Earthcare
TECHNICAL

Air Quality Impact Assessment to Support a Bespoke Permit Application for Horse Close Anaerobic Digestion (AD) Plant, Courteenhall, Northamptonshire, NN7 2QF

On behalf of: Acorn Bioenergy Operations Limited

Prepared by:

ETL747/2025

Earthcare Technical Ltd
Manor Farm
Chalton
Waterlooville
Hants PO8 0BG

Tel: 02392 290 488

Email: Office@earthcaretechnical.co.uk

11 June 2025

Document Control

Document Title:	**Air Quality Impact Assessment to Support a Bespoke Permit Application for Horse Close Anaerobic Digestion (AD) Plant, Courteenhall, Northamptonshire, NN7 2QF**
Revision:	V1.1
Date:	11 June 2025
Document Reference:	ETL747_HRCL_AQIA_V1.1_June25
Prepared For:	On behalf of: Acorn Bioenergy Operations Limited
Project Reference:	ETL747/2025
Copyright:	Earthcare Technical Ltd. © 2025

Version Control

Issue	Date	Revision details	Author	Technical review	Approved by
V1 Issue 0	21/02/2025	First Issue	M Fuhrmann	C McHugh	A Becvar
V1 Issue 1	11/06/2025	Revised First Issue	M Fuhrmann	C McHugh	A Becvar

Contents

LIST OF TABLES

LIST OF FIGURES

Abbreviations

AAD	Ambient Air Quality Directive (2008/50/EC)
AADT	Annual average daily traffic
AEL	Associated Emissions Level
AcidDep	Acid deposition
acph	Air changes per hour
AD	Anaerobic Digester
AOD	Above Ordnance Datum
APIS	Air Pollution Information System
AQMA	Air Quality Management Area
AQIA	Air Quality Impact Assessment
AQS	Air Quality Standards
AQSR	Air Quality Standards Regulations 2010
AW	Ancient Woodland
BAT	Best Available Techniques
BG	Biogas
BLD	Boundary layer depth
BUP	Biogas upgrading plant
CH_4	Methane
CHP	Combined heat and power (engine)
CLe	Critical level (concentration)
CLo	Critical load (deposition)
CO_2	Carbon dioxide
Defra	Department for the Environment, Food and Rural Affairs
EA	Environment Agency
EAL	Environmental Assessment Level
EC	European Commission
ELV	Emission Limit Value
EPR	Environmental Permitting Regulations
EPUK	Environmental Protection UK
ETL	Earthcare Technical Ltd
EU	European Union
GFS	Global Forecast System
h/day	hours per day
H1	Environment Agency Horizontal Guidance Note H1
H_2S	Hydrogen sulphide
HGV	Heavy goods vehicle
IAQM	Institute of Air Quality Management
IED	Industrial Emissions Directive

kWe	Kilowatts electrical output
kWthi	Kilowatts thermal input
kWtho	Kilowatts thermal output
LAQM	Local Air Quality Management
LWS	Local wildlife site
MCP	Medium Combustion Plant
MCPD	Medium Combustion Plant Directive
MWth	Megawatts thermal input
n/a	Not applicable
N	Nitrogen
NDep	Nutrient nitrogen deposition
NBRC	Northamptonshire Biodiversity Records Centre
NG	Natural gas
NGR	National Grid Reference
NOx	Nitrogen oxides
O_2	Oxygen
PC	Process Contribution
PEC	Predicted environmental concentration
PRV	Pressure relief valve
PVRV	Pressure and vacuum relief valve
PST	Pre-storage tank
S	Sulphur
SAC	Special Area of Conservation
SO_2	Sulphur dioxide
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
TG	Technical Guidance
TPA	Tonnes per annum
TVOC	Total gaseous and vaporous organic substances, expressed as total organic carbon
VOC	Volatile organic compounds
%v/v	Percent by volume (v/v)
WNC	West Northamptonshire Council

Executive Summary

Earthcare Technical Ltd (ETL) have evaluated the potential air quality impact associated with the proposed operation of the Horse close Anaerobic Digestion (AD) Plant, Courteenhall, Northamptonshire, NN7 2QF.

The evaluation, based on detailed atmospheric dispersion modelling using ADMS 6, assesses the significance of any potential short and long-term effects in relation to the air quality standards set in legislation and relevant evaluation criteria provided in guidance.

In accordance with relevant guidance, for sensitive receptors that may be affected by emissions from the operation of the plant, the long- and short-term predicted impacts at all receptors can be screened out as not significant and there is no need for further assessment. Based on Total Volatile Organic Compounds (TVOC) from combustion sources assessed proportionally as benzene, the relevant standards are not predicted to be exceeded at locations where the long and short-term objectives apply. On this basis, the potential impacts of TVOCs assessed as benzene are considered not significant.

Long-term and short-term air quality impacts of predicted concentrations at nationally and locally designated ecological sites are determined as not significant.

The potential for impact on these sites as a result of nitrogen and acid deposition from the process is considered unlikely.

Detailed modelling was also applied to predict the potential odour impact at nearby sensitive locations. Predicted odour concentrations are below the adopted criterion of $3ou_E/m^3$ for 'moderately offensive' odours. On this basis, the site operation is not likely to cause odour impact at human receptors.

1 Introduction

1.1 Background

This Air Quality Impact Assessment (AQIA) is produced to support an application for a new bespoke Installation Environmental Permit for an anaerobic digestion (AD) plant including the use of resultant biogas for Horse Close AD Plant, located on agricultural land at Courteenhall, Northamptonshire, NN7 2QF centred on National Grid Reference (NGR): SP 77438 52588, herein termed 'the Site'. The plant will be operated by Acorn Bioenergy Operations Limited (ABL), herein termed 'the Operator'.

An H1 risk assessment, following H1 methodology set out in Environment Agency (EA) guidance[1] and using the EA H1 Assessment Tool has been undertaken to determine whether any pollutants can be screened out from further consideration. The H1 tool is considered a conservative tool and the H1 assessment is reported in a document submitted alongside this AQIA.[2] It concluded that the following pollutants, (and averaging time), required detailed modelling for comparison with Environmental Assessment Levels (EALs):

EALs for human health:

- Nitrogen dioxide (annual and 1-hour mean)
- Carbon monoxide (8-hour mean)
- Benzene (annual and 24-hour mean)
- Sulphur dioxide (15-minute mean)
- Sulphur dioxide (24-hour mean)

EALs for potential impacts on the local and nationally designated ecological sites:

- Nitrogen dioxide (ecological - daily mean)
- Sulphur dioxide (ecological-other vegetation)
- Sulphur dioxide (ecological -lichens and bryophytes)
- Ammonia (ecological-other vegetation)
- Ammonia (ecological -lichens and bryophytes, lower critical level of 1μg/m^3)

1.2 Site description

Figure 1 shows the proposed green line permit boundary for the AD Plant,

Figure 2 shows the emission points of the AD Plant. The area enclosed by the permit boundary is referred to herein as 'the Site.'

[1] Environment Agency and Department for Environment, Food & Rural Affairs, Air emissions risk assessment for your environmental permit, Available at: https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit [Accessed June 2025]
[2] Earthcare Technical Ltd (11 June 2025) H1 Assessment to Support a Bespoke Permit Application for Horse Close Anaerobic Digestion (AD) Plant, Courteenhall, Northamptonshire, NN7 2QF Document reference: ETL747_HRCL_H1_V1.1_June25.

The Site is located within the administrative area of West Northamptonshire Council (WNC). The nearest Air Quality Management Area (AQMA) is situated approximately 7.7km to the northwest.

The Site is situated approximately 170m southwest of the M1. Land use in the immediate locale is agricultural; there is a permitted poultry Installation located adjacent to the northeast of the Site boundary. The nearest sensitive receptors include commercial premises at East Lodge, Courteenhall, approximately 211m to the north of the proposed site boundary, and a residential property at East Lodge, Courteenhall, located 270m north of the Site. The village of Roade lies over 1.4km west of the Site.

Within 2km of the proposed site, there are:

- two sites of Ancient Woodland (AW); the closest is Salcey Forest situated 1.3km east of the site. The eastern section of Salcey Forest is designated as a Site of Special Scientific Interest (SSSI) and is located 2.9km from the Site. Rowley Wood AW, located 1.6km southeast, is also a Local Wildlife Site.
- four Local Wildlife Sites (LWS); Roade Disused Railway East (0.5km south southeast), Salcey Forest (1.3km east), Rowley Wood (1.6km southeast) and Preston Wood 2km northeast).

Roade Cutting SSSI, situated 2 km to the west of the Site, is designated for geological features only and is therefore not assessed further. Northamptonshire Biodiversity Records Centre note the presence of a Potential Wildlife Site (PWS), adjacent to the northwest site corner which has not been considered as such as this is unverified.

Within 10km of the Site the Upper Nene Valley Gravel Pits is designated as a Special Protection Area (SPA), is a Ramsar wetlands site and SSSI.

A Nature and Conservation Screening Report provided by the Environment Agency is provided as Appendix A to this report.

1.3 Scope of report

This AQIA assesses the impact on human and ecological receptors of emissions to air from the proposed AD Plant. Emissions to air have been modelled in normal operation at the specified ELVs if ELVs exist for the sources; if there are no ELVs, the emission concentrations have been taken from indicative monitoring data from similar plant at other sites.

The ADMS 6 dispersion model has been used to calculate concentrations of the pollutants, from which dry deposition to sensitive conservation sites has been calculated.

While ELVs and the air quality standards for ecological receptors are specified for nitrogen oxide (NOx), standards for human health are for nitrogen dioxide (NO_2) which is emitted as a by-product of combustion and is formed (and consumed) in chemical reactions including NOx and other species.

Predicted concentrations have been compared with relevant air quality standards (AQS) (limits, targets, objectives, and assessment levels) to assess their significance, considering background concentration data where relevant. There are no AQS for Total volatile organic compounds

(TVOC) but there is an AQS for benzene which is one of the VOCs emitted. Benzene emission from the CHPs has been assessed as a fraction of TVOC, 2% for the CHPs and 5% for the emergency flare, as detailed in Section C.5.3.

The pollutants considered in this AQIA are, therefore:

- Nitrogen oxide (NOx)/nitrogen dioxide (NO_2)
- Sulphur dioxide (SO_2)
- Carbon monoxide (CO)
- TVOCs/ benzene
- Ammonia (NH_3)
- Odour

Predicted deposition fluxes have been compared with critical loads for nutrient nitrogen deposition and acid deposition at sensitive conservation sites.

This report describes the: proposed AD Plant processes on Site (Section 2); relevant legislation and guidance for industrial emissions, ambient air quality and modelling of emissions to air (Section 3); the assessment methodology used to model concentrations of pollutants and odour (Section 4); assessment criteria including air quality limit values, objectives and Environmental Assessment Levels and significance criteria (Section 5); background concentrations (Section 6); and results of the dispersion modelling (Sections 7, 8 and 9); before Section 10 provides conclusions.

2 Process description and emissions to air

2.1 Process description

This section provides a summary of the process which should be read in conjunction with the Process Flow Diagram provided in Appendix B.

With specific regard to emissions to air, supporting infrastructure includes the following, where numbering A1-A24 refer to point source emissions, as shown on the emission point plan (Figure 2) and within Table 1 below.

Table 1 Description of emission points A1-A24

Emission Point Reference	Source
A1	Combined Heat and Power Engine stack 1 (8.7m height stack TEDOM Quanto 1200 1.2 MWe)
A2	Combined Heat and Power Engine stack 2 (8.7m height stack (TEDOM Quanto 1200 1.2MWe)
A3	Emergency Flare (10.5m height stack)
A4	Emergency Boiler stack (7m height stack) 500 kWtho (BG)/ 560kWtho (NG)
A5	Emergency Diesel Generator (770 kVA)
A6	Emissions abatement plant stack (Manure Reception Building)
A7	Biogas upgrade unit Pressure Relief Valve (PRV)
A8	Biogas upgrade unit carbon dioxide recovery vent
A9	Carbon dioxide recovery plant PRV1
A10	Carbon dioxide recovery plant PRV2
A11	Compressor PRV 1
A12	Compressor PRV 2
A13	Underground Leachate Tank vent
A14	Pressure and Vacuum Relief Valve (PVRV) on Primary Digester 1
A15	PVRV on Secondary Digester 1
A16	PVRV on Primary Digester 2
A17	PVRV on Secondary Digester 2
A18	PVRV on Tertiary Digester
A19	Covered Digestate Storage Lagoon (12,350m^3 capacity) carbon filter outlet
A20	Liquid Feedstock Tank carbon filter outlet
A21	Liquid Digestate off-take point carbon filter outlet
A22	PVRV on liquid digestate storage lagoon
A23	Carbon dioxide recovery plant unit carbon dioxide vent
A24	Liquid digestate off-take point carbon filter outlet

The facility will treat around 94,900 tonnes per annum (TPA) of liquid and solid feedstocks comprising livestock waste (poultry litter, farmyard manures and slurry), energy crops and crop residues; and as well as dirty water, several non-hazardous liquid wastes, if required to supplement process water use, and reduce consumption of potable water. The 6.2ha of Site area was previously arable land and is adjacent to a poultry unit, the manures from which will be treated within the AD Plant.

The site will produce 20,286 Nm^3/y of biogas which will be used on site to generate heat and power and upgraded to biomethane for injection to the National Gas Grid via virtual pipeline and carbon dioxide captured for use or sequestration. In addition, around 26,182 TPA of solid fibre digestate and 67, 454 TPA of liquid digestate will be produced to be used as a biofertiliser on local farms.

All solid manure feedstock is received and processed within an enclosed Manure Reception Building which benefits from the continuous operation of an air extraction and emissions abatement plant (emission point **A6**).

There are two PowerRing Digesters (incorporating a primary and secondary digester in a unique Biogest design) and one Tertiary Digester. Each digester will have a PVRV (emission points **A14** to **A18**) to emit biogas or take in air if there is an over-pressure or under-pressure event respectively. PVRVs will not operate during normal operation, over-pressure is managed by operation of the emergency flare (emission point **A3**) before the PVRVs are operated. The operation of the digester PVRVs has therefore not been considered within this assessment.

Emissions will be released from the combustion of biogas (BG) in CHP1 (SO_2, TVOC, NOx and CO) and natural gas (NG) in CHP2 (TVOC, NOx and CO) from 8.7m height stacks (emission points **A1** and **A2**). The 2No. 1,200kWe CHPs are required to meet the Medium Combustion Plant (MCP) Directive Emission Limit Values (ELVs) for SO_2 and NOx for new plant.[3] The emissions and monitoring standards that apply to TVOC and CO from biogas fuelled engines are the same as those applied to landfill gas engines under LFTGN08 2010: guidance for monitoring landfill gas engine emissions. [4]

- 107 mg/Nm^3 for SO_2 (5% O_2), MCP ELV (for biogas)
- 500 mg/Nm^3 for NOx (5% O_2), MCP ELV (for biogas)
- 250 mg/Nm^3 for NOx (5% O_2), MCP ELV (for natural gas)
- 1,000 mg/Nm^3 for TVOC (5% O_2), LFTGN08
- 1,400 mg/Nm^3 for CO (5% O_2), LFTGN08

Biogas may be burnt under abnormal operating conditions such as during extended periods of maintenance of the CHPs and/or malfunction of the Biogas Upgrade Unit (BUU) by the emergency flare (emission point **A3**). The flare should operate for a limited number of hours per year (<10% or <876 hours) as it is only used under abnormal operating conditions. Guidance for

[3] DIRECTIVE (EU) 2015/2193 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 25 November 2015 on the limitation of emissions of certain pollutants into the air from medium combustion plants
[4] Environment Agency (2010) LFTGN08 v2 2010: guidance for monitoring landfill gas engine emissions (https://assets.publishing.service.gov.uk/media/5a7d87c140f0b64fe6c24434/LFTGN08.pdf)

monitoring enclosed landfill gas flares (LFTGN 05[5]) sets out the emission standards for enclosed gas flares:

- 150 mg/Nm^3 for NOx (3% O_2), LFTGN 05
- 50 mg/Nm^3 for CO (3% O_2), LFTGN 05
- 10 mg/Nm^3 for TVOC (3% O_2), LFTGN 05

The emergency biogas boiler (emission point **A4**) will be used to generate heat for the AD plant when the CHPs are unavailable and/or cannot provide sufficient heat to the AD Plant, for instance in the event of extreme cold weather, or CHP breakdown or prolonged unscheduled maintenance. It has been conservatively assumed in this assessment that the emergency boiler could potentially operate approximately 15% of the time (i.e. for approximately two months) but it is expected it will in practice operate less than 5% of the time. The emergency boiler can run on natural gas if required. The emergency boiler will not be used in normal operation.

The boiler will release emissions to air of NOx, SO_2 and CO from the 7m stack. The 647kWthi (thermal input) biogas-fired emergency standby boiler will meet the MCP Directive ELVs for new plant fired by biogas although it is not an MCP as its thermal input is less than 1MW. There are no BAT-AELs for TVOC and CO, emissions of which will be negligible from the emergency boiler:

- 100 mg/Nm^3 for SO_2 (3% O_2), MCP ELV
- 200 mg/Nm^3 for NOx (3% O_2), MCP ELV
- No limit set for CO (3% O_2)

An emergency standby diesel generator (770 kVA, 616kWe, 1,867kWthi) (emission point **A5**) will provide power when the CHPs are not operational and if power is not available from the grid. Therefore, it would be used only as an emergency backup operating typically less than 50 hours per year and operating less than 500 hours per year as a 3-year rolling average. It would be exempt from meeting MCPD ELVs and as such is not part of this quantitative assessment.

Biogas (45 - 60% CH_4 by volume) will enter the BUU where it will be treated to create biomethane (~97% CH_4 by volume) which leaves the BUU. Biogas from the gas holders will be pass through a series of gas treatment steps including cooling, filtration (2No. carbon filters to remove H_2S and 1 No. filter for VOCs, compression prior to three-stage membrane filtration which separates the biogas into methane (CH_4) and carbon dioxide (CO_2).

Under normal operating conditions there will be no emissions from the BUU. Biogas will be released from the Pressure Relief Valve (PRV) on the BUU in over-pressure scenarios only (emission point **A7**). If the CO_2 recovery plant is not operational, during abnormal conditions, residual CO_2 emissions will be released from the BUU via a stack ('CO_2 vent', emissions point **A8**). The cleaned gas that is vented must comply with Gas Safety Management Regulations for hydrogen sulphide (H_2S) and total sulphur, and TVOC at minimal level of detection. The release of CO_2 due to the abnormal operation of the BUU vent or PRV has therefore not been considered within this assessment.

[5] Environment Agency (2010) Guidance for monitoring enclosed landfill gas flares LFTGN05 v2 2010 (https://www.gov.uk/government/publications/monitoring-enclosed-landfill-gas-flares-lftgn-05)

The BUU will be fitted with CO_2 recovery equipment so the remaining CO_2 output stream will not be released to air but captured. The CO_2 is compressed in a two-stage process compressor and passed through an automatic molecular sieve dryer to completely remove moisture. When both the BUU and CO_2 recovery plant are operational, cleaned gas may be released from the PRVs in (abnormal) over-pressure scenarios only (emission points **A9** and **A10**). The BUU compressor has two PRVs (emission points **A11** and **A12**).

The gas (99.9% v/v CO_2 purity) is sent to a CO_2 liquefier; traces of non-condensable gases still contained in the CO_2 gas remain gaseous when the CO_2 transforms to liquid in the liquefier. Any entrained non-condensable gases, such as oxygen, methane, and nitrogen are effectively removed in a stripping tower. These non-condensable gases are used for regeneration of the dryer, the pure liquid CO_2 flows to a storage tank.

Under normal operating conditions there will be no emissions from the CO_2 recovery unit. CO_2 may also be released via a vent on the CO_2 capture equipment (emission point **A23**), when carbon capture is not being undertaken. The gas treatment technology is designed specifically to remove contaminants and ensure a high level of CO_2 purity. Emissions from the CO_2 recovery plant have therefore not been assessed.

Dirty water draining from areas within the containment bund (e.g. around the feed hoppers, the clamp covers), and from within the Manure Reception Building and the Digestate Separator Building is collected through a series of drainage channels, pipes and chambers and stored within the process water tanks; the Liquid Feedstock Tank (402 m^3) and the 2 No. Dirty Water Tanks (402 m^3) for use in the AD process. During periods of high rainfall additional dirty water storage is provided by the Dirty Water Lagoon which will allow 510 m^3 of water to be stored (i.e., up to 5 days' worth of process water storage) (Appendix B, Drainage Process Flow). Surface waters held within the lagoon would be dilute at these times and would not be expected to be a source of odour.

Silage leachate produced within the clamps runs forwards from the clamps into drainage channels, then to an (54 m^3) underground leachate storage tank, from which it is passed to the process water tanks, then used in the AD process. The leachate storage tank will be fitted with one vent (emissions point **A13**).

Tankers discharge liquid feedstock via sealed pipework into the Liquid feedstock tank (402 m^3). The headspace of the Liquid feedstock tank will be linked to an impregnated carbon filter outlet (**A20**).

Whole digestate from the Tertiary Digester will be screened and pasteurised before being cooled. Pasteurised digestate is pumped to the Hygienized Digestate Tank (80 m^3). Any displaced air during the pasteurisation process will be directed either to the gas line or to the Manure Reception Building emissions abatement plant. Whole digestate is then routed to the 2 No. RC75 Börger type mechanical separators capable of separating 75m^3/hr and up to 1800 m^3 per day of whole digestate each.

Separated liquor is pumped from the separator to either: the 12,350m^3 covered Digestate Storage Lagoon or the sealed 402m^3 Digestate Buffer Tank. Any displaced air during this transfer to the tank will be directed either to the gas line or to the Manure Reception Building emissions abatement plant.

During filling of the lagoon, when the Site is supervised during operational hours, a fan will be used to assist with ventilating displaced air through an impregnated carbon filter outlet (emission point **A19**). The fan will not operate at other times and the connection to the carbon filter sealed.

There will be a PVRV connected to the Liquid Digestate Lagoon as a safety feature to manage over pressure within the lagoon storage system should this occur (emission point **A22)**. This will not operate under normal conditions and therefore this emission point is not considered further within the assessment. Tankers will be filled with liquid digestate at 2No. tanker loading points, each fitted with an impregnated carbon filter emissions abatement system. It is expected that 75% of all vehicle offtake movements will take place at the main site's loading point (emission point **A24**), while the remaining 25% will occur at the loading point adjacent to the digestate lagoon (emission point **A21**).

2.2 Pressure and Vacuum Relief Valves

Pressure and Vacuum Relief Valves (PVRVs) are fitted on the digester tanks, in addition to Pressure Relief Valves (PRVs) on the biomethane upgrading and injection unit, the CO_2 recovery plant, compressors and the sealed Liquid Digestate Lagoon.

PVRVs are a necessary safety feature for an AD Plant but will only be used as a contingency to maintain the integrity of the infrastructure and/or equipment. The PVRVs are only activated in the event of over or under pressure within the AD tanks. Biogas will be burnt via an emergency flare in preference to release to atmosphere via the PVRVs. The supervisory control and data acquisition system (SCADA) for the AD Plant ensures that biogas is controlled in this manner.

Activation of the PVRVs represents an abnormal operating scenario and therefore the frequency of PVRV activation is not possible to predict for any plant in any given year albeit it is monitored when it occurs. The operator will seek to minimise PVRV activation through diligent optimised operation of the AD Plant. Therefore, the nature of these releases, typically very short-term sporadic events, would be difficult to represent accurately. PVRVs have therefore been neglected as a source of pollutants.

2.3 Summary of emissions to air

Table 2 lists the sources of emissions to air at the AD Plant that have been considered in this impact assessment.

Table 2 AD Plant sources of emissions to air to be assessed

Emission point reference	Source	Emissions	Modelled operational profile
Point Sources			
A1	CHP1 stack (BG)	NOx, SO_2, TVOC, CO	Continuous
A2	CHP2 stack (NG)	NOx, TVOC, CO	Continuous
A3	Emergency flare stack	NOx, TVOC, CO	Emergency back-up (1)
A4	Emergency biogas boiler stack	NOx, SO_2	Emergency back-up (2)
A6	Emissions abatement plant stack	NH_3, odour	Continuous
A13	Underground leachate tank vent	NH_3, odour	Continuous
A19	Covered Digestate Storage Lagoon carbon filter outlet	NH_3, odour	Continuous (3)
A20	Liquid Feedstock Tank carbon filter outlet	NH_3, odour	Continuous
A21	Liquid digestate off-take point carbon filter outlet	NH_3, odour	Modelled as continuous during operational hours. Factored for 25% vehicle offtake movements relative to offtake point A24 and operational hours (4)
A24	Liquid digestate off-take point carbon filter outlet	NH_3, odour	Modelled as continuous during operational hours. Factored for 75% vehicle offtake movements relative to offtake point A21 and operational hours (4)
Other sources			
N/A	Digestate separator bunker	NH_3, odour	Continuous (5)
N/A	Feed hoppers	Odour	Continuous
N/A	Clamp	Odour	Continuous

Notes: N/A = Not applicable

(1) Assumed conservatively to operate for 10% of the year (876 hours) for comparison with long-term AQS.

(2) Assumed conservatively to operate for 15% of the year (approximately 2 months) for comparison with long-term AQS. Typically, however the boiler will operate for approximately only 5% of the time.

(3) Modelled conservatively as a continuous emission.

(4) Intermittent emissions are modelled as equivalent total emissions continuous across operational hours.

(5) Modelled conservatively as a continuous emission, with emissions factored for periods when the access door is closed and those when the door is open during digestate loading.

2.4 Operational scenarios

This assessment considers the impact on receptors of emissions to air from combustion plant; the CHPs, emergency boiler, emergency flare, alone and when added to background concentrations.

The following scenarios have been modelled:

- **Modelled Long-term Scenario**, **normal operation**, all sources
  - CHP1 (BG), CHP2 (NG), operating continuously, emergency boiler (15%), emergency flare (10%) plus all other sources operating continuously
- **Modelled Short-term Scenario**, **normal operation**
  - CHP1 (BG), CHP2 (NG), plus all other sources except the emergency boiler and emergency flare operating continuously.
- **Modelled Short-term Scenario**, **abnormal operation**
  - CHP1 (BG), emergency boiler, emergency flare, plus all other sources except CHP2 (NG), all operating continuously.

For long-term impacts (annual means), the emergency boiler and emergency flare have been modelled with annual emissions equivalent to operating at full load for 15% and 10% of the year respectively.

The assessment of 'abnormal' short-term impacts pessimistically assumes that CHP1 (BG), the emergency boiler and emergency flare will operate at full load continuously and simultaneously, which would be very unlikely to occur; it is worst case as it assumes that emissions from the operation of the emergency boiler and flare might coincide with all worst-case meteorological conditions during the year.

3 Legislation and guidance

3.1 Overview

This section describes the relevant legislation, policy, and guidance relevant to this assessment which is summarised in Table 3 and described further in Section 3.2 and Section 3.3.

Table 3 Summary of legislation, policy and guidance

Short name	Name	Body	Scope
Legislation			
1995 Act	Environment Act 1995[6]	UK Parliament	Establishes the framework for managing air quality to achieve compliance with air quality objectives.
4th Daughter Directive	Directive 2004/107/EC[7]	European Commission, now EU	Sets limit values for arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air.
AAD	Ambient Air Quality Directive 2008/50/EC[8]	EU	Ambient air quality, sets limit and target values.
IED	Industrial Emissions Directive, 2010/75/EU[9]	EU	Industrial emissions.
MCPD	Medium Combustion Plant Directive, EU/2015/2193[10]	EU	Emission limit values for pollutants from combustion plant greater than 1MWth and less than 50MWth.
AQSR	Air Quality (Standards) Regulations 2010[11] as amended in 2016[12]	UK Parliament	Ambient air quality, standards for pollutant concentrations. Transposed EU limit values defined in AAD into law in England and Wales.
EPR	Environmental Permitting Regulations 2018[13]	UK Parliament	Industrial emissions. Transposed IED into law in England and Wales.

[6] Environment Act 1995, 1995 Chapter 25, Part IV Air Quality
[7] DIRECTIVE 2004/107/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL, of 15 December 2004, relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air.
[8] DIRECTIVE 2008/50/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 21 May 2008 on ambient air quality and cleaner air for Europe comment on amendment
[9] DIRECTIVE 2010/75/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 24 November 2010 on industrial emissions (integrated pollution prevention and control)
[10] DIRECTIVE (EU) 2015/2193 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 25 November 2015 on the limitation of emissions of certain pollutants into the air from medium combustion plants.
[11] Statutory Instrument: 2010 No. 1001, ENVIRONMENTAL PROTECTION, The Air Quality (Standards) Regulations 2010 comment on amendment
[12] The Air Quality Standards (Amendment) Regulations 2016, Statutory Instrument 2016 No, 1184, Made 6th December 2016
[13] The Environmental Permitting (England and Wales) (Amendment) Regulations 2018, Statutory Instrument 2010 No, 675

Short name	Name	Body	Scope
Guidance			
Defra permit guidance	Air emissions risk assessment for your environmental permit[14]	Department for Environment, Food & Rural Affairs and Environment Agency	How to undertake an air quality assessment for a permit
Waste Treatment BREF	BAT Reference Document Waste Treatment[15]	European IPPC Bureau,	Indicative BAT for waste treatment including Associated Emission Levels
Appropriate Measures	Biological waste treatment: appropriate measures for permitted facilities[16]	Environment Agency	Sets out appropriate measures for the treatment of organic materials
EA H4	Technical Guidance Note H4 – Odour Management[17]	Environment Agency	Guidance on assessing odour impact, includes benchmark values
Defra SWIP	Specified generators: dispersion modelling assessment[18]	Environment Agency and Natural Resources Wales	Includes reference for conversion of NOx to NO_2
AQTAG06	AQTAG06 Technical guidance on detailed modelling approach for an appropriate assessment for emissions to air[19]	Air Quality Advisory Group	Guidance on calculating deposition
LAQM.TG16	Local Air Quality Management, Technical Guidance (TG16)[20]	Department for Environment, Food & Rural Affairs and the Devolved Authorities	Includes general guidance on dispersion modelling

[14] Department for Environment, Food & Rural Affairs and Environment Agency, Air emissions risk assessment for your environmental permit, Available at: https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit [Accessed June 2025].
[15] Best Available Techniques (BAT) Reference Document for Waste Treatment, European IPPC Bureau, 2018
[16] Environment Agency (21 September 2022) Biological waste treatment: appropriate measures for permitted facilities. Available at: (https://www.gov.uk/guidance/biological-waste-treatment-appropriate-measures-for-permitted-facilities/1-when-appropriate-measures-apply).
[17] Environment Agency (March 2011) Technical Guidance Note H4 - Odour Management. How to comply with your environmental permit
[18] Environment Agency and Natural Resources Wales, Specified generators: dispersion modelling assessment, Available at: https://www.gov.uk/guidance/specified-generators-dispersion-modelling-assessment#nosubxsub-to-nosub2sub-conversion-ratios-to-use [Accessed February 2025].
[19] Air Quality Advisory Group, 2014, AQTAG06 Technical guidance on detailed modelling approach for an appropriate assessment for emissions to air
[20] Department for Environment, Food & Rural Affairs and the Devolved Authorities, Local Air Quality Management Technical Guidance (TG16), February 2018

3.2 Legislation and policy

3.2.1 Environment Act

The Environment Act, which established the Environment Agency for England and Wales with functions including the control of pollution. Part IV of the Environment Act 1995 establishes the framework for managing air quality to achieve compliance with air quality objectives and for local air quality management (LAQM). Under LAQM local authorities (district councils) are required to monitor, review, assess and improve air quality in their areas; if exceedances are monitored or predicted, they must consider establishing an AQMA. Part IV requires the Secretary of State to prepare a National Air Quality Strategy.

3.2.2 Ambient Air Quality Directive and 4th Daughter Directive

The Ambient Air Quality Directive and 4th Daughter Directive contain **Limit Values** and **Target Values** with which the UK must comply. The Ambient Air Quality Directive also addresses common methods and criteria; information on ambient air quality to help combat air pollution and nuisance, to monitor long-term trends; and making information and pollution alerts available to the public.

3.2.3 Air Quality Standards Regulations

The Air Quality (Standards) Regulations 2010 is the instrument by which the Ambient Air Quality Direction and the 4th Daughter Directive were transposed into English law.

3.2.4 Industrial Emissions Directive

The IED is the main EU instrument by which pollutant emissions from industrial installations are regulated. It consolidated seven earlier directives including, in particular, the Integrated Pollution Prevention and Control Directive and the Waste Incineration Directive. It defines emissions limit values (ELVs) for some process-fuel combinations but there are no ELVs relevant to the Biogas upgrading stack.

3.2.5 Medium Combustion Plant Directive

The MCPD regulates emissions of SO_2, NOx and dust to air and requires monitoring of carbon monoxide (CO) emissions in order to reduce emissions and risks to human and ecological receptors. MCPD ELVs apply from 2025 or 2030 for existing plants, depending on their size.

The relevant ELVs for proposed engines using biogas, which have been used in this assessment, are those defined in Part 2 of Annex II of the MCPD.

3.2.6 Environmental Permitting Regulations

The Environmental Permitting (England and Wales) (Amendment) Regulations 2023 is the latest consolidated version of instrument by which the IED was transposed into national legislation.

3.3 Guidance

3.3.1 Air emissions risk assessment for your environmental permit

The webpage provides Department for Environment, Food & Rural Affairs and Environment Agency guidance on how to carry an air emissions risk assessment.[21] It includes guidance on the ecological receptors to be assessed, tests on significance on results, relevant air quality Limit Values (from the Ambient Air Directory), objectives from the National Air Quality Strategy and it lists short-term (hourly) and long-term (annual mean) **Environmental Assessment Levels (EALs)** for human health.

3.3.2 Biological waste treatment: appropriate measures for permitted facilities.

This guidance applies to aerobic and anaerobic processes including AD including the combustion or upgrading of the resulting biogas and treating the digestate (AD can include wet, dry, and dry-batch digestion). There is overlap between BAT and necessary measures for waste operations. The EA uses the term 'appropriate measures' to cover both sets of requirements.

3.3.3 Technical Guidance Note H4 – Odour Management

The guidance from EA is intended for permit holders and applicants, to advise them on how to comply with odour conditions set by the permit. It covers, assessing odour pollution, measures to reduce pollution, control measures and monitoring. It contains advice on odour thresholds or benchmarks for assessment.

3.3.4 Specified generators: dispersion modelling assessment

The webpage provides Defra and Environment Agency guidance on how to do detailed air quality modelling for specified generators. This includes the use environmental standards for air, the use of NOx to NO_2 conversion ratios, and guidance on impact assessment.

3.3.5 Technical guidance on detailed modelling approach for an appropriate assessment for emissions to air

This document (AQTAG06) provides guidance on how to carry out a quantitative assessment (Stage 3 appropriate assessment) including guidance on calculating deposition for emissions to air in order to fulfil the requirements of the Habitats Regulations.

3.3.6 Local Air Quality Management, Technical Guidance

This technical guidance (LAQM.TG16) is published to support local authorities in carrying out their duties under the Environment Act 1995, which established the LAQM process. It provides guidance on monitoring and assessing air quality, action planning and reporting. While aimed at local authorities the advice in used more widely by those working in the field, and not just for LAQM.

[21] Environment Agency (EA) and Department for Environment, Food & Rural Affairs (Defra) Air emissions risk assessment for your environmental permit (last updated 7 January 2025) (https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit). Accessed June 2025.

4 Assessment Methodology

4.1 Introduction

The assessment methodology comprised three parts which are described in more detail in Sections 4 to 6:

1. Baseline conditions assessment at the Site and the surrounding area:
    - AQMAs and designated conservation areas; background concentration and deposition (section 6).
2. Modelling of impacts:
    - Assessment of the likely changes in concentration and deposition due to emissions from the sources listed in Table 2. Operation of the plant under normal and abnormal operating conditions. The assessment was undertaken using the ADMS 6 dispersion model (section 4.2).
    - The modelling assessment included an assessment of the sensitivity of model results and hence, the impacts, to changes in model input.
3. Assessment of significance. Sections 5.2, 5.3 and 5.4 describe the significance criteria.

If the impacts are significant then further investigation would be required.

4.2 Modelling of air quality impacts

4.2.1 Model

The dispersion model used to predict ambient concentrations due to the stack emissions was ADMS 6 (version 6.0.0.1). The model is termed a 'new generation' model and is commonly used in the UK for industrial permit applications to the Environment Agency.

It requires as input: data on the source of emissions and the mass emission rates of each pollutant (Table 4 to Table 6), meteorological data and associated parameters, buildings data, terrain data, and receptor locations. Full details of the meteorological, buildings and receptor data are described in Appendix C.

The outputs calculated by the model are the air concentrations of pollutants from the sources modelled for the relevant averaging times and statistics. The contribution from the modelled sources on the Site to air concentration and to deposition rates are referred to the Process Contribution (PC), which is then compared with the relevant AQS. When background concentrations or deposition rates are added to the PC, the totals are referred to as Predicted Environmental Concentration (PEC) and Predicted Environmental Deposition Rate (PEDR) respectively, which are also compared with the relevant AQS.

From air concentrations of NO_2 the deposition rate of nitrogen can be calculated and the acid deposition due to nitrogen; from the air concentration of SO_2 the contribution of sulphur to acid deposition can be calculated.

4.2.2 Model scenarios

In section 2.4 the modelled scenarios are summarised as:

- **Modelled Long-term Scenario**, **normal operation**, all sources
    - CHP1 (BG), CHP2 (NG), operating continuously, emergency boiler (15%), emergency flare (10%) plus all other sources operating continuously
- **Modelled Short-term Scenario**, **normal operation**
    - CHP1 (BG), CHP2 (NG), plus all other sources except the emergency boiler and emergency flare operating continuously.
- **Modelled Short-term Scenario**, **abnormal operation**
    - CHP1 (BG), emergency boiler, emergency flare, plus all other sources except CHP2 (NG) all operating continuously.

Both scenarios have been modelled as occurring all year in order to capture the impacts if the scenario were to coincide with the worst-case meteorological data that gives rise to the greatest impacts.

It is a very conservative assumption in terms of the abnormal scenarios to assume that their occurrence, which will persist for a short period, will coincide with all the worst-case meteorological conditions.

4.2.3 Model options and sensitivity

The model was run for each of the five years of meteorological data (2019-2023) for three combinations of model option scenarios:

- Flat terrain: no buildings and no terrain (hills)
- Buildings: with buildings and no terrain (hills)
- Terrain (hills): with buildings

Results at the receptors were calculated as the maximum value at each receptor from these 15 models runs and are therefore worst-case values across all five years and the three model options scenarios. Use of five years' meteorological data in the modelling is to account for intra-annual variation.

The impact of buildings, terrain and meteorological data year were assessed, and the results are given in Appendix D.

For human and ecological receptors, modelling buildings led to higher model prediction than for flat terrain. Modelling terrain as well as buildings generally led to a further increase. The variation due to meteorological data year is generally less significant than the impact of modelling buildings.

The results presented in this report are the worst case across 15 model runs: flat terrain, with buildings, with buildings and terrain, each modelled with five years of meteorological data. The assessment is therefore conservative (pessimistic) is this respect.

4.2.4 Sources and emissions

The source geometry, parameters, ELVs, design emission limits and calculated emissions are given in Table 4 for the CHPs (**A1, A2**), emergency flare (**A3**) and emergency boiler (**A4**), Table 5 summarises the input parameters for the emissions abatement plant stack (**A6**) for the Manure Reception Building, the Underground Leachate Tank (**A13**), 1No. Covered digestate storage lagoon carbon filter outlet (**A19**), Liquid Feedstock Tank carbon filter outlet (**A20**), and the Liquid Digestate Off-take point carbon filter outlet (**A21**). Table 6 sets out the parameters for volume sources including the silage clamps, feedstock hoppers, and Separation Bunker.

There are changes in ground level across the site. In the Flat terrain and Buildings model scenarios (section 4.2.3) stack and building heights were modified to account for changes in ground level as described in Appendix C, section C.3. In the Terrain (hills) model scenario such an adjustment is not required as the ADMS model accounts for changes in terrain height. The heights of emission sources given in Table 4, Table 5 and Table 6 are the unadjusted heights.

The CHPs and emergency boiler have been modelled using MCP ELVs. While the exact plant has not been finalised at this stage, representative data have been used in this assessment (Appendix E and Appendix F). Emissions from the emergency flare, a Gas Technik Himmel ground flare, were modelled at the permit ELVs; it can burn up to 2,600m^3/h of biogas. The efflux parameters have been provided by the manufacturer (Appendix G). Benzene emissions have been represented as 5% of TVOC emissions from the combustion plant (Appendix C, section C.5.3).

For the assessment of short-term impacts, all combustion plant is assumed to operate continuously at full load. Assuming the continuous operation of these sources provides a pessimistic prediction of impacts as no account has been taken of planned outages for maintenance.

Key design details of the proposed system are based on advice provided by the technology provider. Table 5 details the input parameters for the **Emissions abatement plant** point source (**A6**). The system is expected to achieve the Best Available Techniques (BAT) associated emission levels (AELs) for the waste treatment sector, BAT-AEL[15] of 1,000ou$_E$/m^3 for odour. Exhaust concentrations of NH_3 are based on the predicted outlet concentrations provided in the manufacturer's specification (Appendix H). Based on inlet concentrations, the abatement plant is contractually guaranteed to reduce NH_3 emissions to meet the BAT-AEL of 0.3-20 mg/m^3 for channelled emissions of NH_3, although it is expected to achieve a 95% reduction (equivalent to 1 mg/m^3).

The 12,350m^3 covered **Digestate Storage Lagoon** with have a LDPE floating cover installed, and seam welded within the anchor trench around the lagoon such that the storage lagoon is sealed. The use of a three-stage digestion process with a 71-day hydraulic retention time reduces the residual biogas potential of the digestate. Further process monitoring and management of the AD process ensures that this is achieved. This is the primary control to ensure that a stable digestate is stored within the lagoon. There are no vents to the system, instead pipework channels emissions through an impregnated carbon filter with flow assisted by a fan system. The level of emissions containment and abatement afforded by this system is considered comparable to that provided in the SCAIL tool[22] by a slurry bag (95%). As a conservative approach an emissions reduction of 90% was applied to account for containment within the covered Digestate Storage Lagoon, which represents a median value between that of a slurry bag, an emission reduction value of 90% for an 'engineered cover' reported by SCAIL[23] and a tank rigid cover (tent-like) (81%).[22]

The Digestate Storage Lagoon 1No. carbon filter outlet (**A19**) will enable the treatment of displaced air released during filling of the lagoon. The impregnated carbon filter outlet will incorporate forced ventilation (a fan) that will be operated during lagoon filling. The lagoon cover will be fitted with a separate PVRV as a safety measure for periods when the fan is not operational. As a conservative approach, emissions from the covered Digestate Storage Lagoon carbon filter outlet (**A19**) have been modelled as continuous.

The carbon filter outlet (**A19**) has been estimated to have a height of 2.0m, diameter of 0.25m and exit velocity of 3.0m/s. Odour emission rates from the carbon filter outlet have been calculated based on an odour concentration of 10,000ou_E/m^3.[24] Emissions of NH_3 from the stored liquid digestate have been calculated using the estimated total nitrogen content of the feedstock material, 5.3kg total nitrogen per tonne (kg/N/t) and an emission rate of 0.0266 kg NH_3-N per kg N in feedstock from EMEP/EEA.[25] As advised by the carbon filter technology provider, emissions reductions of between 80% – 95% are expected. As a cautious approach, emission rates used within the assessment have been reduced by 80%.

Approximately 67,454 TPA of digestate liquor will be produced that will be transferred for spreading and/or to dedicated offsite storage on destination farms. The liquid digestate will be pumped from the covered Digestate Storage Lagoon via a sealed connection to one of two liquid **Digestate offtake points**; each include an impregnated carbon filter and associated ductwork to treat displaced air during off-take (emission points **A21** and **A24**). It is expected that 75% of all vehicle offtake movements will take place at the main site's loading point (emission point A24), while the remaining 25% will occur at the loading point adjacent to the digestate lagoon (emission point A21).

It is expected that liquid digestate will be removed from site on average 11 times per day, based on 60% of the liquor removed daily via an HGV vehicle (capacity 27m^3) and 40% via tractor and trailer/ slurry tanker (capacity 13m^3). This equates to approximately 3,152 removals per year, taking into account an average mix of vehicle types used. The storage and transfer process will be undertaken through sealed pipework into sealed vessels. As a worst-case assumption, it will take approximately 20 minutes to fill a 27m^3 tanker during which time there will be an emission

[22] Simple Calculation of Atmospheric Impact Limits (SCAIL) Agriculture (https://www.scail.ceh.ac.uk/cgi-bin/agriculture/input.pl)
[23] SCAIL-Agriculture Update Sniffer ER26: Final Report, Sniffer, 2014 (https://www.scail.ceh.ac.uk/agriculture/Sniffer%20ER26_SCAIL- Agriculture%20Final%20report_Issue_11032014.pdf#:~:text=Figure%205-P:%20Best%20estimate%20concentrations)
[24] A S Modelling & Data (2017) A Dispersion Modelling Study of the Impact of Odour from the Proposed Biofertilizer Storage Lagoon at land west of Hangman Stone Lane, near High Melton in South Yorkshire.
[25] European Monitoring and Evaluation Programme and European Environment Agency (EMEP/EEA) (2023) Air pollutant emission inventory guidebook 2023 Emissions Guidebook, NFR 5.B.2, Biological treatment of waste – anaerobic digestion at biogas facilities. (https://www.eea.europa.eu//publications/emep-eea-guidebook-2023)

of displaced air from within the tanker via the tanker 'breather' valve connected to a carbon filtration system.

Emissions of NH_3 and odour from the digestate tanker off-take emission point have been calculated on the same principles not as that for the covered Digestate Storage Lagoon. Intermittent emissions were modelled as equivalent total emissions continuous across operational hours. That is, calculated NH_3 and odour emission rates for a 20-minute filling period (as a worst-case for a 27m^3 tanker) were factored as an hourly emission rate, adjusted for the total number of hours annually during which offtake movements may occur (2,860 hours), and the total number of tankers per annum (3,152). Tankers will connect to the carbon filtration system at the off-take point prior to filling. A reduction factor of 80% has been applied to account for emissions abatement via a carbon filter.

The 54m^3 **underground leachate tank** will be fitted with a vent (**A13**) that will enable the release of displaced air during filling. The tank will have a maximum cross-sectional area of 28.3m^2 (2.5m x 11.3m) and will passively vent at ground level via a vent assumed to be 0.34m equivalent diameter, which has been modelled as a point source with a low emission velocity (0.1m/s). The odour and NH_3 emission rates have been calculated on the same basis as those from the covered Digestate Storage Lagoon, with an 80% reduction afforded by containment within the tank, and a further 55% reduction for dilution of the silage clamp leachate on the basis that the tank will provide storage for run-off from the silage clamps apron including the clamp covers, and run-off from areas including the feeders, and waste and digestate handling areas.

Emissions of NH_3 from the **Liquid Feedstock Tank** (**A20)** will vent via an impregnated carbon filter**.** The carbon filter outlet has been estimated to have a height of 2.0m, diameter of 0.15m and exit velocity of 0.1m/s. Odour emission rates from the carbon filter outlet have been calculated based on an odour concentration of 10,000ou$_E$/m^3, using values for digestate as a proxy.[24] NH_3 emission rates have been calculated using the estimated total nitrogen content of slurry feedstock material, 4.2kg total nitrogen per tonne (kg/N/t) and an emission rate of 0.0266 kg NH_3-N per kg N in feedstock from EMEP/EEA[25] and based on a maximum slurry storage quantity of 100m^3 (limited so as to maintain available capacity for water storage) as a worst case scenario.

Slurry and liquid feedstock will be fed from the Liquid Feedstock Tank to the digesters. Emissions from the tank may occur as displaced air during filling of the tank but will be vented via a carbon filter. Although slurry has been modelled this is worst case scenario as a greater volume of dilute dirty water/ other liquid waste inputs may be stored, which will have less NH_3 and odour potential than slurry. Emission rates from the feedstock have been reduced by an 80% reduction due to containment within the tank, and a further 80% of the final emission due to the carbon filter.

The **working face of the silage clamps** will be uncovered just enough to enable the loader to remove the required quantity of silage, to ensure minimum disturbance of the ensiled material, and transfer to the external solid feeders. The clamps hold approximately 48,660m^3 of silage. Based on current feedstock quantities, approximately 130 tonnes of silage and 55 tonnes of straw may be processed per day (that is, 65 tonnes of silage and 27 tonnes of straw every 12 hours).

It has been assumed that 30% of the total width of the clamps would be exposed at any one time as an average. Ensiled material is removed from the working face only using equipment that cuts 'cleanly' such that the clamp face remains compacted and intact to minimise disturbance and the generation of odour and to avoid deterioration of ensiled material. It is further assumed that the average height of the clamp is 5m, and that 1m of the top of the clamps is exposed at any time. This corresponds to approximately 191m^3 (143 tonnes). Measured odour emission rates within the literature for silage (stored within clamps) have been reported between <1.0 and 22 $ou_E/m^2/s$.[26,27] The odour emission rate of 20$ou_E/m^2/s$[28] for silage was applied, and it is assumed that odour is emitted continuously from this source.

Twice daily loading of the external **feed hoppers** for silage (120m^3 each) will take approximately 1 hour on each occasion, depending on the location of the working clamp face. A large loading bucket will be used for transfer and drop heights kept to a minimum. The feed hoppers will operate continuously, transferring feedstock to the digesters.

Odour emissions from material handling, agitation and loading within the hoppers is based on the estimated odour emission rate of 50$ou_E/m^2/s$ as a continuous emission from the surface of the material contained within the hopper. Emissions from the feedstock material within each feed hopper were estimated by multiplying the surface area of materials (31m^2) within each hopper by the estimated odour emission rate of 50$ou_E/m^2/s$. The calculated modelled emission rate for the volume of material exposed/ agitated, based on a surface layer depth of 0.5m within the hopper, was 100$ou_E/m^3/s$. Emissions have been assumed to occur continuously and have been modelled as an elevated volume source, 0.5m in depth, at the top of the feed hoppers to represent the fugitive nature of the emissions.

In the **Straw Building** the straw is processed (bales are destringed, the bales broken and water added until it is extruded in the final bunker for feeding into the plant). The resultant processed straw is loaded into the feed hopper for straw feedstocks, situated between the two feed hoppers for silage, from where it is loaded into the primary digesters. The processed straw will not be a source of odour or NH_3 emissions. Standard operating procedures will include the clearing of any silage deposits dropped during loading.

Approximately 26,182 TPA of solid fibre digestate will be produced. Emissions from the **Separator Bunker** have been modelled as a volume source for the size of the bunker (409m^3 or 215 tonnes). NH_3 emissions have been calculated as for NH_3 emissions from the digestate. An odour emission rate of 2.8$ou_E/m^2/s$ has been applied based on similar assessment and has been used here.[29] The Separator Bunker will have a roof which forms a sealed join with the bunker base and a roller shutter door opening. A reduction factor has been applied to account for the bunker being fitted with a roller shutter door, which will be opened for access during loading. The bunker door will be open for 20 mins only during loading and thereafter closed.

[26] Ricardo (2018) Odour impact assessment West Fen Farm AD development.
[27] Odournet (2008) Odour impact assessment for a proposed Crop CHP Plant at Stoke Bardolph.
[28] Redmore Environmental, Odour Assessment, Herriard Anaerobic Digestion Plant, Herriard, Reference: 2256-4r1, 16th December 2021r
[29] Odournet UK Ltd (October 2013) Odour Impact Assessment for a proposed Anaerobic Digestion facility in Chatteris, Cambridgeshire.

Approximately 72 tonnes of solid fibre digestate (one days' worth of production), will be removed from Site via an estimated 7 vehicle movements per working shift based on 100% of the digestate removed via 13 tonne farm tractor and trailer. The Separator building has a roller shutter door that will be opened approximately seven times per day, as a conservative estimate, to enable the removal of solid (fibre) digestate. The roller shutter will be closed following loading. Emissions have been modelled as continuous from the bunker. During periods when the bunker is closed, a reduction factor of 0.2 has been applied in the model to allow for some residual emission from the bunker (i.e. 80% containment afforded by the closed bunker).[30] For a 7-hour period 7 days per week, the release rate was increased to represent periods when the bunker is opened for loading; emission rates were reduced by 60% (a reduction factor of 0.4) to account for the containment of the bunker.[31]

Table 4 CHP, flare and boiler emission parameters (points A1, A2, A3, A4)

Parameter	Units	CHP A1 (BG)[1]	CHP A2 (NG)[2]	Emergency flare (A3)[3]	Emergency boiler (A4)[4]
Location	X,Y	477444, 252701	477451, 252706	477369, 252700	477456, 252693
Fuel	-	Biogas	Natural gas	Biogas	Biogas/ Natural gas
Electrical output	kWe	1,200	1,200	-	-
Thermal output	kWtho	n/a	n/a	-	500 (BG), 560 (NG)
Stack height	m	8.7	8.7	10.51	7.0
Internal diameter at exit	m	0.4	0.4	1.864	0.25
Volume flow rate (dry)	Nm^3/s	1.04	1.19	4.5	0.14
Volume flow rate (wet)	Am^3/s	2.21	2.51	57.5	0.30
Velocity	m/s	17.6	20.0	21.1	6.01
Temperature	°C	150	150	1,000	180
Exit concentration SO_2	mg/Nm^3	107 (ELV, 5% O_2)	n/a	n/a	100 (ELV, 3% O_2)
Exit concentration TVOC	mg/Nm^3	1,000 (ELV, 5% O_2)	1,000 (ELV, 5% O_2)	10 (ELV, 3% O_2)	n/a
Exit concentration NOx	mg/Nm^3	500 (ELV, 5% O_2)	250 (ELV, 5% O_2)	150 (ELV, 3% O_2)	200 (ELV, 3% O_2)
Exit concentration CO	mg/Nm^3	1,400 (ELV, 5% O_2)	1,400 (ELV, 5% O_2)	50 (ELV, 3% O_2)	n/a
Emission rate SO_2	g/s	0.11	-	-	0.014 (0.002)
Emission rate TVOC	g/s	1.04 (0.02)[5]	1.19 (0.02)[5]	0.04 (0.002)[6]	-
Emission rate NOx	g/s	0.52	0.30	0.67 (0.067)	0.028 (0.004)
Emission rate CO	g/s	1.46	1.66	0.22 (0.022)	-

Notes:

[1] CHP1, TEDOM Quanto 1200 TCG2020V12, fuelled by biogas (Appendix E). ELVs are the MCP Directive values for new plant (Annex II, Part 2, Table 2: gaseous fuels other than natural gas). Flue gas diameter and height were advised by ABL based on similar plant. The exhaust gas volume flow rate (wet) is from the manufacturer's datasheet; the oxygen (8%) and moisture content (10%) were estimated based on monitoring data from comparable engines.

[2] CHP2, TEDOM Quanto 1200 TCG2020V12, fuelled by natural gas (Appendix E). ELVs are the MCP Directive values for new plant (Annex II, Part 2, Table 2: natural gas). Flue gas diameter and height were advised by ABL. The exhaust gas volume flow rate (wet) was taken from the manufacturer's datasheet; the oxygen (8%) and moisture content (10%) were estimated based on monitoring data from comparable engines.

[3] Based on GT Himmel flare, MTU 3000-HT-GVD. Maximum capacity 2,600Nm^3/h biogas. Flame temperature > 1,000°C (Appendix G). Data on ELVs, temperature and volume flow rate were supplied by the manufacturer.

[30] Equivalent to SCAIL Agriculture emissions reduction of 80% for a circular store with a rigid cover. (https://www.scail.ceh.ac.uk)

[31] Equivalent to SCAIL Agriculture emissions reduction of 60% for a circular store with a floating cover. (https://www.scail.ceh.ac.uk)

Emission rates shown are for continuous operation; for long-term impact it has been assumed the flare will operate for a maximum of 10% of the time. Brackets denote adjusted long-term emission rate. The oxygen and moisture content were estimated based on a first principles calculation. [4] Boiler parameters for a 560 kW, Veissmann Vitoplex 200, Type SX2A, Dual fuel: oil/gas boiler (Appendix F). ELVs for SO_2 and NOx are the MCP Directive values for new plant (Annex II, Part 2, Table 1). The specification was used to reference volumetric flow rates; the oxygen (4.3%) and moisture (15.2%) content of the exhaust gas have been referenced from monitoring data from the same boiler at Wardley Biogas AD Facility (16 November 2020). Emission rates shown are for continuous operation; for long-term impact it has been assumed the emergency boiler will operate for a maximum of 15% of the time. Brackets denote adjusted long-term emission rate. [5] TVOC emission rates have been calculated on the basis of the likely benzene component: represented as 2% of TVOC emissions from the CHP i.e. 2% of TVOC ELV of 1,000 mg/m^3. Brackets denote the benzene emission rate. The release concentration of 20 mg/m^3 is used as input in H1 screening. [6] Benzene emissions have been represented as 5% of TVOC emissions from the emergency flare i.e., 5% of TVOC ELV of 10 mg/m^3. Brackets denote the benzene emission rate. The release concentration of 0.5mg/m^3 is used as input in H1 screening.

Table 5 Other point source emission parameters (A6, A13, A19- A24)

Parameter	Units	(A6) Emissions abatement plant stack[1]	(A13) Leachate tank vent[2]	(A19) Covered digestate storage lagoon carbon filter outlet [4]	(A20) Liquid feedstock tank carbon filter	(A21) Liquid digestate offtake point carbon filter [8]	(A24) Liquid digestate offtake point carbon filter [8]
Location	NGR (X,Y) m	477396, 252632	477396, 252639	477421, 252533	477439, 252674	477421, 252522	477368, 252575
Stack height	m	15.5	0.1	2.0	2.0	2.0	2.0
Internal diameter at stack exit	m	0.70	0.34 [10]	0.20	0.15	0.15	0.15
Volume flow rate (dry)	Nm^3/s	-	-	-	-	-	-
Volume flow rate (wet)	Am^3/s	5.14	0.009	0.069	0.002	0.018	0.018
Exit velocity	m/s	13.4	0.1	2.21	0.1	1.01	1.01
Temperature	°C	22.5	Modelled as 'Ambient'	Modelled as 'Ambient'	Modelled as 'Ambient'	Modelled as 'Ambient'	Modelled as 'Ambient'
Exit concentration NH_3	mg/Nm^3	20.0	32.3 (2.9) [3]	969 (19) [5]	508 (20) [7]	1.19 (0.06) [9]	1.19 (0.18) [9]
Exit concentration Odour	ou_E/Nm^3	1,000	10,000 (900) [3]	10,000 (200) [5]	10,000 (400) [7]	10,000 (184) [9]	10,000 (551) [9]
Emission rate NH_3	g/s	0.103	0.00029 (0.000026) [3]	0.067 (0.0013) [6]	0.00042 (0.000017) [7]	0.00002 ($1.1x10^{-6}$) [9]	0.00002 ($3.2x10^{-6}$) [9]
Emission rate Odour	ou_E/s	5,139	90 (8.1) [3]	694 (13.9) [6]	8 (0.33) [7]	66 (3.28) [9]	66 (9.83) [9]

Notes:

[1] Emissions abatement system designed and supplied by Centri-Air AB. Data on the extraction system flow rates and design parameters taken from the data sheet (Appendix H). NH_3 concentrations (29ppm or 20 mg/m^3 at 22.5°C) based on technical specification; odour concentrations are based on BAT-AEL for channelled emissions (1,000 ou_E/Nm^3). The BAT-AEL for NH_3 and odour is not necessarily applicable where waste is derived principally from manure.

[2] Underground leachate tank vent: stack height, diameter and volume flow rates based on assumptions. Exit concentrations of NH_3 have been calculated based on the nitrogen content of fresh matter in the feedstock (5.3kg total N/tonne) derived from the feedstocks used within the process. Odour concentrations based on measured odour concentrations for a digestate storage lagoon (AS Modelling & Data, 2017[32]). A 55% reduction to emissions has been applied to account for dilution of the leachate by surface water run-off.

[3] Brackets indicate values used for modelling, factored to account for 55% reduction in emissions due to dilution of leachate stored and 80% due to containment within the underground tank.

[32] A S Modelling & Data (2017) A Dispersion Modelling Study of the Impact of Odour from the Proposed Biofertilizer Storage Lagoon at land west of Hangman Stone Lane, near High Melton in South Yorkshire.

[4] 1No. carbon filter outlet: stack height, diameter and volume flow rates based on assumptions. NH_3 concentrations have been calculated based on the nitrogen content of fresh matter in the feedstock (5.1 kg total N/tonne) derived from the feedstocks used within the process. Odour concentrations based on measured odour concentrations for a digestate storage lagoon.[32]
[5] NH_3 concentration at outlet based on upper BAT limit of 20 mg/m^3 (29 ppm at 22.5°).
[6] Brackets indicate values used for modelling, factored to account for 90% reduction in emissions due to containment within a digestate storage lagoon, and a further 80% reduction in emissions through the carbon filter.
[7] NH_3 concentrations have been calculated based on the nitrogen content of slurry (4.2kg total N/tonne) that may be used within the process. Odour concentrations based on measured odour concentrations for a digestate storage lagoon.[33] Brackets indicate values used for modelling, factored to account for 80% reduction in emissions due to containment within the tank, and a further 80% reduction in emissions through the carbon filter.
[8] Digestate off-take point with carbon filter abatement system. Stack height, diameter and volume flow rates from carbon filter based on assumptions. NH_3 concentrations have been calculated based on the nitrogen content of fresh matter in the feedstock (5.3kg total N/tonne) derived from the feedstocks used within the process. Odour concentrations based on measured odour concentrations for a digestate storage lagoon.[33]
[9] Emission rates have been factored to account for: 75% of offtake movements occurring at emission point A24 and the remaining 25% at emission point A21; together with intermittent tanker filling, assuming constant rate Monday to Friday, 10 hours per day, Saturday 5 hours per day (2,860 hours/ year), with a further reduction of 80% in emissions through a carbon filter.
[10] Equivalent diameter.

[33] A S Modelling & Data (2017) A Dispersion Modelling Study of the Impact of Odour from the Proposed Biofertilizer Storage Lagoon at land west of Hangman Stone Lane, near High Melton in South Yorkshire.

Table 6 Volume sources Clamps, Hoppers, Separation Bunker

Parameter	Units	Working face of clamp exposed	2No. Feed hoppers	Separator bunker [7]
Depth, width, length	Each in m	5, 38, 1	0.5[3], 11.3, 2.8	14, 10, 3 [8]
Emitting surface area	m^2	191 (cutting face)	31.3	284 [9]
Emission mid-height	m	4.28[2]	3.0	1.5
Maximum solid digestate stored	Tonnes	n/a	n/a	215
Exit concentration NH_3	kg/yr	n/a	n/a	37 [10]
Area emission rate odour	$ou_E/m^2/s$	20[1]	50 [4]	2.8 [11]
Emission rate NH_3	$g/m^3/s$	n/a	n/a	0.0000028 [12] (0.0000022)
Emission rate Odour	$ou_E/m^3/s$	0.28[2]	100 (118.8)[5] (112.9)[6]	2.14 (1.66) [12]

Notes:
n/a = not applicable
[1] Redmore Environmental, Odour Assessment, Herriard Anaerobic Digestion Plant, Herriard, Reference: 2256-4r1, 16th December 2021.
[2] The total clamp height, including surcharge, will be up to 5.0m; the total maximum theoretical surcharge volume is 14,229m^3. The mid-height represents the total clamp height minus the surcharge mid-height (0.73m). It is assumed that 30% of the clamp face will be worked at a time, giving a daily volume of approximately 191m^3 (5m x 38m x 1m). Emissions of odour have been calculated assuming a rate of 20$ou_E/m^2/s$ from the vertical face (191m^2). The emissions from the working face of the clamps have been assumed to occur equally across all three clamps, as the working face will vary in location throughout the year. Emission rates are adjusted for the dimensions of the source as represented within the model.
[3] Depth of the modelled, elevated volume source.
[4] Odour concentration increased from 20$ou_E/m^2/s$ to 50$ou_E/m^2/s$ to account for agitation within the hopper.
[5] Brackets indicate Feed hopper 1 emission rate, adjusted for the dimensions of the source as represented within the model
[6] Brackets indicate Feed hopper 2 emission rate, adjusted for the dimensions of the source as represented within the model
[7] Time varying emissions profile used within the model: a reduction factor of 0.4 was used for a 7-hour period each day, 7 days per week, to account for the impact of opening of the separator building door to allow for loading (duration approximately 20 minutes per hour), otherwise a reduction factor of 0.2 was used to account for residual emission when separator bunker door closed (Section 4.2.4).
[8] Dimensions of digestate pile as a rectangle: length, width, height.
[9] Surface area of pile as a rectangle. Up to 215 tonnes (409m^3) of solid digestate will be stored, mostly as two cones up to approximately 6m high. The surface area of two cones (each 6m high, base diameter of 5.7m), gives a total surface area of 312m^2. An odour emission rate of 2.8$ou_E/m^2/s$ from the surface area has been assumed, applied based on similar assessment by Odournet UK Ltd, October 2013 (refer to table note 11).
calculated based on the shape of two cones to account for two piles of digestate on the floor within Separation bunker. Brackets denote total surface area of the two cones.
[10] Emissions before consideration of a reduction in emissions due to containment by the structure. Calculated assuming 5.3kg total N/t of fibre digestate and an emission rate of 0.0266kg NH_3/kg N from EMEP/EEA.[25]
[11] Odournet UK Ltd (October 2013) Odour Impact Assessment for a proposed Anaerobic Digestion facility in Chatteris, Cambridgeshire. Emissions before consideration of a reduction in emissions due to containment by the structure.
[12] Emissions before consideration of a reduction in emissions due to containment by the structure. Brackets indicate emission rate adjusted for the dimensions of the source as represented within the model.

5 Assessment criteria

5.1 Air Quality Standards

European and national legislation, policy, and guidance, as described in Section 3, set various limit values, target values, objectives and environmental assessment levels (EALs) that may apply to human or ecological receptors. These will be collectively referred to throughout this report as air quality standards (AQS).

The AQS are defined with respect to an averaging time and a statistic. Annual mean AQS are an example of a long-term AQS, which is defined over a long period of time as the effects of the pollutant on human health or the environment are chronic, that is, due to long-term exposure. Pollutants may also have acute impacts, that is, the effects become apparent after short period of exposure to high values. For these pollutants short-term AQS are defined, for instance the 24-hour limit for benzene and 1-hour limit for H_2S are a maximum average that must not be exceeded.

5.2 AQS for human health

Table 7 sets out the AQS for human health for the pollutants relevant to this assessment. Emissions are specified for TVOC for which there are no AQS; there is an AQS for benzene, one component of TVOC.

Table 7 Air Quality Standards for human health

Substance	Emission period	Limit (average)	Standard	Exceedances[1]
Benzene	24 hour	30 µg/m^3	EAL	None
Benzene	Annual	5 µg/m^3	AAD Limit Value and AQS Objective	None
Carbon monoxide	8 hour running average across a 24-hour period	10,000 µg/m^3	AAD Limit Value	None
Nitrogen dioxide	1 hour	200 µg/m^3	AAD Limit Value	Up to 18 1-hour periods
Nitrogen dioxide	Annual	40 µg/m^3	AAD Limit Value	None
Sulphur dioxide	15 minutes	266 µg/m^3	UK AQS Objective	Up to 35 15-minute periods
Sulphur dioxide	1 hour	350 µg/m^3	AAD Limit Value	Up to 24 1-hour periods
Sulphur dioxide	24 hour	125 µg/m^3	AAD Limit Value	Up to 3 24-hour periods
Notes: AQS taken from https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit [1]number of times a year that you can exceed the limit				

The AQS apply where members of the public will be exposed for the relevant time period. Defra guidance states that the following are relevant receptors for long-term AQS: building facades of residential properties, care homes, hospitals and schools. A short-term AQS such as the 1-hour AQS would apply at all locations where longer period AQS apply plus public spaces where the public may spend one hour or more, such as footpaths, kerbside locations and car parks.

Workplaces are not relevant receptors for the AQS[34] unless members of the public may be present for the relevant time period. Is it noted that there is a permitted poultry Installation located adjacent to the northeast of the Site boundary. The poultry unit is not considered a potential sensitive receptor; the installation is not accessible to the general public, and following a review of the site personnel attendance hours, employees are typically present on the site for short periods (<6 hours at a time) with the exception of approximately two days out of every 7 weeks when the units are cleared out.

5.2.1 Significance of results

The Defra permit guidance[14] addresses when impacts can be considered insignificant. The guidance considers initial screening and then detailed modelling.

At the initial screening stage, a PC can be screened out from further assessment if:

- 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.

The second stage of screening considers the background concentration as well as the PC. The Predicted Environmental Concentration (PEC) is the sum of the PC and background concentration. A further assessment is not needed if:

- the short-term PC is less than 20% of the ‘headroom,’ where headroom is defined as 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.

If the PC cannot be screened out on that basis, following detailed modelling, two tests are applied:

- the proposed emissions must comply with BAT associated emission levels (AELs) or the equivalent requirements where there is no BAT AEL
- the resulting PECs will not exceed environmental standards.

If those tests are not satisfied it is necessary to consider whether: the PCs could cause the PEC to exceed an AQS; the PEC already exceeds an AQS; or the activity on site is not covered by a BAT reference document. Further action is not required if the following both apply:

- your proposed emissions comply with BAT associated emission levels (AELs) or the equivalent requirements where there is no BAT AEL

[34] Department for Environment, Food and Rural Affairs (August 2022) Local Air Quality Management Technical Guidance (TG22).

- the resulting PECs will not exceed environmental standards.

5.3 AQS for sensitive conservation sites

The Defra/Environment Agency guidance[14] specifies that SACs, SPAs and Ramsar sites within 10 km should be considered and SSSIs, AWs, LWSs, Local Nature Reserves and National Nature Reserves within 2 km should also be considered.

Data supplied by Northamptonshire Biodiversity Records Centre (NBRC) confirmed the presence of 4 No. LWS some of which are coincident with AW within 2 km of the permit boundary and provided information on the habitats at those sites. The closest site is Roade Disused Railway East LWS located 0.5 km south southeast of the site.

Within 2 km of the proposed site the EA in their Screening Report for Nature and Heritage Conservation identified two AW sites (Salcey Forest and Rowley Wood), 4No. LWS (Roade Disused Railway East, Salcey Forest, Rowley Wood, Preston Wood) and, within 10km, Upper Nene Valley Gravel Pits SPA and Ramsar wetland site (of which are also coincident with Upper Nene Valley Gravel Pits SSSI), that are to be considered within the assessment.

For modelling purposes, discrete ecological receptors were placed in each designated area at the nearest locations to the Site. Table 8 presents the sensitive conservation sites, receptors, and habitats in each area. AQS for concentrations of pollutants are referred to as critical levels (CLes) and those for deposition flux of nutrient nitrogen (NDep) and acid deposition due to nitrogen (N) and sulphur (S) (AcidDep) are referred to as critical loads (CLos). In Table 9 the CLes for the pollutants relevant to this assessment for designated ecological site receptors are summarised, in Table 10 Table 10 the CLos for NDep are given and in Table 11 the CLos for AcidDep. CLos for AcidDep vary with habitat and location.

Table 8 Sensitive conservation sites

Site	Designation	Receptor	Habitat
Upper Nene Valley Gravel Pits	SPA/Ramsar/ SSSI	E1, E2	Series of shallow and deep open waters with sparsely vegetated islands, gravel bars and shorelines. Habitats including reed swamp, marsh, wet ditches, rush pasture, rough grassland and scattered scrub that provide resting and feeding conditions for wintering waterbirds.[35]
Preston Wood Local Wildlife Site	AW/ LWS	E3	Lowland Mixed Deciduous Woodland
Rowley Wood Local Wildlife Site	AW/ LWS	E4	Woodland
Salcey Forest AW	AW/ LWS	E5, E6, E7, E8	Lowland Meadow, Lowland Mixed Deciduous Woodland
Roade Disused Railway East	LWS	E9, E10	Lowland Meadow, Lowland Mixed Deciduous Woodland
Data source: NBRC, Ecological data search. Reference: 24-377 (21/11/2024).			

[35] EC Directive 2009/147 on the Conservation of Wild Birds Special Protection Area (SPA), Upper Nene Valley Gravel Pits SPA Citation, (uploaded 07/07/2014) (https://publications.naturalengland.org.uk/publication/5495529882517504)

Table 9 Environmental standards for protected conservation areas

Substance	Target	Emission period
Sulphur dioxide[1]	10 µg/m³ where lichens or bryophytes are present. 20 µg/m³ where they are not present	Annual
Nitrogen oxide (expressed as nitrogen dioxide)[2]	30 µg/m³	Annual
Nitrogen oxide (expressed as nitrogen dioxide)[3]	75 µg/m³ 200 µg/m³ for detailed assessments where the ozone is below the AOT40 critical level[36] and sulphur dioxide is below the lower critical level of 10 µg/m³	Daily
Nutrient nitrogen deposition	Depends on location, use www.apis.ac.uk[37]	Annual
Acidity deposition	Depends on location, use www.apis.ac.uk	Annual
Notes: Environmental standards taken from https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit [1]20 µg/m³ is an AAD Limit Value if you have nature or conservation sites in the area; [2]30 µg/m³ is an AAD Limit Value [3]The lower (stricter) value of 75 µg/m³ has been used throughout this assessment.		

Table 10 shows whether sites were modelled as grass or forest for the calculation of deposition flux.

Table 10 Nutrient nitrogen deposition critical loads

Site	Nitrogen critical load class	Critical load (kg/ha/yr)	Forest / Grass
Upper Nene Valley Gravel Pits	Broadleaved deciduous woodland	10 - 15	Forest
	Atlantic upper-mid & mid-low salt marshes / Low and medium altitude hay meadows	10 - 20	Grass
Preston Wood Local Wildlife Site	Broadleaved deciduous woodland	10 - 15	Forest
	No applicable class	-	N/A
Rowley Wood Local Wildlife Site	Broadleaved deciduous woodland	10 - 15	Forest
	No applicable class	-	N/A
Salcey Forest AW	Carpinus and Quercus mesic deciduous forest	15 - 20	Forest
	Low and medium altitude hay meadows	10 - 20	Grass
Roade Disused Railway East	Broadleaved deciduous woodland	10 - 15	Forest
	Low and medium altitude hay meadows	10 - 20	Grass
Note: Values from www.apis.ac.uk. N/A = Not applicable			

[36] The sum of difference between hourly ozone concentration and 40ppb for each hour when the concentration exceeds 40ppb during a relevant growing season (May to July). Available at: AOT40 — European Environment Agency (europa.eu) [Accessed February 2025]
[37] UK Air Pollution Information System (APIS) (http://www.apis.ac.uk/) Accessed June 2025.

Table 11 Acid deposition critical loads

Site	Acidity critical load class	Critical load (keq/ha/yr)	Forest / Grass
Upper Nene Valley Gravel Pits	Unmanaged Broadleaved/ Coniferous Woodland[1]	CLmaxS: 0.934, CLminN: 0.142, CLmaxN: 1.076	Forest
	Calcareous grassland (using base cation)	CLmaxS: 4.0, CLminN: 0.856, CLmaxN: 4.856	Grass
Preston Wood Local Wildlife Site	Unmanaged Broadleaved/ Coniferous Woodland	CLmaxS: 10.67, CLminN: 0.214, CLmaxN: 10.88	Forest
	N/A	No applicable class	N/A
Rowley Wood Local Wildlife Site	Unmanaged Broadleaved/ Coniferous Woodland	CLmaxS: 8.232, CLminN: 0.357, CLmaxN: 8.589	Forest
	N/A	No applicable class	N/A
Salcey Forest AW	Unmanaged Broadleaved/ Coniferous Woodland[2]	CLmaxS: 8.242, CLminN: 0.357, CLmaxN: 8.599	Forest
	Calcareous grassland (using base cation)	CLmaxS: 4.0, CLminN: 1.071, CLmaxN: 5.071	Grass
Roade Disused Railway East	Unmanaged Broadleaved/ Coniferous Woodland	CLmaxS: 10.68, CLminN: 0.214, CLmaxN: 10.89	Forest
	Calcareous grassland (using base cation)	CLmaxS: 4.0, CLminN: 0.928, CLmaxN: 4.928	Grass

Note: Values from www.apis.ac.uk. N/A = Not applicable

[1] Values for Upper Nene Valley Gravel Pits SSSI

[2] Values for Salcey Forest SSSI

5.3.1 Significance of results

For nationally designated sites (Upper Nene Valley Gravel Pits) tests on significance are the same as for human receptors (as given in section 5.2) with the exception that PC as a percentage of Headroom is not assessed for short-term impacts (daily NOx).

For locally designated sites such as AW and LWS, impacts can be screened out as insignificant if the short-term and long-term PCs are less than 100% of the relevant AQS.

5.4 Odour benchmarks

Most odours arise from mixtures of pollutants and the odour threshold is judged subjectively.

Environment Agency H4 Odour Management guidance[17] sets out benchmark odour criteria based on the 98th percentile of hourly mean concentrations of odour modelled over a year at a site boundary, that is, the benchmarks are odour concentrations that may be exceeded during 2% of hours.

The benchmarks, to which predicted odour impacts have been compared are:

- 1.5ou_E/m^3 for "most offensive" odours e.g., processes involving septic effluent or sludge, processes involving decaying animal or fish remains, biological landfill odours.
- 3.0 ou_E/m^3 for "moderately offensive" odours e.g., intensive livestock rearing, well-aerated green composting, sugar beet processing. Odours from poultry rearing and Wastewater Treatment Works operating normally i.e., non-septic conditions, are usually placed in the "moderately offensive" category.
- 6.0 ou_E/m^3 for "less offensive" odours e.g., brewery, bakery, coffee roasting.

Odours from the normal operation of the AD plant are considered to fall within the "moderately offensive" category for which 3ou_E/m^3 is the appropriate benchmark.

6 Background concentrations and deposition fluxes

6.1 District Council air quality monitoring

West Northamptonshire Council previously designated six Air Quality Management Areas (AQMAs) in the district due to exceedances of the annual mean NO_2 objective. Among them, AQMA1-M1 (2.7km northwest) and AQMA5-A45 (4km northwest) were revoked in 2024, as data from the past three years showed NO_2 levels consistently remained below, or within 10% of, the air quality objective.[38] As a result, the nearest AQMA is now 'AQMA No.2,' located 7.7km north-northwest of the site.

In 2023, the latest year for which results are published, WNC undertook NO_2 m onitoring via a network of non-automatic (passive) diffusion tubes.[38] WCC does not undertake automatic monitoring of NO_2 or monitoring for PM_{10}. A Defra operated automatic urban background site, AURN site UKA00632, is situated 12km north northeast of the Site. WNC operate a non-automatic monitoring The nearest WNC operated urban background monitoring site (No.94) is located 13.7km north northwest, Commercial Street Carpark - Outdoor Market.

Monitoring results across the network, for sites classified as either 'roadside' or 'other' (other areas of potentially elevated concentrations across the wider district), demonstrated compliance with the annual mean objective for NO_2 both within the AQMAs and within the wider district, with the exception of one exceedance in Northampton town centre (Location No.74).

Table 12 details the most recent 5-year monitoring results at locations closest to the site, in addition to the nearest Urban Background monitoring locations.

Roadside monitoring location 'RO4', is the closest monitoring point to the site situated approximately 1.7 km to the southwest. The measured 2023 concentration was 9.7μg/m^3. Measured NO_2 concentrations at a comparable roadside monitoring location, 'H1' situated approximately 2.5km southeast of the Site, were 12.4 μg/m^3 in 2023. These measured concentrations are much less than the national objective, and the Urban Background concentration measured at location No.94 (19.2 μg/m^3), 14km from the Site.

[38] West Northamptonshire Council (03/09/2024) 2024 Air Quality Annual Status Report (ASR) (https://www.westnorthants.gov.uk/environmental-health/air-quality/air-quality-reports-and-data)

Table 12 Annual Mean NO_2 Monitoring Results ($\mu g/m^3$)

Location ID	Type	Method	X NGR	Y NGR	Distance from Site (km)	2019	2020 (b)	2021	2022	2023
RO4	Roadside	Non-automatic	475798	251732	1.7	15.7	11.7	11.8	11.4	9.7
RO2	Roadside	Non-automatic	475476	251816	2.0	28.5	21.0	21.6	19.5	15.1
RO3	Roadside	Non-automatic	475506	251655	2.0	24.5	18.3	19.8	17.5	14.8
RO6	Roadside	Non-automatic	475450	251264	2.2	22.8	16.9	18.6	17.3	12.3
RO1	Roadside	Non-automatic	475437	251288	2.2	23.1	14.9	17	16.2	12.8
H1	Roadside	Non-automatic	479225	250737	2.5	16.5	12.4	13.3	12.5	12.4
GPKa	Roadside	Non-automatic	475890	254870	2.6	25.4	21.4	22.7	20.7	18.8
14	Roadside	Non-automatic	475005	255394	3.5	24.2	18.9	20.5	20	21.4
13	Roadside	Non-automatic	475772	256417	4.1	38.2	28.9	22.2	20.5	16.0
12	Roadside	Non-automatic	475840	256513	4.1	25.8	19.4	20.2	19.7	17.7
11	Kerbside	Non-automatic	475894	256974	4.5	33.8	26.3	26.5	25.9	23.4
67	Roadside	Non-automatic	475809	257066	4.6	/	17	21.3	15.7	20.0
Bi1	Other	Non-automatic	472449	253557	4.9	/	/	/	7.9	6.6
66	Roadside	Non-automatic	475639	257431	5.1	/	30.1	20.6	16.4	15.1
15	Roadside	Non-automatic	473471	256805	5.6	29.5	24.2	19.3	17.7	17.4
UKA00632	Urban BG	Automatic	474021	264343	12.0	14	9	10	10	10.0
94	Urban BG	Non-automatic	475254	266282	13.7	/	/	/	19.2	19.2
RO4	Roadside	Non-automatic	475798	251732	1.7	15.7	11.7	11.8	11.4	9.7

Notes: Data source: West Northamptonshire Council (03/09/2024) 2024 Air Quality Annual Status Report (ASR).
The decrease observed in some instances in 2020 is attributed largely to the COVID-19 pandemic and the associated lockdowns.

6.2 Defra modelled background concentrations

Defra provides maps of 2025 background concentrations of NOx and NO_2 on a 1km x 1km gridded basis that have been projected from a reference year of 2021;[39] and data for SO_2 and benzene for 2023, CO for 2010, also on a 1km x 1km basis.[40] Defra guidance states that the concentrations for SO_2, benzene and CO can be used, unadjusted for future years, such as 2025. Background 2025 concentrations have been determined using background monitoring data (for NO_2),[41] otherwise the maps and factors have been used, which are shown in Table 13. Background concentrations of NH_3 are not part of the Defra mapped data and have been obtained from APIS.[42]

The 2024 Defra spatially varying background concentrations for NO_2 (6.37 – 8.13 $\mu g/m^3$) are comparable albeit slightly lower than the 2023 roadside concentrations (section 6.1) monitored in WNC and at the non-automatic Urban Background monitoring location. They are however comparable to Defra-operated automatic Urban Background monitoring location. The Site and some nearby receptors are situated within 200m of the M1, and therefore the 2023 monitored NO_2 background concentration measured at location H1 (12.4 $\mu g/m^3$), situated approximately

[39] Defra, Background Maps, Available at: https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html (Accessed January 2025].
[40] Defra, UK AAIR, Modelled background pollution data, Available at: https://uk-air.defra.gov.uk/data/pcm-data [Accessed 17 January 2025]
[41] West Northamptonshire Council 2024 Air Quality Annual Status Report, 3rd September 2024. https://www.westnorthants.gov.uk/environmental-health/air-quality/air-quality-reports-and-data.
[42] Air Pollution Information System, Available at www.apis.ac.uk, [Accessed January 2025]

40m from the M1, has been applied in this assessment as a conservative approach. For other relevant pollutants, the Defra spatially varying background concentrations are applied.

Table 13 2025 Annual mean background concentrations (μg/m³)

ID	Annual mean concentration (μg/m³)				
	NOx	NO_2	SO_2	Benzene	CO (mg/m³)
R1	9.22	7.24	1.34	0.34	1.65
R2	8.49	6.69	1.11	0.35	1.65
R3	9.76	7.63	1.22	0.36	1.65
R4	10.4	8.13	1.74	0.41	1.65
R5	8.31	6.55	1.16	0.35	1.65
R6	8.31	6.55	1.16	0.35	1.65
R7	8.49	6.69	1.11	0.35	1.65
R8	8.31	6.55	1.16	0.35	1.65
R9	9.89	7.73	1.17	0.35	1.65
R10	8.49	6.69	1.11	0.35	1.65
R11	9.59	7.52	1.10	0.34	1.65
R12	8.14	6.43	1.21	0.35	1.65
R13	9.66	7.56	1.11	0.34	1.65
R14	8.07	6.37	1.08	0.34	1.65
R15	8.14	6.43	1.21	0.35	1.65
R16	8.74	6.88	1.27	0.36	1.65

6.3 Background concentration and deposition at sensitive conservation sites

Background concentrations of NOx, SO_2, NH_3 and values for nitrogen and acid deposition at all the ecological receptors have been obtained from APIS maps which provide the data on a 1 km grid cell basis (Table 14 and

Table 15). The deposition values depend on whether the habitat is forest (woodland) or grass (moorland) as deposition rates vary according to the nature of the vegetation. Table 10 and Table 11 show which receptors have been modelled as forest and/or as grass. The background values are the latest available and are an average for the years 2020-2022 and are shown in Table 14.

Table 14 Background concentrations at ecological receptors (APIS, 2020 – 2022)

Receptor ID		NOx (µg/m^3)	NH_3 (µg/m^3)	SO_2 (µg/m^3)
E1	Upper Nene Valley Gravel Pits	14.1	1.44	1.36
E2	Upper Nene Valley Gravel Pits	14.6	1.40	1.36
E3	Preston Wood Local Wildlife Site	10.2	1.42	1.00
E4	Rowley Wood Local Wildlife Site	12.8	1.44	0.94
E5	Salcey Forest AW	12.8	1.44	0.94
E6	Salcey Forest AW	10.5	1.42	0.93
E7	Salcey Forest AW	10.5	1.42	0.93
E8	Salcey Forest AW	12.7	1.42	0.96
E9	Roade Disused Railway East (1)	10.2	1.45	0.92
E10	Roade Disused Railway East (2)	12.0	1.43	1.15

Table 15 Background deposition rates at ecological receptors (APIS, 2020 – 2022)

Receptor ID	NDep (kgN/ha/yr)		AcidSDep (keqS/ha/yr)	AcidNDep (keqN/ha/yr)	AcidSDep (keqS/ha/yr)	AcidNDep (keqN/ha/yr)
	Forest	Grass	Forest		Grass	
E1	27.91	14.91	0.18	1.99	0.13	1.07
E2	28.01	14.98	0.18	2.00	0.13	1.07
E3	28.51	n/a	0.18	2.04	n/a	n/a
E4	28.92	n/a	0.18	2.07	n/a	n/a
E5	28.92	15.70	0.18	2.07	0.13	1.12
E6	28.89	15.71	0.18	2.06	0.14	1.12
E7	28.89	15.71	0.18	2.06	0.14	1.12
E8	29.07	15.84	0.18	2.08	0.14	1.13
E9	29.04	15.79	0.18	2.07	0.13	1.13
E10	29.26	15.98	0.18	2.09	0.14	1.14
Notes: n/a = not applicable						

7 Impact assessment of air quality on human health

Predicted impacts of each pollutant at each human receptor are given in Appendix I. In this section the highest results are presented, that is, the impacts at the worst-case receptor. Impacts have been compared to the screening thresholds given in section 5.

Table 16 shows the maximum annual mean (long-term) concentration and Table 17 shows the maximum predicted short-term impacts, from 15 minutes to 24 hours. The predicted concentrations, with and without background concentrations, have been compared with the AQS. Long-term AQS are not applicable at the workplaces nor recreational locations where the public are unlikely to spend long periods of time.

7.1 Long-term AQS

Maximum long-term impacts for all pollutants are predicted at receptor R1, a location selected as representative of both commercial and residential receptors situated at East Lodge, Courteenhall. The nearest commercial receptor (R1) is situated approximately 211m north of the Site; the residential premises at East Lodge, Courteenhall, is approximately 270m in the same direction north of the Site. As a conservative approach, R1 has been assessed for long-term impacts.

The PCs exceed 1% of the AQS (2.1% for NO_2, 1.1% for benzene) although the PECs are less than 70% of AQS respectively. The long-term impacts at all receptors can therefore be screened out as **not significant** and there is no need for further assessment.

Table 16 Results, long-term AQS

Pollutant	AQS (μg/m³)	PC (μg/m³)	PC/AQS (%)	PEC (μg/m³)	PEC/AQS (%)	Receptor
NO_2	40	0.83	**2.1%**	13.2	33%	R1
Benzene	5	0.06	**1.1%**	0.40	7.9%	R1
Notes: bold font indicates an exceedance of the screening threshold. Data on each row is for one receptor, the receptor at which the percentage of PC/AQS is greatest.						

7.2 Short-term AQS

The maximum short-term concentrations for each AQS, across all receptors and all meteorological years, and the worst of with and without buildings and terrain, are given in Table 17.

The maximum short-term impacts are predicted at receptor R1, representative of East Lodge, Courteenhall. Calculated PCs have been compared with the AQS and to the 'Headroom' as defined in section 5.2. It is a measure used by the Environment Agency in assessing air quality impacts for an environmental permit.

With the exception of the short-term PC for NO_2, the PCs do not exceed the initial screening threshold of 10% of the AQS. The maximum short-term NO_2 PC is predicted to be 13% of the AQS.

All maximum predicted PCs, including short-term NO_2, do not however exceed the screening threshold of 20% for PC/Headroom. There is therefore no need for further assessment of any pollutant. A conservative approach has been taken to the short-term modelling of combustion emissions, assuming that operation of either both CHPs, or one CHP in addition to the emergency flare and emergency boiler are operating simultaneously, and of which might coincide with all the worst-case meteorological conditions. The short-term impacts at all receptors can therefore be screened out as **not significant**.

Table 17 Results, short-term AQS

Pollutant	Statistic	AQS (µg/m³)	PC (µg/m³)	PC/AQS (%)	Headroom (µg/m³)	PC/ Headroom (%)	PEC/ AQS (%)	Receptor
NO_2	99.79th 1h	200	25.2	**13%**	175	14%	25%	R1
SO_2	99.9th 15min	266	8.31	3.1%	263	3.2%	4.1%	R1
SO_2	99.73rd 1h	350	5.56	1.6%	347	1.6%	2.4%	R1
SO_2	99.18th 24h	125	3.14	2.5%	122	2.6%	4.7%	R1
CO*	Max daily 8h*	10,000	145	1.5%	6,694	2.2%	35%	R1
Benzene	Max 24h	30	1.23	4.1%	29.3	4.2%	6.4%	R1
Notes: *Maximum daily 8h running. Bold font indicates an exceedance of the screening threshold. Data on each row is for one receptor, the receptor at which the percentage of PC/AQS is greatest.								

8 Impact assessment of air quality on ecological receptors

Predicted impacts of each pollutant at each ecological receptor are given in Appendix J. In this section the highest results are presented, that is, the impacts at the worst-case receptor across all meteorological years, and the worst with and without buildings and terrain. Impacts have been compared to the screening thresholds given in Section 5.

8.1 Nationally designated sites

Considering the closest areas of the nationally designated site, represented as receptors E1 and E2, Upper Nene Valley Gravel Pits SPA/Ramsar/ SSSI, Table 18 shows that the maximum predicted long-term and short-term concentration PCs at E2 are below the respective 1% and 10% screening thresholds; and Table 20 and Table 21Table 21 show that the predicted contributions to NDep and AcidDep are below 1%.

Impacts at E2, Upper Nene Valley Gravel Pits SPA/Ramsar/ SSSI, can therefore be screened out as **not significant**.

8.2 Locally designated sites

Considering the locally designated sites, AWs and LWSs, Table 19 shows that predicted PCs do not exceed any of the screening thresholds (section 5.3.1). Maximum long-term and short-term concentrations were predicted at E10, representative of Roade Disused Railway East LWS.

Table 20 and Table 21 show that the maximum NDep and AcidDep impacts are predicted at E10, Roade Disused Railway East LWS. Predicted contributions to NDep and AcidDep less than 100% of the relevant Clos.

Impacts at LWSs and AW can therefore be screened out as **not significant**.

Table 18 Results at SPA/ Ramsar/SSSI, long-term and short-term AQS, worst case impact

Pollutant	AQS ($\mu g/m^3$)	Averaging time	Statistic	LT or ST AQS*	PC ($\mu g/m^3$)	PC/AQS (%)	PEC ($\mu g/m^3$)	PEC/AQS (%)	Receptor
NOx	30	Annual	mean	LT	0.025	0.1%	14.6	48.7%	E2
SO_2	20	Annual	mean	LT	0.003	0.02%	1.36	6.8%	E2
SO_2	10	Annual	mean	LT	0.003	0.03%	1.36	13.6%	E2
NH_3	**1 ****	Annual	mean	LT	0.004	0.4%	1.40	140%	E2
Pollutant	**AQS ($\mu g/m^3$)**	**Averaging time**	**Statistic**	**LT or ST AQS***	**PC ($\mu g/m^3$)**		**PC/AQS (%)**		**Receptor**
NOx	75	24-hour	100th percentile	ST	0.86		1.1%		E2

Notes: *LT= long-term, ST = short-term; Bold font indicates an exceedance of the screening threshold (long-term PC/AQS = 1%, short-term PC/AQS = 10%).
Data on each row is for one receptor, the receptor at which the percentage of PC/AQS is greatest.
** Lower NH_3 CLe adopted as a conservative approach although lichens and bryophytes are not cited as integral to the SPA habitat (www.apis.co.uk).

Table 19 Results at AW, LWS - long-term and short-term AQS, worst case impact

Pollutant	AQS ($\mu g/m^3$)	Averaging time	Statistic	LT or ST AQS*	PC ($\mu g/m^3$)	PC/AQS (%)	Receptor
NOx	30	Annual	mean	LT	0.55	1.8%	E10
SO_2	20	Annual	mean	LT	0.08	0.4%	E10
SO_2	10	Annual	mean	LT	0.08	0.8%	E10
NH_3	**1 ****	Annual	mean	LT	0.08	8.1%	E10
Pollutant	**AQS ($\mu g/m^3$)**	**Averaging time**	**Statistic**	**LT or ST AQS***	**PC ($\mu g/m^3$)**	**PC/AQS (%)**	**Receptor**
NOx	75	24-hour	100th percentile	ST	7.70	10%	E10

Notes: *LT= long-term, ST = short-term; Bold font indicates an exceedance of the screening threshold (long and short-term PC/AQS = 100%).
Data on each row is for one receptor, the receptor at which the percentage of PC/AQS is greatest.
** Lower NH_3 CLe adopted as a conservative approach although lichens and bryophytes were not cited as integral to the habitats (www.apis.co.uk).

Table 20 Worst-case nutrient nitrogen deposition

Habitat	Landcover	PC (kg/ha/y)	CLomin (ka/ha/y)	CLomax (ka/ha/y)	PC/CLomin (%)	PC/CLomax (%)	PEDR/CLomin (%)	PEDR/CLomax (%)	Receptor
SPA/ Ramsar/SSSI	Forest	0.03	10	15	0.3%	0.2%	280%	187%	E2
SPA/ Ramsar/SSSI	Grass	0.02	10	20	0.2%	0.1%	150%	75%	E2
AW, LWS	Forest	0.74	10	15	7.4%	5.0%	300%	200%	E10
AW, LWS	Grass	0.48	10	20	4.8%	2.4%	165%	82%	E10
Notes: Bold font indicates an exceedance of the screening threshold; data on each row is for one receptor, the receptor at which the percentage of PC/CLo is greatest.									

Table 21 Worst-case acid deposition

Habitat	Landcover	PC_N (keqN/ha/yr)	PC_S (keqN/ha/yr)	PC/CLo (%)	Background/CLo (%)	PEDR/CLo (%)	Receptor
SPA/ Ramsar/SSSI[1]	Forest	0.002	0.0008	0.0%	203%	203%	E2
SPA/ Ramsar/SSSI[1]	Grass	0.002	0.0004	0.0%	24.7%	24.7%	E2
AW, LWS[1]	Forest	0.053	0.018	0.6%	20.8%	21.5%	E10
AW, LWS[1]	Grass	0.034	0.009	0.8%	26.0%	26.8%	E10
Notes: Bold font indicates an exceedance of the screening threshold; data on each row is for one receptor, the receptor at which the percentage of PC/CLo is greatest. [1] %PC of minimum critical load determined using the Critical Load Function tool, available at www.apis.co.uk.							

9 Impact assessment of odour

Table 22 shows the predicted 98th percentile of 1-hour mean odour concentrations at the modelled discrete receptor locations. The values given are the worst case for each year (with or without buildings and terrain), the maximum at each receptor and the year for which it was predicted are given in the final two columns.

The maximum predicted, 0.70ou_E/m^3, is at the nearest receptor R1, East Lodge Courteenhall, representative of commercial premises situated approximately 211m north of the Site boundary. The maximum predicted odour concentration at R1, where medium to high levels of amenity may be expected, is below the adopted criterion of 3ou_E/m^3 for 'moderately offensive' odours. On this basis, the site operation is not likely to cause odour impact at human receptors.

Table 22 98th percentile hour mean odour concentration (ou_E/m^3)

ID	2019	2020	2021	2022	2023	Maximum	Worst case year
R1	0.65	0.67	0.65	0.65	**0.70**	0.70	2023
R2	0.21	0.26	0.25	0.19	0.22	0.26	2020
R3	0.15	0.15	0.14	0.15	0.15	0.15	2020/ 2022
R4	0.04	0.04	0.04	0.04	0.06	0.06	2023
R5	0.15	0.15	0.14	0.15	0.14	0.15	2020
R6	0.10	0.11	0.10	0.11	0.11	0.11	2020/ 2022
R7	0.15	0.16	0.16	0.13	0.15	0.16	2021
R8	0.06	0.07	0.06	0.07	0.07	0.07	2020
R9	0.07	0.08	0.08	0.07	0.08	0.08	2023
R10	0.08	0.07	0.08	0.08	0.07	0.08	2021
R11	0.07	0.08	0.09	0.07	0.07	0.09	2021
R12	0.06	0.06	0.09	0.06	0.06	0.09	2021
R13	0.08	0.07	0.06	0.08	0.05	0.08	2022
R14	0.04	0.05	0.06	0.04	0.05	0.06	2021
R15	0.05	0.05	0.07	0.05	0.05	0.07	2021
R16	0.03	0.03	0.05	0.03	0.03	0.05	2021
Note: Bold font indicates maximum predicted concentration							

10 Conclusion

This AQIA has been prepared in accordance with a revised permit application for the operation of the Horse Close Anaerobic AD Plant, Courteenhall, Northamptonshire, NN7 2QF.

An H1 risk assessment concluded that the following pollutants and averaging time required detailed modelling for comparison with the following EALs (or AQS):

EALs for human health:

- Nitrogen dioxide (annual and 1-hour mean)
- Carbon monoxide (8-hour mean)
- Benzene (annual and 24-hour mean)
- Sulphur dioxide (15-minute mean)
- Sulphur dioxide (24-hour mean)

EALs for potential impacts on the local and nationally designated ecological sites:

- Nitrogen dioxide (ecological - daily mean)
- Sulphur dioxide (ecological-other vegetation)
- Sulphur dioxide (ecological -lichens and bryophytes)
- Ammonia (ecological-other vegetation)
- Ammonia (ecological -lichens and bryophytes, lower critical level of 1µg/m^3)

The proposed Site is not in an AQMA, the nearest of which is approximately 7.7 km away.

Within 2km of the Site there are two sites of Ancient Woodland; the closest is Salcey Forest is situated approximately 1.3 km east of the site. Rowley Wood Ancient Woodland, located approximately 1.6 km southeast, is also a Local Wildlife Site. There are four Local Wildlife Sites within 2 km, the nearest of which is Roade Disused Railway East (0.5 km south southeast), Salcey Forest (1.3 km east), Rowley Wood (1.6 km southeast) and Preston Wood 2 km northeast). Upper Nene Valley Gravel Pits SPA is also designated as a Ramsar wetland site and SSSI and is located approximately 6.9km north of the Site.

Baseline conditions of sensitive receptors, current background concentrations and deposition rates have been established and updated in line with the assessment. Detailed modelling has been carried out using the ADMS 6 dispersion model and numerical modelled meteorological data for the Site location. Conservative assumptions have been made throughout the assessment.

The proposed point source and fugitive emissions to air at the Site were taken into account in assessing impacts at human and ecological receptors.

Three modelling scenarios were considered for the assessment of long and short-term impacts (section 2.4). Long-term impacts of the proposed sources were calculated assuming the proposed CHPs operate continuously at full load, the emergency boiler for 15% of the year (approximately two months) at full load, and the emergency flare 10% of the time (i.e., 876 hours per year).

Two short-term scenarios were considered: the normal operation of CHP1 (BG) and CHP2 (NG) plus all other sources except the emergency boiler and emergency flare operating continuously, in addition to the abnormal operation of CHP1 (BG), emergency boiler, and emergency flare plus all other sources except CHP2 (NG), all operating continuously. This is a conservative approach as it assumes that the emergency boiler and flare may be operating at full load during all the worst-case meteorological conditions, whereas the boiler is expected to operate for no more than 15% of the year, and the emergency flare no more than 10% and therefore their infrequent hours of operation are unlikely to coincide with all the worst-case conditions.

10.1 Human health receptors

The long-term and short-term impacts at all receptors can be screened out as **not significant** and there is no need for further assessment.

Based on TVOC from combustion sources assessed proportionally as benzene, the relevant standards are not predicted to be exceeded at locations where the long and short-term objectives apply. On this basis, the potential impacts of TVOCs assessed as benzene are considered not significant.

10.2 Ecological receptors

Impacts at the internationally designated site, Upper Nene Valley Gravel Pits SPA/ Ramsar, can be screened out as **not significant**.

Impacts at locally designated sites, AWs and LWSs, can be screened out as **not significant**.

10.3 Odour impact

Predicted odour concentrations are below the adopted criterion of $3ou_E/m^3$ for ‘moderately offensive’ odours. On this basis, the site operation is not likely to cause odour impact at human receptors.

Figures

Figure 1 Site location

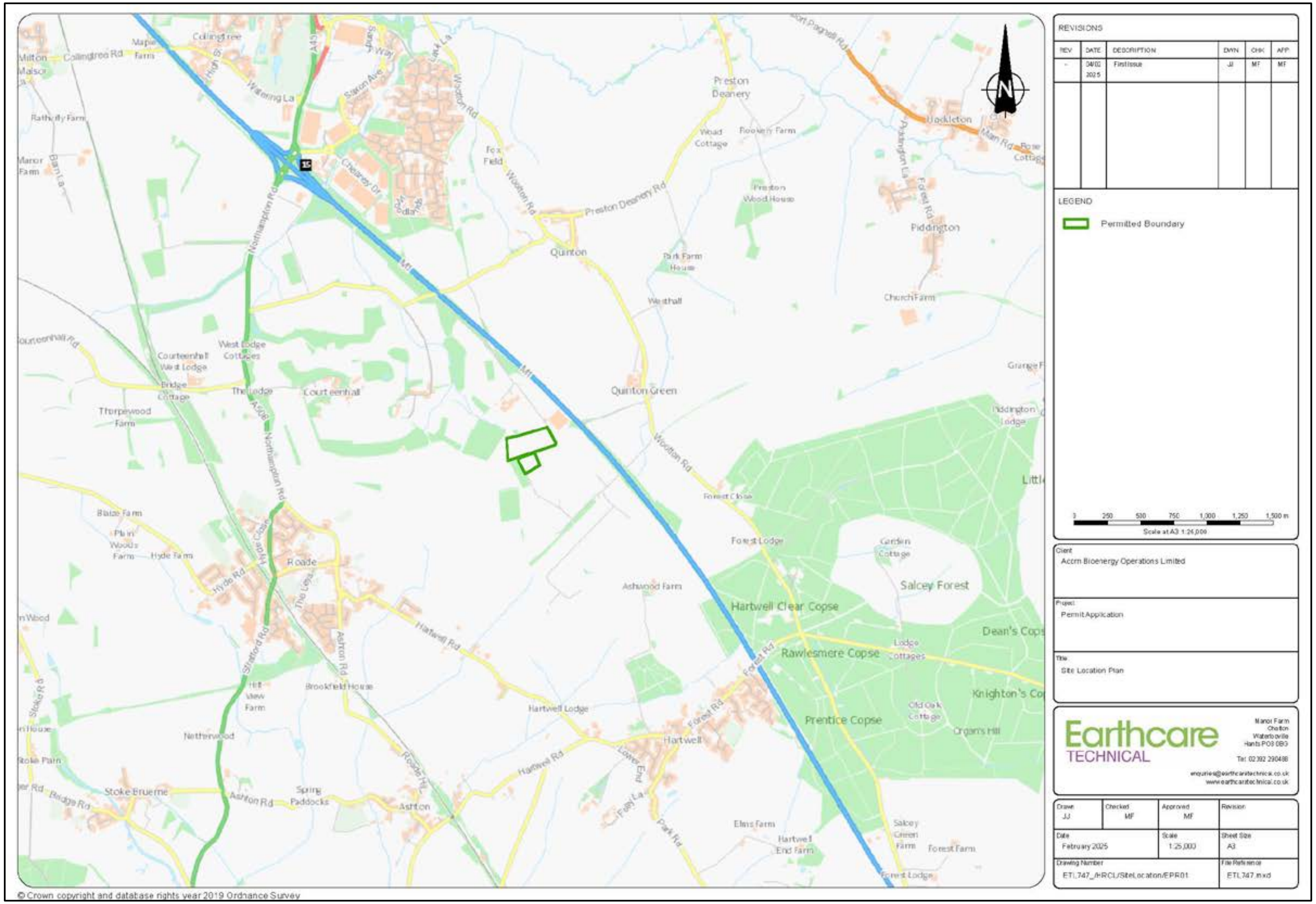
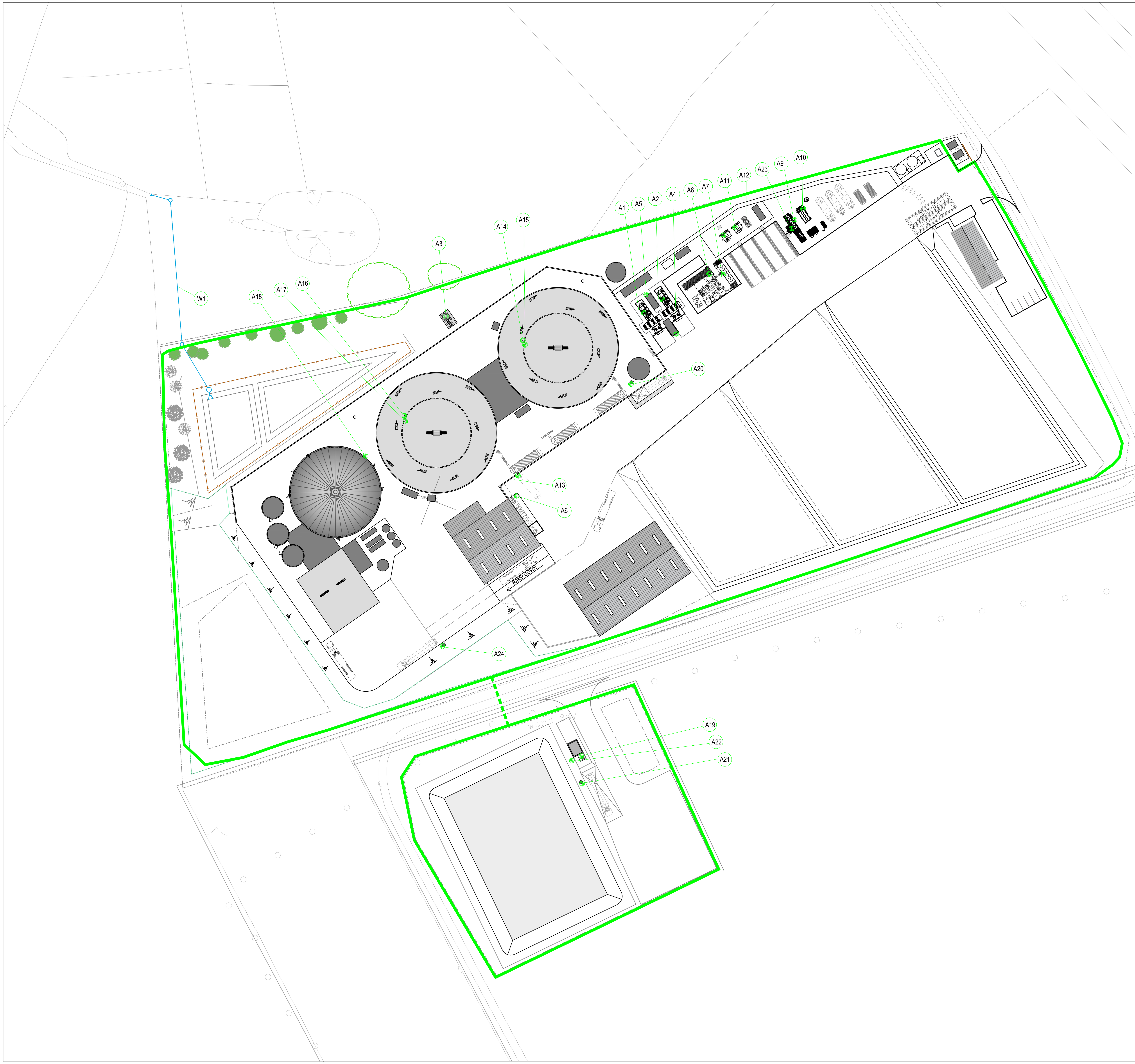


Figure 2 Permit boundary and emission point plan

AS NOTED ON A1 FRAME

Reference Table	
A1	Combined heat and power engine stack 1
A2	Combined heat and power engine stack 2
A3	Emergency flare stack
A4	Emergency boiler stack
A5	Emergency generator stack
A6	Emissions abatement plant stack
A7	Biogas upgrade unit PRV
A8	Biogas upgrade unit CO_2 vent
A9	Carbon dioxide recovery plant PRV 1
A10	Carbon dioxide recovery plant PRV 2
A11	Compressor PRV 1
A12	Compressor PRV 2
A13	Underground leachate tank vent
A14	PVRV on Primary digester 1
A15	PVRV on Secondary digester 1
A16	PVRV on Primary digester 2
A17	PVRV on Secondary digester 2
A18	PVRV on Tertiary digester
A19	Covered digestate storage lagoon carbon filter outlet
A20	Liquid feedstock tank carbon filter outlet
A21	Liquid Digestate off-take point carbon filter outlet
A22	PVRV on liquid digestate storage lagoon
A23	Carbon dioxide recovery plant unit CO_2 vent
A24	Liquid Digestate off-take point carbon filter outlet
W1	Clean surface water from lagoon storage



SITE PLAN
Scale: 1:750 @ A1

NOT FOR CONSTRUCTION

NOTES:-

Permitted Area Boundary (5.89ha)
Emission Release Location
Underground pipe conduit with leak detection

N

Rev	Date	Description	DR	CH
C	15/05/25	Issued For Approval	SJC	-
B	27/01/25	Issued For Approval	SJC	-
A	21/11/24	Issued For Approval	SJC	-

acorn
BIOENERGY

Job Title
AD Plant.
Horse Close

Drawing Title
Site Emissions Plan.

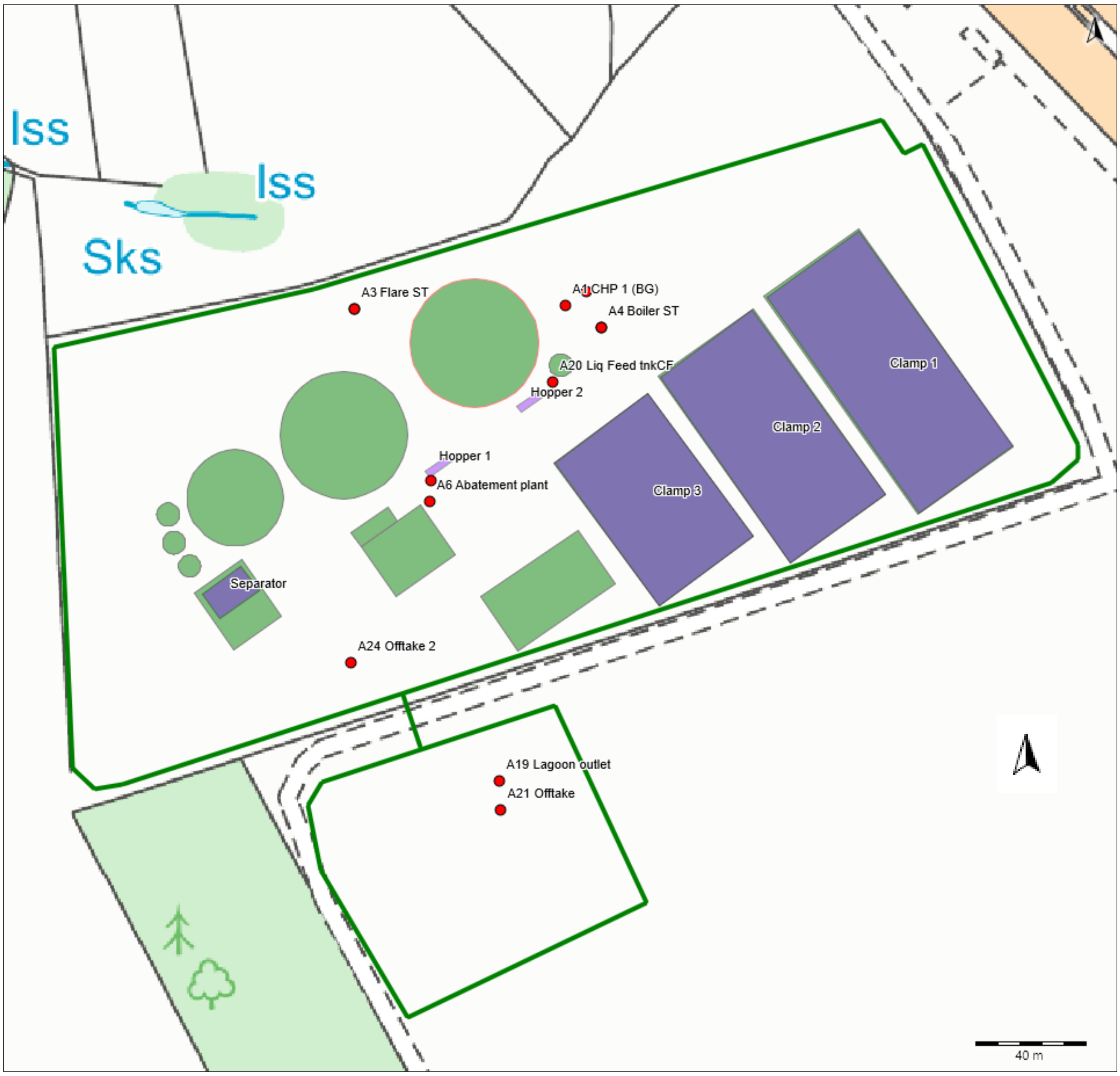
Status
Approval

Scale: As Shown
Date: Nov '24

Drawn By: SJC
Checked: –
Approved: –

Drg. No.: HRCL-LAY-ABE-010
Rev: C

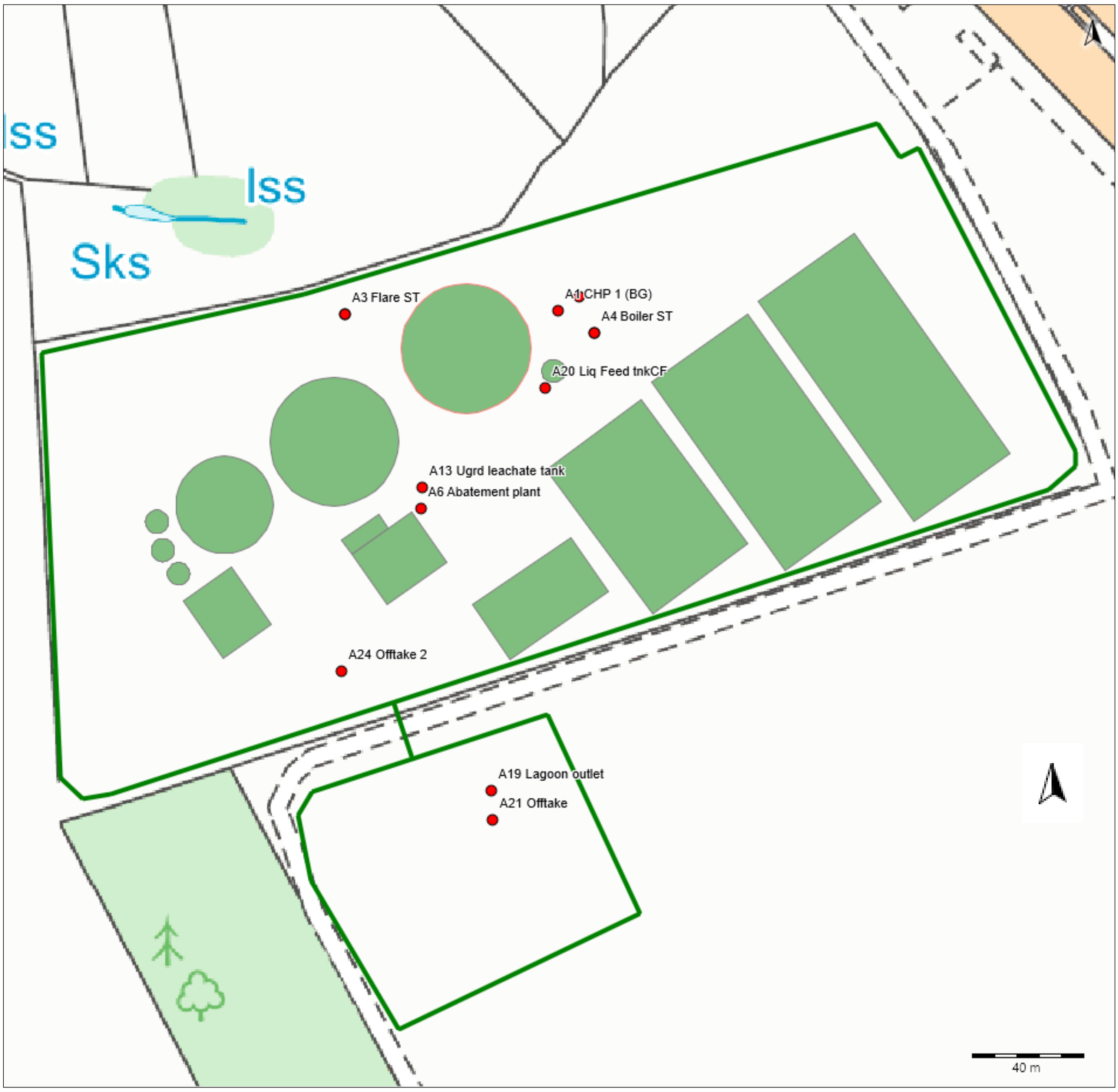
Figure 3 Modelled point and volume sources



Background image © 2025 Groundsure. www.groundsure.com

Legend

Figure 4 Modelled buildings



Background image © 2025 Groundsure. www.groundsure.com

Legend

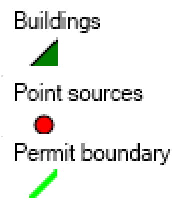


Figure 5 GFS meteorological data (52.166°, -0.868°), wind roses 2019 - 2023

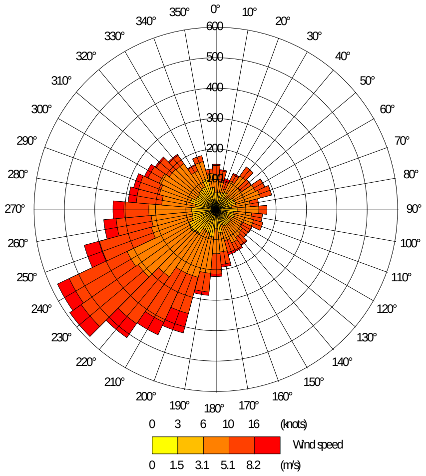
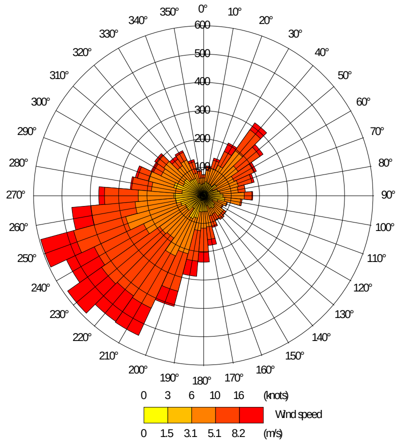
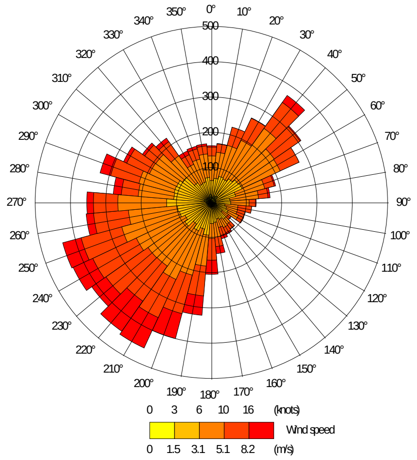
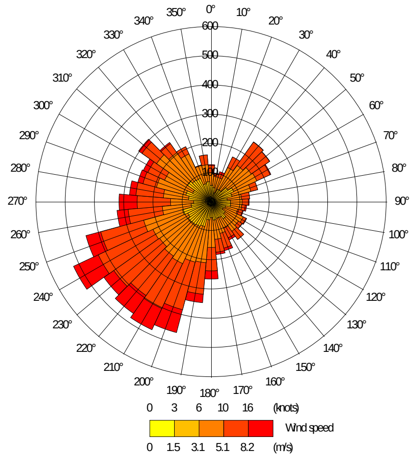
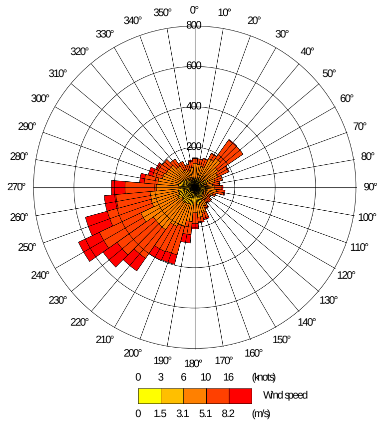
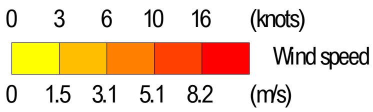
2019	**2020**
	
2021	**2022**
	
2023	**Legend**
	
Data source: AS Modelling & Data	

Figure 6 Terrain data

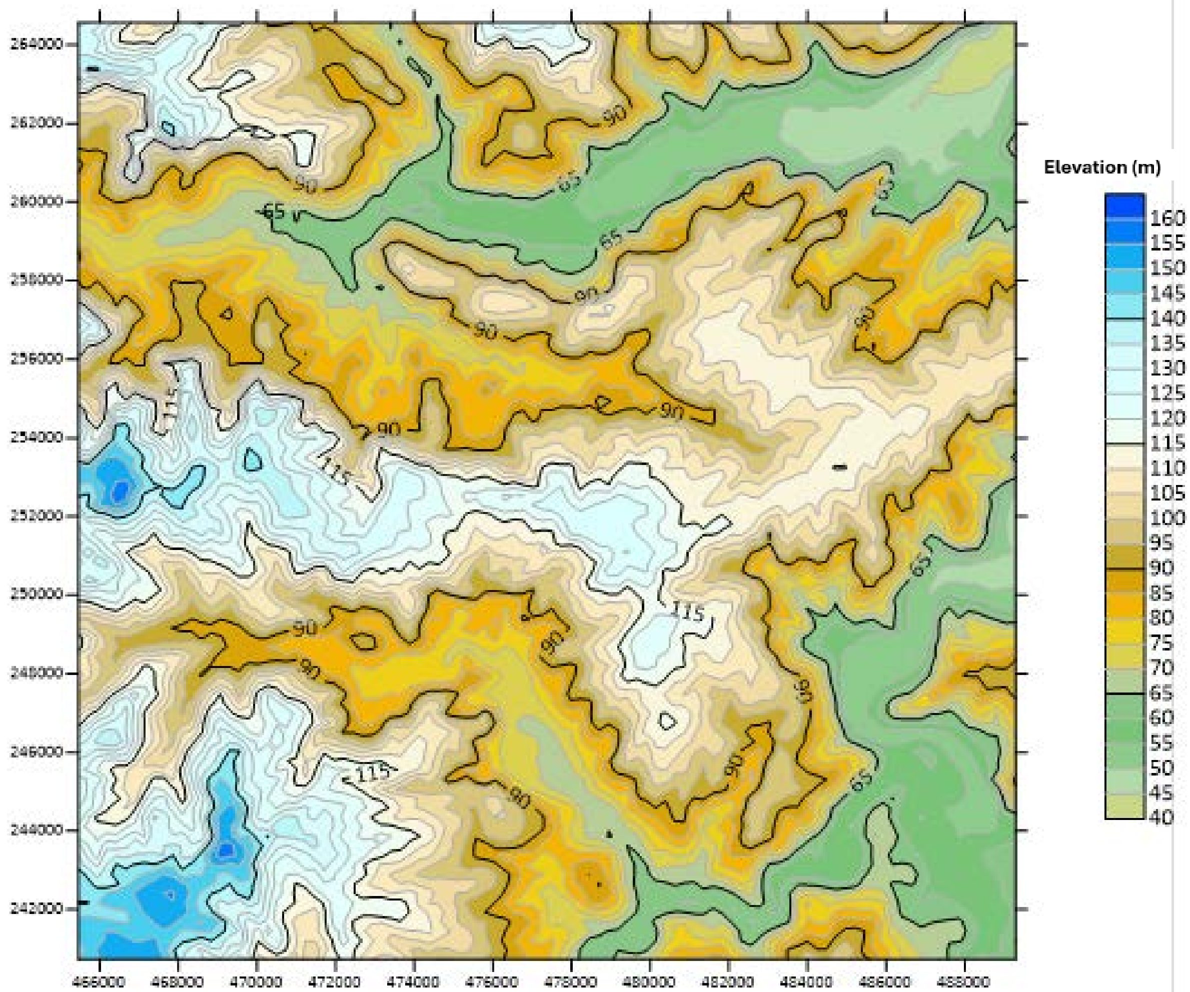
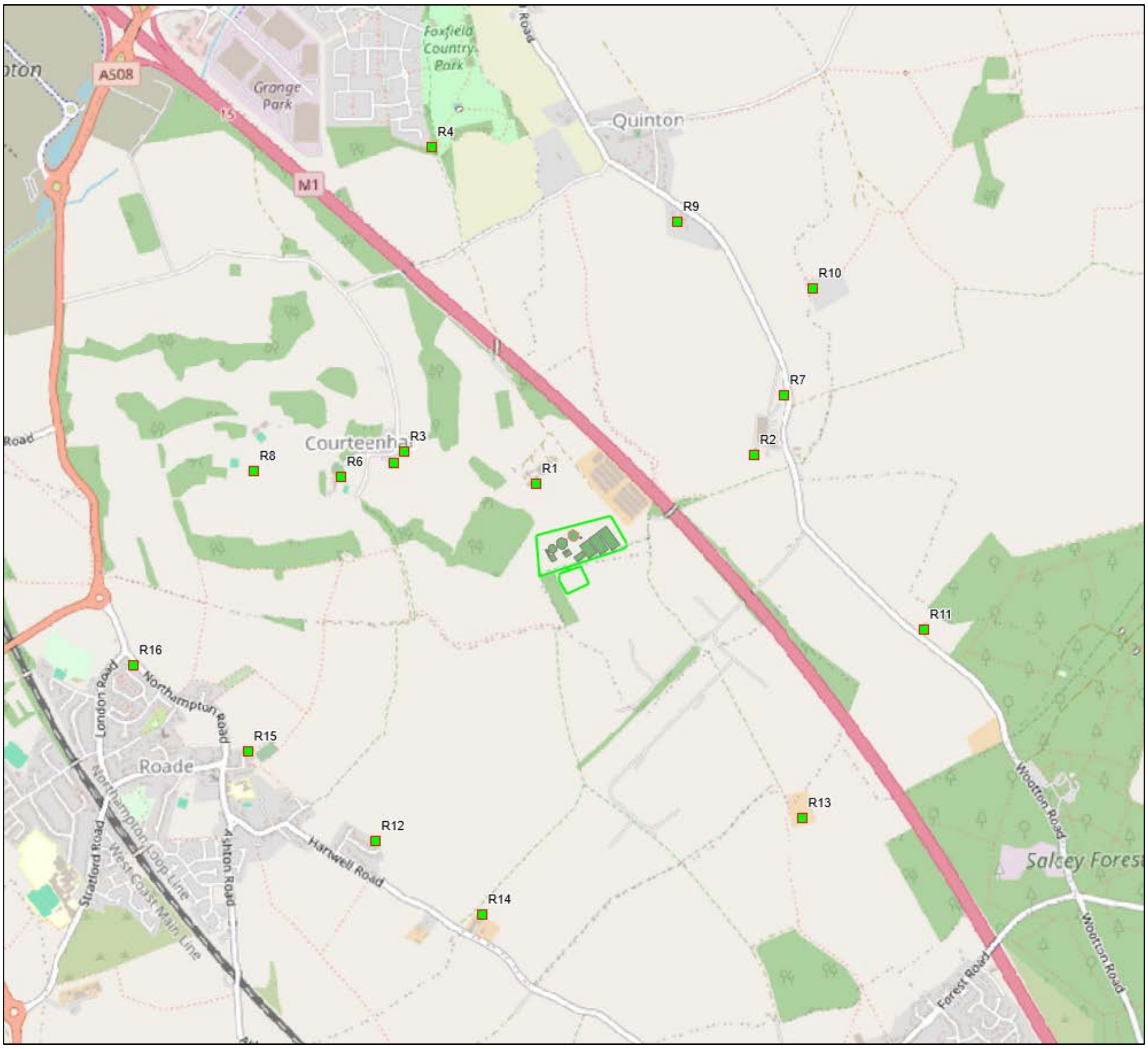


Figure 7 Modelled human receptors



Background image ©OpenStreetMap contributors www.openstreetmap.org/copyright

Legend

Permit boundary

Human Receptor

Figure 8 Ecological receptors (+/-2 km)

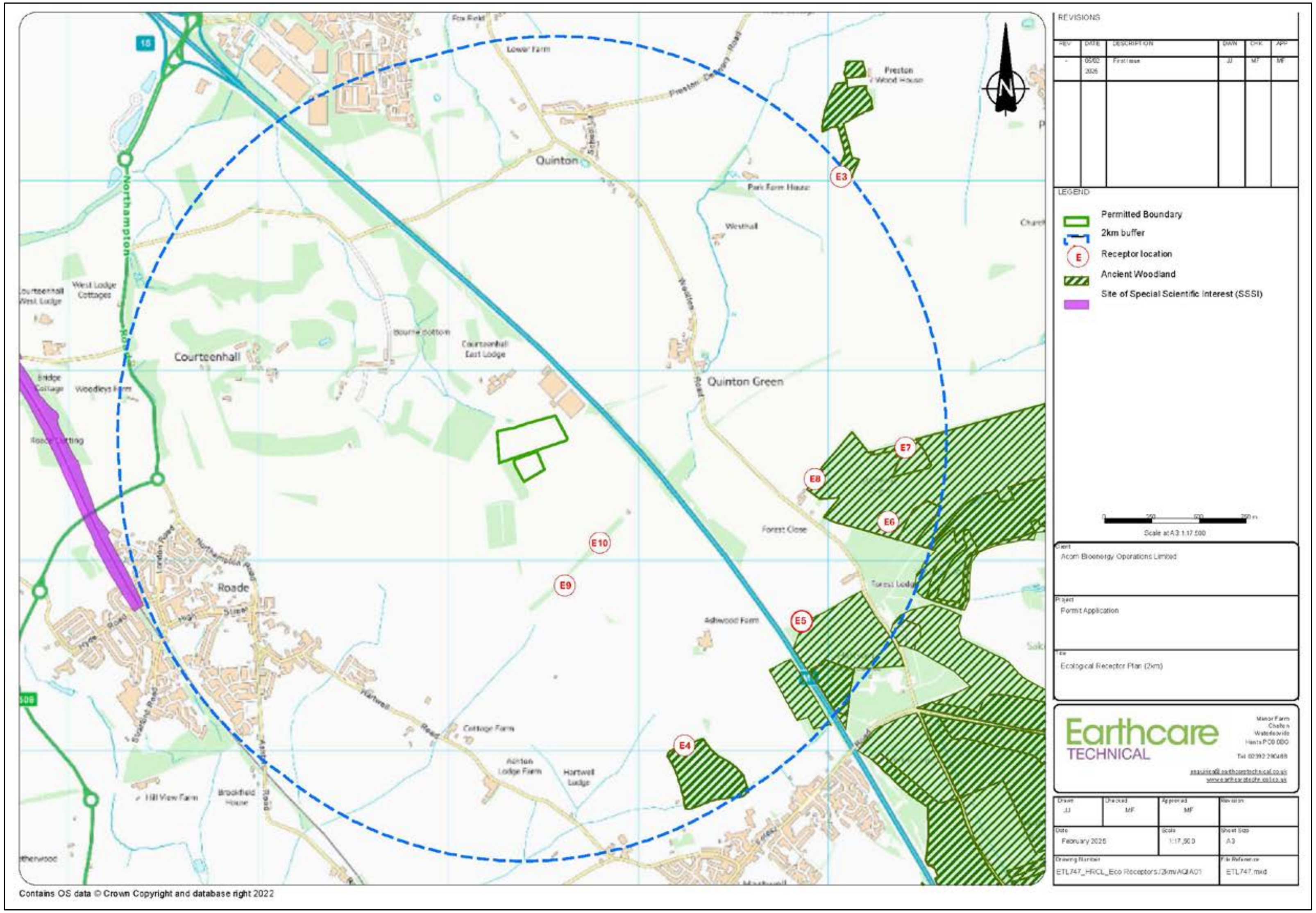
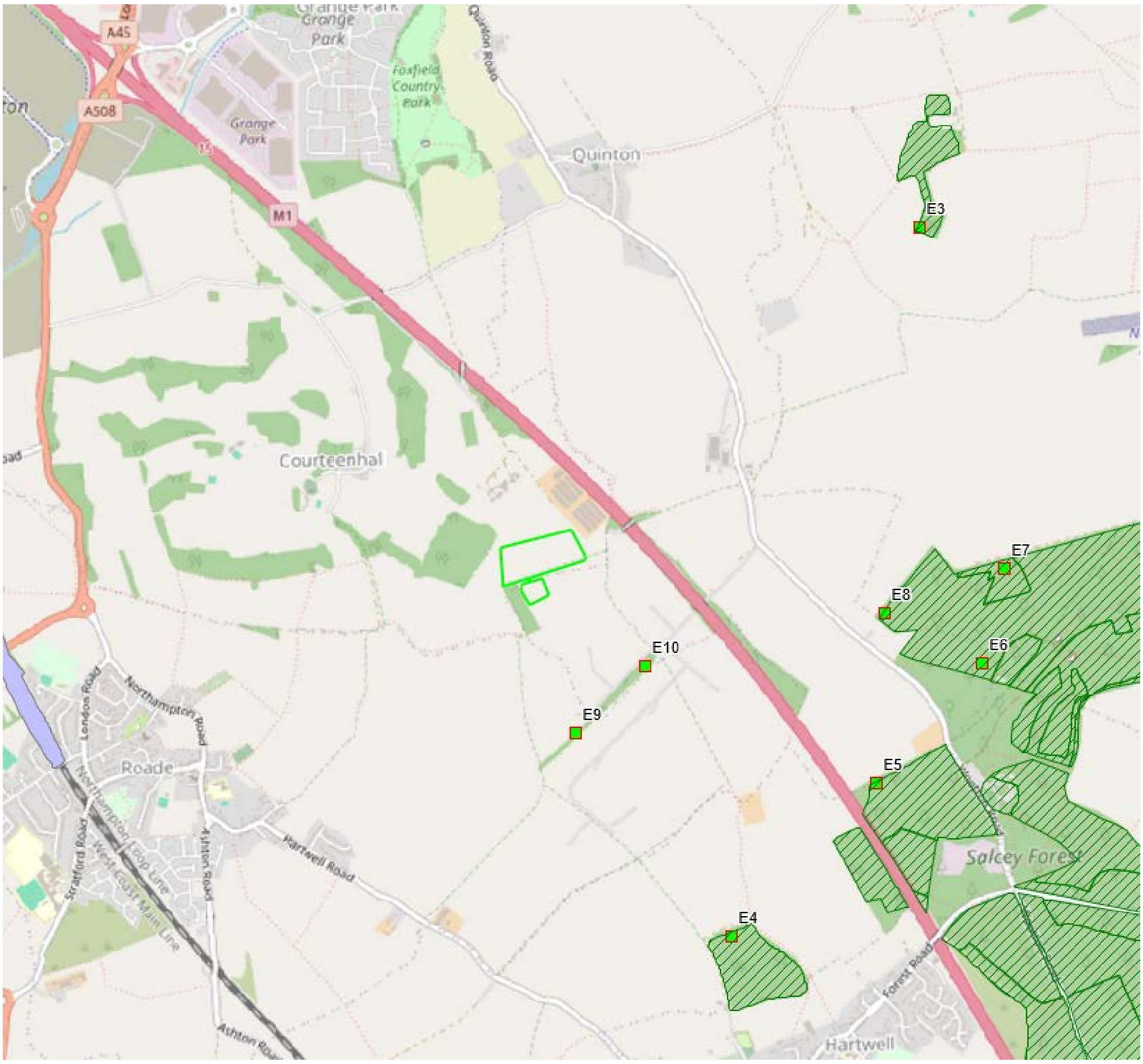


Figure 9 Modelled ecological receptors (+/-2 km)



Background image ©OpenStreetMap contributors www.openstreetmap.org/copyright

Legend

Sites_of_Special_Scientific_Interest

Ancient_Woodland

Ecological Receptor (10)

Figure 10 Ecological receptors (+/-10 km)

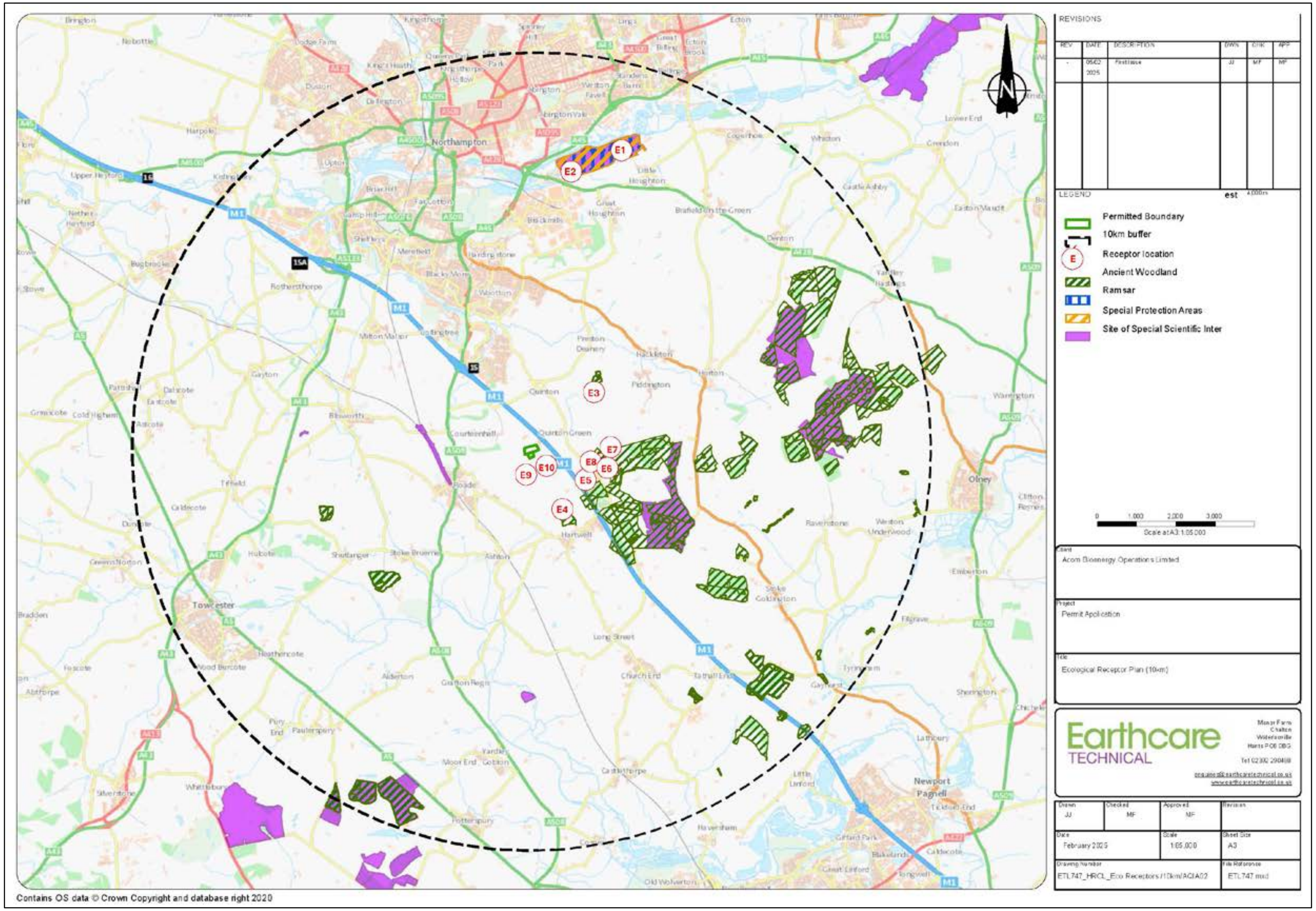
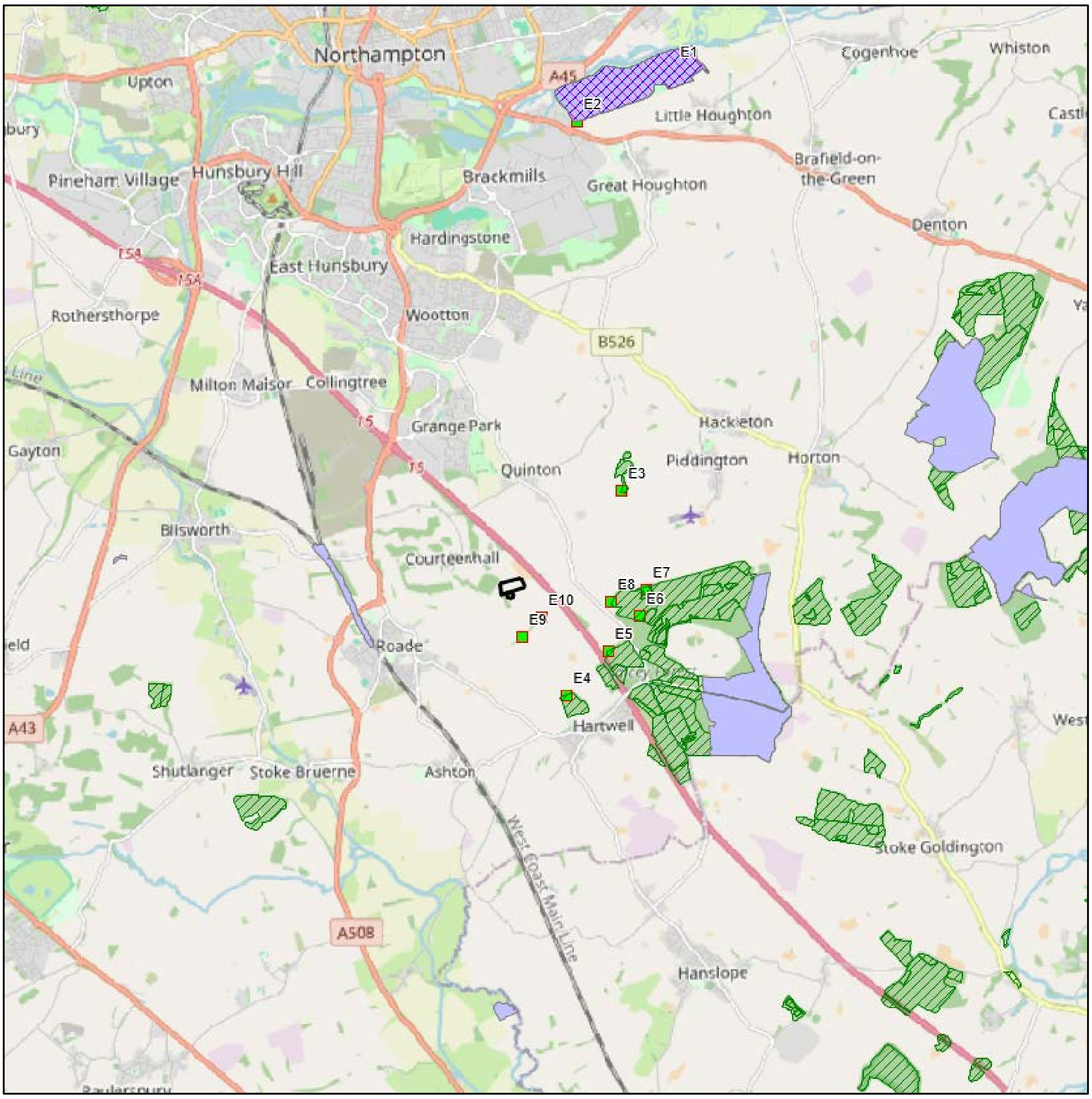


Figure 11 Modelled ecological receptors (+/-10 km)



Background image ©OpenStreetMap contributors www.openstreetmap.org/copyright

Legend

Ramsar_England

Special_Protection_Areas

Sites_of_Special_Scientific_Interest

Ancient_Woodland

Permit boundary (12)

Ecological Receptor (10)

Appendix A Environment Agency Nature Conservation Screening Report

Nature and Heritage Conservation

Screening Report: Bespoke installation

Reference	**EPR/RP3426SN/P001**
NGR	**SP 77433 52673**
Buffer (m)	**190**
Date report produced	**15/03/24**
Number of maps enclosed	**1**

This nature and heritage conservation report

The nature and heritage conservation sites, protected species and habitats, and other features identified in the table below **must be considered in your application**.

In the further information column, there are links which give more information about the site or feature type and indicate where you are able to self-serve to get the most accurate site boundaries or feature locations.

Most designated site boundaries are available on Magic map. Using Magic map allows you to zoom in and see the site boundary or feature location in detail, Magic map also allows you to measure the distance from these sites and features to your proposed boundary. Help videos are available on Magic map to guide you through.

Where information is not publicly available, or is only available to those with GIS access, we have provided a map at the end of this report.

Sites and Features within screening distance	Screening distance (km)	Further Information
Special Protection Area (pSPA or SPA) **Upper Nene Valley Gravel Pits**	10	Joint Nature Conservation Committee and Magic map
Ramsar **Upper Nene Valley Gravel Pits**	10	Joint Nature Conservation Committee and Magic map

Local Wildlife Sites (LWS) (see map below) **Roade Disused Railway East, Salcey Forest, Rowley Wood, Preston Wood**	2	Appropriate Local Record Centre (LRC)
Ancient Woodland **Salcey Forest, Rowley Wood**	2	Woodland Trust Forestry Commission Natural England and Magic map

Where protected species are present, a licence may be required from Natural England to handle the species or undertake the proposed works.

The relevant Local Records Centre must be contacted for information on the features within local wildlife sites. A small administration charge may also be incurred for this service.

The following nature and heritage conservation sites, protected species and habitats, and other features have been checked for, where they are relevant for the permit type requested, but have not been found within screening distance of your site unless included in the list above.

Special Areas of Conservation (cSAC or SAC), Special Protection Area (pSPA or SPA), Marine Conservation Zone (MCZ), Ramsar, Sites of Special Scientific Interest (SSSI), National Nature Reserve (NNR), Local Nature Reserve (LNR), Local Wildlife Sites (LWS), Ancient Woodland, relevant species and habitats.

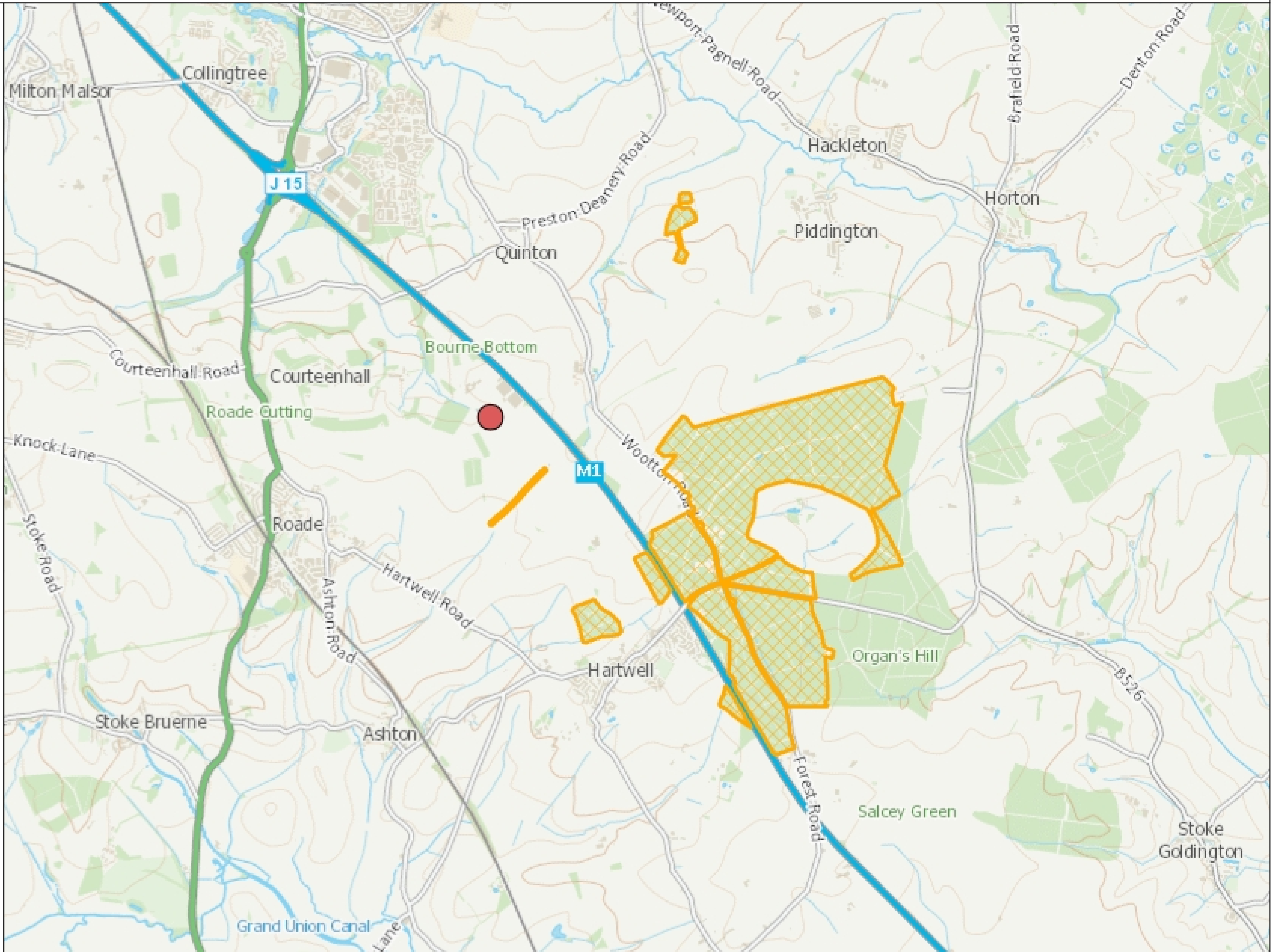
Please note we have screened this application for features for which we have information. It is however your responsibility to comply with all environmental and planning legislation, this information does not imply that no other checks or permissions will be required.

The nature and heritage screening we have conducted as part of this report is subject to change as it is based on data we hold at the time it is generated. We cannot guarantee there will be no changes to our screening data between the date of this report and the submission of the permit application, which could result in the return of an application or requesting further information

Local Wildlife Sites

Legend

Local Wildlife Sites



1: 50,000

0 1,250

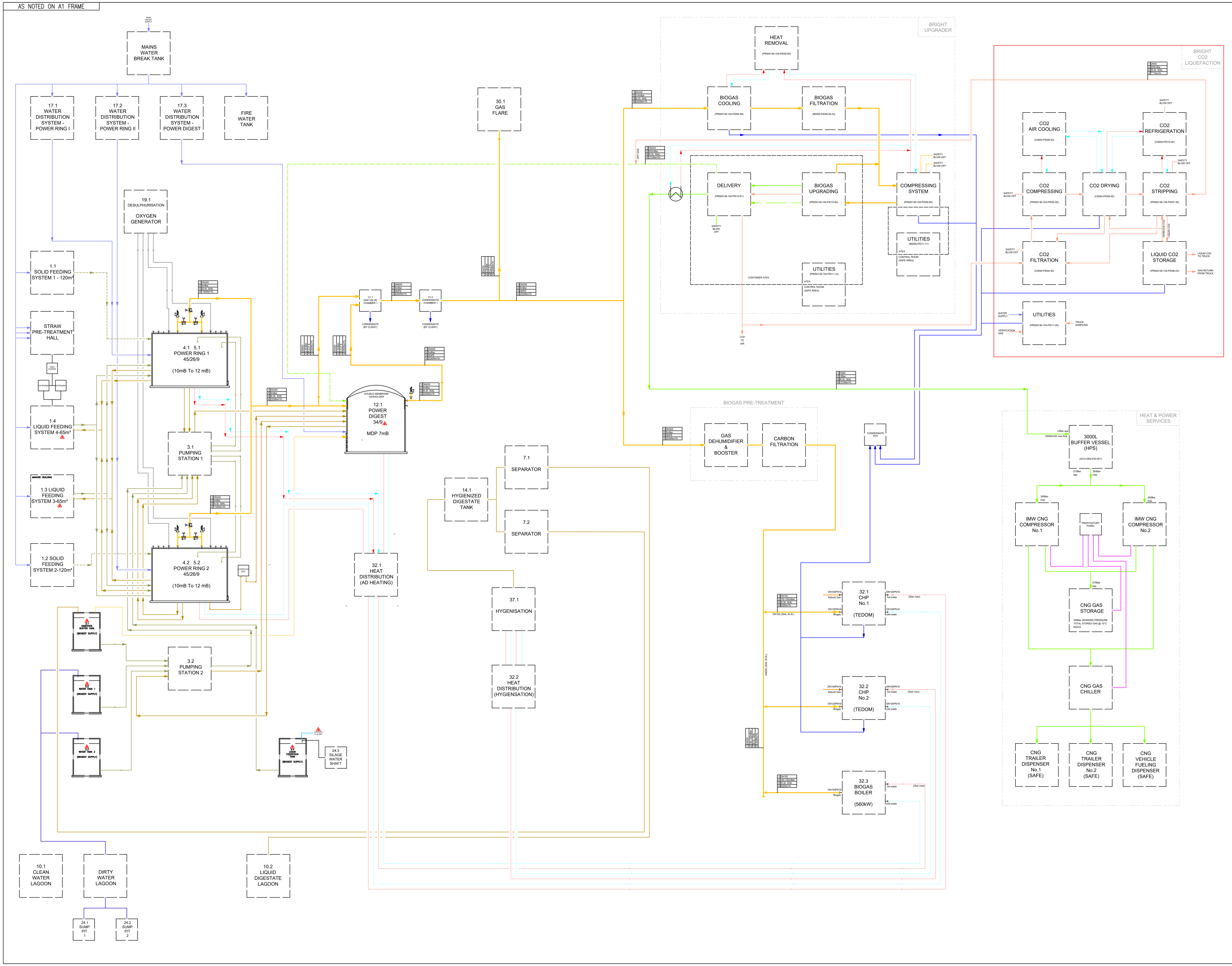
Metres

N W E S

Appendix B Process Flow Diagrams

B.1 AD Plant Process Flow Diagram

AS NOTED ON A1 FRAME



NOTES:-

KEY

- BIOGAS
- BIOMETHANE
- BIOMETHANE REJECT
- NATURAL GAS
- CARBON DIOXIDE
- CONDENSATE
- OXYGEN
- HOT WATER
- COLD WATER
- DIGESTATE
- LIQUID WASTE/SUBSTRATE
- FRESH WATER
- WASTE WATER
- SIGNAL CABLE

PIPE IDENTIFICATION

Rev	Date	Description
B	12/12/24	UPDATED
A	17/06/24	FIRST ISSUE

PRELIMARY

Job Title
AD Plant.
HORSE CLOSE

Drawing Title
PROCESS FLOW DIAGRAM
HORSE CLOSE

Status
PRELIMINARY

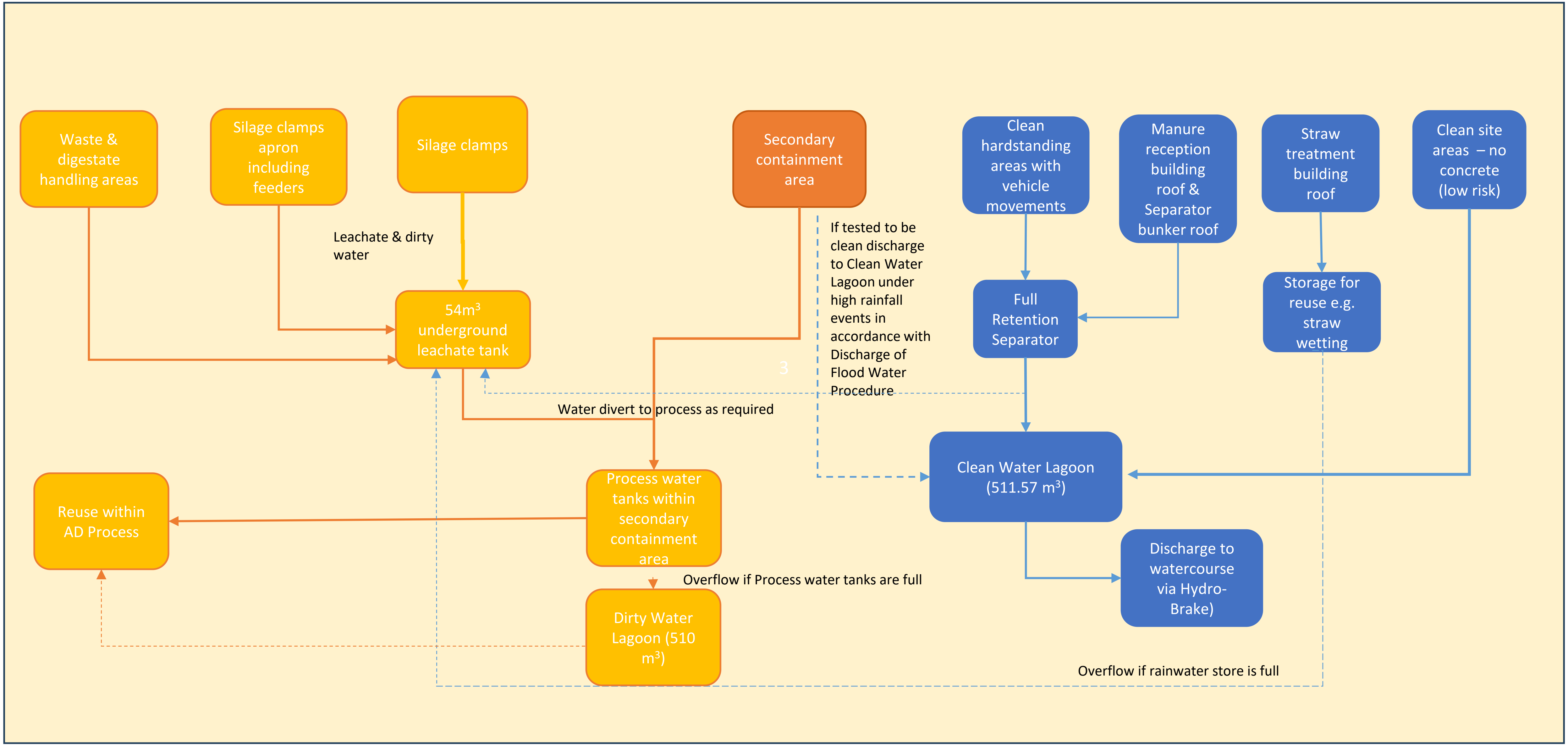
Scale N.T.S.
Date Jun '24

Drawn By NBJ
Checked – –

Drg. No.
HRCL-ABE-PFD-001 B

B.2 Drainage Process Flow Diagram

HRCL-ETL-Drainage Process-PFD-P1 Horse Close AD, Drainage Process Flow Diagram V1.0, February 2025



Appendix C Model and model set-up

C.1 Meteorology and associated parameters

C.1.1 Hourly meteorological data

The model uses hourly data of surface meteorology parameters that are typically measured at a synoptic station or are generated by a numerical model. In this assessment, five years' meteorological data were obtained for the period 2018-2022 for the area surrounding the Site location (Latitude 51.102°, Longitude -1.342°), from a Numerical Weather Prediction system known as the Global Forecast System (GFS).

The GFS is a spectral model and data are archived at a horizontal resolution of 0.5 degrees longitude, or approximately 50 km over the UK (latterly 0.25 degrees, or approximately 25 km). The GFS resolution captures major topographical features and the broad-scale characteristics of the weather over the UK. The use of NWP data has advantages over traditional meteorological records as:

- Calm periods in traditional records may be over-represented.
- Traditional records may include local deviations from the broad-scale wind flow that would not necessarily be representative of the site being modelled
- Information on the state of the atmosphere above ground level which would otherwise be estimated by the meteorological pre-processor may be included explicitly.

Figure 5 shows wind roses for each year of data. The prevailing wind direction is south westerly (south westerly and south-south westerly) although with an additional component from the northeast. The data were used with the ADMS 6 calms option with default values. Table 23 shows the number of lines of usable data each year with and without calms option. Without the calms options the lowest percentage of usable lines was 99.87% and with the calms option 100%.

Defra's LAQM TG16[20] contains cautionary guidance on use of data with less than 85% usable data in calculating for comparison with short-term AQS. The minimum values of usable data were far above this threshold.

Table 23 Meteorological station data for calm conditions

Year of data	Number of hours modelled with calm conditions	Number of hours with inadequate data (excluding calms)	Hours used
2019	4	0	8761
2020	11	0	8785
2021	9	0	8761
2022	6	0	8761
2023	7	0	8761
Notes: Meteorological parameters supplied are: wind speed, wind direction, near-ground air temperature, cloud cover			

C.1.2 Meteorological parameters

The ADMS 6 model uses various meteorological parameters to represent the area at the meteorological station and the site of the Site. The key parameters that have been defined are the surface roughness and minimum Monin-Obuhkov length which are defined at the site of the meteorological data measurement and the Site.

- Surface roughness: this is related to land-use and the height of obstacles on the ground which give rise to mechanically generated turbulence; and
- Minimum Monin-Obuhkov length: this is used to model the extent to which the urban heat island effect limits the most stable atmospheric conditions. Heat released from the urban area prevents the atmospheric boundary layer becoming very stable.

Table 24 shows the values of the parameters that can be selected in the model from a drop-down menu. Other, intermediate, values can be entered directly. The values selected for the meteorological data site and the Site are given Table 25. A value of 1m for minimum Monin-Obuhkov length reflects the rural nature of the surrounding area; values of 0.3m for surface roughness across the wider area reflect the mixed arable, grassland and woodland.

ADMS 6 sets a higher value of minimum turbulence when modelling terrain, therefore, a value of 0.01m/s was set in the ADMS additional input file (.aai) so that the value used when modelling terrain would be the same as that calculated by the model for flat terrain as a function of Monin-Obuhkov length (ADMS 6 User Guide, section 4.15.3).

Table 24 ADMS 6 meteorological parameter values

Surface roughness	
Descriptor	**Value (m)**
Large urban areas	1.5
Cities, woodland	1.0
Parkland, open suburbia	0.5
Agricultural areas (max)	0.3
Agricultural areas (min)	0.2
Root crops	0.1
Open grassland	0.02
Short grass	0.005
Sea	0.0001

Minimum Monin-Obuhkov length	
Descriptor	**Value (m)**
Large conurbations >1million	100m
Cities and large towns	30m
Mixed urban/industrial	30m
Rural areas (max) [1]	20m
Small towns < 50,000	10m
Rural areas (min)[1]	2m

Notes: [1] Not available from the ADMS drop-down menu

Table 25 Meteorological site and Site met parameters

Parameter	**Meteorological data site**	**Site**
Surface roughness	0.3m	0.3m
Minimum Monin-Obhukov length	2m	2m

C.2 Buildings

The presence of buildings close to an emission point can affect the dispersion from a source, bringing the plume centreline down towards the ground in the lee of a building and entraining pollutant into the cavity (or, recirculation) region in the lee of a building. In the cavity, concentrations are assumed to be uniform, and it may be a region of high concentrations depending on the amount of pollutant entrained. The presence of buildings may increase or decrease concentrations at a location compared with the no buildings scenario.

ADMS 6 allows up to 25 buildings to be included as input and the model combines the relevant input buildings into one effective building; the effective building is calculated for each line of meteorological data. Buildings can only be circular or rectangular in cross-section, so the buildings entered are simplified geometries. Buildings less than one third of the height of the stack will be ignored by the ADMS 6 model. Smaller Site structures such as the CHP containers and tanks with smaller diameters than the digesters have been neglected as their effect will be limited compared with the larger structures: digesters, buildings.

The building height entered into the model is the height to the eaves plus a proportion (50%) of roof height. The roof height is the height to the apex minus the height to the eaves. Table 26 shows the (simplified) parameters of the buildings on site used as input to the model; they are shown in Figure 4. In ADMS 6, for each stack a 'main' building must be specified; the option to allow ADMS 6 to automatically select the main building for each source was selected.

Table 26 Modelled buildings

Building name	Building centre X	Building centre Y	Height to eaves (m)	Height to apex (m)	Height modelled (m)	Length/ Diameter (m)	Width (m)	Orientation (°)
Digester 1	477412	252688	9.00	9.00	9.00	45.42	45.42	/
Digester 2	477365	252655	9.00	9.00	9.00	45.11	45.11	/
Tertiary Digester	477327	252633	9.00	17.4	13.20	33.97	33.97	/
Separation Bunker	477328	252595	6.20	6.20	6.20	20.57	24.62	54.96
Manure Reception Building	477388	252614	12.4	13.9	13.14	21.46	25.84	144.92
Manure Hopper Shed	477376	252623	6.97	8.60	7.79	6.00	15.89	144.43
Straw Processing Building	477438	252600	8.00	9.25	8.63	23.11	41.53	145.51
Liquid Feedstock Tank	477442	252680	8.50	8.50	8.50	8.10	8.10	/
Water Tank 2	477303	252627	8.50	8.50	8.50	8.18	8.18	/
Water Tank 1	477305	252617	8.50	8.50	8.50	8.06	8.06	/
Digestate Buffer Tank	477311	252609	8.50	8.50	8.50	7.92	7.92	/
Clamp 3	477475	252632	5.00	5.00	5.00	41.53	62.97	53.57
Clamp 2	477517	252655	5.00	5.00	5.00	41.37	80.67	54.49
Clamp 1	477558	252678	5.00	5.00	5.00	40.98	94.49	54.77

Notes: Buildings with circular cross-section, such as the digesters, do not have a width and orientation specified

C.3 Terrain

The effect of terrain is not usually modelled when terrain gradients in the modelled domain are below the 1:10 threshold usually applied. However, when using numerical weather data, it is recommended to consider the dispersion model predictions with and without terrain. Figure 6 shows the terrain data used. The terrain data file covered a domain 12 km x 12 km, with a total of 63,504 data points, with a grid spacing of 95m. In ADMS 6 a calculation grid of resolution 128x128 was used.

C.3.1 Local changes in ground level

There will be changes in ground level across the site and in the Flat terrain and Buildings model scenarios (section 4.2.3) stack and building heights were modified to account for changes in ground level. In the Terrain (hills) model scenario such an adjustment is not required as the ADMS 6 model accounts for changes in terrain height. Based on the proposed site levels, a datum was established for the lowest point on-site (m Above Ordnance Datum (AOD) at the location of the emergency flare), and adjustment made to buildings and emission sources in accordance with that datum. Table 27 shows the base elevation, unadjusted and adjusted height of each source and building.

Table 27 Actual and modified stack and building heights

Building/ source	Name	AOD of base (m)	Unadjusted height (m) (a)	Adjusted height (m)
Building	Digester 1	119.83	9.00	9.53
Building	Digester 2	119.83	9.00	9.53
Building	Tertiary Digester	119.80	13.20	13.7
Building	Separation Bunker	120.25	6.20	7.15
Building	Manure Reception Building	120.30	13.14	14.14
Building	Manure Hopper Shed	120.30	7.79	8.79
Building	Straw Processing Building	122.52	8.63	11.8
Building	Liquid Feedstock Tank	120.00	8.50	9.20
Building	Water Tank 2	119.90	8.50	9.10
Building	Water Tank 1	119.85	8.50	9.05
Building	Digestate Buffer Tank	119.90	8.50	9.10
Building	Clamp 1	123.33	5.00	9.03
Building	Clamp 2	124.00	5.00	9.70
Building	Clamp 3	124.95	5.00	10.65
Stack	A1 CHP 1 (BG)	122.73	8.70	12.13
Stack	A2 CHP 2 (NG)	122.73	8.70	12.13
Stack	A3 Flare ST	119.30	10.51	10.51
Stack	A4 Boiler ST	122.73	7.00	10.43
Stack	A6 Abatement plant	122.30	15.5	18.50
Stack	A13 Underground leachate tank	122.30	0.10	3.10
Stack	A19 Lagoon CF	126.00	2.00	8.70
Stack	A20 Liquid Feed tank carbon filter	120.00	2.00	2.70
Stack	Offtake A21	126.00	2.00	8.70
Stack	Offtake A24	123.00	2.00	5.70
Volume source	Separator	120.3	1.5	2.45
Volume source	Hopper 1	120.3	2.5	3.46
Volume source	Hopper 2	120.0	2.5	3.20
Volume source	Clamp 3	125.0	4.28	8.31
Volume source	Clamp 2	124.0	4.28	8.98

Volume source	Clamp 1	123.3	4.28	9.93
Notes: Lowest site datum 119.3 (flare). (a) Height to the eaves plus a proportion (50%) of roof height.				

C.4 Receptors

The impact of stack emissions at relevant human and ecological receptors has been modelled. A relevant receptor is defined in Defra's LAQM TG16[20] as:

> '*A location representative of human (or ecological) exposure to a pollutant, over a time period relevant to the objective that is being assessed against, where the Air Quality Strategy objectives are considered to apply*.'

C.4.1 Human receptors

For long-term AQS the relevant receptors are residences (including care homes), schools and hospitals. For short-term AQS additional receptors may also need to be considered: outdoor spaces such as balconies, gardens, leisure sites and public space where human populations may spend the relevant time period. As most short-term AQS allow for a number of exceedances per annum, the human exposure may need to be repeated in order to be relevant. Workplaces are usually excluded from consideration as air quality in workplaces is covered by Health and Safety legislation.[43]

Table 28 shows the locations and type of the receptors selected to be representative of the relevant human receptors. All the receptors have been modelled at a height of 1.5m, representative of inhalation height (nose level) at ground level. Their locations are shown in Figure 7.

Table 28 Human receptors

ID	Location	Type	NGR X	NGR Y	Distance and direction from main AD Plant site boundary	
					Distance (m)	Direction
R1	East Lodge, Courteenhall	Residential + Commercial units including building supplies and physiotherapists	477260	252901	211	N
R2	Quinton Green	Residential and commercial units including children's day care	478151	253020	634	W
R3	Courteenhall, West Northamptonshire	Residential	476718	253031	645	NW
R4	Bluebell Rise, Grange Park	Residential	476832	254278	1,643	NW
R5	Village Spinney	Residential	476679	252985	660	W
R6	St Peter and St Pauls Church	Place of worship	476460	252929	836	NW
R7	Quinton, West Northamptonshire	Residential	478276	253263	865	SW
R8	Courteenhall Farm	Residential, public house and gardens, commercial units	476103	252952	1,190	S
R9	Quinton	Residential	477839	253970	1,239	SW
R10	Quinton	Residential	478394	253701	1,248	NE

[43] Health and Safety Executive EH40/2005 Workplace Exposure Limits (Fourth Edition 2020)

ID	Location	Type	NGR X	NGR Y	Distance and direction from main AD Plant site boundary	
					Distance (m)	Direction
R11	Quinton	Residential	478849	252302	1,258	W
R12	14, Fox Covert Drive, Roade	Residential	476603	251440	1,268	SE
R13	M1, Quinton	Residential	478350	251531	1,280	SE
R14	Ashton, Roade	Commercial	477038	251137	1,336	SE
R15	Manor Close, Roade	Residential	476080	251805	1,451	SE
R16	Northampton Road, Roade	Residential	475612	252158	1,702	SE
Note: The poultry unit is not considered a potential sensitive receptor; the installation is not accessible to the general public, and in addition employees are typically present on the site for short periods (<6 hours at a time) with the exception of approximately two days out of every 7 weeks when the units are cleared out.						

C.4.2 Ecological receptors

The Defra/Environment Agency guidance[20] specifies that SACs, SPAs and Ramsar site within 10km should be considered and SSSIs, AWs, LWSs, Local Nature Reserves and National Nature Reserves within 2km should also be considered.

Ecological receptors were placed in the designated areas at the nearest locations to the Site. Table 8 in section 5.3 lists the sensitive conservation sites identified within the specified distance, their designation and main habitat. Table 29 lists the ecological receptors modelled which are illustrated in Figure 8 to Figure 11. All the ecological receptors have been modelled at a height of 1.5m.

Table 29 Ecological receptors

ID	Location	Type	NGR X	NGR Y	Distance and direction from main AD Plant site boundary	
					Distance (m)	Direction
E1	Upper Nene Valley Gravel Pits	SPA/ Ramsar/ SSSI	479834	260332	7,974	NNE
E2	Upper Nene Valley Gravel Pits	SPA/ Ramsar/ SSSI	478413	259559	6,855	N
E3	Preston Wood Local Wildlife Site	AW/ LWS	479069	254069	2,000	NE
E4	Rowley Wood Local Wildlife Site	AW/ LWS	478255	251017	1,642	SE
E5	Salcey Forest AW	AW/ LWS	478879	251679	1,619	SE
E6	Salcey Forest AW	AW/ LWS	479336	252196	1,882	SE
E7	Salcey Forest AW	AW/ LWS	479434	252600	1,955	E
E8	Salcey Forest AW	AW/ LWS	478917	252410	1,310	ESE
E9	Roade Disused Railway East (1)	LWS	477586	251895	578	S
E10	Roade Disused Railway East (2)	LWS	477886	252179	515	SSE

C.5 Post-processing

C.5.1 Use of background data

Considering long-term AQS, it is a straightforward matter to add the annual mean contribution from the source, (annual mean PC) to the annual mean background concentration to predict the total concentration (annual mean PEC).

For comparison with short-term AQS the addition of background is not so straightforward. The ADMS 6 model allows for the calculation of percentiles from hourly background and process concentrations, but hourly background concentrations are not commonly available, and not for all pollutants. The approach used was that described in the Defra permit guidance:[14]

> '*When you calculate background concentration, you can assume that the short-term background concentration of a substance is twice its long-term concentration*.'

This has been used for all for short-term AQS for averaging times for 15 minutes to 24 hours.

C.5.2 Conversion of NOx to NO_2

The ADMS 6 model includes a NOx chemistry model, but the conversion of primary NOx emissions to NO_2 is usually undertaken as a post-processing step for industrial permitting applications. For primary NO_2 to NO_x ratios of 10% or less, which is likely to be the case for the stack emissions, the Environment Agency and Natural Resources Wales[44] recommend use of the following conversion ratios:

- 35% for short term assessment
- 70% for long term assessment.

These ratios have been used in main part of this assessment. In fact, combustion sources emit NOx with approximately 5% NO_2 by volume,[45] and conversion from nitric oxide (NO) to NO_2 proceeds relatively slowly, depending on temperature. Assuming a temperature of 15°C and a wind speed of 3m/s, in the 50 seconds taken for emissions to travel 150m, 19% of a mole of NO would have been converted to NO_2.[46] The prediction of short-term NO_2 impacts at the nearest human receptor (R1) is therefore conservative.

C.5.3 Conversion of TVOC to benzene

Emissions are specified as TVOC for which there are no AQS. There is an AQS for benzene, one component of TVOC. An AEA Technology report on the Speciation of UK emissions of non-methane volatile organic compounds (2002) [47] reported on a series of VOC species profiles available for stationary combustion sources, covering a range of both fuel types and scale of

[44] Environment Agency and Natural Resources Wales (Last updated 27 March 2023) (https://www.gov.uk/guidance/specified-generators-dispersion-modelling-assessment#nosubxsub-to-nosub2sub-conversion-ratios-to-use)
[45] CERC Ltd (2023) ADMS 6 Atmospheric Dispersion Modelling System, user Guide, Version 6.0, March 2023
[46] CERC Ltd (2023) NOx Chemistry Model in ADMS 6, P18/02K/23, March 2023
[47] N R Passant (2002) Speciation of UK emissions of non-methane volatile organic compounds. Reference: AEAT/ENV/R/0545 Issue 1

combustion. The benzene fraction in industrial and commercial combustion of natural gas was reported to be less than 10% of NMVOC, a subset of TVOC. For flares the NMVOC ELV is usually given as half that of TVOC, so the flare it has been assumed that 5% of the TVOC emission is benzene. The assumption is conservative as benzene is one component of NMVOC. For the CHPs, monitoring data from another AD site has shown that NMVOC, of which benzene is a component, is less than 2% of TVOC, so benzene has been modelled as 2% of TVOC. Both assumptions are conservative as benzene is one component of NMVOC.

C.5.4 Deposition to ecological receptors

The ADMS 6 model includes the ability to calculate the deposition flux rate (deposition) of pollutants, but the Environment Agency recommends deposition be calculated as a post-processing step in order to give conservative estimates of both ground level concentration and deposition, by assuming no loss of pollutant from air concentration to ground deposition.

Deposition may be 'dry' or 'wet'. Dry deposition of gases occurs due to diffusive motions and removal at surfaces, primarily the ground. It is characterised by a deposition velocity that depends on the pollutant and the nature of the surface. Table 30 gives the deposition velocities for grassland and forest for the pollutants included in this assessment which are the values recommended by AQTAG 06.[19] The values for grassland, which are lower than those for forest, have been used to represent deposition at all receptors.

Wet deposition occurs when precipitation washes pollutants out of the air. Some pollutants have a low solubility, and in addition, wet deposition is considered to be of limited importance close to the source. Wet deposition has been neglected.

Table 30 Dry deposition velocities

Pollutant	Deposition velocity (m/s)	
	Grassland	Forest
NO_2	0.0015	0.003
SO_2	0.012	0.024
NH_3	0.020	0.030

Deposition (μg/m^2/s) is calculated by multiplying the near ground air concentration (μg/m^3) by deposition velocity. Ecological receptors are sensitive to deposition of nitrogen (nutrient nitrogen) and to deposition of acid species including nitrogen (N), sulphur (S) and HCl. To convert from deposition of a pollutant to deposition of a species, the conversion factors given in

Table 31 Table 31 were used. Nutrient nitrogen deposition is calculated as the total deposition of N in kg/ha/year, due to NO_2 and NH_3. To convert from deposition of N or S deposited to equivalent acidification units, a measure of how acidifying the chemical species can be, (keq/ha/year), the conversion factors given in Table 32 were used. Acid deposition is calculated taking into account the acidifying nitrogen and sulphur deposition, both expressed as keq/ha/year.

Table 31 Conversion factors for deposition of species N, S

Pollutant	Species deposited	Conversion factor from deposition of pollutant ($\mu g/m^2/s$) to deposition of species (kg/ha/year)
NO_2	N	96
SO_2	S	157.7
NH_3	N	259.7

Table 32 Conversion factors from deposition of species to deposition of acid equivalent

Species	Conversion factor from deposition of species (kg/ha/year) to deposition of equivalent acidification units (keq/ha/year)
N	0.071428
S	0.0625

Appendix D Results of sensitivity tests

The impact of buildings, terrain and meteorological data year have been assessed. The eight cases modelled, A-G, are shown in Table 33. Long-term impacts have been predicted assuming the proposed CHP operates continuously at full load and the emergency boiler emissions are equivalent to operating 15% of the year. Short-term impacts have been predicted assume both sources operate continuously at full load.

The sensitivity tests were based on the maximum concentration predicted at any human receptor and any ecological receptor. For each AQS, the predicted maximum was divided by (normalised) the AQS value, or if the AQS is expressed as a number of exceedances of threshold value, by the threshold value. These normalised values have been expressed as a percentage and are shown in Table 34Table 34. The comparison is expressed this way to show the relative importance of the change in terms of exceedance of the AQS. If all the results are a very small percentage of the AQS, the variation in results is unlikely to affect the conclusions of the study.

For human and ecological receptors, comparing the results for tests A, B and C, modelling buildings led to higher model prediction than for flat terrain. Modelling buildings with terrain produced results that were comparable with modelling buildings without terrain. Comparing the results for tests A, D, E, F and G shows that the variation due to meteorological data year is generally less significant than the impact of modelling buildings for human receptors, whereas for ecological receptors the variation due to the meteorological year is of greater significance.

Table 33 Sensitivity tests

Sensitivity test	Flat/Buildings/Terrain model options	Meteorological data year
A	Flat	2019
B	Buildings	2019
C	Terrain & buildings	2019
A	Flat	2019
D	Flat	2020
E	Flat	2021
F	Flat	2022
G	Flat	2023

Table 34 Sensitivity tests: results as a percentage of the AQS or threshold

Pollutant	Long-term (LT) or Short-term (ST)	Scenario	Value, EAL or threshold, (µg/m^3)	A	B	C	A	D	E	F	G
Human receptors											
NOx	LT	LT	40	1.7%	2.0%	2.0%	1.7%	1.3%	1.1%	1.7%	1.5%
NOx	ST	ST Abnormal	200	3.4%	4.3%	4.0%	3.4%	3.4%	3.3%	3.4%	3.3%
NOx	ST	ST Normal	200	4.9%	6.2%	5.7%	4.9%	4.7%	4.5%	4.9%	4.6%
VOC	LT	LT	5	0.9%	1.1%	1.1%	0.9%	0.7%	0.6%	0.9%	0.8%
SO_2	ST	ST Abnormal	125	1.5%	1.5%	1.8%	1.5%	1.5%	1.5%	2.0%	1.3%
SO_2	ST	ST Normal	125	1.3%	1.32%	1.4%	1.3%	1.3%	1.2%	1.7%	1.1%
SO_2	ST	ST Abnormal	350	1.3%	1.5%	1.5%	1.3%	1.2%	1.2%	1.3%	1.2%
SO_2	ST	ST Normal	350	1.1%	1.3%	1.2%	1.1%	1.0%	1.0%	1.1%	1.0%
SO_2	ST	ST Abnormal	266	2.0%	3.1%	2.6%	2.0%	2.1%	2.0%	2.1%	2.0%
SO_2	ST	ST Normal	266	1.7%	2.6%	2.1%	1.7%	1.7%	1.6%	1.7%	1.6%
CO	ST	ST Abnormal	10000	0.4%	0.6%	0.5%	0.4%	0.5%	0.4%	0.5%	0.5%
CO	ST	ST Normal	10000	0.9%	1.3%	1.0%	0.9%	1.1%	0.9%	1.1%	1.0%
VOC	ST	ST Abnormal	30	1.0%	1.3%	1.2%	1.0%	1.4%	1.1%	1.5%	1.1%
VOC	ST	ST Normal	30	2.0%	2.5%	2.3%	2.0%	2.7%	2.1%	3.0%	2.2%
Ecological receptors											
NOx	ST	ST Abnormal	75	7.1%	7.1%	7.4%	7.1%	6.6%	6.3%	6.5%	6.5%
NOx	ST	ST Normal	75	8.5%	8.5%	8.7%	8.5%	8.1%	8.2%	8.3%	8.3%
NOx	LT	LT	30	1.4%	1.5%	1.6%	1.4%	1.2%	1.3%	1.6%	1.6%
SO_2	LT	LT	20	0.3%	0.3%	0.3%	0.3%	0.2%	0.3%	0.3%	0.3%
SO_2	LT	LT	10	0.6%	0.6%	0.6%	0.6%	0.5%	0.5%	0.7%	0.7%
NH_3	LT	LT	1	6.1%	6.3%	7.0%	6.1%	4.7%	6.0%	6.9%	6.9%

Appendix E Proposed CHP technical specification

Technical specification - datasheet

TEDOM
Combined Heat & Power

Quanto 1200

Basic technical data

Electrical output	1200	kW	Voltage	400	V
Heat output nominal/max.	1238/-	kW	Frequency	50	Hz
electrical efficiency	42,4	%	secondary circuit temperature inlet/outlet	70/90	°C
heat efficiency nominal/max.	43,8/-	%	Service weight of complete CHPU		
total efficiency nominal/max.	86,2/-	%	- container (C)	38	t
fuel input	2828	kW			

Emission	lean mixture	
NOx emission at 5% O2 in exhaust gas standard/option	500/-	mg/Nm^3
CO emission at 5% O2 in exhaust gas standard/option	1100/-	mg/Nm^3

Noise parameters		standard	
C	- CHPU at 10m	66	dB(A)

Notes

The Basic Technical Data are applicable for the standard conditions pursuant to the "Technical instructions" document. The minimum permanent electrical output must not drop below 50 % of the nominal output. Gas consumption is expressed under the normal conditions (0°C, 101.325 kPa) and gas LHV according to the section Fuel. Gas consumption tolerance, or fuel input tolerance, at 100% load is +5%. Tolerances of other parameters are mentioned in "Technical Instructions-Validity of Technical Data" document.

The manufacturer reserves the right to change this document and related documents.

TEDOM
Combined Heat & Power

Quanto 1200

Extended technical data

Standard design	100%	75%	50%	
electrical output	1200	900	600	kW
heat output	1238	976	725	kW
gas consumption	569	439	310	m^3/h
fuel input	2828	2183	1543	kW
electrical efficiency	42,4	41,2	38,9	%
heat efficiency	43,8	44,7	47,0	%
total efficiency	86,2	85,9	85,9	%

1) Heat output is formed of a secondary circuit heat output with exhaust gas cooled to 150°C.

Guaranteed parameters		
electrical output	1200	kW
electrical efficiency	40,4	%
heat efficiency	45,8	%
total efficiency	86,2	%
fuel input	2969	kW
NOx emission at 5% O2 in exhaust gas	500	mg/Nm^3
CO emission at 5% O2 in exhaust gas	1100	mg/Nm^3
CHPU at 10m	70	dB(A)

Electrical parameters

voltage	400	V
frequency	50	Hz
nominal current	2000	A
nominal power factor (GCB settings)	0,87	

operational current at cos φ=0,9	1925	A
short circuit resistance of the switchboard	40	kA
contribution of the actual source to the short-circuit current	< 20	kA
cos φ regulation range (underexcited/overexcited) 1)	0,9÷1÷0,9	

1) Operation of generator with power factor lower than 0,98 decreaes generator efficiency, what can cause reduction of the CHPU active power.

Engine / Generator

Engine	TCG2020V12	
manufacturer	MWM	
oil consumption	0,15	g/kWh
quantity of oil in the engine	715	dm^3
volume of oil tank for refilling	350	dm^3

Generator	MJB 500 MB4
manufacturer	MARELLI

Quanto 1200

Heat system

Secondary circuit

heat carrier: water		
heat output	1238	kW
inlet/outlet temperature	70/90	°C
min./max. inlet temperature	50/70	°C
nominal flow	14,8	kg/s
max. allowed pressure in circuit	600	kPa
volume (OM/SE/C)	-/-/145	dm^3
pressure drop at nominal flow (OM/SE/C)	-/-/45	kPa

Aftercooler circuit

heat carrier: antifreeze		
ethylene glycol concentration	35	%
heat output	91	kW
max. coolant inlet temperature into CHPU	50	°C
nominal flow	7,7	kg/s
expansion vessel volume (OM/SE/C)	/-/35	dm^3
min. inlet pressure into CHPU	100	kPa
max. inlet pressure into CHPU	300	kPa
max. outlet pressure from CHPU	450	kPa
volume (OM/SE/C)	-/-/45	dm^3
dry cooler volume	*tbd	dm^3

Primary circuit

heat carrier: antifreeze		
ethylene glycol concentration	35	%
heat output (OM, C)	1238	kW
max. allowed pressure in circuit	300	kPa
volume (OM/SE/C)	-/-/980	dm^3
dry cooler volume	*tbd	dm^3
**tbd - to be defined*		

Exhaust gas

quantity	6254	kg/h
temperature at the engine outet	466	°C
temperature at the CHPU outlet nominal/max.	150/180	°C
max. allowed back-pressure	1	kPa

Fuel

biogas		
low heat value	17,9	MJ/m^3
min. methane content	45	%
nominal methane content	50	%
pressure (C)	10 - 15	kPa
max. temperature	35	°C

Combustion and ventilation air

Combustion air

ambient temperature min./max. (C)	-20/35	°C
combustion air temperature min./max.	10/35	°C
quantity	5490	kg/h

Ventilation	C	
unused heat removed by the ventilation	76	kW

Quanto 1200

Related documents

dimensional drawing C	R0550

TEDOM
Combined Heat & Power

Quanto 1200

Basic technical data

Electrical output	1200	kW	Voltage	400	V
Heat output nominal/max.	1220/-	kW	Frequency	50	Hz
electrical efficiency	42,0	%	secondary circuit temperature inlet/outlet	70/90	°C
heat efficiency nominal/max.	42,7/-	%	Service weight of complete CHPU		
total efficiency nominal/max.	84,7/-	%	- container (C)	38	t
fuel input	2854	kW			

Emission	lean mixture	
NOx emission at 5% O2 in exhaust gas standard/option	250/-	mg/Nm^3
CO emission at 5% O2 in exhaust gas standard/option	1100/-	mg/Nm^3

Noise parameters		standard	
C	- CHPU at 10m	66	dB(A)

Notes

The Basic Technical Data are applicable for the standard conditions pursuant to the "Technical instructions" document. The minimum permanent electrical output must not drop below 50 % of the nominal output. Gas consumption is expressed under the invoicing conditions (15°C, 101.325 kPa) and gas LHV according to the section Fuel. Gas consumption tolerance, or fuel input tolerance, at 100% load is +5%. Tolerances of other parameters are mentioned in "Technical Instructions-Validity of Technical Data" document.

The manufacturer reserves the right to change this document and related documents.

Quanto 1200

Extended technical data

Standard design	100%	75%	50%	
electrical output	1200	900	600	kW
heat output	1220	962	714	kW
gas consumption	302	233	165	m^3/h
fuel input	2854	2203	1558	kW
electrical efficiency	42,0	40,8	38,5	%
heat efficiency	42,7	43,7	45,8	%
total efficiency	84,7	84,5	84,3	%

1) Heat output is formed of a secondary circuit heat output with exhaust gas cooled to 150°C.

Guaranteed parameters		
electrical output	1200	kW
electrical efficiency	40,0	%
heat efficiency	44,7	%
total efficiency	84,7	%
fuel input	2997	kW
NOx emission at 5% O2 in exhaust gas	250	mg/Nm^3
CO emission at 5% O2 in exhaust gas	1100	mg/Nm^3
CHPU at 10m	70	dB(A)

Electrical parameters

voltage	400	V
frequency	50	Hz
nominal current	2000	A
nominal power factor (GCB settings)	0,87	

operational current at cos φ=0,9	1925	A
short circuit resistance of the switchboard	40	kA
contribution of the actual source to the short-circuit current	< 20	kA
cos φ regulation range (underexcited/overexcited) [1)]	0,9÷1÷0,9	

1) Operation of generator with power factor lower than 0,98 decreaes generator efficiency, what can cause reduction of the CHPU active power.

Engine / Generator

Engine	TCG2020V12	
manufacturer	MWM	
oil consumption	0,15	g/kWh
quantity of oil in the engine	715	dm^3
volume of oil tank for refilling	350	dm^3

Generator	MJB 500 MB4
manufacturer	MARELLI

Quanto 1200

Heat system

Secondary circuit

heat carrier: water		
heat output	1220	kW
inlet/outlet temperature	70/90	°C
min./max. inlet temperature	50/70	°C
nominal flow	14,6	kg/s
max. allowed pressure in circuit	600	kPa
volume (OM/SE/C)	-/-/145	dm^3
pressure drop at nominal flow (OM/SE/C)	-/-/45	kPa

Aftercooler circuit

heat carrier: antifreeze		
ethylene glycol concentration	35	%
heat output	95	kW
max. coolant inlet temperature into CHPU	47	°C
nominal flow	9,7	kg/s
expansion vessel volume (OM/SE/C)	/-/35	dm^3
min. inlet pressure into CHPU	100	kPa
max. inlet pressure into CHPU	300	kPa
max. outlet pressure from CHPU	450	kPa
volume (OM/SE/C)	-/-/45	dm^3
dry cooler volume	*tbd	dm^3

Primary circuit

heat carrier: antifreeze		
ethylene glycol concentration	35	%
heat output (OM, C)	1220	kW
max. allowed pressure in circuit	300	kPa
volume (OM/SE/C)	-/-/980	dm^3
dry cooler volume	*tbd	dm^3
**tbd - to be defined*		

Exhaust gas

quantity	7114	kg/h
temperature at the engine outet	402	°C
temperature at the CHPU outlet nominal/max.	150/180	°C
max. allowed back-pressure	1	kPa

Fuel

natural gas		
low heat value	34	MJ/m^3
min. methane number	101	
pressure (C)	10 - 15	kPa
max. temperature	35	°C

Combustion and ventilation air

Combustion air

ambient temperature min./max. (C)	-20/35	°C
combustion air temperature min./max.	10/35	°C
quantity	6896	kg/h

Ventilation

	C	
unused heat removed by the ventilation	77	kW

Quanto 1200

Related documents

dimensional drawing C	R0550

Appendix F Emergency boiler technical specification

VIESSMANN

VITOPLEX 200
Low temperature oil/gas boiler
90 to 560 kW

Datasheet
Part no. and prices: See pricelist

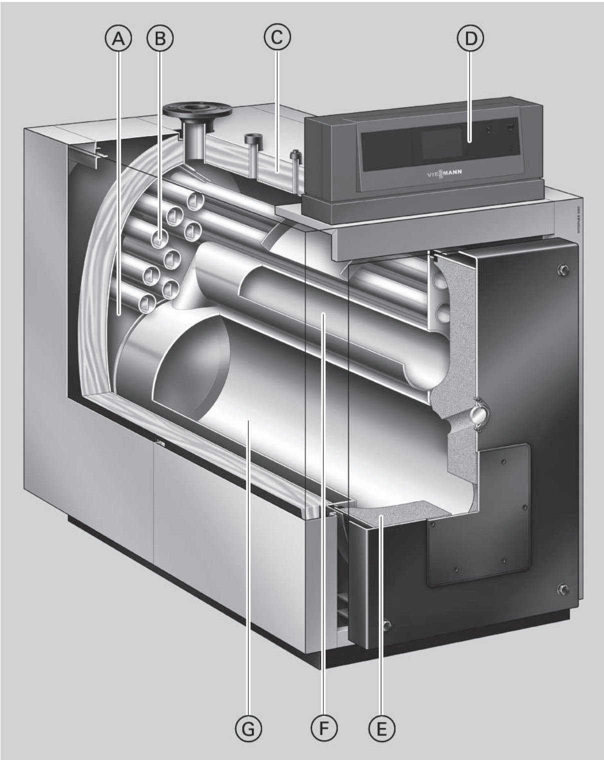
VITOPLEX 200 Type SX2A

Low temperature oil/gas boiler
- Three-pass boiler
- For operation with modulating boiler water temperature
- With Vitotrans 300 as condensing unit

Information for type SX2A, 90 to 350 kW:
In accordance with the Ecodesign Directive for Heating Appliances and Water Heaters (Dir. 2009/125/EC), Implementing Regulation (EU) No. 813/2013 and (EU) No. 814/2013, these boilers may not be sold and used within the EU for the purpose of generating space heating and domestic hot water. A sale is subject to the proviso of exclusive use for purposes not included in the regulations stated above.

Benefits at a glance

- Economical and environmentally responsible thanks to modulating boiler water temperature
- Standard seasonal efficiency [to DIN] for operation with fuel oil: 89 % (H_s) [gross cv]
- Optional stainless steel flue gas/water heat exchanger for higher standard seasonal efficiency [to DIN], utilising the condensing effect
- Three-pass boiler with low combustion chamber loading, resulting in clean combustion with low emissions
- Wide water galleries and large water content provide excellent natural circulation and reliable heat transfer.
- Integral Therm-Control start-up system for easy hydraulic connection – no shunt pump or return temperature raising facility are required.
- Boilers up to 300 kW do not require a low water indicator
- Compact design for easy transportation into boiler rooms and economical use of space – important for modernisation projects
- Fastfix installation system for control unit and thermal insulation
- Easy to use Vitotronic control unit with colour touchscreen
- Integral WiFi for service interface
- Economical and safe operation of the heating system through the Vitotronic control system with communication capability which, in conjunction with Vitogate 300 (accessories), enables integration into building management systems.



Ⓐ Wide water galleries and large water content ensure excellent natural circulation and easy hydraulic connection
Ⓑ Third hot gas flue
Ⓒ Highly effective thermal insulation
Ⓓ Vitotronic control unit with colour touchscreen
Ⓔ Thermal insulation on boiler door
Ⓕ Hot gas flue (second pass)
Ⓖ Combustion chamber

5797332

Boiler specification

Specification

Rated heating output	kW	90	120	150	200	270	350	440	560
Rated heat input	kW	98	130	163	217	293	380	478	609
CE designation									
– According to Efficiency Directive		CE-0085BQ0020						—	—
– According to Gas Appliances Directive		CE-0085BQ0020							
Permiss. flow temperature (= safety temperature)	°C	110 (up to 120 °C on request)							
Permiss. operating temperature	°C	95							
Permiss. operating pressure	bar	4							
	kPa	400							
Pressure drop on the hot gas side	Pa	60	80	100	200	180	310	280	400
	mbar	0.6	0.8	1.0	2.0	1.8	3.1	2.8	4.0
Boiler body dimensions									
Length (dim. q)*1	mm	1195	1400	1385	1580	1600	1800	1825	1970
Width (dim. d)	mm	575	575	650	650	730	730	865	865
Height (incl. connectors) (dim. t)	mm	1145	1145	1180	1180	1285	1285	1455	1455
Total dimensions									
Total length (dim. r)	mm	1260	1460	1445	1640	1660	1860	1885	2030
Total length incl. burner and hood, depending on burner make (dim. s)	mm	1660	1860	1865	2060	2085	–	–	–
Total width (dim. e)	mm	755	755	825	825	905	905	1040	1040
Total height (dim. b)	mm	1315	1315	1350	1350	1460	1460	1625	1625
Service height (control unit) (dim. a)	mm	1485	1485	1520	1520	1630	1630	1795	1795
Height									
– Adjustable anti-vibration feet	mm	28	28	28	28	28	28	28	28
– Anti-vibration boiler supports (under load)	mm	–	–	–	–	–	37	37	37
Foundation									
Length	mm	1000	1200	1200	1400	1400	1650	1650	1800
Width	mm	760	760	830	830	900	900	1040	1040
Combustion chamber diameter	mm	380	380	400	400	480	480	570	570
Combustion chamber length	mm	800	1000	1000	1200	1200	1400	1400	1550
Weight boiler body	kg	315	365	415	460	585	700	895	1100
Total weight Boiler incl. thermal insulation and boiler control unit	kg	360	410	465	510	635	760	960	1170
Total weight Boiler incl. thermal insulation, burner and boiler control unit	kg	390	440	495	540	665	–	–	–
Capacity boiler water	litres	180	210	255	300	400	445	600	635
Boiler connections									
Boiler flow and return	PN 6 DN	65	65	65	65	65	80	100	100
Safety connection (safety valve) (male thread)	R	1¼	1¼	1¼	1¼	1¼	1¼	1½	1½
Drain (male thread)	R	1¼							
Flue gas parameters*2									
Temperature (at 60 °C boiler water temperature)									
– At rated heating output	°C	180							
– At partial load	°C	125							
Temperature (at 80 °C boiler water temperature)	°C	195							
Flue gas mass flow rate									
– For natural gas	kg/h	1.5225 x combustion output in kW							
– For fuel oil EL	kg/h	1.5 x combustion output in kW							
Required draught	Pa/mbar	0							
Flue gas connection	Ø mm	180	180	200	200	200	200	250	250
Standard seasonal efficiency [to DIN] (for operation with fuel oil) For heating system temperature 75/60 °C	%	89 (H_s) [gross cv]							

*1 *Boiler door removed.*

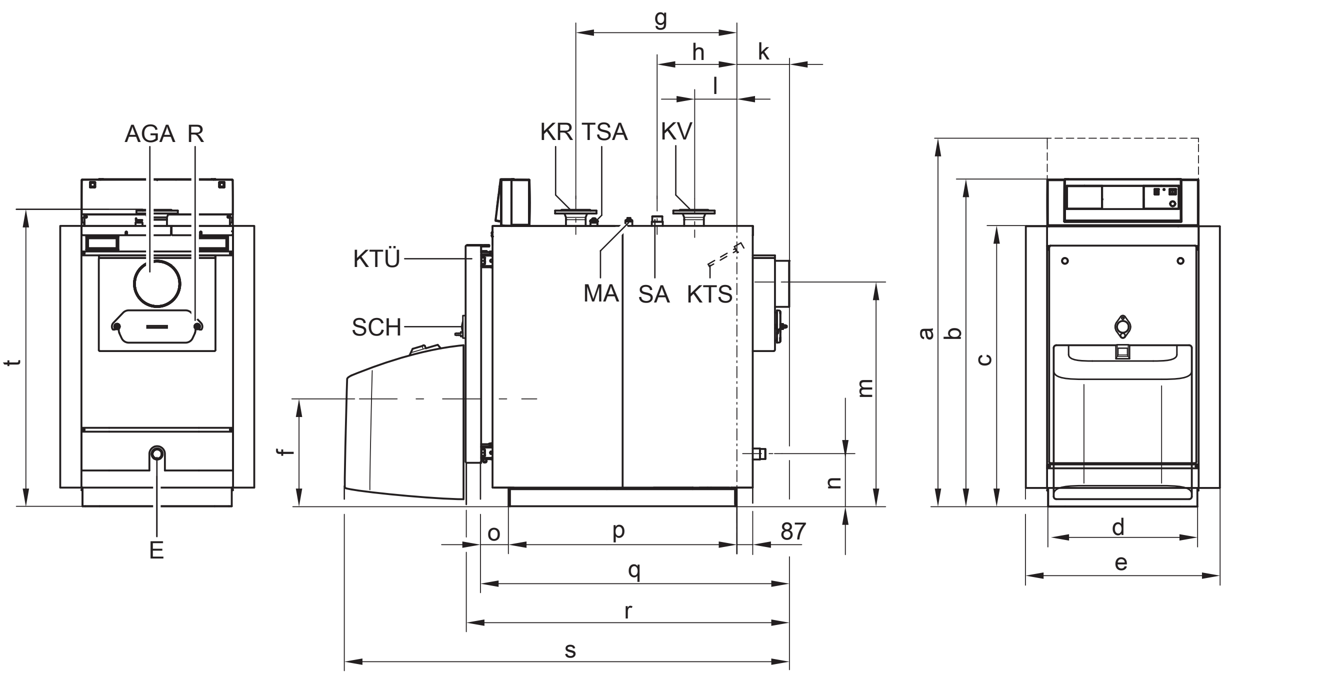
*2 *Values for calculating the size of the flue system to EN 13384, relative to 13.2 % CO_2 for fuel oil EL and 10 % CO_2 for natural gas.*
Flue gas temperatures as actual gross values at 20 °C combustion air temperature.
The details for partial load refer to an output of 60 % of rated heating output. If the partial load differs (depending on operating mode), calculate the flue gas mass flow rate accordingly.

5797332

Boiler specification (cont.)

Rated heating output	kW	90	120	150	200	270	350	440	560
Standby loss $q_{B,70}$	%	0.40	0.35	0.30	0.30	0.25	0.25	0.22	0.20
Sound pressure level[*3]									
1 m in front of the boiler (1st/2nd stage)	dB(A)	<68/<69					–		
In the flue pipe (1st/2nd stage)	dB(A)	<96/<103					–		
Matching Vitotrans 300									
– Gas operation	Part no.	Z010326		Z010327		Z010328		Z010329	
– Oil operation	Part no.	Z010330		Z010331		Z010332		Z010333	
Rated heating output									
Boiler with Vitotrans 300									
– Gas operation	kW	98.7	131.4	164.3	219.0	295.6	383.3	478.7	608.9
– Oil operation	kW	95.8	127.8	159.8	213.0	287.5	372.7	466.4	593.5
CE designation Vitotrans 300 in conjunction with boiler as a condensing unit		CE-0085BS0287							
Pressure drop on the hot gas side	Pa	125	145	185	285	280	410	385	505
Boiler with Vitotrans 300	mbar	1.25	1.45	1.85	2.85	2.80	4.10	3.85	5.05
Total length Boiler with Vitotrans 300 excl. burner	mm	1990		2290		2570		2950	

Dimensions

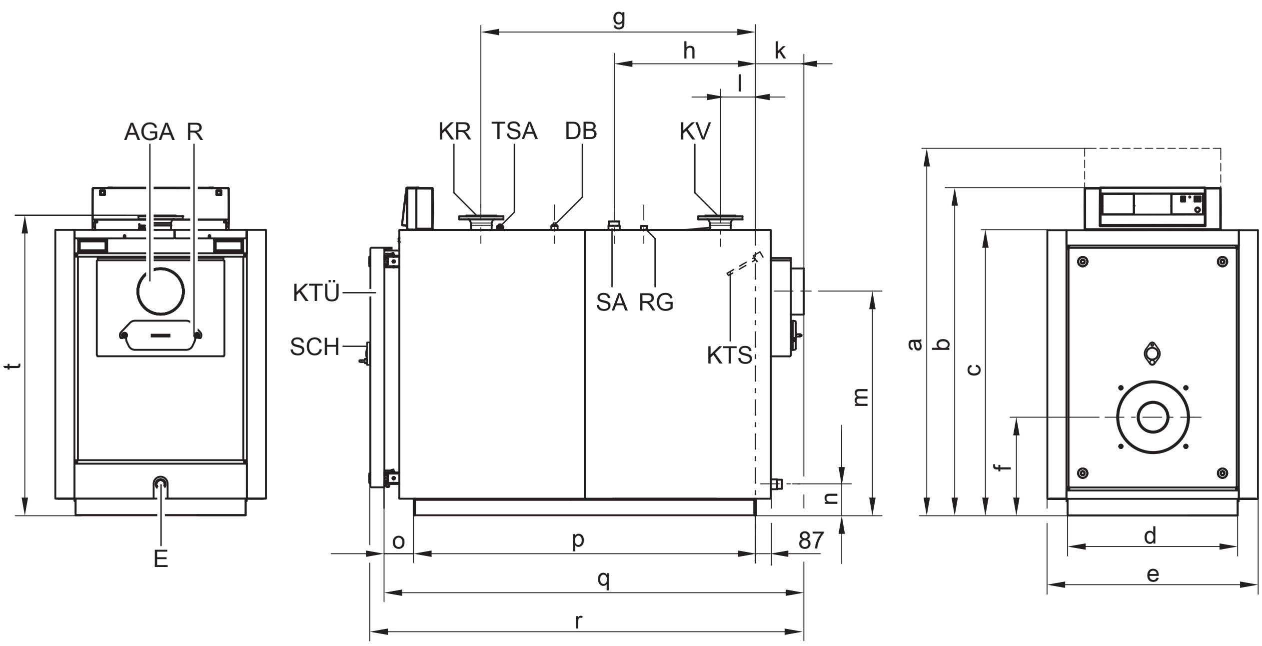


90 to 270 kW

AGA Flue outlet
E Drain
KR Boiler return
KTS Boiler water temperature sensor
KTÜ Boiler door
KV Boiler flow
MA Female connection R ½ (male thread) for pressure gauge
R Cleaning aperture
SA Safety connection (safety valve)
SCH Inspection port
TSA Female connection R ½ (male thread) for Therm-Control temperature sensor

*3 *Standard values resulting from sound pressure level testing cannot be guaranteed, as sound pressure level tests are always dependent on the specific system. The data provided here refers to Viessmann Vitoflame 100 pressure-jet oil/gas burners.*

5797332



350 to 560 kW

AGA Flue outlet
DB Female connection R ½ (male thread) for maximum pressure limiter
E Drain
KR Boiler return
KTS Boiler water temperature sensor
KTÜ Boiler door
KV Boiler flow
R Cleaning aperture
RG Female connection R ½ (male thread) for additional control equipment
SA Safety connection (safety valve)
SCH Inspection port
TSA Female connection R ½ (male thread) for Therm-Control temperature sensor

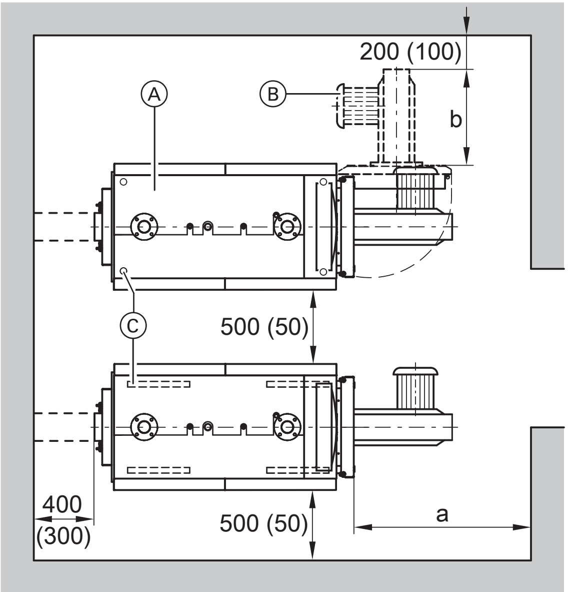
Dimensions

Rated heating output	**kW**	**90**	**120**	**150**	**200**	**270**	**350**	**440**	**560**
a	mm	1485	1485	1520	1520	1630	1630	1795	1795
b	mm	1315	1315	1350	1350	1460	1460	1625	1625
c	mm	1085	1085	1115	1115	1225	1225	1395	1395
d	mm	575	575	650	650	730	730	865	865
e	mm	755	755	825	825	905	905	1040	1040
f	mm	440	440	440	440	420	420	470	470
g	mm	622	825	811	1009	979	1179	1146	1292
h	mm	307	395	324	423	409	609	710	783
k	mm	203	203	203	203	203	203	224	224
l	mm	165	165	151	151	153	153	166	166
m	mm	860	860	885	885	960	960	1110	1110
n	mm	200	200	190	190	135	135	135	135
o	mm	110	110	110	110	130	130	130	130
p (length of base rails)	mm	882	1085	1071	1268	1269	1469	1471	1617
q (transport dimension)	mm	1195	1400	1385	1580	1600	1800	1825	1970
r	mm	1260	1460	1445	1640	1660	1860	1885	2030
s (depending on burner make)	mm	1670	1875	1880	2075	2095	–	–	–
t	mm	1145	1145	1180	1180	1285	1285	1455	1455

Where access to the boiler room is difficult the boiler door can be removed.
Dim. f: Observe the installed burner height.
Dim. q: With boiler door removed

Siting

Minimum clearances



Observe the stated dimensions to ensure easy installation and maintenance. Where space is tight, only the minimum clearances (dimensions in brackets) need to be maintained. In the delivered condition, the boiler door is fitted so it opens to the left. The hinge pins can be repositioned so the door opens to the right.

Ⓐ Boiler
Ⓑ Burner
Ⓒ Adjustable anti-vibration feet (90 to 560 kW) or anti-vibration boiler supports (350 to 560 kW)

Rated heating output	kW	90	120	150	200	270	350	440	560
a	mm		1100		1400			1600	

Dim. a: Maintain this space in front of the boiler to enable removal of the turbulators and cleaning of the hot gas flues.
Dim. b: Observe the installed burner length.

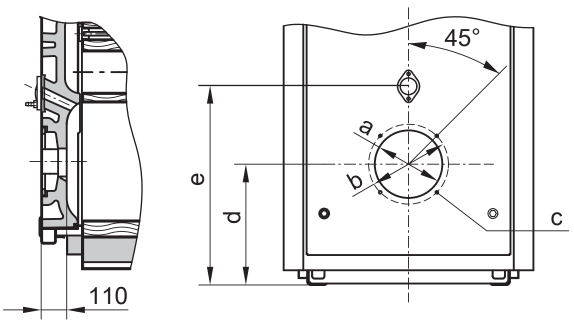
Siting conditions

- Prevent air contamination by halogenated hydrocarbons (e.g. as contained in sprays, paints, solvents and cleaning agents)
- Prevent very dusty conditions
- Prevent high levels of humidity
- Prevent frost and ensure good ventilation

Otherwise the system may suffer faults and damage.
In rooms where air contamination through **halogenated hydrocarbons** may occur, install the boiler only if adequate measures can be taken to provide a supply of uncontaminated combustion air.

Burner installation

Boilers up to 120 kW:
The burner fixing hole circle, burner fixing holes and flame tube aperture comply with EN 226.
Boilers from 150 kW:
The burner fixing hole circle, burner fixing holes and flame tube aperture are as detailed in the table below.
The burner may be mounted directly on the hinged boiler door. If the burner dimensions deviate from those stated in the table below, use the burner plate included in the standard delivery.
Burner tiles can be prepared at the factory on request (chargeable option). If this is required, state the burner make and type when ordering. The flame tube must protrude from the thermal insulation of the boiler door.

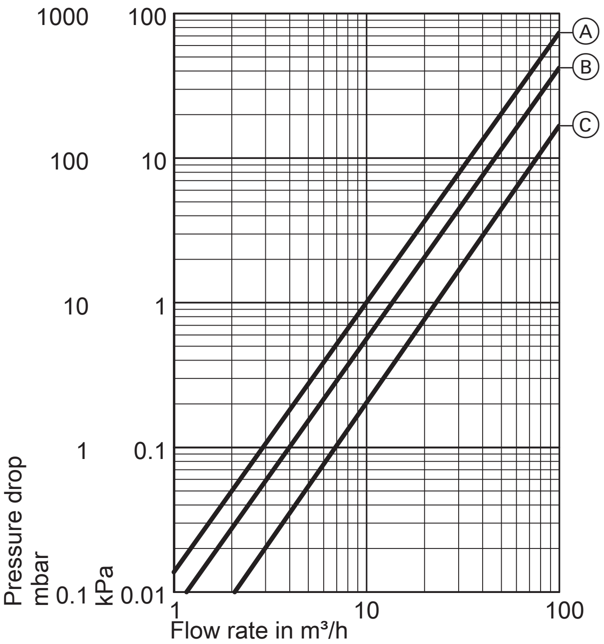


Rated heating output	kW	90	120	150	200	270	350	440	560
a	Ø mm	135	135	240	240	240	240	290	290
b	Ø mm	170	170	270	270	270	270	330	330
c	Number/thread	4/M 8	4/M 8	4/M 10	4/M 10	4/M 10	4/M 10	4/M 12	4/M 12

5797332

Rated heating output	kW	90	120	150	200	270	350	440	560
d	mm	440	440	440	440	420	420	470	470
e	mm	650	650	650	650	670	670	780	780

Pressure drop on the heating water side



Ⓐ Rated heating output 90 to 270 kW
Ⓑ Rated heating output 350 kW
Ⓒ Rated heating output 440 and 560 kW

The Vitoplex 200 is only suitable for fully pumped hot water heating systems.

Specification

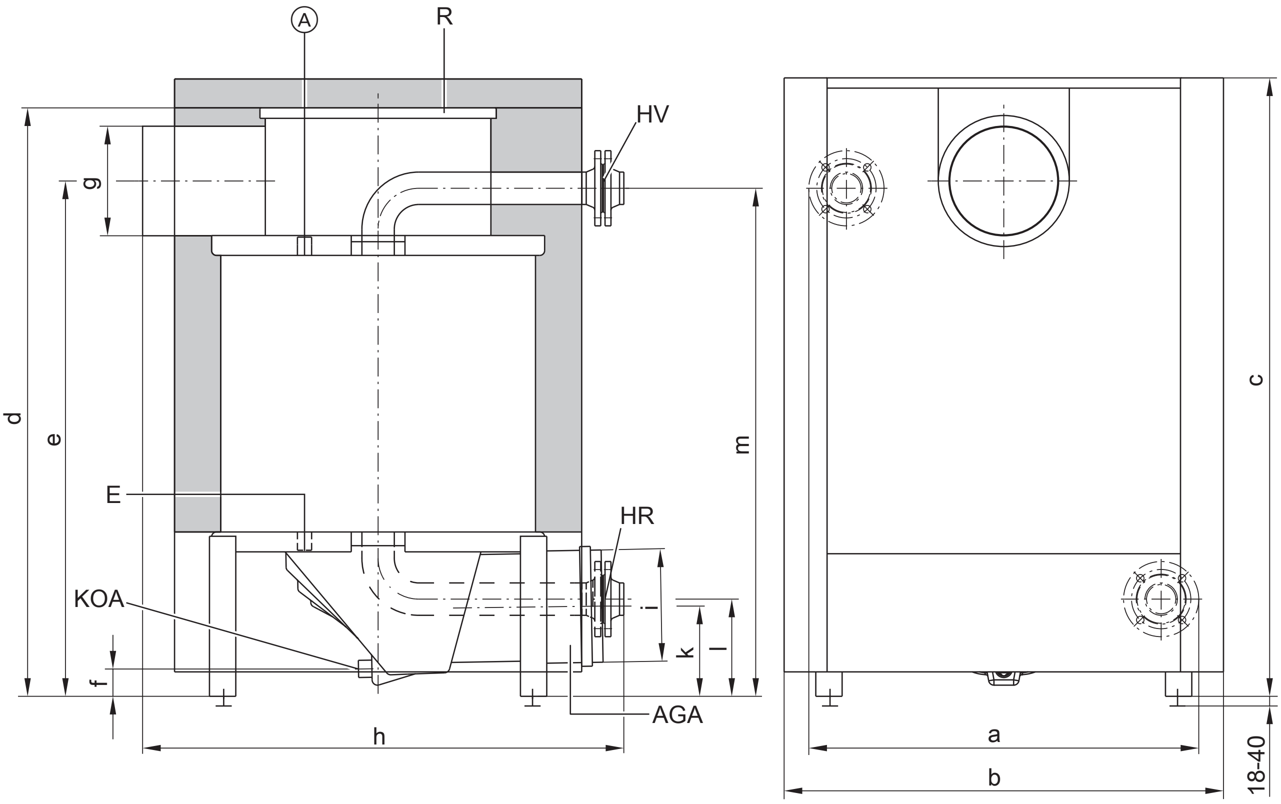
Vitotrans 300					
– Gas operation	**Part no.**	**Z010326**	**Z010327**	**Z010328**	**Z010329**
– Oil operation	**Part no.**	**Z010330**	**Z010331**	**Z010332**	**Z010333**
Rated boiler heating output	kW	90-125	140-200	230-350	380-560
Rated heating output range of the Vitotrans 300 for					
– Gas operation	from kW	8.7	12.7	21.8	33.3
	to kW	11.9	19.0	33.3	48.9
– Oil operation	from kW	5.8	8.8	14.9	22.9
	to kW	8.1	13.0	22.7	33.5
Permiss. operating pressure	bar	4	4	4	6
	MPa	0.4	0.4	0.4	0.6
Permiss. flow temperature (= safety temperature)	°C	110	110	110	110
Pressure drop on the hot gas side	mbar	0.65	0.85	1.00	1.05
	Pa	65	85	100	105
Flue gas temperature					
– Gas operation	°C	65	65	65	65
– Oil operation	°C	70	70	70	70
Flue gas mass flow rate	from kg/h	136	213	383	546
	to kg/h	213	341	596	954
Total dimensions					
Total length (dim. h) incl. mating flanges	mm	666	777	856	967
Total width (dim. b)	mm	714	760	837	928
Total height (dim. c)	mm	1037	1152	1167	1350
Transport dimensions					
Length excl. mating flanges	mm	648	760	837	928
Width (dim. a)	mm	618	636	706	839
Height (dim. d)	mm	1081	1098	1172	1296
Heat exchanger weight	kg	94	119	144	234
Total weight	kg	125	150	188	284
Heat exchanger incl. thermal insulation					
Capacity					
Heating water	litres	70	97	134	181
Flue gas	m^3	0.055	0.096	0.133	0.223
Connections					
Heating water flow and return	DN	40	50	50	65
Condensate drain (male thread)	R	½	½	½	½
Flue gas connection					
– To the boiler	DN	180	200	200	250
– To the flue system	DN	150	200	200	250

Rated heating output range of the Vitotrans 300 and flue gas temperature
Heating output of the Vitotrans 300 with flue gas cooling of 200/65 °C for gas operation and 200/70 °C for oil operation, with a heating water temperature rise in the Vitotrans 300 from 40 °C to 42.5 °C.
For conversion to other temperatures, see chapter "Output data".

Pressure drop on the hot gas side
Pressure drop on the hot gas side at rated heating output. The burner must overcome the hot gas pressure drop of the boiler, the Vitotrans 300 and the flue pipe.

Tested quality
CE designation according to current EC Directives at a permissible flow temperature (safety temperature) of up to 110 °C to EN 12828.

Dimensions



A	Additional female connection R ½ (male thread)
AGA	Flue outlet
E	Drain R ½ (male thread)
HR	Heating water return (inlet)
HV	Heating water flow (outlet)
KOA	Condensate drain ∅ 32
R	Cleaning aperture

Dimensions

Part no.		Z010326 Z010330	Z010327 Z010331	Z010328 Z010332	Z010329 Z010333
a	mm	628	656	726	839
b	mm	714	746	818	912
c	mm	1022	1098	1151	1308
d	mm	965	1043	1096	1245
e	mm	851	907	960	1080
f	mm	73	53	51	88
g (internal)	∅ mm	181	201	201	251
h	mm	707	818	896	1015
i (internal)	∅ mm	151	201	201	251
k	mm	165	170	168	230
l	mm	170	172	181	232
m	mm	851	899	946	1075

Delivered condition

Heat exchanger body with fitted flue gas collector. Mating flanges are fitted to all connectors

1 box with thermal insulation

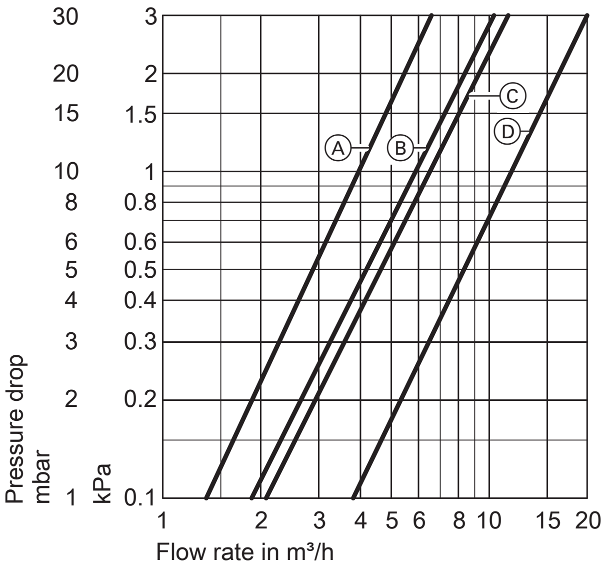
Connection on the flue gas side

Connect the boiler flue outlet and offset flue adaptor of the flue gas/ water heat exchanger through a connection collar (accessories) (do not weld).

Height compensation:
- Vitoplex boiler through adjusting screws
- Vitorond boiler through on-site adaptor

Pressure drop on the heating water side

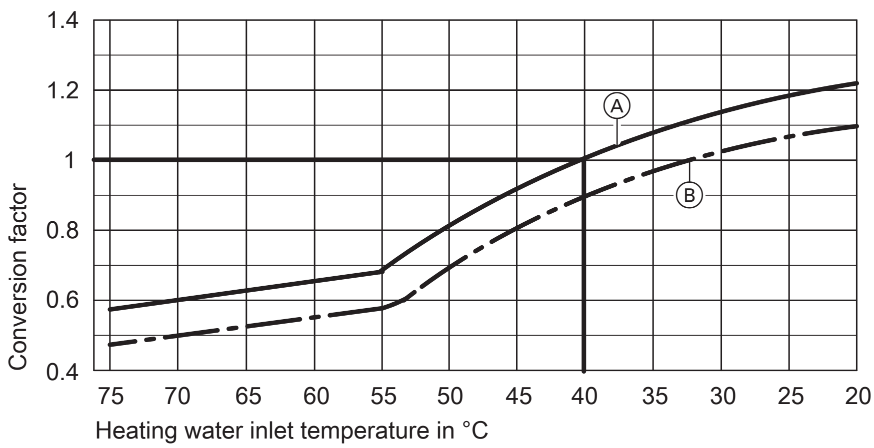
Part no. Z010326 to Z010333



Part no.	Curve
Z010326 Z010330	A
Z010327 Z010331	B
Z010328 Z010332	C
Z010329 Z010333	D

Output data

Vitotrans 300 for gas operation



A Flue gas inlet temperature 200 °C
B Flue gas inlet temperature 180 °C

Conversion of the output data
The heating output data of the Vitotrans 300 flue gas/water heat exchanger refers to a flue gas inlet temperature of 200 °C and a heating water inlet temperature into the heat exchanger of 40 °C.

For different conditions the heating output can be calculated by multiplying the specified rated heating output by the conversion factor established from the diagram.

Delivered condition of the boiler

Boiler body with fitted boiler door and cleaning cover.
Mating flanges are fitted to all connectors.
The adjusting screws are supplied in the combustion chamber.
Cleaning equipment can be found on top of the boiler.

2 boxes with thermal insulation
1 box with boiler control unit and 1 bag with technical documentation
1 Therm-Control
1 coding card and technical documentation for Vitoplex 200
1 burner plate (from 150 kW)

5797332

Control unit versions

For a single boiler system

- **Vitotronic 100, type CC1E**
  For the control unit with a constant boiler water temperature.
  For weather-compensated or room temperature-dependent operation in conjunction with an external control unit.
- **Vitotronic 200, type CO1E**
  For weather-compensated operation and mixer control for up to 2 heating circuits with mixer. For the 2 heating circuits with mixer, the accessory "Extension for heating circuits 2 and 3" is required.

Control panel
- Vitocontrol control panel with e.g. Vitotronic 200-H, type HK1B or HK3B for 1 or up to 3 heating circuits with mixer on request.

For a multi boiler system (up to 8 boilers)

- **Vitotronic 300, type CM1E**
  For weather-compensated operation of a multi boiler system. This Vitotronic control unit also regulates the boiler water temperature of one boiler in this multi boiler system.
  Vitotronic 100, type CC1E and LON communication module
  To control the boiler water temperature for each additional boiler in the multi boiler system.
- **Vitocontrol 200-M multi mode system controller**
  For weather-compensated cascade control of boilers with a Vitotronic 100 control unit and a Vitobloc 200 CHP unit or other heat generators on request.

Control panel
- Vitocontrol control panel with e.g. Vitotronic 200-H, type HK1B or HK3B for 1 or up to 3 heating circuits with mixer on request.

Boiler accessories

See pricelist.

Operating conditions for systems with Vitotronic boiler protection

Vitotronic boiler protection, e.g. Therm-Control.

		Requirements	
Operation with burner load		**≥ 60 %**	**< 60 %**
1.	Heating water flow rate	None	
2.	Boiler return temperature (minimum value)*4	None*5	
3.	Lower boiler water temperature	– Oil operation 50 °C – Gas operation 60 °C	– Oil operation 60 °C – Gas operation 65 °C
4.	Two-stage burner operation	Stage 1: 60 % of rated heating output	No minimum load required
5.	Modulating burner operation	Between 60 and 100 % of rated heating output	No minimum load required
6.	Reduced mode	Single boiler systems and the lead boiler in multi boiler systems – Operation with lower boiler water temperature Lag boilers in multi boiler systems – Can be shut down	
7.	Weekend setback	As per reduced mode	

For water quality requirements see the technical guide to this boiler.

Operating conditions for systems with on-site boiler protection

		Requirements	
Operation with burner load		**≥ 60 %**	**< 60 %**
1.	Heating water flow rate	None	
2.	Boiler return temperature (minimum value)	– Oil operation 40 °C – Gas operation 53 °C	– Oil operation 53 °C – Gas operation 58 °C
3.	Lower boiler water temperature	– Oil operation 50 °C – Gas operation 60 °C	– Oil operation 60 °C – Gas operation 65 °C
4.	2-stage burner operation	1st stage 60 % of rated heating output	No minimum load required
5.	Modulating burner operation	Between 60 and 100 % of rated heating output	No minimum load required

**4 The technical guide "System examples" contains relevant sample systems for use of the Therm-Control start-up system.*
**5 No requirements; only in conjunction with Therm-Control.*

		Requirements	
Operation with burner load		≥ 60 %	< 60 %
6.	Reduced mode	Single boiler systems and lead boiler in multi boiler systems – Operation with lower boiler water temperature Lag boilers in multi boiler systems – Can be shut down	
7.	Weekend setback	As per reduced mode	

For water quality requirements see the technical guide to this boiler.

Design/engineering information

Mounting a suitable burner

The burner must be suitable for the relevant rated heating output and the pressure drop on the hot gas side of the boiler (see burner manufacturer's specification).
The material of the burner head must be suitable for operating temperatures of at least 500 °C.

Pressure-jet oil burner
The burner must be tested and designated to EN 267.

Pressure-jet gas burner
The burner must be tested to EN 676 and CE-designated in accordance with Directive 2009/142/EC.

Burner adjustment
Adjust the oil or gas throughput of the burner to suit the rated boiler heating output.

Low water indicator

If the standard boiler control unit is connected in accordance with the installation instructions, the Vitoplex 200 up to 300 kW (except in attic heating centres) does not require a low water indicator to EN 12828.

In the event of a water shortage due to a leak in the heating system and simultaneous burner operation, the control unit will automatically shut down the burner before the boiler and/or flue system reach impermissible high temperatures.

Permissible flow temperatures

Hot water boiler for permissible flow temperatures (= safety temperatures)

Up to 110 °C
- **CE designation:**
  CE-0085 (90 to 350 kW) compliant with Efficiency Directive
  and
  CE-0085 compliant with the Gas Appliances Directive

Above 110 °C (up to 120 °C) (with individual test certification on request)
- **CE designation:**
  CE-0035 in compliance with the Pressure Equipment Directive
  For operation with safety temperatures in excess of 110 °C additional safety equipment is required.
  Boilers with a safety temperature **above 110 °C** require supervision, according to the Health & Safety at Work Act [Germany]. In accordance with the conformity assessment diagram no. 5 of the EU Pressure Equipment Directive, these boilers must be classed as category III.
  The system must be tested prior to commissioning.
  – Annually: External inspection, inspection of the safety equipment and water quality.
  – Every 3 years: Internal inspection (or water pressure test as an alternative).
  – Every 9 years: Water pressure test (for max. test pressure see type plate).
  An approved inspection body (e.g. TÜV [in Germany]) must carry out the test.

Further information on design/engineering

See the technical guide to this boiler.

Tested quality

CE designation according to current EC Directives

Subject to technical modifications.

Viessmann Werke GmbH & Co. KG
D-35107 Allendorf
Telephone: +49 6452 70-0
Fax: +49 6452 70-2780
www.viessmann.com

Viessmann Limited
Hortonwood 30, Telford
Shropshire, TF1 7YP, GB
Telephone: +44 1952 675000
Fax: +44 1952 675040
E-mail: info-uk@viessmann.com

5797332

Appendix G Emergency flare technical specification

Datasheet for MTU 3000-HT-GVD

Gasflare MTU 3000-HT-GVD (full automatic type)

High temperature gas flare with hidden flame according to TA-Luft Pt. 5.4.8.1.3a. Designed for thermic disposing of Biogas with **100mm** flame tube insulation.

All gas-bearing parts of the flare are made of stainless steel, welded, stained and passivated.

Specifications:

gas flow step 1/2/3:	1300 / 1950 / 2600 Nm³/h
max. thermal Power:	16000kW
Gas:	Biogas filtered and drained
CH4 concentration:	45-65 % CH_4
Flame Temperature:	**> 1000°C** above 1300m³/h
Residence time:	0,3 seconds
Gas pressure:	max. -5mbar with integrated gas blower
Gas Flange:	DN 300
Ignition:	Ignition burner biogas
Flame detection:	UV-Cell, heat resistant type
Sound level:	~ 75 dB(A) in 15 m at 2600 Nm3/h
Dimensions (LxWxH):	220 x 220 x 1050cm

Controls and Instruments (mounted ready to start)

20 Biogas burner
4 Flame Arrestor DN100, Insert SS,
ATEX approved
4 Shut off gas valve DN100, EN 161 certified
2 Pressure switch (p-min, p-max)
1 Gas blower GVD652-15kW with FI, Atex approved
1 Suction pressure switch, set to -7mbar
1 Manual flap inlet DN300

7,5m Flame tube 1.4301

- 100mm heat resistant insulation up to 1400°C
- 2x Thermocouple for monitoring and control of the
- Combustion temperature, t-max. protection at 1150°C.
- 2pcs. sampling port`s DN80, 90 degrees offset

3,5m base frame 1.4301

- Enclosed base frame with air control flap`s.
- temperature regulation to > 1000°C

E-cabinet IP 54 mounted on flare body

Operating voltage 3x400V with blower. Flame detecting with UV-Sensor, including EN approved Flame Controller IFD 258 for flame, ignition and valve control.

- PLC with touch display for 1000°C control
- Manual operation or automatic operation
- 5 automatic re-cycling attempts
- Start with an external signal (on/off)
- Extended data exchange and data storage
- 4-20mA output for external temperature monitoring

Options

E-cabinet made of Stainless steel, 1.4301

Standard is carbon steel stove-enamelled. IP 54

Separated E-Cabinet

For external mounting, according to some national safety regulations. We lead all cables in a IP65 Junction Box on the flare. (7 meter cable)

Frost protection

Heating and housing of the instruments

Flame arrester SS

Housing stainless steel DN100

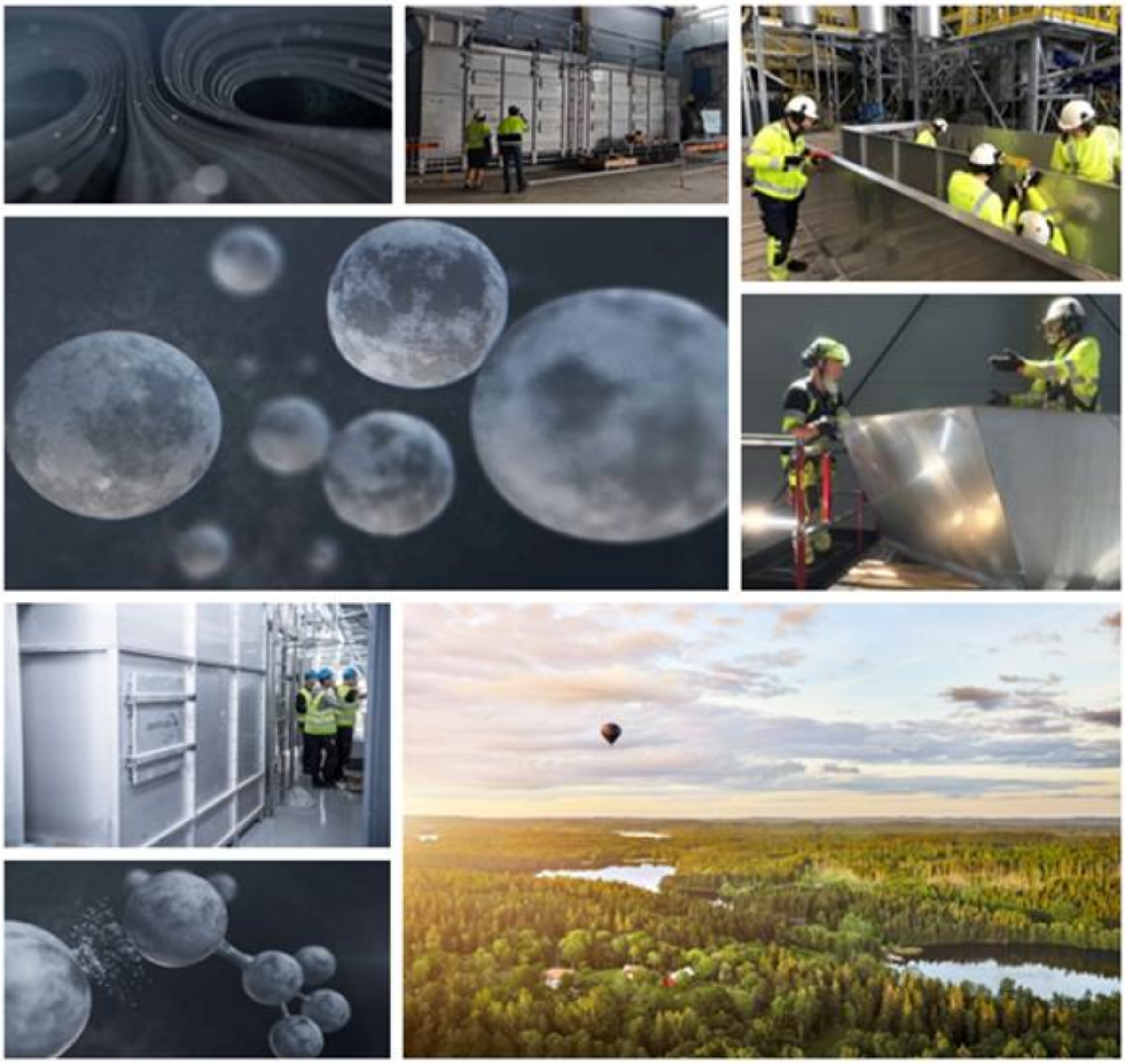
Anchor Set

16 pcs. Anchor Bolts SS, M20

Appendix H Manure Reception Building emissions abatement system

Quotation no.: 1 517

Acorn Bioenergy



Quotation no:	1517	Valid through:	2024-09-19	Customer:	Acorn Bioenergy
Date	2024-08-19	Your ref:	Emanuel Andersson	Our ref:	Roger Hammet

Budget Quotation for Odour removal

Centriair develops and offers technology leading solutions for abatement of industrial airborne emissions. We provide solutions with proven environmental and economic benefits. Our systems typically have higher performance and lower energy consumption than prevailing solutions. We help the industry solve a broad range of emission problems while

- increasing the productivity and
- reducing operations and maintenance costs.

These benefits are achieved through higher performance, lower energy consumption and by recovering energy from the process. We work across a broad range of industry sectors, however most of our customers are in the food processing and waste processing industries.

Biogas

Biogas plants typically have a challenge with odour, mainly due to the fact that the sources in the plant have very varying odour concentrations. Public perception is also that the biogas plants generate fairly aggressive odors, something that creates resistance to new projects and raise the focus of authorities. Centriair have focused on these particular aspects of the technical challenge in biogas odour treatment, with our range of technologies targeting different odour concentrations with adapted technologies. This has resulted in a number of very well-functioning plants that still have relatively low consumption of energy and consumables.

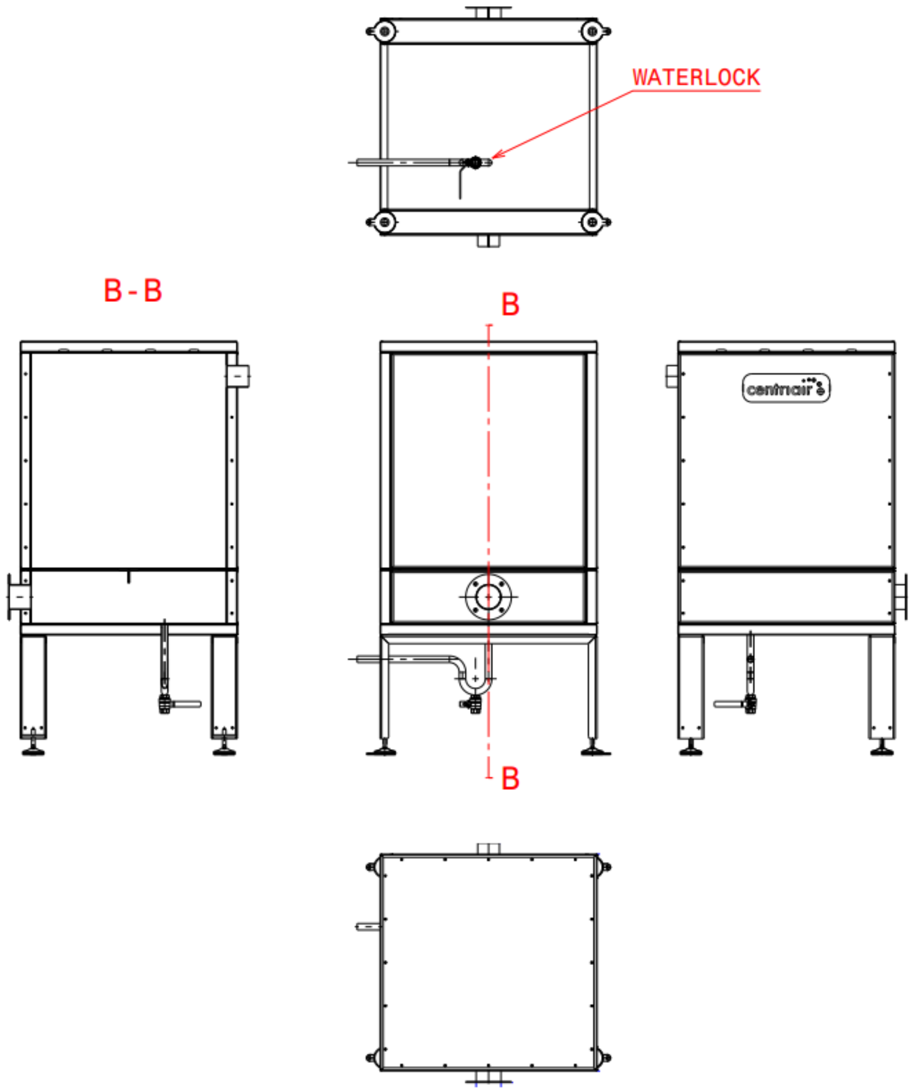
Introduction

Centriair is pleased to offer this quotation for odour removal at the client site based on the ColdOx™ system.

The following system is suggested to be designed for the application:

Position	No	Component	Power Installed/Normal operation	Material
	3	Activated carbon filter unit		Stainless steel AISI 316

Preliminary Layout



Overall system specification:

Active Carbon Specification:

Description:	Centriairs standard carbon CTC-60 is a high quality pellet media from coal. High quality raw material guarantees a physically stable product, hard with low dust levels. A large variation in pore size and high activation degree makes it a versatile product suitable for the complex gas compositions of odour treatment.
Carbon volume:	300 kg
Material:	Stainless steel AISI 316
Dimensions:	1 000 x 1 000 x 1 800 mm
Disposal of Carbon	For the disposal of spent media, we recommend following the guidelines of the European Waste Catalogue EWC and use the waste code number 19 09 04 or 15 02 03 – non hazard waste. Numerous landfills containing household trash and building materials will accept the loaded gas purification product, which is totally harmless to the environment, after submitting a declaration of analysis.

Example picture of the activated carbon filter unit

Schedule 16: Performance tests and procedures

1. Schedule Summary

This schedule describes the performance tests, per Clause 35, that are to be carried out, their duration, the raw materials to be used, what product is to be made, the conditions under which they are to be carried out, how the Plant is to be operated and so on. The parameters that are actually to be guaranteed and their associated liquidated damages are then set out below and in Schedule 17.

Performance Test shall demonstrate:

- the Plant satisfies the Performance Guarantees; and
- the Plant complies with the Specification and the requirements of this Contract.

2. Pre-requisites to Performance Tests

These include but not limited to:

- Following completion & acceptance of Schedules 9, 10, 13, 14 & 15, the performance test period will commence.
- All values and figures are based on the fact that the Plant is operated in line with the operation and maintenance manuals supplied by the **Contractor** and with the feedstock supplied by the **Purchaser** under Schedule 3
- Steady state operation as stated in Schedule 15
- The **Purchaser** shall instruct the **Contractor** as to where and how noise and emissions shall be measured. In response, the **Contractor** shall prepare a method statement outlining the process for measuring noise and emissions, such method statement to be in accordance with all requirements set out in the **Purchaser's** planning permission.

3. Performance Test Parameters

The **Contractor** will provide to the **Purchaser** a Performance Test plan which will include all procedures to achieve a successful test. it will follow to demonstrate the Plant will meet the Performance Parameters listed below

The following table details the performance parameters, expected and guaranteed values that are to be demonstrated by the **Contractor** and are linked to the Performance Damages in Schedule 17:

Design and guaranteed process values					
Parameter	**Unit**	**Expected Value**	**Guarantee Value**	**Acceptability Criterion**	**Comments**
Total Air flow	$m^{3/}hour$	18,500	18,500*	not less than	Equates to building dimension to give a minimum of 3 changes per hour
Ammonia concentration (from exhaust stack)	Mg/Nm^3	0.3-20	0.3-20	not more than	Conform to BAT guidelines

Odour units (from exhaust stack)	Ou/Nm^3	<800	<1000	not more than	Conform to BAT guidelines

* The flow rate and changes will be sufficient to ensure a negative pressure within the building based on dimensions supplied by on Acorn, in normal operation.

The following table details the performance parameters with expected values and acceptability criteria that are to be demonstrated and are linked to the achieving an Acceptance Certificate under Clause 35 and 36:

Additional Performance Parameters				
Parameter	**Unit**	**Expected Value**	**Acceptability Criterion**	**Comments**
Power usage	kW	39.25- in normal operation	No more than	Total power of complete Works in normal operation
Air changes per hour	No. per hour	3*	No less than	
Water usage	Litres per day	1000- Based on expected ammonia concentrations	No more than	

* The flow rate and changes will be sufficient to ensure a negative pressure within the building in normal operation

4. Performance tests and procedures

The **Contractor** agrees to provide performance guarantees. Guarantees of performance measured by tests will establish how well the Plant is performing against the Contract requirements. The tests and criteria are set out above and the guaranteed values are in Schedule 17. The Performance test and procedures are defined in Clause 35 and set out below;

1. The **Contractor** is to confirm in writing to the **Purchaser** that the Plant has achieved steady state, i.e., it runs as per the requirements as defined in Schedule 15 for 48 hours prior to the commencement of the Performance Test. A 2-week notification period will be given prior to the commencement of the performance test.
2. Once the Performance Test window commences the window will last for a maximum of 6 weeks

3. Proof of performance is considered to have been achieved as soon as the Performance Parameters of the Plant over a rolling period of 28 days is on average within the parameters stated and their respective acceptability criteria in the Performance test parameters. Testing frequency and methodology to be agreed.
4. If any equipment reliability issues hinder the performance test, the 6-week testing period will reset, within the 18-week window.
5. There are a maximum of 3 resets during the 6-week performance testing window.
6. As a minimum to evidence the performance the following information will be recorded and logged:
   6.1. Parasitic power consumption
   6.2. Total air flow (Nm^3 per hour)_
   6.3. Odour (units) from exhaust stack
   6.4. Ammonia (units) from exhaust stack

   6.5. Any other non-air components (units) exiting the exhaust stack
   6.6. Consistent negative pressure within the building
7. The Contractor and Purchaser shall calibrate all instruments used in the Performance test in their respective scope prior to the Performance test.
8. If the performance of the Plant will be reduced or interrupted for any reasons not caused by the Contractor, the performance test duration as well as the performance test window will be extended by the same amount of time lost due to the disruption (including the time required to get back to steady state conditions, if applicable). In this case, the Contractor must notify the Purchaser within 5 working days of the disruption. Consequently, the output recorded due to the reduction and/or interruption shall be excluded from the dataset.
9. The plant will be operated by the **Purchaser** (Acorn Operations) staff during this period under the direction of the **Contractors'** experienced staff**.**

Appendix I Human receptor results

Table 35 Long-term and short-term results NO_2

ID	Receptors	Comparison with annual mean AQS: 40 μg/m³				Comparison with 99.79th percentile 1-hour threshold 200 μg/m³			
		PC (μg/m³)	PC/AQS (%)	PEC (μg/m³)	PEC/AQS (%)	PC (μg/m³)	PC/AQS (%)	Headroom (μg/m³)	PC/Headroom (%)
R1*	East Lodge, Courteenhall	0.83	2.1%	13.2	33%	25.2	13%	175	14%
R2	Quinton Green	0.58	1.5%	13.0	32%	10.0	5%	175	5.7%
R3	Courteenhall, West Northamptonshire	0.17	0.4%	12.6	31%	7.19	4%	175	4.1%
R4	Bluebell Rise, Grange Park	0.06	0.1%	12.5	31%	3.58	2%	175	2.0%
R5	Village Spinney	0.17	0.4%	12.6	31%	7.61	4%	175	4.3%
R6	St Peter and St Pauls Church	0.12	0.3%	12.5	31%	6.16	3%	175	3.5%
R7	Quinton, West Northamptonshire	0.40	1.0%	12.8	32%	6.99	3%	175	4.0%
R8	Courteenhall Farm	0.08	0.2%	12.5	31%	4.40	2%	175	2.5%
R9	Quinton	0.19	0.5%	12.6	31%	5.53	3%	175	3.2%
R10	Quinton	0.23	0.6%	12.6	32%	6.23	3%	175	3.6%
R11	Quinton	0.13	0.3%	12.5	31%	4.96	2%	175	2.8%
R12	14, Fox Covert Drive, Roade	0.15	0.4%	12.5	31%	7.35	4%	175	4.2%
R13	M1, Quinton	0.12	0.3%	12.5	31%	5.10	3%	175	2.9%
R14*	Ashton, Roade	0.08	0.2%	12.5	31%	3.84	2%	175	2.2%
R15	Manor Close, Roade	0.11	0.3%	12.5	31%	5.19	3%	175	3.0%
R16	Northampton Road, Roade	0.06	0.1%	12.5	31%	4.23	2%	175	2.4%
Notes: Long-term AQS are not applicable at workplaces. *Exact location is a non-residential receptor.									

Table 36 Short-term results, 15-minute and 1-hour, SO_2

ID	Receptors	Comparison with 99.9th percentile 15-min threshold: 266 µg/m³				Comparison with 99.73rd percentile 1-hour threshold: 350 µg/m³			
		PC (µg/m³)	PC/AQS (%)	Headroom (µg/m³)	PC/Headroom (%)	PC (µg/m³)	PC/AQS (%)	Headroom (µg/m³)	PC/Headroom (%)
R1	East Lodge, Courteenhall	8.31	3.1%	263	3.2%	5.56	1.6%	347	1.6%
R2	Quinton Green	3.84	1.4%	264	1.5%	2.11	0.6%	348	0.6%
R3	Courteenhall, West Northamptonshire	3.07	1.2%	264	1.2%	1.55	0.4%	348	0.4%
R4	Bluebell Rise, Grange Park	1.50	0.6%	263	0.6%	0.77	0.2%	347	0.2%
R5	Village Spinney	3.15	1.2%	264	1.2%	1.64	0.5%	348	0.5%
R6	St Peter and St Pauls Church	2.83	1.1%	264	1.1%	1.32	0.4%	348	0.4%
R7	Quinton, West Northamptonshire	3.61	1.4%	264	1.4%	1.53	0.4%	348	0.4%
R8	Courteenhall Farm	1.81	0.7%	264	0.7%	0.89	0.3%	348	0.3%
R9	Quinton	2.24	0.8%	264	0.8%	1.19	0.3%	348	0.3%
R10	Quinton	2.84	1.1%	264	1.1%	1.36	0.4%	348	0.4%
R11	Quinton	2.14	0.8%	264	0.8%	1.03	0.3%	348	0.3%
R12	14, Fox Covert Drive, Roade	4.76	1.8%	264	1.8%	1.45	0.4%	348	0.4%
R13	M1, Quinton	2.36	0.9%	264	0.9%	1.13	0.3%	348	0.3%
R14	Ashton, Roade	1.67	0.6%	264	0.6%	0.77	0.2%	348	0.2%
R15	Manor Close, Roade	2.77	1.0%	264	1.1%	1.12	0.3%	348	0.3%
R16	Northampton Road, Roade	1.75	0.7%	263	0.7%	0.86	0.2%	347	0.2%

Table 37 Short-term results, 24-hours, SO_2

ID	Receptors	Comparison with maximum 24h average AQS: 125 µg/m³			
		PC (µg/m³)	PC/AQS (%)	Headroom (µg/m³)	PC/Headroom (%)
R1	East Lodge, Courteenhall	3.14	2.5%	122	2.6%
R2	Quinton Green	0.74	0.6%	123	0.6%
R3	Courteenhall, West Northamptonshire	0.61	0.5%	123	0.5%
R4	Bluebell Rise, Grange Park	0.30	0.2%	122	0.2%
R5	Village Spinney	0.65	0.5%	123	0.5%
R6	St Peter and St Pauls Church	0.46	0.4%	123	0.4%
R7	Quinton, West Northamptonshire	0.57	0.5%	123	0.5%
R8	Courteenhall Farm	0.31	0.2%	123	0.3%
R9	Quinton	0.39	0.3%	123	0.3%
R10	Quinton	0.35	0.3%	123	0.3%
R11	Quinton	0.31	0.2%	123	0.2%
R12	14, Fox Covert Drive, Roade	0.57	0.5%	123	0.5%
R13	M1, Quinton	0.35	0.3%	123	0.3%
R14	Ashton, Roade	0.26	0.2%	123	0.2%
R15	Manor Close, Roade	0.38	0.3%	123	0.3%
R16	Northampton Road, Roade	0.21	0.2%	122	0.2%

Table 38 Short-term results, CO

ID	Receptors	Comparison with maximum 8-hour running AQS: 10,000µg/m³			
		PC (µg/m³)	PC/AQS (%)	Headroom (µg/m³)	PC/Headroom (%)
R1	East Lodge, Courteenhall	145	1.45%	6,694	2.2%
R2	Quinton Green	48.9	0.49%	6,694	0.7%
R3	Courteenhall, West Northamptonshire	41.4	0.41%	6,694	0.6%
R4	Bluebell Rise, Grange Park	19.7	0.20%	6,694	0.3%
R5	Village Spinney	44.3	0.44%	6,694	0.7%
R6	St Peter and St Pauls Church	36.4	0.36%	6,694	0.5%
R7	Quinton, West Northamptonshire	42.6	0.43%	6,694	0.6%
R8	Courteenhall Farm	24.4	0.24%	6,694	0.4%
R9	Quinton	25.4	0.25%	6,694	0.4%
R10	Quinton	41.1	0.41%	6,694	0.6%
R11	Quinton	25.3	0.25%	6,694	0.4%
R12	14, Fox Covert Drive, Roade	66.8	0.67%	6,694	1.0%
R13	M1, Quinton	21.6	0.22%	6,694	0.3%
R14	Ashton, Roade	21.3	0.21%	6,694	0.3%
R15	Manor Close, Roade	26.3	0.26%	6,694	0.4%
R16	Northampton Road, Roade	21.3	0.21%	6,694	0.3%

Table 39 Long-term and short-term results, annual mean and 24h benzene

ID	Receptors	Comparison with annual mean AQS: 5µg/m³				Comparison with 100th percentile 24-hour threshold 30µg/m³			
		PC (µg/m³)	PC/AQS (%)	PEC (µg/m³)	PEC/AQS (%)	PC (µg/m³)	PC/AQS (%)	Headroom (µg/m³)	PC/Headroom (%)
R1*	East Lodge, Courteenhall	0.056	1.1%	0.40	7.9%	1.23	4.1%	29.3	4.2%
R2	Quinton Green	0.039	0.8%	0.38	7.7%	0.46	1.5%	29.3	1.6%
R3	Courteenhall, West Northamptonshire	0.012	0.2%	0.37	7.3%	0.26	0.9%	29.3	0.9%
R4	Bluebell Rise, Grange Park	0.004	0.1%	0.41	8.2%	0.14	0.5%	29.2	0.5%
R5	Village Spinney	0.011	0.2%	0.36	7.2%	0.32	1.1%	29.3	1.1%
R6	St Peter and St Pauls Church	0.008	0.2%	0.35	7.1%	0.29	1.0%	29.3	1.0%
R7	Quinton, West Northamptonshire	0.027	0.5%	0.37	7.4%	0.24	0.8%	29.3	0.8%
R8	Courteenhall Farm	0.005	0.1%	0.35	7.0%	0.19	0.6%	29.3	0.6%
R9	Quinton	0.013	0.3%	0.36	7.3%	0.15	0.5%	29.3	0.5%
R10	Quinton	0.015	0.3%	0.36	7.2%	0.19	0.6%	29.3	0.6%
R11	Quinton	0.009	0.2%	0.35	7.0%	0.11	0.4%	29.3	0.4%
R12	14, Fox Covert Drive, Roade	0.010	0.2%	0.36	7.2%	0.19	0.6%	29.3	0.7%
R13	M1, Quinton	0.008	0.2%	0.35	7.0%	0.14	0.5%	29.3	0.5%
R14*	Ashton, Roade	0.006	0.1%	0.34	6.8%	0.10	0.3%	29.3	0.3%
R15	Manor Close, Roade	0.007	0.1%	0.36	7.1%	0.14	0.5%	29.3	0.5%
R16	Northampton Road, Roade	0.004	0.1%	0.36	7.2%	0.14	0.5%	29.3	0.5%
Notes: Long-term AQS are not applicable at workplaces. *Exact location is a non-residential receptor.									

Appendix J Ecological receptor results

Table 40 Results: Ecological receptors, long-term and short-term AQS for NOx

ID	Receptors	Comparison with annual mean AQS: 30 µg/m³				Comparison with maximum daily AQS: 75 µg/m³	
		PC (µg/m³)	PC/AQS (%)	PEC (µg/m³)	PEC/AQS (%)	PC (µg/m³)	PC/AQS (%)
E1	Upper Nene Valley Gravel Pits	0.02	0.1%	14.1	47.1%	0.49	0.7%
E2	Upper Nene Valley Gravel Pits	0.02	0.1%	14.6	48.7%	0.86	1.1%
E3	Preston Wood Local Wildlife Site	0.17	0.6%	10.4	34.6%	2.69	3.6%
E4	Rowley Wood Local Wildlife Site	0.09	0.3%	12.9	42.9%	1.67	2.2%
E5	Salcey Forest AW	0.16	0.5%	13.0	43.2%	3.63	4.8%
E6	Salcey Forest AW	0.12	0.4%	10.6	35.3%	1.79	2.4%
E7	Salcey Forest AW	0.12	0.4%	10.6	35.3%	1.63	2.2%
E8	Salcey Forest AW	0.18	0.6%	12.9	43.0%	2.14	2.9%
E9	Roade Disused Railway East (1)	0.26	0.9%	10.5	35.0%	4.72	6.3%
E10	Roade Disused Railway East (2)	0.55	1.8%	12.6	42.0%	7.70	10%
Notes: No further analysis required for LWS/ AW if PC/AQS < 100%							

Table 41 Results: Ecological receptors, long-term AQS for SO_2

ID	Receptors	Comparison with annual mean AQS: 20µg/m^3				Comparison with annual mean AQS: 10µg/m^3			
		PC (µg/m^3)	PC/AQS (%)	PEC (µg/m^3)	PEC/AQS (%)	PC (µg/m^3)	PC/AQS (%)	PEC (µg/m^3)	PEC/AQS (%)
E1	Upper Nene Valley Gravel Pits	0.003	0.01%	1.36	6.8%	0.003	0.03%	1.36	13.6%
E2	Upper Nene Valley Gravel Pits	0.003	0.02%	1.36	6.8%	0.003	0.03%	1.36	13.6%
E3	Preston Wood Local Wildlife Site	0.023	0.12%	1.02	5.1%	0.023	0.23%	1.02	10.2%
E4	Rowley Wood Local Wildlife Site	0.013	0.06%	0.95	4.8%	0.013	0.13%	0.95	9.53%
E5	Salcey Forest AW	0.022	0.11%	0.96	4.8%	0.022	0.22%	0.96	9.62%
E6	Salcey Forest AW	0.016	0.08%	0.95	4.7%	0.016	0.16%	0.95	9.46%
E7	Salcey Forest AW	0.017	0.08%	0.95	4.7%	0.017	0.17%	0.95	9.47%
E8	Salcey Forest AW	0.024	0.12%	0.98	4.9%	0.024	0.24%	0.98	9.84%
E9	Roade Disused Railway East (1)	0.035	0.18%	0.96	4.8%	0.035	0.35%	0.96	9.55%
E10	Roade Disused Railway East (2)	0.075	0.38%	1.23	6.1%	0.075	0.75%	1.23	12.3%
Notes: No further analysis required for LWS/ AW if PC/AQS < 100%									

Table 42 Results: Ecological receptors, long-term AQS for NH_3

ID	Receptors	Comparison with annual mean AQS: 1 µg/m³ *			
		PC (µg/m³)	PC/AQS (%)	PEC (µg/m³)	PEC/AQS (%)
E1	Upper Nene Valley Gravel Pits	0.003	0.3%	1.44	144%
E2	Upper Nene Valley Gravel Pits	0.004	0.4%	1.40	140%
E3	Preston Wood Local Wildlife Site	0.020	2.0%	1.44	144%
E4	Rowley Wood Local Wildlife Site	0.016	1.6%	1.46	146%
E5	Salcey Forest AW	0.022	2.2%	1.46	146%
E6	Salcey Forest AW	0.015	1.5%	1.44	144%
E7	Salcey Forest AW	0.016	1.6%	1.44	144%
E8	Salcey Forest AW	0.023	2.3%	1.44	144%
E9	Roade Disused Railway East (1)	0.040	4.0%	1.49	149%
E10	Roade Disused Railway East (2)	0.081	8.1%	1.51	151%

Notes: No further analysis required for LWS/ AW if PC/AQS < 100%

* Lower NH_3 CLe adopted as a conservative approach although lichens and bryophytes were not cited as integral to the habitats (www.apis.co.uk)

Table 43 Results: Ecological receptors, nutrient nitrogen deposition, (Forest)

Receptors		Comparison with nutrient nitrogen critical loads								
		Deposition velocity type	**PC (kgN/ha/yr)**	**CLmin (kgN/ha/yr)**	**CLmax (kgN/ha/yr)**	**PC/CLmin (%)**	**PC/CLmax (%)**	**Background (kgN/ha/yr)**	**PEDR/CLmin (%)**	**PEDR/CLmax (%)**
E1	SPA/ Ramsar/ SSSI	Forest	0.03	10	15	0.28%	0.2%	27.91	279%	186%
E2	SPA/ Ramsar/ SSSI	Forest	0.03	10	15	0.34%	0.2%	28.01	280%	187%
E3	AW/ LWS	Forest	0.19	10	15	1.91%	1.3%	28.51	287%	191%
E4	AW/ LWS	Forest	0.15	10	15	1.46%	1.0%	28.92	291%	194%
E5	AW/ LWS	Forest	0.21	15	20	1.38%	1.0%	28.92	194%	146%
E6	AW/ LWS	Forest	0.14	15	20	0.95%	0.7%	28.89	194%	145%
E7	AW/ LWS	Forest	0.15	15	20	0.99%	0.7%	28.89	194%	145%
E8	AW/ LWS	Forest	0.21	15	20	1.43%	1.1%	29.07	195%	146%
E9	LWS	Forest	0.36	10	15	3.62%	2.4%	29.04	294%	196%
E10	LWS	Forest	0.74	10	15	7.43%	5.0%	29.26	300%	200%

Notes: No further analysis required for LWS/ AW if PC/AQS < 100%
n/a = Critical Load Range not available

Table 44 Results: Ecological receptors, nutrient nitrogen deposition, (Grass)

Receptors		Comparison with nutrient nitrogen critical loads								
		Deposition velocity type	PC (kgN/ha/yr)	CLmin (kgN/ha/yr)	CLmax (kgN/ha/yr)	PC/CLmin (%)	PC/CLmax (%)	Background (kgN/ha/yr)	PEDR/CLmin (%)	PEDR/CLmax (%)
E1	SPA/ Ramsar/ SSSI	Grass	0.02	10	20	0.2%	0.1%	14.91	149%	75%
E2	SPA/ Ramsar/ SSSI	Grass	0.02	10	20	0.2%	0.1%	14.98	150%	75%
E3	AW/ LWS	Grass	0.12	n/a	n/a	n/a	n/a	n/a	n/a	n/a
E4	AW/ LWS	Grass	0.09	n/a	n/a	n/a	n/a	n/a	n/a	n/a
E5	AW/ LWS	Grass	0.13	10	20	1.3%	0.7%	15.70	158%	79%
E6	AW/ LWS	Grass	0.09	10	20	0.9%	0.5%	15.71	158%	79%
E7	AW/ LWS	Grass	0.09	10	20	0.9%	0.5%	15.71	158%	79%
E8	AW/ LWS	Grass	0.14	10	20	1.4%	0.7%	15.84	160%	80%
E9	LWS	Grass	0.23	10	20	2.3%	1.2%	15.79	160%	80%
E10	LWS	Grass	0.48	10	20	4.8%	2.4%	15.98	165%	82%

Notes: No further analysis required for LWS/ AW if PC/AQS < 100%
n/a = Critical Load Range not available

Table 45 Results: Ecological receptors, acid deposition (Forest)

Receptors		Deposition velocity type	PC (keqS/ha/yr)	PC (keqN/ha/yr)	Background (keqS/ha/yr)	Background (keqN/ha/yr)	Minimum critical loads [1]		
							PC (%)	Background (%)	PEC (%)
E1	SPA/ Ramsar/ SSSI	Forest	0.0007	0.0020	0.18	1.99	0.00%	202%	202%
E2	SPA/ Ramsar/ SSSI	Forest	0.0008	0.0024	0.18	2.00	0.00%	203%	203%
E3	AW/ LWS	Forest	0.0055	0.0136	0.18	2.04	0.20%	20.4%	20.6%
E4	AW/ LWS	Forest	0.0030	0.0104	0.18	2.07	0.10%	26.2%	26.3%
E5	AW/ LWS	Forest	0.0053	0.0147	0.18	2.07	0.20%	26.2%	26.4%
E6	AW/ LWS	Forest	0.0039	0.0101	0.18	2.06	0.10%	26.0%	26.2%
E7	AW/ LWS	Forest	0.0040	0.0105	0.18	2.06	0.20%	26.0%	26.3%
E8	AW/ LWS	Forest	0.0057	0.0152	0.18	2.08	0.20%	26.3%	26.5%
E9	LWS	Forest	0.0083	0.0258	0.18	2.07	0.30%	20.7%	20.9%
E10	LWS	Forest	0.0178	0.0529	0.18	2.09	0.60%	20.8%	21.5%

Note: [1] %PC of minimum critical load determined using the Critical Load Function tool, available at www.apis.co.uk.
n/a = not available: this habitat is not sensitive to acidity

Table 46 Results: Ecological receptors, acid deposition (Grass)

Receptors		Deposition velocity type	PC (keqS/ha/yr)	PC (keqN/ha/yr)	Background (keqS/ha/yr)	Background (keqN/ha/yr)	Minimum critical loads [1]		
							PC (%)	Background (%)	PEC (%)
E1	SPA/ Ramsar/ SSSI	Grass	0.0003	0.001	0.13	1.07	0.00%	24.7%	24.7%
E2	SPA/ Ramsar/ SSSI	Grass	0.0004	0.002	0.13	1.07	0.00%	24.7%	24.7%
E3	AW/ LWS	Grass	0.0027	0.009	n/a	n/a	n/a	n/a	n/a
E4	AW/ LWS	Grass	0.0015	0.007	n/a	n/a	n/a	n/a	n/a
E5	AW/ LWS	Grass	0.0026	0.009	0.13	1.12	0.2%	24.6%	24.8%
E6	AW/ LWS	Grass	0.0019	0.006	0.14	1.12	0.2%	24.8%	25.0%
E7	AW/ LWS	Grass	0.0020	0.007	0.14	1.12	0.2%	24.8%	25.0%
E8	AW/ LWS	Grass	0.0029	0.010	0.14	1.13	0.2%	25.0%	25.2%
E9	LWS	Grass	0.0042	0.017	0.13	1.13	0.4%	25.6%	26.0%
E10	LWS	Grass	0.0089	0.034	0.14	1.14	0.8%	26.0%	26.8%

Note: [1] %PC of minimum critical load determined using the Critical Load Function tool, available at www.apis.co.uk.
n/a = not available: this habitat is not sensitive to acidity