term exposure to be assessed at all locations surrounding the Site.

Table 5-1
Modelled Discrete Human Receptor Locations

Model ID	Description	NGR -X	NGR -Y	Modelled Height (m)
HR1	Stirling Farm	521076	269682	1.5
HR2	Golf Course Club House	521205	269783	1.5
HR3	Founders Drive	521335	269942	1.5
HR4	Berrys Lane	523068	269908	1.5
HR5	Corpus Christi Farm	523000	269060	1.5
HR6	No.5 B1043	522798	268912	1.5
HR7	No.7 B1043	522920	268618	1.5
HR8	Offord Cluny High Street	522139	267583	1.5
HR9	Marina	521539	267739	1.5
HR10	Lodge Farm	520559	268487	1.5
HR11	Churchyard View	520216	268906	1.5
HR12	Sparrow Close	520879	269645	1.5

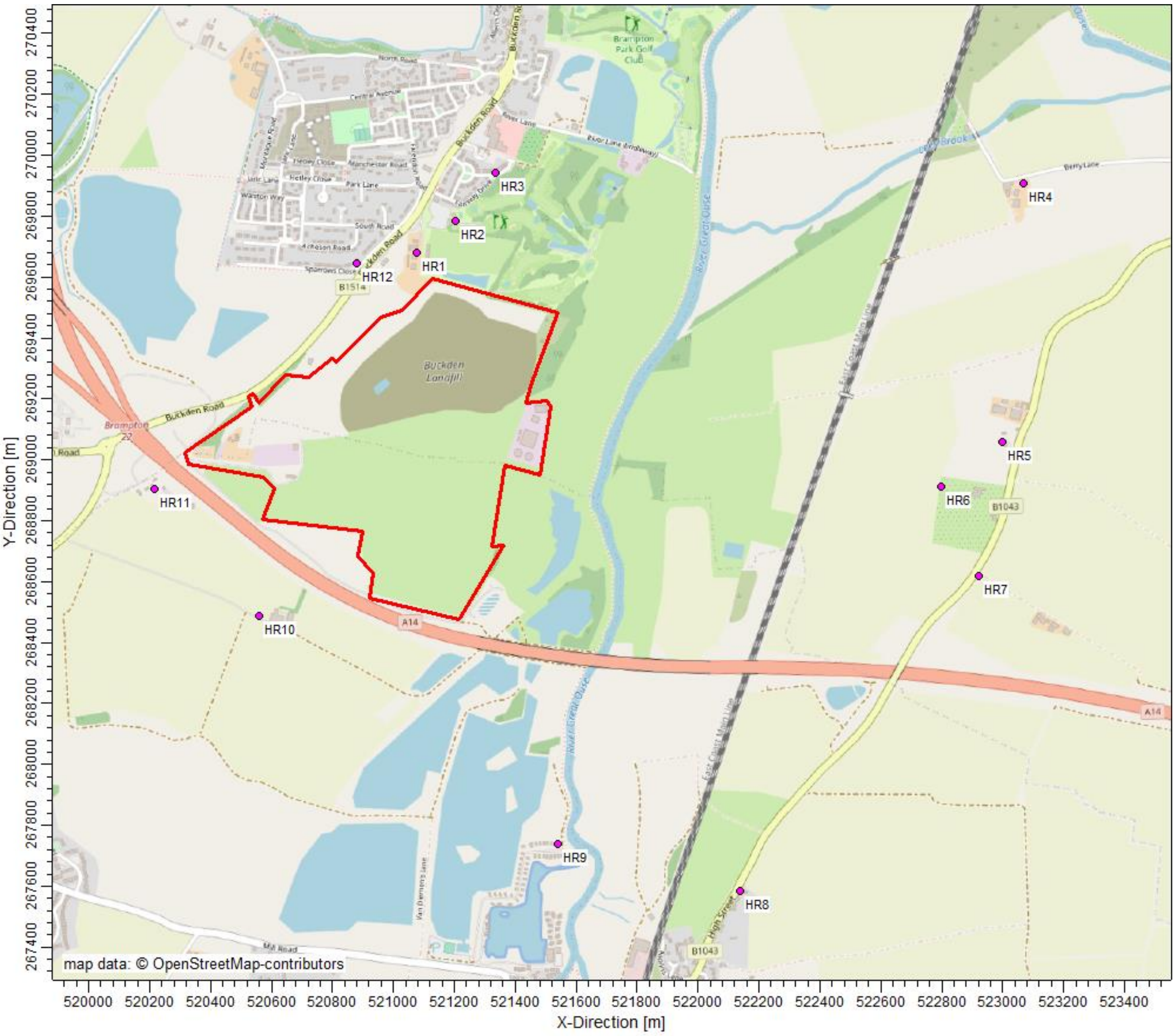


Figure 5-1
Modelled Human Receptor Locations

5.1.2 Ecological Receptors

The ecological designations within the relevant screening distances from the Site are detailed in Table 5-2 and displayed in Figure 5-2.

Table 5-2
Designated Ecological Sites

Reference	Site and Designation	Main Terrestrial Habitat
ER1	Portholme SAC	Lowland hay meadows
ER2	Portholme SSSI	Alopecurus pratensis - Sanguisorba officinalis Grassland
ER3	Brampton Wood SSSI	Fraxinus Excelsior - Acer Campestre - Mercurialis Perennis Woodland
ER4	Buckden Gravel Pits LWS	Coastal and floodplain grazing marsh
ER5	Brampton Flood Meadows LWS	Coastal and floodplain grazing marsh
ER6	River Great Ouse LWS	Coastal and floodplain grazing marsh
ER7	West Meadow LWS	Lowland meadows
ER8	Hinchingbrooke Gravel Pits LWS	Deciduous woodland
ER9	Park Road Grasslands LWS	Lowland meadows
ER10	Brampton A1 Slip Road LWS	Lowland meadows
ER11	Settling Bed East of Silver Street LWS	Deciduous woodland

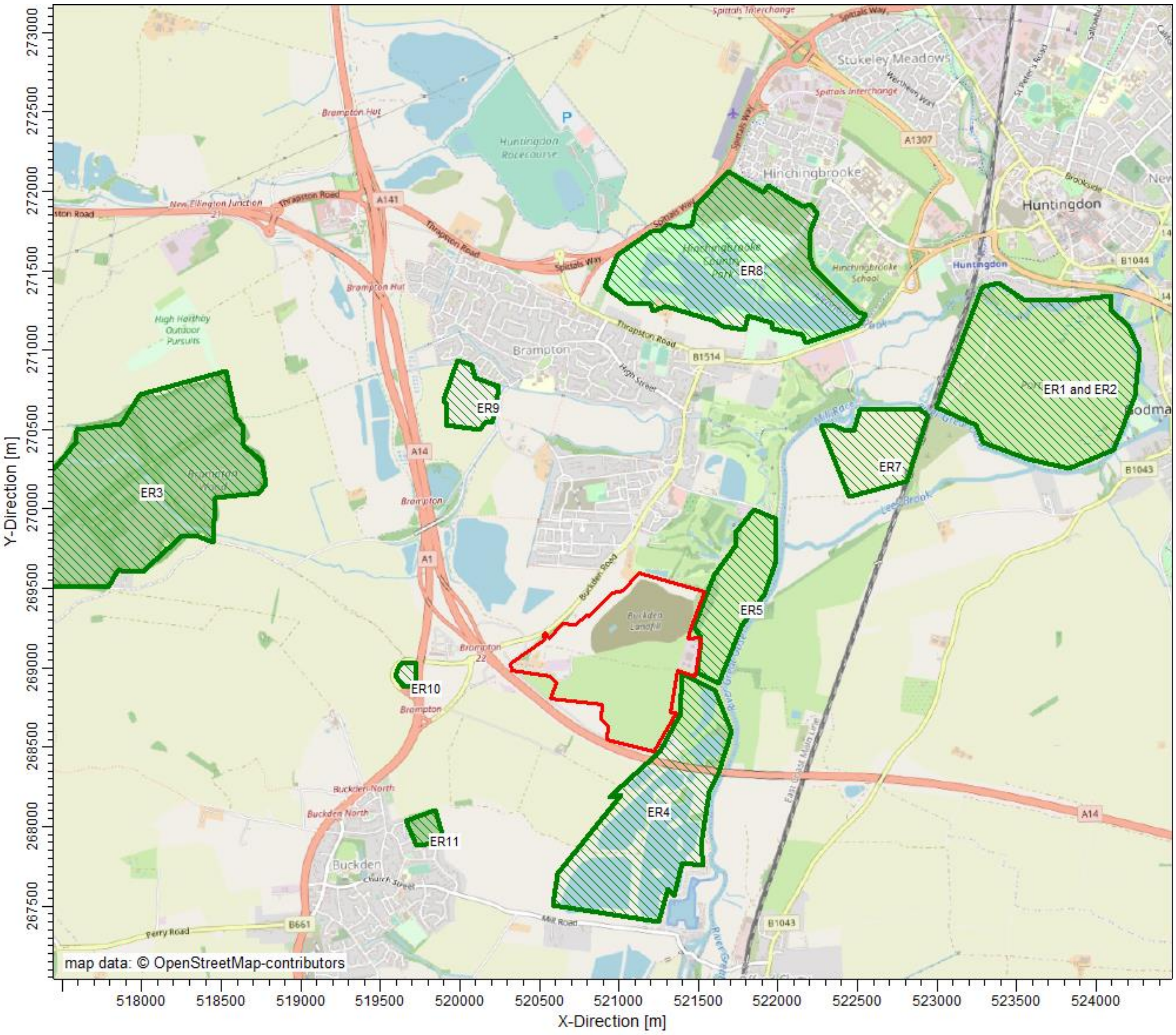


Figure 5-2
Modelled Designated Ecological Site Locations

5.2 Ambient Air Quality

5.2.1 Local Air Quality Management

The Site is located within the administrative area of Huntingdonshire District Council (HDC). HDC 2022 Annual Status Report[14] has been reviewed to establish the air quality baseline. HDC have declared AQMAs for exceedances of the annual mean AQAL for NO_2, however there are no AQMAs within 2km of the combustion plant and no AQMAs declared for SO_2.

5.2.2 Local Monitoring Data

HDC undertake automatic and non-automatic (passive using diffusion tubes) monitoring of NO_2. The nearest relevant diffusion tube, is at Sparrow Close (near HR12), located approximately 870m northwest of the GUP compound. The recent monitoring results are presented in Table 5-3.

Table 5-3
HDC Diffusion Tube Monitoring Results

Tube ID	Y-NGR	2018 (µg/m^3)	2019 (µg/m^3)	2020 (µg/m^3)	2021 (µg/m^3)
Brampton 1	RAF Brampton (Sparrow Close)	13.1	14.1	10.8	10.1

5.2.3 Defra / APIS Modelled Background and Projections

Background pollutant concentration data on a 1km x 1km spatial resolution is provided by Defra through the UK Air Information Resource (UK AIR) website and is routinely used to support LAQM and Air Quality Assessments. The background pollutant concentrations are based upon a 2018 base year and projected to future years[15]. Data for SO_2 has been sourced from APIS and is based on a 3-year average (2018-2020).

Mapped background concentrations of NO_2 and SO_2 were downloaded for the grid squares containing the modelled human receptors, as presented in Table 5-4.

Table 5-4
Defra / APIS Modelled Annual Mean Background Concentrations

Model ID	2023 NO_2 (µg/m^3)	2018-2020 SO_2 (µg/m^3)
HR1	7.6	1.0
HR2	7.6	1.0
HR3	7.6	1.0
HR4	7.5	0.9
HR5	7.8	0.9
HR6	7.4	0.9
HR7	7.4	0.9
HR8	7.1	0.9

[14] Huntingdonshire District Council, 2022 Air Quality Annual Status Report (ASR), 8th July 2022.
[15] Background mapping data for local authorities – http://uk-air.defra.gov.uk/data/laqm-background-home.

Model ID	2023 NO_2 (µg/m^3)	2018-2020 SO_2 (µg/m^3)
HR9	7.6	0.9
HR10	7.4	0.9
HR11	7.4	0.9
HR12	8.6	1.4

5.2.4 Applied Backgrounds

On the basis of the review of background air quality data the following has been applied in the assessment:

- 2018 annual mean for NO_2 from HDC 'Sparrow Close' diffusion tube (13.1µg/m^3) to all receptors, given that this is precautionary against 2023 Defra predictions;
- APIS 2018-2020 annual mean for SO_2 in the absence of more reliable dataset; and
- no background H_2S applied (given the absence of any dataset).

5.3 Baseline Conditions at Ecological Receptors

The APIS website[16], a support tool for assessment of potential effects of air pollutants on habitats and species developed in partnership by the UK conservation agencies and regulatory agencies and the Centre for Ecology and Hydrology, has been used to provide information on NO_x and SO_2 concentrations, current deposition rates and C_{Lo} for nutrient nitrogen (Table 5-5 and Table 5-6), and C_{Lo} functions for acidity (Table 5-7) at the ecological receptors. The most sensitive habitat to nitrogen deposition and acid deposition has been selected for use in the assessment and C_{Lo} applied according to APIS guidance[17].

Table 5-5
Nitrogen Dioxide and Sulphur Dioxide Background

Site	NO_x Annual Mean (µg/m^3)	SO_2 Annual Mean (µg/m^3)
ER1	25.20	1.40
ER2	25.20	1.40
ER3	10.80	0.80
ER4	11.15	0.89
ER5	11.43	0.87
ER6	11.43	0.87
ER7	13.27	1.40
ER8	14.43	1.40
ER9	12.51	1.40
ER10	14.49	0.79
ER11	14.49	0.79

[16] APIS, http://www.apis.ac.uk/, accessed January 2023.
[17] APIS, Indicative values within nutrient nitrogen critical load ranges for use in air pollution impact assessments, http://www.apis.ac.uk/indicative-critical-load-values.

Table 5-6
Nitrogen Critical Loads and Current Loads

Site	APIS C_{Lo} Class	Min. of C_{Lo} Range (kg N/ha/yr)	Max. of C_{Lo} Range (kg N/ha/yr)	C_{Lo} Applied in Assessment (kg N/ha/yr)	Current Load (kg N/ha/yr)
ER1	Low and medium altitude hay meadows	20	30	20	19.70
ER2	Low and medium altitude hay meadows	20	30	20	19.70
ER3	Meso- and eutrophic Quercus woodland	15	20	15	34.40
ER4	Coastal and floodplain grazing marsh	20	30	20	19.05
ER5	Coastal and floodplain grazing marsh	20	30	20	19.05
ER6	Coastal and floodplain grazing marsh	20	30	20	19.05
ER7	Improved grassland	Not sensitive			19.97
ER8	Broadleaved deciduous woodland	10	20	10	35.55
ER9	Acid grassland - Molinia caerulea meadows	15	25	15	19.97
ER10	Acid grassland - Molinia caerulea meadows	15	25	15	19.03
ER11	Broadleaved deciduous woodland	10	20	10	33.75

Table 5-7
Acid Critical Load Functions and Current Loads

Site	APIS C_{Lo} Class	C_{Lo} Function (k_{eq}/ha/yr)			Current Load (k_{eq}/ha/yr)	
		CLmaxS	CLminN	CLmaxN	N	S
ER1	Acid grassland	0.85	0.223	1.073	1.43	0.15
ER2	Acid grassland	0.85	0.223	1.073	1.43	0.15
ER3	Unmanaged Broadleafed/Coniferous Woodland	10.635	0.214	10.849	2.47	0.17
ER4	Coastal and floodplain grazing marsh	Not sensitive			1.36	0.12
ER5	Coastal and floodplain grazing marsh	Not sensitive			1.36	0.12
ER6	Coastal and floodplain grazing marsh	Not sensitive			1.36	0.12
ER7	Improved grassland	Not sensitive			1.43	0.15
ER8	Broadleafed/Coniferous unmanaged woodland	8.177	0.357	8.534	2.54	0.19
ER9	Acid grassland	0.85	0.223	1.073	n/d	n/d
ER10	Acid grassland	4.11	0.295	4.405	1.36	0.13
ER11	Broadleafed/Coniferous unmanaged woodland	10.65	0.214	10.864	2.41	0.17

Table note: n/d = no data

5.4 Meteorological Conditions

A windrose (2017-2021) from the Bedford meteorological station is presented in Figure 5-3 and shows the frequency of wind speed and direction used in the assessment. It is evident that the majority of winds are from the south-west with winds from the east, south-east and north occurring least frequently.

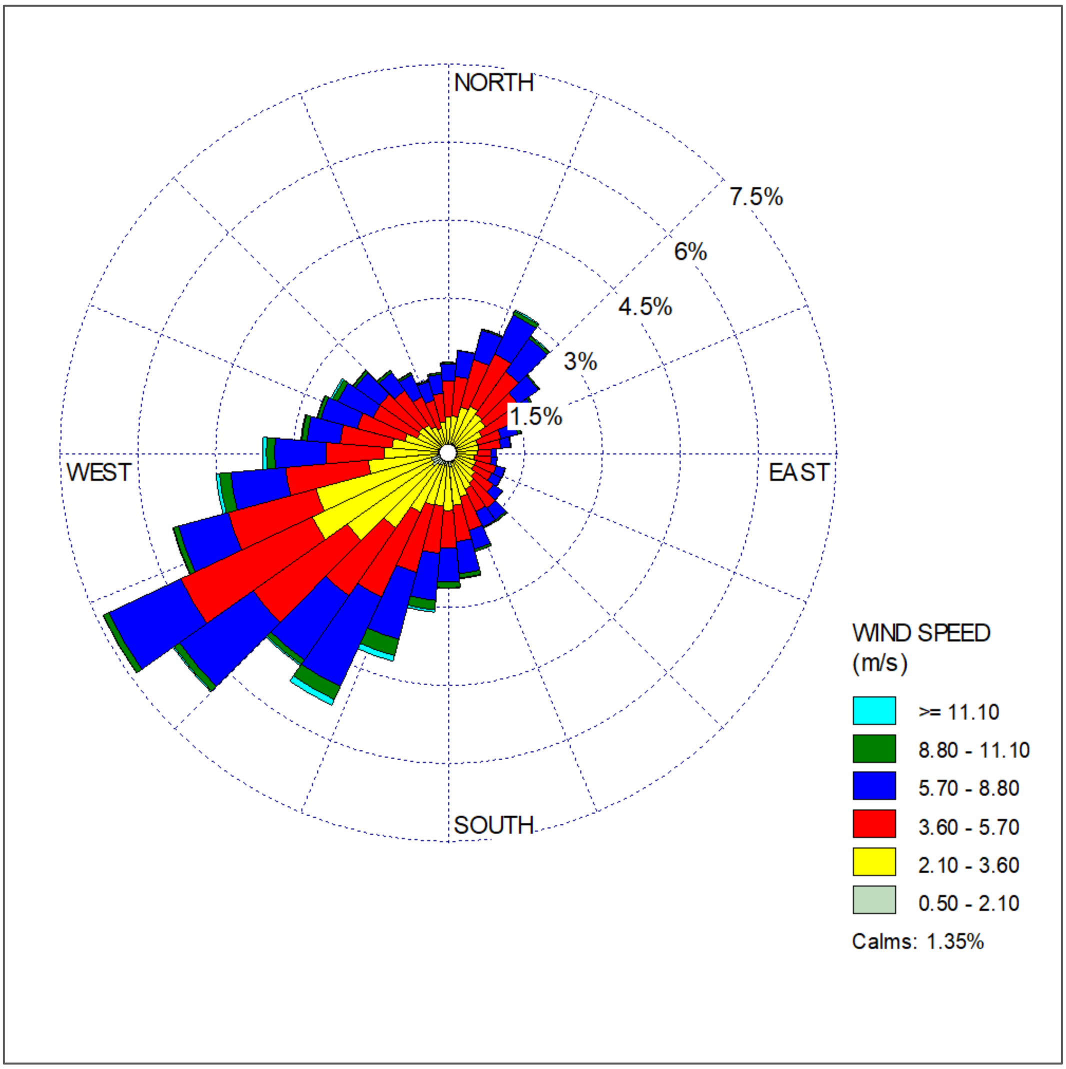


Figure 5-3
Bedford Windrose (2017-2021)

5.5 Topography

The Site lies at approximately 10m Above Ordnance Datum (AOD) in a north-south river valley. To the east and west the land rises to approximately 30-40m AOD within 2km. Topography has been incorporated into the model and is illustrated in Figure 5-4.

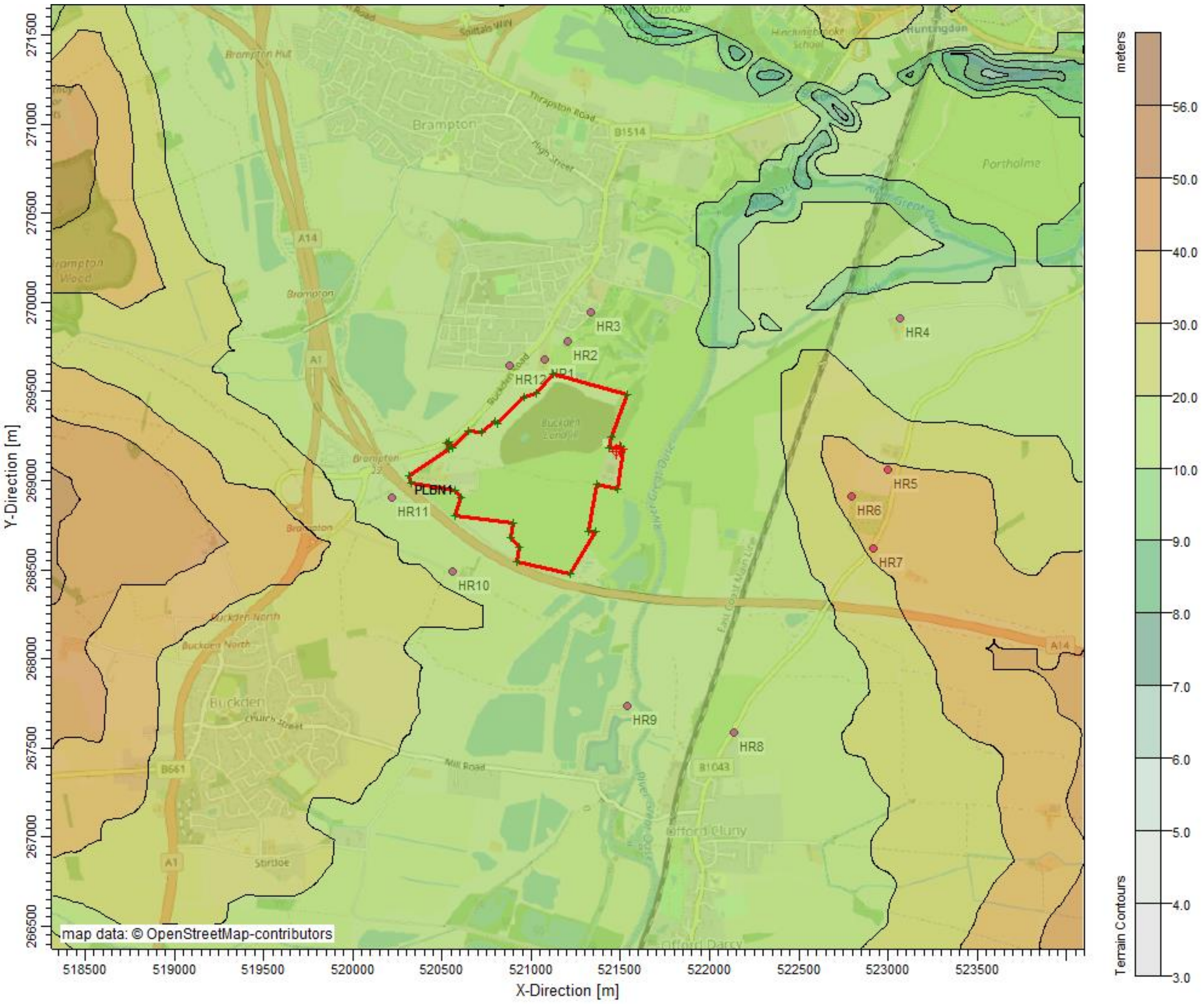


Figure 5-4
Surrounding Topography

6.0 ASSESSMENT RESULTS

6.1 Impacts on Sulphur Dioxide AQAL

6.1.1 15-minute mean

Predicted SO_2 15-minute mean impacts at the modelled receptor locations are summarised in Table 6-1 (isopleth plots are presented in Appendix B Figure B-1 to Figure B-3). The results indicate:

- potential exceedances in Scenario 0 at all receptors;
- no exceedances of the AQAL at modelled receptors in Scenarios 1 or 2; and
- a reduction in peak impacts between Scenarios 1 (PEC 204.3µg/m^3 at HR2) to Scenario 2 (PEC of 143.7µg/m^3 at HR6).

Table 6-1
Predicted SO_2 15-minute Mean (99.9%ile) Impacts (µg/m^3)

Rec.	Scenario 0				Scenario 1				Scenario 2			
	PC	PC as % of EAL	PEC	PEC as % of EAL	PC	PC as % of EAL	PEC	PEC as % of EAL	PC	PC as % of EAL	PEC	PEC as % of EAL
HR1	555.6	208.9%	557.6	209.6%	186.5	70.1%	188.5	70.9%	115.5	43.4%	117.5	44.2%
HR2	557.2	209.5%	559.2	210.2%	202.3	76.1%	204.3	76.8%	117.5	44.2%	119.5	44.9%
HR3	469.5	176.5%	471.5	177.3%	163.9	61.6%	165.9	62.4%	101.7	38.2%	103.7	39.0%
HR4	334.3	125.7%	336.1	126.4%	64.3	24.2%	66.1	24.8%	57.9	21.8%	59.7	22.4%
HR5	711.6	267.5%	713.4	268.2%	78.8	29.6%	80.6	30.3%	107.9	40.6%	109.7	41.2%
HR6	899.4	338.1%	901.2	338.8%	90.2	33.9%	92.0	34.6%	141.9	53.4%	143.7	54.0%
HR7	563.8	211.9%	565.6	212.6%	74.8	28.1%	76.6	28.8%	82.3	30.9%	84.1	31.6%
HR8	278.5	104.7%	280.3	105.4%	62.1	23.3%	63.9	24.0%	52.2	19.6%	54.0	20.3%
HR9	332.2	124.9%	334.0	125.6%	67.6	25.4%	69.4	26.1%	62.0	23.3%	63.8	24.0%
HR10	389.4	146.4%	391.2	147.1%	88.2	33.1%	90.0	33.8%	73.7	27.7%	75.5	28.4%
HR11	324.4	122.0%	326.2	122.6%	68.6	25.8%	70.4	26.5%	57.4	21.6%	59.2	22.3%
HR12	471.3	177.2%	474.1	178.2%	127.2	47.8%	130.0	48.9%	89.3	33.6%	92.1	34.6%

Table note: EAL is 266µg/m^3

6.1.2 1-hour Mean Impacts

Predicted SO_2 1-hour mean impacts at the modelled receptor locations are summarised in Table 6-2 (isopleth plots are presented in Appendix B Figure B-4 to Figure B-6). The results indicate:

- potential exceedances or concentrations close to exceedance levels in Scenario 0 at 6 of the receptors;
- no exceedances of the AQAL at modelled receptors in Scenarios 1 or 2; and
- peak impacts reduce across the scenarios from Scenario 0 through to Scenario 2 (i.e. from a PEC of 450.6µg/m^3 in Sc0, to 115.5µg/m^3 in Sc1, to 69.1µg/m^3 in Sc2)

Table 6-2
Predicted SO_2 1-hour Mean (99.73%ile) Impacts (µg/m^3)

Rec.	Scenario 0				Scenario 1				Scenario 2			
	PC	PC as % of EAL	PEC	PEC as % of EAL	PC	PC as % of EAL	PEC	PEC as % of EAL	PC	PC as % of EAL	PEC	PEC as % of EAL
HR1	363.5	103.9%	365.5	104.4%	88.2	25.2%	90.2	25.8%	67.1	19.2%	69.1	19.7%
HR2	379.9	108.5%	381.9	109.1%	113.5	32.4%	115.5	33.0%	72.5	20.7%	74.5	21.3%
HR3	333.2	95.2%	335.2	95.8%	106.4	30.4%	108.4	31.0%	66.2	18.9%	68.2	19.5%
HR4	231.4	66.1%	233.2	66.6%	43.6	12.4%	45.4	13.0%	40.9	11.7%	42.7	12.2%
HR5	347.1	99.2%	348.9	99.7%	50.2	14.3%	52.0	14.9%	50.2	14.3%	52.0	14.9%
HR6	448.8	128.2%	450.6	128.8%	56.2	16.1%	58.0	16.6%	61.0	17.4%	62.8	18.0%
HR7	298.1	85.2%	299.9	85.7%	47.2	13.5%	49.0	14.0%	46.1	13.2%	47.9	13.7%
HR8	160.3	45.8%	162.1	46.3%	35.8	10.2%	37.6	10.7%	30.3	8.7%	32.1	9.2%
HR9	206.7	59.1%	208.5	59.6%	35.9	10.3%	37.7	10.8%	38.9	11.1%	40.7	11.6%
HR10	249.1	71.2%	250.9	71.7%	43.7	12.5%	45.5	13.0%	44.3	12.7%	46.1	13.2%
HR11	178.6	51.0%	180.4	51.6%	30.5	8.7%	32.3	9.2%	31.3	8.9%	33.1	9.5%
HR12	304.7	87.0%	307.5	87.8%	55.0	15.7%	57.8	16.5%	50.1	14.3%	52.9	15.1%

Table note: EAL is 350µg/m^3

6.1.3 24-hour Mean Impacts

Predicted SO_2 24-hour mean impacts at the modelled receptor locations are summarised in Table 6-3 (isopleth plots are presented in Appendix B Figure B-7 to Figure B-9). The results indicate:

- no exceedances of the AQAL at modelled receptors in any scenario; and
- peak impacts reduce across the scenarios from Scenario 0 through to Scenario 2, (i.e. from a PEC of 110.4µg/m^3 in Sc0, to 35.3µg/m^3 in Sc1, to 21.7µg/m^3 in Sc2).

Table 6-3
Predicted SO_2 24-hour Mean (99.18%ile) Impacts (µg/m^3)

Rec.	Scenario 0				Scenario 1				Scenario 2			
	PC	PC as % of EAL	PEC	PEC as % of EAL	PC	PC as % of EAL	PEC	PEC as % of EAL	PC	PC as % of EAL	PEC	PEC as % of EAL
HR1	105.9	84.7%	107.9	86.3%	30.6	24.4%	32.6	26.0%	18.7	15.0%	20.7	16.6%
HR2	108.4	86.7%	110.4	88.3%	33.3	26.7%	35.3	28.3%	19.5	15.6%	21.5	17.2%
HR3	103.2	82.6%	105.2	84.2%	30.0	24.0%	32.0	25.6%	19.7	15.8%	21.7	17.4%
HR4	62.4	50.0%	64.2	51.4%	12.6	10.1%	14.4	11.5%	11.1	8.9%	12.9	10.3%
HR5	58.1	46.5%	59.9	47.9%	11.8	9.4%	13.6	10.9%	11.0	8.8%	12.8	10.2%
HR6	69.5	55.6%	71.3	57.1%	12.6	10.1%	14.4	11.5%	11.8	9.4%	13.6	10.9%
HR7	58.7	46.9%	60.5	48.4%	11.2	9.0%	13.0	10.4%	10.1	8.1%	11.9	9.6%
HR8	38.0	30.4%	39.8	31.8%	10.6	8.5%	12.4	9.9%	8.2	6.6%	10.0	8.0%

Rec.	Scenario 0				Scenario 1				Scenario 2			
HR9	43.5	34.8%	45.3	36.3%	10.3	8.2%	12.1	9.7%	9.9	7.9%	11.7	9.3%
HR10	67.5	54.0%	69.3	55.4%	16.9	13.5%	18.7	14.9%	11.9	9.5%	13.7	11.0%
HR11	40.1	32.1%	41.9	33.5%	11.9	9.5%	13.7	10.9%	8.8	7.1%	10.6	8.5%
HR12	75.7	60.6%	78.5	62.8%	18.7	14.9%	21.5	17.2%	13.9	11.1%	16.7	13.4%

Table note: EAL is 125µg/m^3

6.2 Impacts on Nitrogen Dioxide AQAL

6.2.1 1-hour mean

Predicted NO_2 1-hour mean impacts at the modelled receptor locations are summarised in Table 6-4. The results indicate:

- process contributions are insignificant (less than 10% of EAL) and no PEC exceedances of the AQAL at modelled receptors in any scenario (an isopleth for Sc2 only has been presented in Figure B-10); and
- a small increase in peak impacts in Scenario 2 on account of more gas being utilised in larger engines, however process contributions are still insignificant and PECs are well below the AQAL.

Table 6-4
Predicted NO_2 1-hour Mean (99.79%ile) Impacts (µg/m^3)

Rec.	Scenario 0				Scenario 1				Scenario 2			
	PC	PC as % of EAL	PEC	PEC as % of EAL	PC	PC as % of EAL	PEC	PEC as % of EAL	PC	PC as % of EAL	PEC	PEC as % of EAL
HR1	5.4	2.7%	31.6	15.8%	3.5	1.7%	29.7	14.8%	6.2	3.1%	32.4	16.2%
HR2	5.6	2.8%	31.8	15.9%	3.6	1.8%	29.8	14.9%	6.4	3.2%	32.6	16.3%
HR3	4.9	2.4%	31.1	15.5%	3.1	1.6%	29.3	14.7%	5.7	2.8%	31.9	15.9%
HR4	3.5	1.7%	29.7	14.8%	2.1	1.0%	28.3	14.1%	3.9	1.9%	30.1	15.0%
HR5	5.6	2.8%	31.8	15.9%	2.9	1.4%	29.1	14.5%	5.6	2.8%	31.8	15.9%
HR6	7.4	3.7%	33.6	16.8%	3.7	1.8%	29.9	14.9%	7.2	3.6%	33.4	16.7%
HR7	4.6	2.3%	30.8	15.4%	2.4	1.2%	28.6	14.3%	4.5	2.2%	30.7	15.3%
HR8	2.4	1.2%	28.6	14.3%	1.6	0.8%	27.8	13.9%	2.9	1.4%	29.1	14.5%
HR9	3.2	1.6%	29.4	14.7%	2.0	1.0%	28.2	14.1%	3.8	1.9%	30.0	15.0%
HR10	3.8	1.9%	30.0	15.0%	2.3	1.2%	28.5	14.3%	4.3	2.1%	30.5	15.2%
HR11	2.8	1.4%	29.0	14.5%	1.7	0.9%	27.9	14.0%	3.1	1.5%	29.3	14.6%
HR12	4.6	2.3%	30.8	15.4%	2.8	1.4%	29.0	14.5%	5.1	2.5%	31.3	15.6%

Table note: EAL is 200µg/m^3

6.2.2 Annual Mean

Predicted NO_2 annual mean impacts at the modelled receptor locations are summarised in Table 6-5. The results indicate:

- process contributions are insignificant (less than 1% of EAL) and no PEC exceedances of the AQAL at modelled receptors in any scenario;
- a small increase in peak impacts in Scenario 2 on account of more gas being utilised in larger engines, however process contributions are still insignificant and PECs are well below the AQAL.

Table 6-5
Predicted NO_2 Annual Mean Impacts (µg/m^3)

Rec.	Scenario 0				Scenario 1				Scenario 2			
	PC	PC as % of EAL	PEC	PEC as % of EAL	PC	PC as % of EAL	PEC	PEC as % of EAL	PC	PC as % of EAL	PEC	PEC as % of EAL
HR1	0.2	0.5%	13.3	33.3%	0.1	0.3%	13.2	33.1%	0.2	0.6%	13.3	33.3%
HR2	0.3	0.6%	13.4	33.4%	0.2	0.4%	13.3	33.1%	0.3	0.7%	13.4	33.4%
HR3	0.3	0.7%	13.4	33.4%	0.2	0.4%	13.3	33.2%	0.3	0.7%	13.4	33.4%
HR4	0.3	0.7%	13.4	33.5%	0.2	0.4%	13.3	33.1%	0.3	0.7%	13.4	33.5%
HR5	0.2	0.5%	13.3	33.2%	0.1	0.3%	13.2	33.1%	0.2	0.5%	13.3	33.3%
HR6	0.2	0.5%	13.3	33.3%	0.1	0.3%	13.2	33.1%	0.2	0.6%	13.3	33.4%
HR7	0.2	0.4%	13.3	33.1%	0.1	0.2%	13.2	33.0%	0.2	0.4%	13.3	33.2%
HR8	0.1	0.2%	13.2	32.9%	0.0	0.1%	13.1	32.9%	0.1	0.2%	13.2	32.9%
HR9	0.1	0.2%	13.2	33.0%	0.1	0.1%	13.2	32.9%	0.1	0.2%	13.2	33.0%
HR10	0.1	0.3%	13.2	33.1%	0.1	0.2%	13.2	33.0%	0.1	0.3%	13.2	33.1%
HR11	0.1	0.2%	13.2	32.9%	0.0	0.1%	13.1	32.9%	0.1	0.2%	13.2	32.9%
HR12	0.1	0.4%	13.2	33.1%	0.1	0.2%	13.2	33.0%	0.2	0.4%	13.3	33.1%

Table note: EAL is 40µg/m^3

6.3 Impacts on Hydrogen Sulphide EALs

6.3.1 30-minute mean

Predicted H_2S 30-minute mean impacts at the modelled receptor locations are summarised in Table 6-6 (isopleth plots are presented in Appendix B: Figure B-11 to Figure B-13). The results indicate:

- no exceedances of the EAL at modelled receptors in any scenario; and
- peak impacts reduce across the scenarios from Scenario 0 through to Scenario 2 (i.e. from 3.4µg/m^3 in Sc0, to 1.5µg/m^3 in Sc1, to 1.3µg/m^3 in Sc2.

Table 6-6
Predicted H_2S 30-minute Mean Impacts (µg/m^3)

Rec.	Scenario 0				Scenario 1				Scenario 2			
	PC	PC as % of EAL	PEC	PEC as % of EAL	PC	PC as % of EAL	PEC	PEC as % of EAL	PC	PC as % of EAL	PEC	PEC as % of EAL
HR1	1.7	25.0%	1.7	25.0%	1.5	21.8%	1.5	21.8%	0.8	11.7%	0.8	11.7%
HR2	1.7	24.1%	1.7	24.1%	1.4	20.5%	1.4	20.5%	0.8	11.4%	0.8	11.4%

Rec.	Scenario 0				Scenario 1				Scenario 2			
HR3	1.4	20.2%	1.4	20.2%	1.1	16.3%	1.1	16.3%	0.7	9.5%	0.7	9.5%
HR4	1.0	13.7%	1.0	13.7%	0.5	6.5%	0.5	6.5%	0.4	5.1%	0.4	5.1%
HR5	2.8	39.5%	2.8	39.5%	0.6	8.4%	0.6	8.4%	1.1	15.1%	1.1	15.1%
HR6	3.4	48.0%	3.4	48.0%	0.7	10.5%	0.7	10.5%	1.3	18.3%	1.3	18.3%
HR7	2.6	37.1%	2.6	37.1%	0.5	7.8%	0.5	7.8%	1.0	13.8%	1.0	13.8%
HR8	0.9	12.7%	0.9	12.7%	0.4	6.4%	0.4	6.4%	0.3	5.0%	0.3	5.0%
HR9	1.0	14.4%	1.0	14.4%	0.6	8.0%	0.6	8.0%	0.4	5.8%	0.4	5.8%
HR10	1.1	16.2%	1.1	16.2%	0.8	11.1%	0.8	11.1%	0.5	6.8%	0.5	6.8%
HR11	1.0	14.3%	1.0	14.3%	0.6	8.8%	0.6	8.8%	0.4	5.7%	0.4	5.7%
HR12	1.4	20.6%	1.4	20.6%	1.2	17.5%	1.2	17.5%	0.7	9.4%	0.7	9.4%

Table note: EAL is 7µg/m^3

6.3.2 24-hour mean

Predicted H_2S 24-hour mean impacts at the modelled receptor locations are summarised in Table 6-7. The results indicate:

- process contributions are insignificant (less than 10% of EAL) at all modelled receptors in all scenarios; and
- peak impacts reduce across the scenarios from Scenario 0 through to Scenario 2.

Table 6-7
Predicted 24-hour Mean Impacts (µg/m^3)

Rec.	Scenario 0				Scenario 1				Scenario 2			
	PC	PC as % of EAL	PEC	PEC as % of EAL	PC	PC as % of EAL	PEC	PEC as % of EAL	PC	PC as % of EAL	PEC	PEC as % of EAL
HR1	0.5	0.4%	0.5	0.4%	0.4	0.3%	0.4	0.3%	0.2	0.2%	0.2	0.2%
HR2	0.5	0.3%	0.5	0.3%	0.4	0.2%	0.4	0.2%	0.2	0.1%	0.2	0.1%
HR3	0.4	0.3%	0.4	0.3%	0.4	0.2%	0.4	0.2%	0.2	0.1%	0.2	0.1%
HR4	0.3	0.2%	0.3	0.2%	0.1	0.1%	0.1	0.1%	0.1	0.1%	0.1	0.1%
HR5	0.2	0.2%	0.2	0.2%	0.1	0.1%	0.1	0.1%	0.1	0.1%	0.1	0.1%
HR6	0.3	0.2%	0.3	0.2%	0.1	0.1%	0.1	0.1%	0.1	0.1%	0.1	0.1%
HR7	0.2	0.1%	0.2	0.1%	0.1	0.1%	0.1	0.1%	0.1	0.1%	0.1	0.1%
HR8	0.2	0.1%	0.2	0.1%	0.1	0.1%	0.1	0.1%	0.1	0.1%	0.1	0.1%
HR9	0.2	0.2%	0.2	0.2%	0.1	0.1%	0.1	0.1%	0.1	0.1%	0.1	0.1%
HR10	0.3	0.2%	0.3	0.2%	0.2	0.1%	0.2	0.1%	0.1	0.1%	0.1	0.1%
HR11	0.2	0.1%	0.2	0.1%	0.1	0.1%	0.1	0.1%	0.1	0.1%	0.1	0.1%
HR12	0.4	0.2%	0.4	0.2%	0.2	0.1%	0.2	0.1%	0.2	0.1%	0.2	0.1%

Table note: EAL is 150µg/m^3

6.3.3 Annual mean

Predicted H_2S annual mean impacts at the modelled receptor locations are summarised in Table 6-8. The results indicate:

- process contributions are insignificant (less than 1% of EAL) at all modelled receptors in all scenarios; and
- peak impacts reduce across the scenarios from Scenario 0 through to Scenario 2.

Table 6-8
Predicted Annual Mean Impacts (µg/m^3)

Rec.	Scenario 0				Scenario 1				Scenario 2			
	PC	PC as % of EAL	PEC	PEC as % of EAL	PC	PC as % of EAL	PEC	PEC as % of EAL	PC	PC as % of EAL	PEC	PEC as % of EAL
HR1	0.02	0.01%	0.02	0.01%	0.01	0.01%	0.01	0.01%	0.01	0.01%	0.01	0.01%
HR2	0.02	0.02%	0.02	0.02%	0.01	0.01%	0.01	0.01%	0.01	0.01%	0.01	0.01%
HR3	0.03	0.02%	0.03	0.02%	0.01	0.01%	0.01	0.01%	0.01	0.01%	0.01	0.01%
HR4	0.03	0.02%	0.03	0.02%	0.01	0.01%	0.01	0.01%	0.01	0.01%	0.01	0.01%
HR5	0.02	0.01%	0.02	0.01%	0.01	0.01%	0.01	0.01%	0.01	0.01%	0.01	0.01%
HR6	0.02	0.02%	0.02	0.02%	0.01	0.01%	0.01	0.01%	0.01	0.01%	0.01	0.01%
HR7	0.02	0.01%	0.02	0.01%	0.01	<0.01%	0.01	<0.01%	0.01	<0.01%	0.01	<0.01%
HR8	0.01	<0.01%	0.01	<0.01%	<0.01	<0.01%	<0.01	<0.01%	<0.01	<0.01%	<0.01	<0.01%
HR9	0.01	0.01%	0.01	0.01%	<0.01	<0.01%	<0.01	<0.01%	<0.01	<0.01%	<0.01	<0.01%
HR10	0.01	0.01%	0.01	0.01%	0.01	<0.01%	0.01	<0.01%	<0.01	<0.01%	<0.01	<0.01%
HR11	0.01	0.01%	0.01	0.01%	<0.01	<0.01%	<0.01	<0.01%	<0.01	<0.01%	<0.01	<0.01%
HR12	0.01	0.01%	0.01	0.01%	0.01	<0.01%	0.01	<0.01%	0.01	<0.01%	0.01	<0.01%

Table note: EAL is 140µg/m^3

6.4 Impacts on Ecological Receptors

6.4.1 Critical Levels

The results of the assessment of impacts on the SO_2 C_{Le} are presented in Table 6-9 (isopleths are presented in Appendix B Figure B-14 to Figure B-16. The findings are that:

- the annual SO_2 PCs do not exceed the long-term C_{Le} at any of designated sites with the exception of ER5 (Brampton Flood Meadows LWS that is adjacent to the Site); and
- the impacts reduce significantly from Scenario 0 at ER5 compared to Scenario 1 and 2. Scenario 2 results in an increase in PC compared to Scenario 1 likely as a result of the requirement for routine flaring of LFG in the GUP compound. The spatial extent of impact in Scenario 2 is small as seen in Figure B-16 accounting for approximately 1.5% of the Site area. This small area of exceedance is a precautionary prediction given the assumptions regarding the sulphur dioxide concentration in the flare (i.e. 9158mg/Nm^3 when recent trends show concentrations have not exceeded 5379mg/Nm^3 since 30th September 2022) and also future years would see a decline in LFG volumes flared.

Table 6-9
Impact on Annual Mean SO_2 Critical Levels (µg/m³)

Rec.	Scenario 0				Scenario 1				Scenario 2			
	PC	PC as % of Cle	PEC	PEC as % of Cle	PC	PC as % of Cle	PEC	PEC as % of Cle	PC	PC as % of Cle	PEC	PEC as % of Cle
ER1	8.4	42%	9.8	49%	1.7	8%	3.1	15%	1.3	6%	2.7	13%
ER2	8.4	42%	9.8	49%	1.7	8%	3.1	15%	1.3	6%	2.7	13%
ER3	1.3	6%	2.1	10%	0.3	1%	1.1	5%	0.2	1%	1.0	5%
ER4	32.8	164%	n/a	n/a	3.7	19%	n/a	n/a	6.1	30%	n/a	n/a
ER5	471.7	2358%	n/a	n/a	23.9	119%	n/a	n/a	24.5	123%	n/a	n/a
ER6	52.6	263%	n/a	n/a	6.9	34%	n/a	n/a	8.2	41%	n/a	n/a
ER7	12.9	65%	n/a	n/a	2.6	13%	n/a	n/a	2.1	10%	n/a	n/a
ER8	5.4	27%	n/a	n/a	1.5	7%	n/a	n/a	1.0	5%	n/a	n/a
ER9	2.4	12%	n/a	n/a	0.5	2%	n/a	n/a	0.4	2%	n/a	n/a
ER10	1.7	9%	n/a	n/a	0.4	2%	n/a	n/a	0.3	2%	n/a	n/a
ER11	2.5	13%	n/a	n/a	0.6	3%	n/a	n/a	0.5	2%	n/a	n/a

Table note: n/a = PEC at LWS's not assessed

The results of the assessment of impacts on annual NOx C_{Le} are presented in Table 6-10. The findings are that:

- the annual NO_x PCs do not exceed the long-term C_{Le} at any of designated sites, and the PEC at ER1 and ER22 (Portholme SAC/SSSI) is below the C_{Le}.
- Scenario 2 results in an increase in PC compared to Scenario 1 likely as a result of the introduction of Engine 3 to increase the utilisation of LFG.

Table 6-10
Impact on Annual Mean NO_x Critical Levels (µg/m³)

Rec.	Scenario 0				Scenario 1				Scenario 2			
	PC	PC as % of Cle	PEC	PEC as % of Cle	PC	PC as % of Cle	PEC	PEC as % of Cle	PC	PC as % of Cle	PEC	PEC as % of Cle
ER1	0.3	1%	25.5	85%	0.2	1%	25.4	85%	0.3	1%	25.5	85%
ER2	0.3	1%	25.5	85%	0.2	1%	25.4	85%	0.3	1%	25.5	85%
ER3	<0.1	<1%	n/a	n/a	<0.1	<1%	n/a	n/a	0.1	<1%	n/a	n/a
ER4	1.3	4%	n/a	n/a	0.6	2%	n/a	n/a	1.2	4%	n/a	n/a
ER5	21.4	71%	n/a	n/a	2.3	8%	n/a	n/a	4.3	15%	n/a	n/a
ER6	2.1	7%	n/a	n/a	1.0	3%	n/a	n/a	1.9	6%	n/a	n/a
ER7	0.5	2%	n/a	n/a	0.3	1%	n/a	n/a	0.5	2%	n/a	n/a
ER8	0.2	1%	n/a	n/a	0.1	<1%	n/a	n/a	0.2	1%	n/a	n/a

Rec.	Scenario 0				Scenario 1				Scenario 2			
ER9	0.1	<1%	n/a	n/a	0.1	<1%	n/a	n/a	0.1	<1%	n/a	n/a
ER10	0.1	<1%	n/a	n/a	<0.1	<1%	n/a	n/a	0.1	<1%	n/a	n/a
ER11	0.1	<1%	n/a	n/a	0.1	<1%	n/a	n/a	0.1	<1%	n/a	n/a

Table note: n/a = PEC at LWS's not assessed, and PC <1% not assessed.

The results of the assessment of impacts on the 24-hour NOx C_{Le} are presented in Table 6-11. The findings are that:

- the 24-hour NO_x PCs do not exceed the C_{Le} at any of designated sites, with the exception of ER5 (Brampton Flood Meadows LWS that is adjacent to the Site) in Scenario 0, however the PC falls below the C_{Le} in Scenarios 1 and 2.;
- the PEC at ER1 and ER2 (Portholme SAC and SSSI) is below the C_{Le}.
- Scenario 2 results in an increase in PC compared to Scenario 1 likely as a result of the introduction of Engine 3 to increase the utilisation of LFG.

Table 6-11
Impact on 24-hour NO_x Critical Levels (µg/m^3)

Rec.	Scenario 0				Scenario 1				Scenario 2			
	PC	PC as % of Cle	PEC	PEC as % of Cle	PC	PC as % of Cle	PEC	PEC as % of Cle	PC	PC as % of Cle	PEC	PEC as % of Cle
ER1	2.3	3%	n/a	n/a	1.7	2%	n/a	n/a	2.9	4%	n/a	n/a
ER2	2.3	3%	n/a	n/a	1.7	2%	n/a	n/a	2.9	4%	n/a	n/a
ER3	1.2	2%	n/a	n/a	0.8	1%	n/a	n/a	1.3	2%	n/a	n/a
ER4	28.4	38%	n/a	n/a	13.4	18%	n/a	n/a	25.8	34%	n/a	n/a
ER5	158.6	211%	n/a	n/a	33.4	45%	n/a	n/a	68.3	91%	n/a	n/a
ER6	23.7	32%	n/a	n/a	13.6	18%	n/a	n/a	25.6	34%	n/a	n/a
ER7	3.4	5%	n/a	n/a	2.5	3%	n/a	n/a	4.3	6%	n/a	n/a
ER8	2.1	3%	n/a	n/a	1.4	2%	n/a	n/a	2.3	3%	n/a	n/a
ER9	1.8	2%	n/a	n/a	1.1	1%	n/a	n/a	1.9	3%	n/a	n/a
ER10	1.7	2%	n/a	n/a	1.1	1%	n/a	n/a	1.9	3%	n/a	n/a
ER11	2.3	3%	n/a	n/a	1.4	2%	n/a	n/a	2.5	3%	n/a	n/a

Table note: n/a = PEC at LWS's not assessed, and PC <10% not assessed

6.4.2 Critical Loads

The results of the assessment of impacts on the N C_{Lo} are presented in Table 6-12 below. The findings are that:

- Scenario 0 result in the highest PC's, Scenarios 1 and 2 result in a reduction in PC across most of the designations;

- the PC's do not exceed 1% of the C_{Lo} at the SAC/SSSI's and do not exceed 100% of the C_{Lo} at the LWS's for any Scenario. Therefore it is concluded that the PC will have 'no likely significant effects (alone and in-combination)' on the SAC, and will cause no significant pollution at the LWS's, for any scenario.

Table 6-12
Impact on N Critical Loads (kg N/ha/yr)

Rec.	Scenario 0		Scenario 1		Scenario 2	
	PC	PC as % of CLo	PC	PC as % of CLo	PC	PC as % of CLo
ER1	0.03	0.2%	0.02	0.1%	0.03	0.2%
ER2	0.03	0.2%	0.02	0.1%	0.03	0.2%
ER3	0.01	0.1%	0.01	<0.1%	0.01	0.1%
ER4	0.13	0.6%	0.06	0.3%	0.12	0.6%
ER5	2.15	10.8%	0.23	1.2%	0.43	2.1%
ER6	0.21	1.0%	0.10	0.5%	0.20	1.0%
ER8	0.04	0.4%	0.03	0.3%	0.05	0.5%
ER9	0.01	0.1%	0.01	<0.1%	0.01	0.1%
ER10	0.01	<0.1%	0.00	<0.1%	0.01	0.1%
ER11	0.02	0.2%	0.01	0.1%	0.02	0.2%

Table note: n/a = PEC at LWS's not assessed

The results of the assessment of impacts on the acid C_{Lo} functions are presented in Table 6-13 below. The findings are that:

- Scenario 0 result in the highest PC's, Scenarios 1 and 2 result in a reduction in PC;
- the PC's do not exceed 100% of the C_{Lo} at the LWS's and will cause no significant pollution in any scenario;
- for all scenarios the PC's exceed 1% of the C_{Lo} at the ER1/ER2 SAC/SSSI's and the PEC exceeds the 'minimum' C_{Lo}'s applied as a screening stage, however the PEC's do not exceed the 'maximum' C_{Lo}'s. Therefore it is concluded that the PC will have 'no likely significant effects'.

Table 6-13
Impact on Acid Critical Loads (Keq/ha/yr)

Rec.	Scenario 0				Scenario 1				Scenario 2			
	PC	PC as % of CLo	PEC	PEC as % of CLo	PC	PC as % of CLo	PEC	PEC as % of CLo	PC	PC as % of Cle	PEC	PEC as % of CLo
ER1 / ER2 (min C_{Lo}'s)	0.99	92.2%	2.57	239%	0.20	18.5%	1.78	166%	0.15	14.4%	1.73	162%
ER1 / ER2 (max C_{Lo}'s)	0.99	24.1%	2.57	63%	0.20	4.9%	1.78	43%	0.15	3.8%	1.73	42%
ER3	0.30	2.7%	2.94	27.1%	0.07	0.6%	n/a	n/a	0.05	0.5%	n/a	n/a
ER8	1.29	33.3%	n/a	n/a	0.36	7.0%	n/a	n/a	0.24	3%	n/a	n/a
ER9	0.28	4.7%	n/a	n/a	0.06	1.0%	n/a	n/a	0.05	6.2%	n/a	n/a

Rec.	Scenario 0				Scenario 1				Scenario 2			
ER10	0.21	5.5%	n/a	n/a	0.05	1.3%	n/a	n/a	0.04	0.9%	n/a	n/a
ER11	0.60	5.5%	n/a	n/a	0.14	1.3%	n/a	n/a	0.12	1.1%	n/a	n/a

Table note: n/a = PEC at LWS's not assessed, PC's less than 1% not assessed

7.0 SUMMARY AND CONCLUSIONS

This AERA has quantified and assessed the potential air quality impacts associated with LFG engine and flare combustion emissions at the Site using Environment Agency approved techniques against published AQALs / EALs for the protection of human health and designated ecological sites. Three scenarios have been compared for the utilisation and/or treatment of LFG, specifically the originally permitted plant configuration (Scenario 0), the current configuration (Scenario 1) and the proposed configuration (Scenario 2).

The findings of the AERA are as follows:

- Scenarios 1 and 2 result in a reduction in impacts compared to Scenario 0;
- Scenario 2 results in a reduction in highest impacts at human receptor locations compared to Scenario 1;
- neither Scenarios 1 or 2 result in exceedances of any AQAL or EAL for nitrogen dioxide, sulphur dioxide or hydrogen sulphide at any assessed receptor location;
- neither Scenarios 1 or 2 result in exceedances of Critical Levels or Critical Loads at designated ecological sites with the exception of the annual mean sulphur dioxide Critical Level for which all scenarios result in an exceedance at Brampton Flood Meadows LWS that is adjacent to the Site, however both Scenarios 1 and 2 result in a significant reduction in impact compared to Scenario 0 and the spatial extent of impact in Scenario 2 is small accounting for approximately 1.5% of the LWS area. Further the prediction can be considered precautionary given the assessment assumptions.

APPENDIX A

Modelling Checklist

Item	Yes/No	Details / Reason for Omission
Location map	Yes	Figure 5-1 and Figure 5-2
Site plan	Yes	Figure 4-1 to Figure 4-3
Pollutants modelled and relevant EALs	Yes	Section 2.2 and 2.3
Details of modelled scenarios	Yes	Section 1.1
Details of relevant ambient concentrations	Yes	Section 5.0
Model description and justification	Yes	Section 4.1
Special model treatment used	Yes	Section 4.2.1 and 4.3.1
Table of emission parameters used	Yes	Table 3-2
Details of modelled domain and receptors	Yes	Section 4.1.1 and Section 5.1
Details of meteorological data used	Yes	Section 4.1.4 and Section 5.4
Details of terrain treatment	Yes	Section 4.1.3
Details of building treatment	Yes	Section 4.1.2
Details of modelling deposition	Yes	Section 4.3.1
Model uncertainty and sensitivity	Yes	Section 4.1.6
Assessment of impacts	Yes	Section 6.0
Contour plots	Yes	Appendix B
Model input files	Yes	Appendix C

APPENDIX B

Isopleth Plots

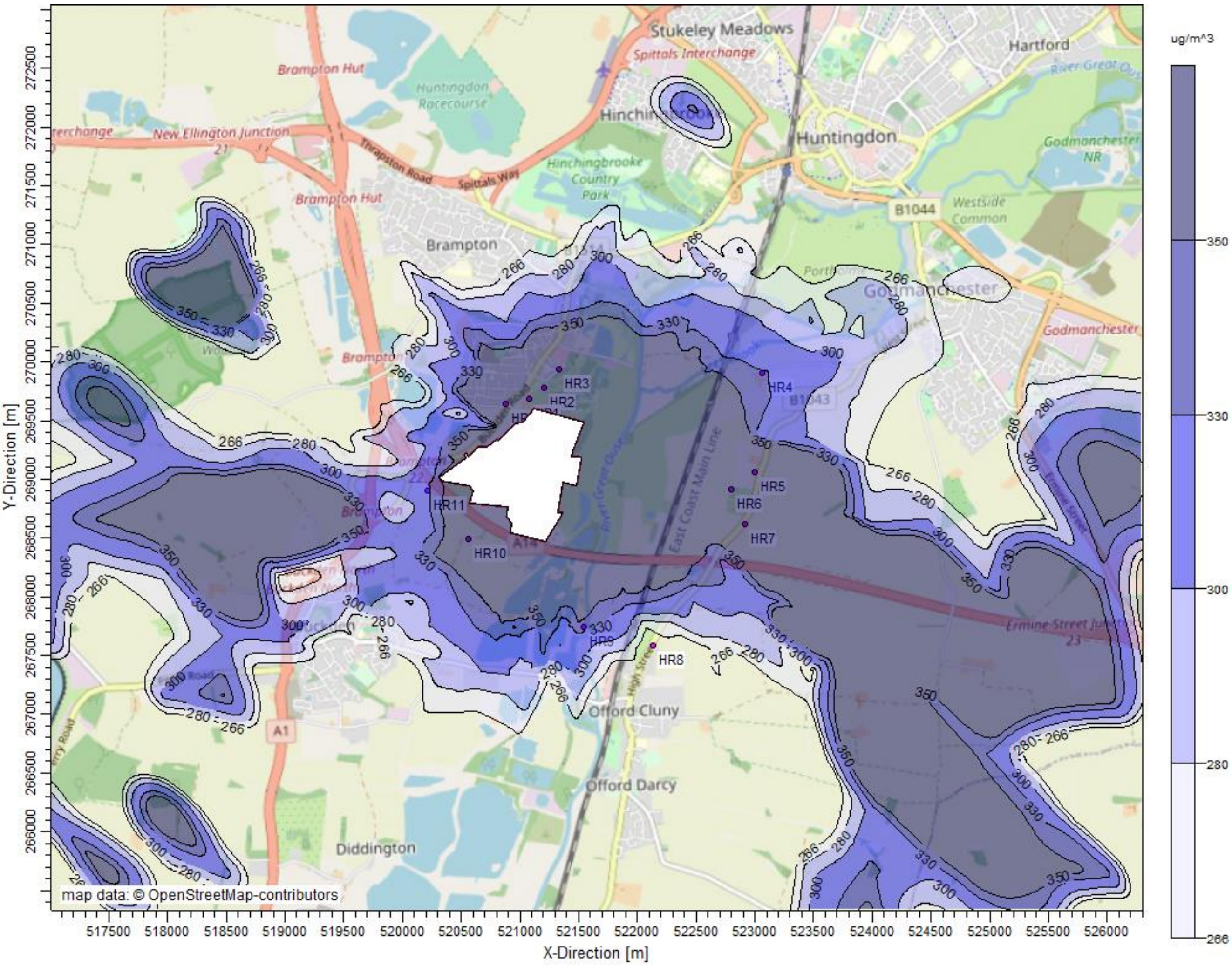


Figure B-1
15-minute Mean (99.9%ile) Sulphur Dioxide Process Contribution (Sc0)

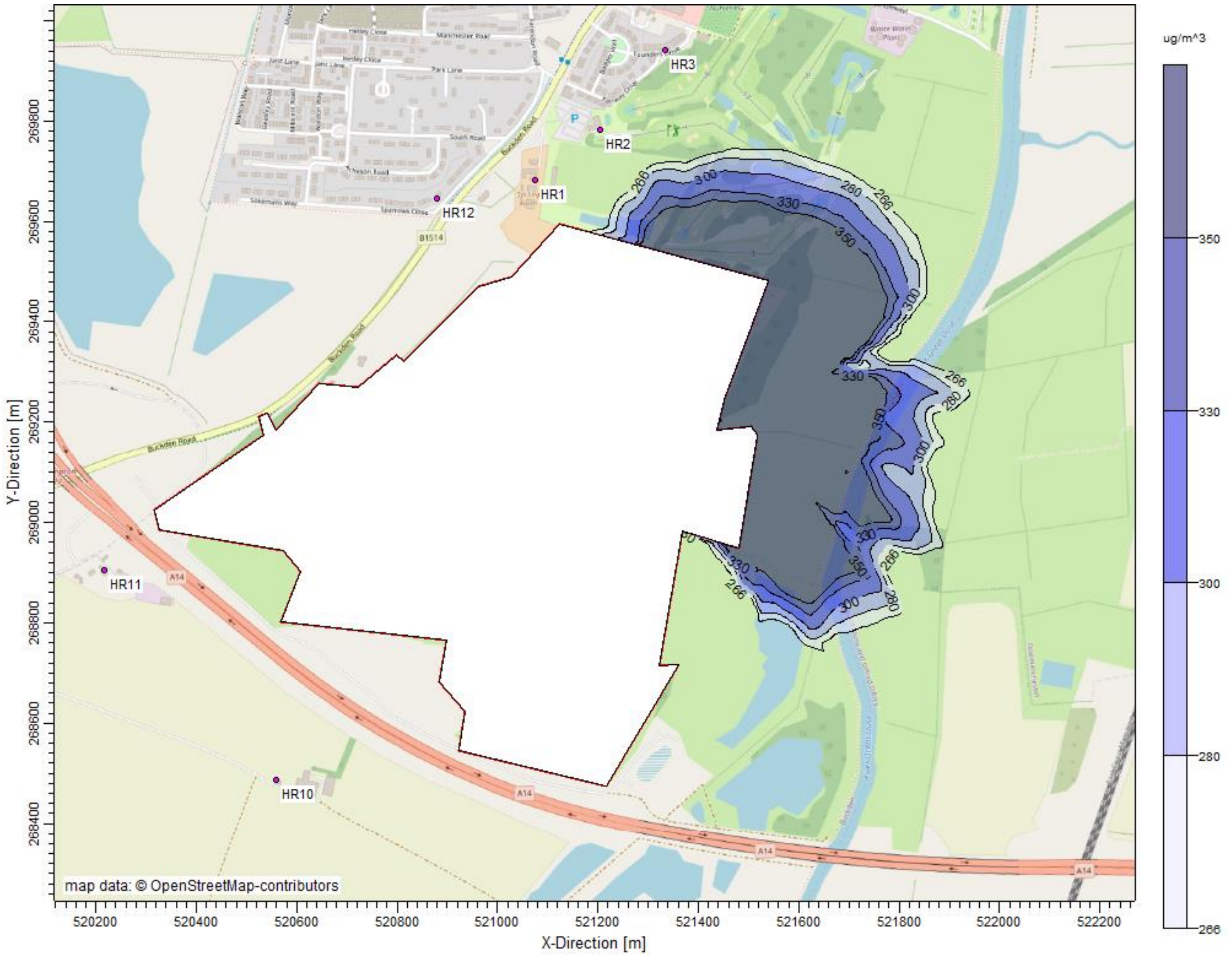


Figure B-2
15-minute Mean (99.9%ile) Sulphur Dioxide Process Contribution (Sc1)

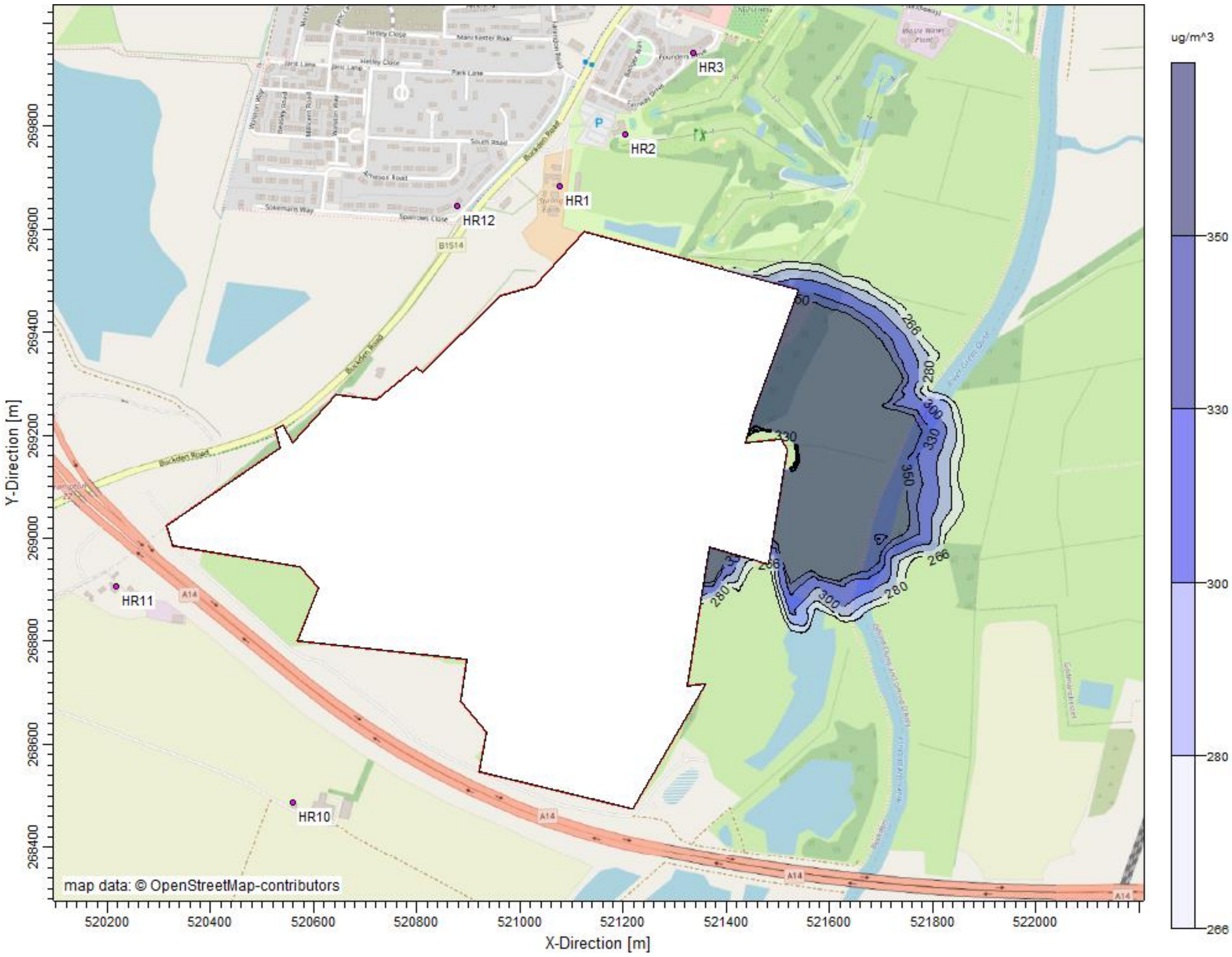


Figure B-3
15-minute Mean (99.9%ile) Sulphur Dioxide Process Contribution (Sc2)

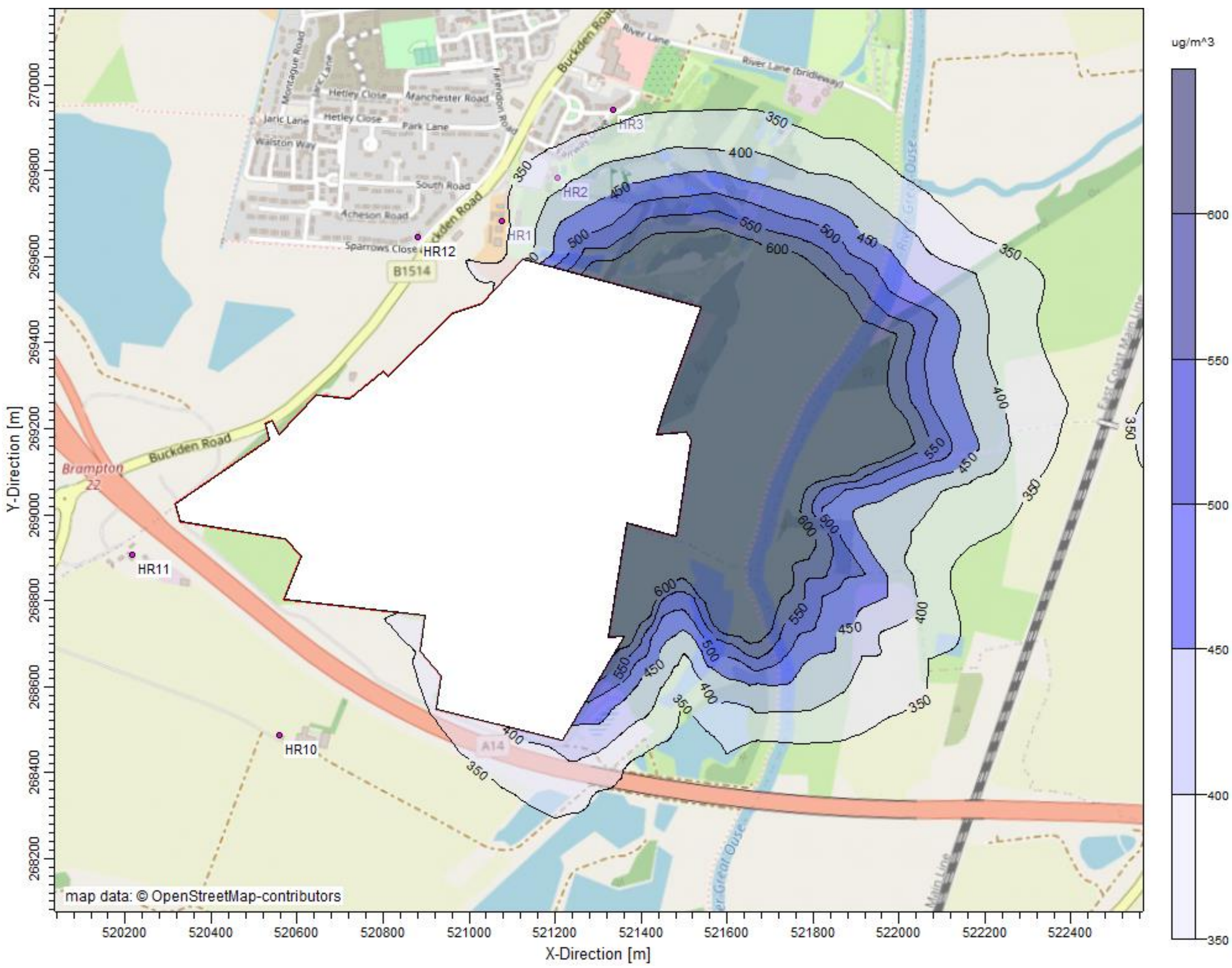


Figure B-4
1-hour Mean (99.73%ile) Sulphur Dioxide Process Contribution (Sc0)

Figure B-5
1-hour Mean (99.73%ile) Sulphur Dioxide Process Contribution (Sc1)

Figure B-6
1-hour Mean (99.73%ile) Sulphur Dioxide Process Contribution (Sc2)

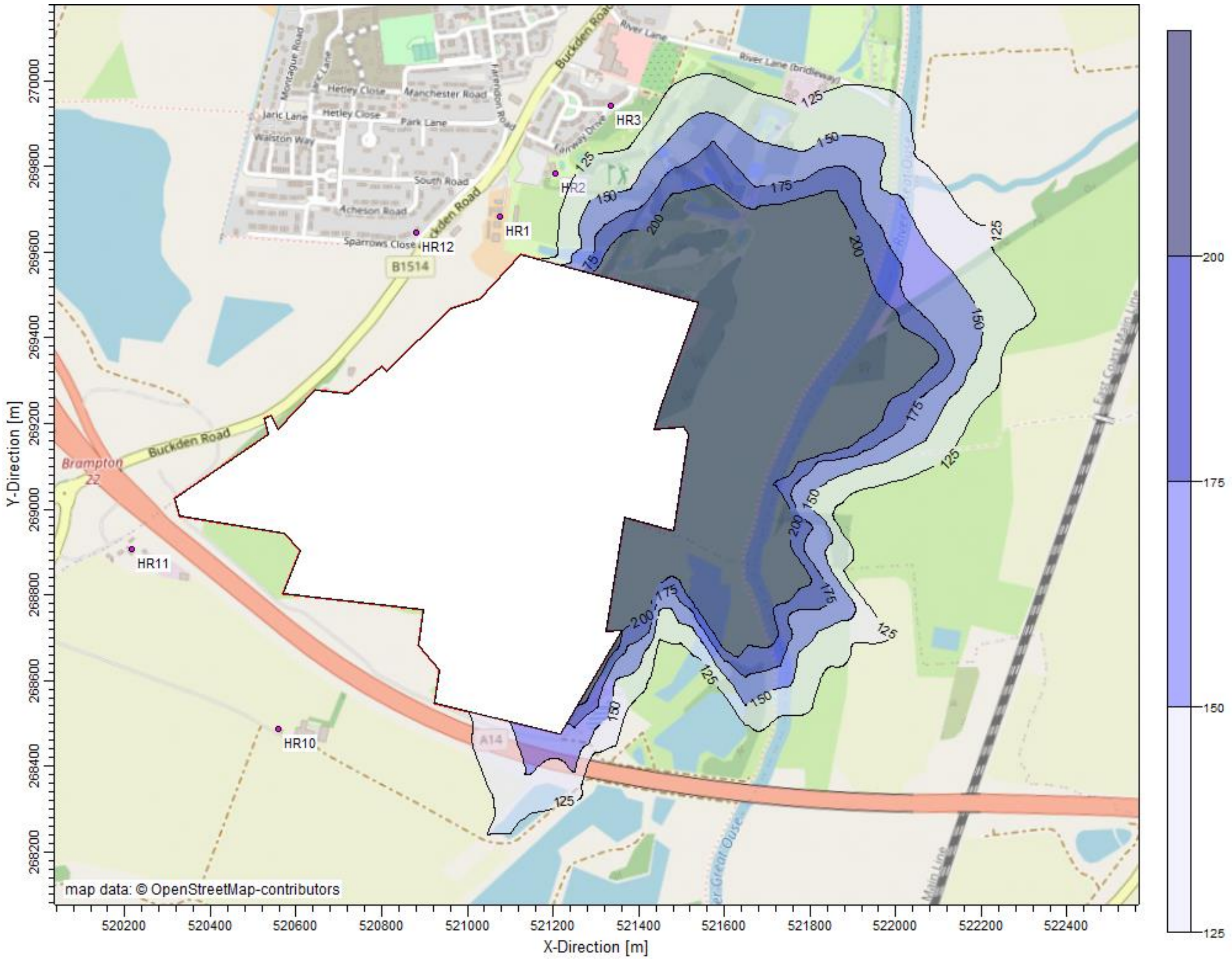


Figure B-7
24-hour Mean (99.18%ile) Sulphur Dioxide Process Contribution (Sc0)

Figure B-8
24-hour Mean (99.18%ile) Sulphur Dioxide Process Contribution (Sc1)

Figure B-9
24-hour Mean (99.18%ile) Sulphur Dioxide Process Contribution (Sc2)

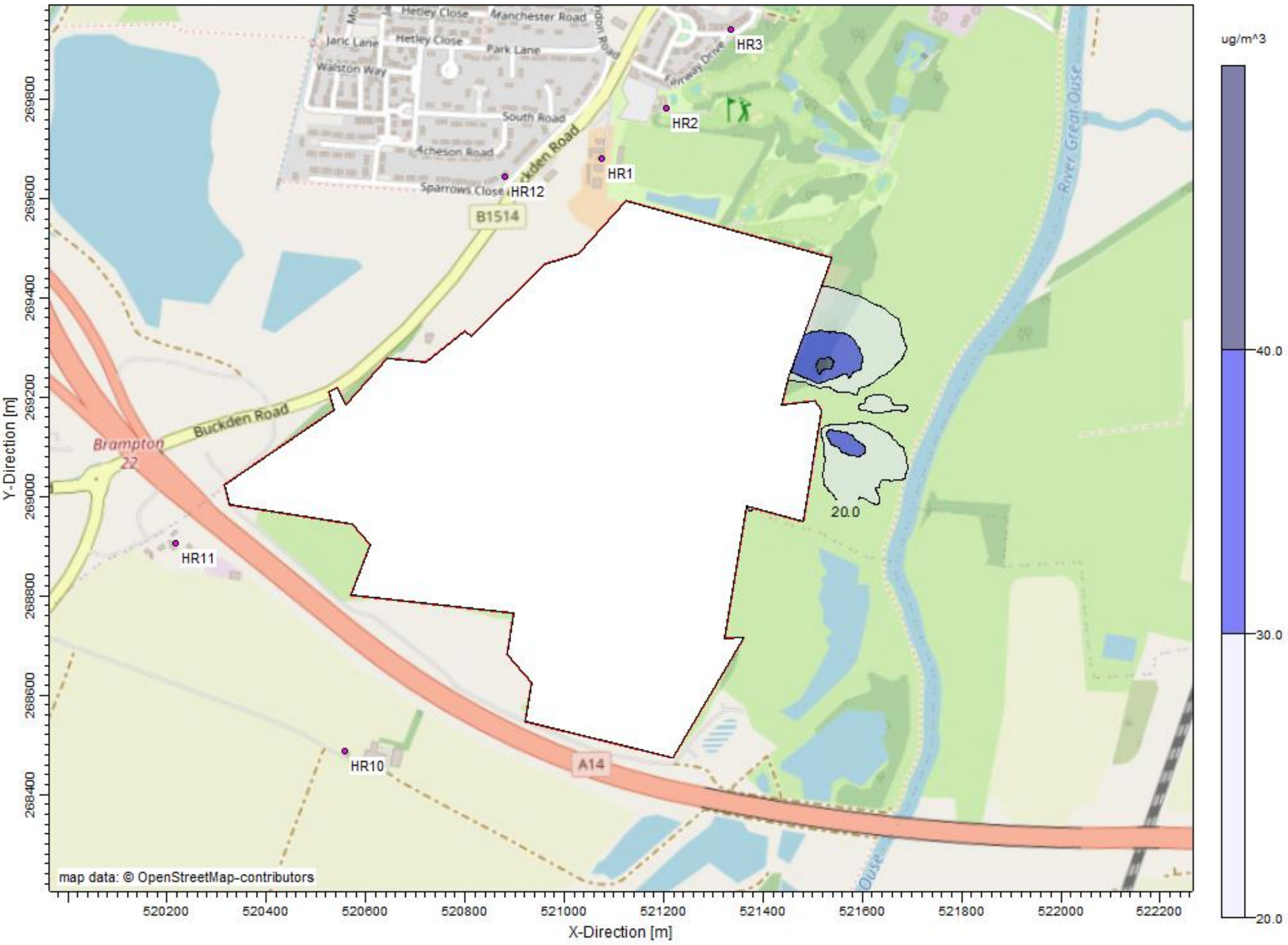


Figure B-10
1-hour Mean (99.79%ile) Nitrogen Dioxide Process Contribution (Sc2)

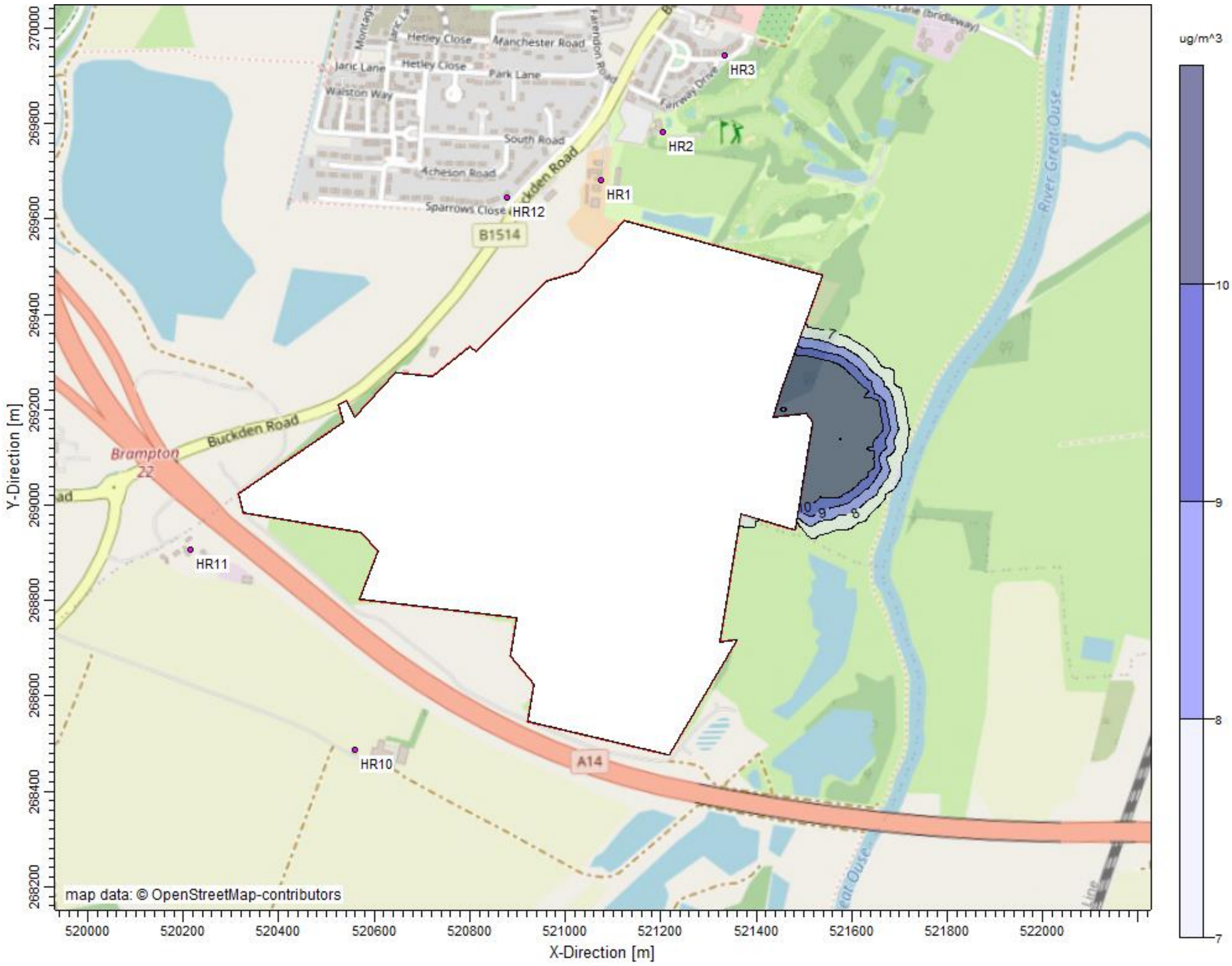


Figure B-11
30-minute Mean Hydrogen Sulphide Process Contribution (Sc0)

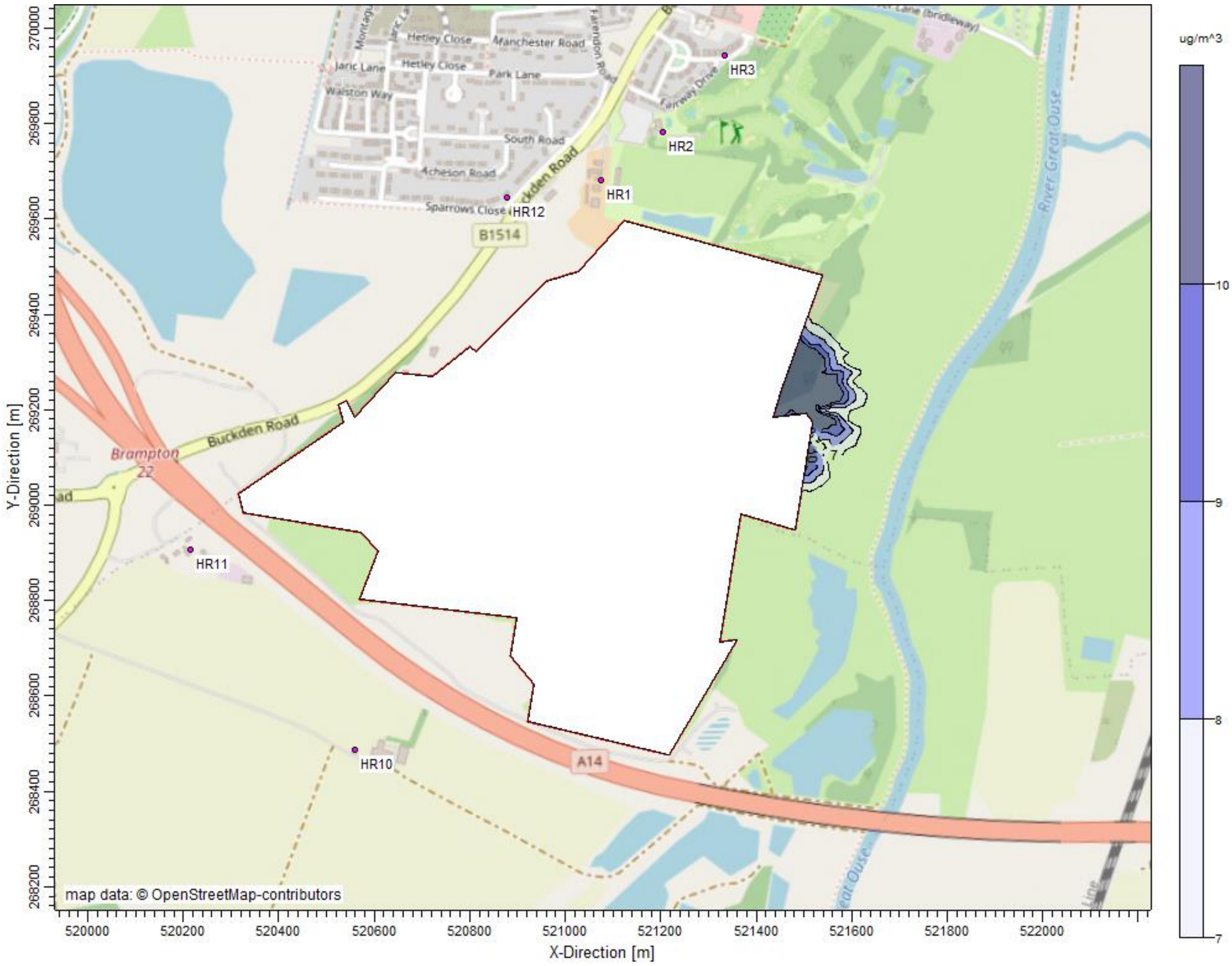


Figure B-12
30-minute Mean Hydrogen Sulphide Process Contribution (Sc1)

Figure B-13
30-minute Mean Hydrogen Sulphide Process Contribution (Sc2)

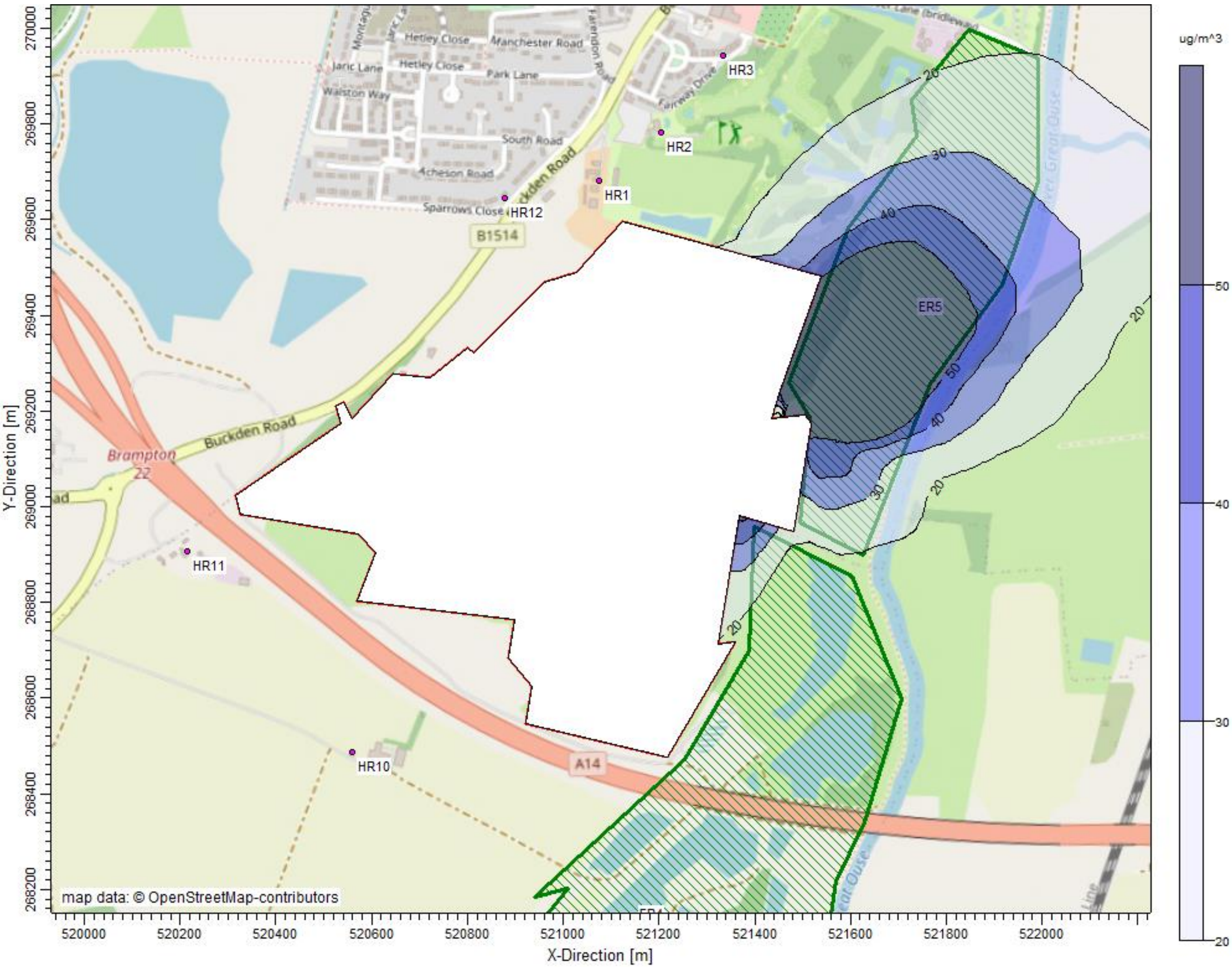


Figure B-14
Annual Mean Sulphur Dioxide Critical Level Process Contribution (Sc0)

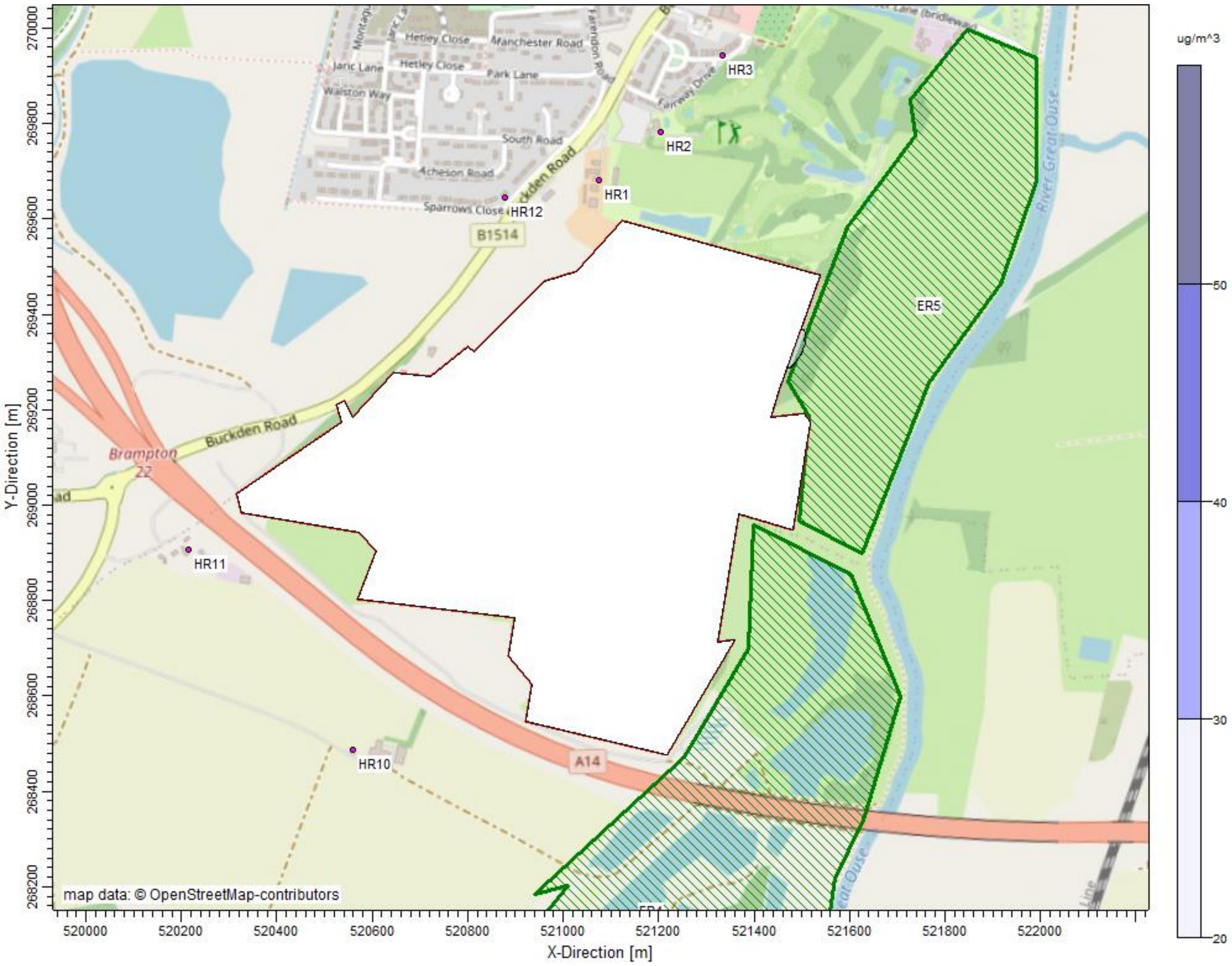


Figure B-15
Annual Mean Sulphur Dioxide Critical Level Process Contribution (Sc1)

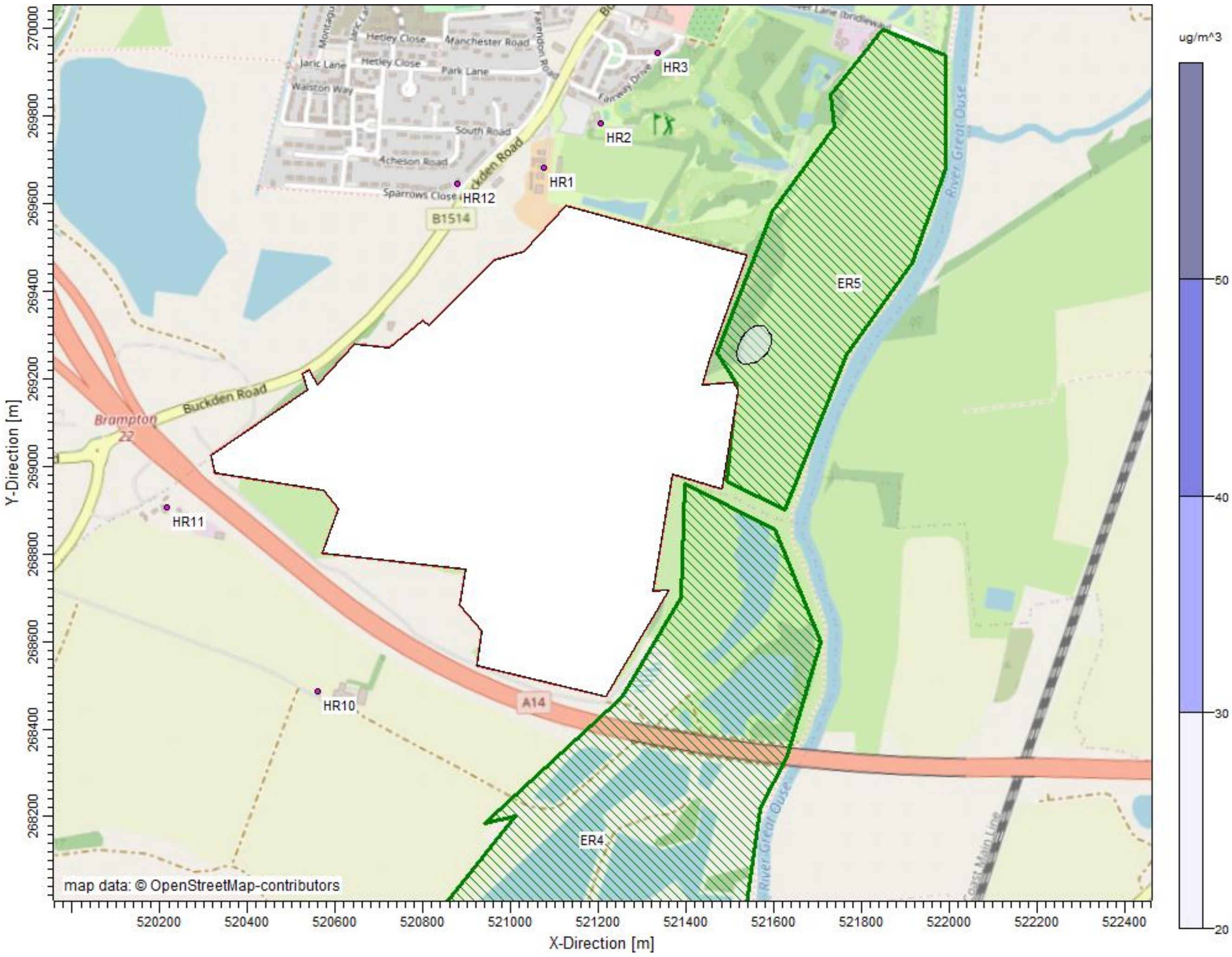


Figure B-16
Annual Mean Sulphur Dioxide Critical Level Process Contribution (Sc2)

APPENDIX C

Model Files (electronic only)

APPENDIX D

Monitoring Data (electronic only)

EUROPEAN OFFICES

AYLESBURY
T: +44 (0)1844 337380

BELFAST
belfast@slrconsulting.com

BIRMINGHAM
T: +44 (0)121 2895610

BONN
T: +49 (0)176 60374618

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

BRISTOL
T: +44 (0)117 9064280

CARDIFF
T: +44 (0)2920 491010

CHELMSFORD
T: +44 (0)1245 801630

CORK
T: +(021) 240 9000

DUBLIN
T: +353 (0)1 296 4667

EDINBURGH
T: +44 (0)131 335 6830

EXETER
T: +44 (0)1392 490152

FRANKFURT
frankfurt@slrconsulting.com

GLASGOW
glasgow@slrconsulting.com

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

KILKENNY
kilkenny@slrconsulting.com

LEEDS
T: +44 (0)113 5120293

LONDON
T: +44 (0)203 8056418

MAIDSTONE
T: +44 (0)1622 609242

MANCHESTER
T: +44 (0)161 8727564

NETHERLANDS
T: +31 6 28 02 18 80

NEWCASTLE UPON TYNE
T: +44 (0)1844 337380

NOTTINGHAM
T: +44 (0)115 9647280

SHEFFIELD
T: +44 (0)114 2455153

SHREWSBURY
T: +44 (0)1743 239250

SPAIN
T: +34 6 82 04 83 01

STIRLING
T: +44 (0)1786 239900

WORCESTER
T: +44 (0)1905 751310