Acorn Bioenergy Operations Ltd Odour Management Plan (OMP) Three Maids AD Plant

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1 Version Control

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Contents

Abbreviations

AD	Anaerobic digester/ digestion
ABL	Acorn Bioenergy Operations Limited
AMP	Accident Management Plan
BUU	Biogas upgrade unit
CH_4	Methane
CNG	Compressed Natural Gas
CO_2	Carbon dioxide
DMS	Dimethyl sulphide
DSEAR	The Dangerous Substances and Explosive Atmospheres Regulations 2002
EA	Environment Agency
EMS	Environmental Management System
EVCS	Electric Vehicle Charging Station
EWC	European Waste Catalogue
GFS	Global Forecast System
H_2S	Hydrogen Sulphide
HDPE	High density polyethylene
LDAR	Leak detection and repair
mAOD	Metres Above Ordnance Datum
MDPE	Medium-density polyethylene
NGR	National Grid Reference
N_2	Nitrogen
NH_3	Ammonia
NO_2	Nitrogen Dioxide
NO_x	Oxides of nitrogen
OMP	Odour Management Plan
ppm	Parts per million
PRV	Pressure relief valve
PVC	Polyvinyl chloride
PVRV	Pressure and vacuum relief valve
SCADA	Supervisory Control and Data Acquisition
SOP	Standard Operating Procedure
TCM	Technically Competent Manager
UV	Ultraviolet
VOC	Volatile Organic Compound

1. Introduction

1.1. Site description

This Odour Management Plan (OMP) (**THR-OD-05**) supports a bespoke installation permit application (Permit ref: EPR/FP3945QH/A001) to cover the scope of operations for Three Maids anaerobic digestion (AD) plant at Three Maids Farm, Three Maids Hill, Winchester, SO21 2QG ('the site') operated by Acorn Bioenergy Operations Limited (ABL) ('the Operator').

The AD plant will have a treatment capacity of over 100 tonnes per day and will process livestock waste (poultry and farmyard manures and dairy and pig slurry), energy crops and crop residues.

The site location is shown in Figure 2.1 - Map of Site location and receptors.

The site is 4.5 hectares (11 acres) in extent. The site, formerly farmland, sits within the northwest section of the intersection between the A34 dual carriageway and the A272. The site is located approximately 4km north northwest of the city of Winchester.

The surrounding area is used principally for arable farming and grassland with pockets of protected Ancient Woodland. There is also a solar farm (120m north of the site), an area used for muck-away, recycling and aggregates processing (150m east), a pig farm (approximately 600m northwest), and Harestock Wastewater Treatment Works (1.6km south southeast). The site's gradient slopes in a north easterly direction towards the A34 from approximately 93.5m AOD to approximately 87.8m AOD.

Human receptors within 1km of the site are listed in Table 2.1 and shown in Figure 2.1. The nearest residential premises, Three Maids Bungalow, is situated approximately 250m southwest of the Site. The village of Littleton lies over 1km southwest of the proposed site.

On the 18 December 2023 Winchester County Council granted planning permission (reference: 23/01594/FUL) for the development of an Electric Vehicle Charging Station (EVCS) with associated ancillary restaurant, outdoor seating and play area on land directly adjacent to the southern site boundary. At the time of writing construction had not started.

The proposed site layout is provided in Appendix A Figure A1. The operation of the proposed AD plant is outlined in Section 3.3.

The site infrastructure will comprise:

- Liquid feedstock pre-treatment system (macerate and screen)
- Liquid feedstock tank (8 m height x 8 m diameter) (400 m^3 capacity)
- Manure reception building (24.623 m x 20.154 m x 12.24 m to eaves, 13.53 m to ridge) containing:
    - Fast acting roller shutter doors
    - Air handling and emissions abatement system ('Centri-Air AB')
    - Dedicated manure conveyor feed hopper (44 m^3)
    - Pre-mix system

- Straw treatment building (41.6 m x 23 m x 7 m to eaves, 8.2 m to ridge) containing:
    - Bale conveyor
    - Destringer
    - Bale breaker
    - Straw mill with water injection
    - 7.9 m x 12.9 m storage bay for crushed wet straw
    - 2 No. straw extruders with 1 No. feed hopper
    - 1 No. set down bay for prepared straw
- 2 No. silage clamps:
    - Clamp 1 – 123.75 m x 42.5 m wide x 3.52 m high (28,534 m^3)
    - Clamp 2 – 118.75 m x 40 m wide x 3.52 m high (25,080 m^3)
- 1 No. underground leachate tanks with leak detection (1 x 50 m^3)
- 2 No. feed hoppers (external) (150 m^3 each)
- 5 No. digesters:
    - 2 No. Primary digesters (5,840 m^3 each)
    - 2 No. Secondary digesters (6,430 m^3 each)
    - 1 No. Tertiary digester (6,430 m^3)
- 3 No. pasteurisation tanks (35 m^3 each)
- Suspension buffer tank (400 m^3)
- Covered Separator bunker:
    - 2 No. Separators
    - Fibre storage bay (18 m x 13.2 m wide x 6.4 m high)
- 2 No. Buffer water tanks (400 m^3 each)
- 1 No. Process water buffer tank (100 m^3)
- 1 No. Digestate storage bag with leak detection (7,344 m^3)
- 1 No. Digestate off-take bay with sump (3 m^3) and carbon filter abatement system on the liquid digestate tanker off-take point
- Emergency flare – 8.7 m stack height
- Biogas upgrade unit (BUU) (includes a gatekeeper as there is no Grid Entry Unit)
    - Biogas booster on inlet to BUU
- Carbon dioxide (CO_2) capture unit
    - 2. No. CO_2 storage tanks (50 m^3 each)

- 2 No. dual fuel CHP engines with 7 m stacks (TEDOM Quanto 1200 1.2 MWe)
- 1 No. 300 kW chiller between two Primary digesters
- 1 No. chiller on BUU
- 2 No. condensate sumps
- 1 No. dual fuel 550 kW emergency biogas boiler
- 1 No. diesel emergency generator (770 kVA)
- 2 No. compressors (compressing gas before injecting into road tankers)
- 4 No. biomethane / CO_2 off-take vehicle bays
- Secondary containment bunds
- Full surface water interceptor and cellular storage system (266 m^3 at 95% void space)
- 3. No pump containers (1 No. inside bund, 2 No. outside bund)
- Site boundary fence
- Parking area and access road
- Weighbridge and Site office
- Cesspool (55 m^3)

The proposed AD plant will operate 24-hours per day and will be open to deliveries only when site personnel are present from 07:00 to 19:00 (Monday to Sunday), thus avoiding night-time operations. The planning permission restricts deliveries or dispatch from the site to between 07:00 and 20:00 hours on any day.

In addition to the above hours, during peak harvest times (for approximately 4 weeks a year) deliveries of crops to the site can take place from 07:00 to 22:00.

1.2. Maintenance and review of the OMP

It will be the responsibility of the Site Manager to be fully aware of the contents of the OMP, to update the OMP and to provide relevant training to staff. It is expected that the Site Manager will also fulfil the role of the Technically Competent Manager (TCM).

A copy of the OMP will be maintained electronically and a paper copy held in the Site Office such that all employees have access to the latest version. The OMP will be reviewed on an annual basis (as a minimum) or immediately following any incident, complaints or a change in the operation or infrastructure to ensure that it continues to remain relevant to the Site activities and in line with current guidance. In the event of a revision to the OMP the Environment Agency (EA) will be notified, and a copy will be submitted for approval by the EA.

The Site Manager will ensure all persons performing tasks for the organisation or on its behalf, whose work may have a significant impact on the environment, are competent based on appropriate education, training and/or experience, and will retain associated records. The Site Manager will establish and implement procedures to identify the training needs associated with the OMP, the operation of the Site and the retention of staff competencies.

The training requirements for new staff will be determined following the Training Procedure **(ABL-SOP-04)**. All staff are to be fully aware of the OMP to ensure that procedures and controls are upheld. All new staff will receive appropriate training on the OMP using the Environmental Management System (EMS) (**THR-OD-01**) and procedures to understand and reduce impact of the odour. Thereafter, any changes made to the OMP will be communicated to all operational staff via a Toolbox Talk. All formal training and Toolbox Talks received will be logged in the Skills and Competency Matrix **(ABL-OD-02).**

1.3. Relevant sector guidance on which this OMP is based

This OMP follows the suggested EA OMP format and has been produced in accordance with:

EA H4 Odour Management guidance (2011)[1]

The EA H4 guidance is intended for permit holders and applicants, to advise them on how to comply with odour conditions set by the permit. It includes measures to assess, reduce, take control measures, and monitor pollution. It contains advice on odour thresholds or benchmarks for assessment.

Waste Treatment BREF (2018)[2]

The Waste Treatment BREF is a reference document on indicative Best Available Techniques (BAT) for the waste treatment sector. This includes BAT for the anaerobic treatment of waste, the associated emission levels (and other environmental performance levels) and the associated monitoring.

Biological feedstock treatment: appropriate measures for permitted facilities (2022)[3]

Appropriate measures guidance applies to aerobic and anaerobic processes including AD and 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.

[1] Environment Agency (2011) H4 Odour Management – How to Comply with your Permit. Horizontal Guidance Note IPPC H4.
[2] Best Available Techniques (BAT) Reference Document for Waste Treatment, European IPPC Bureau, 2018
[3] Environment Agency (21 September 2022) Biological waste treatment: appropriate measures for permitted facilities. (https://www.gov.uk/guidance/biological-waste-treatment-appropriate-measures-for-permitted-facilities/1-when-appropriate-measures-apply).

2 Receptors

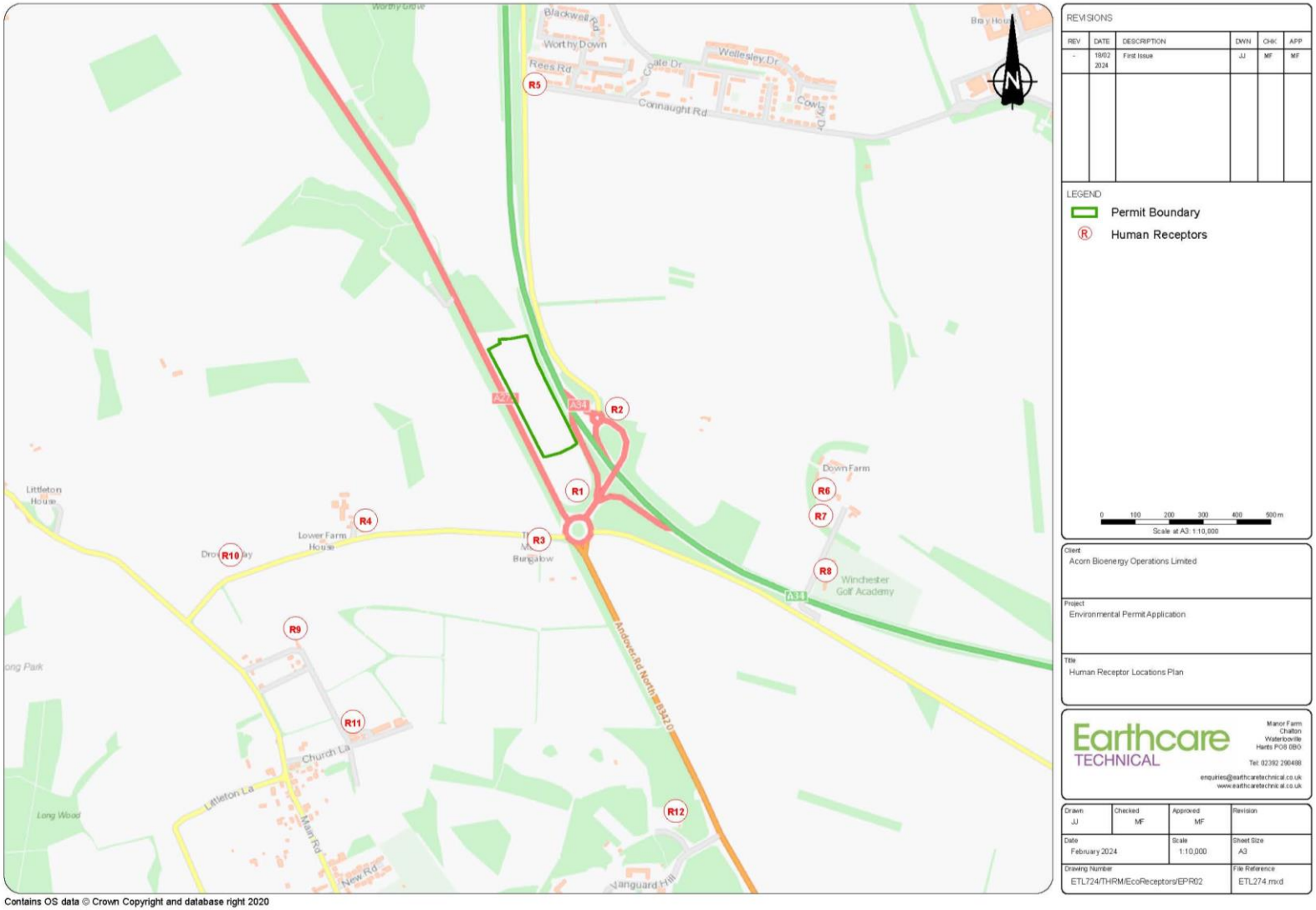
Receptors which may be sensitive to odour within approximately 1km of the site have been identified in Table 2.1 below and their locations in respect of the site are shown in Figure 2.1 - Map of Site location and receptors.

2.1. Receptor List

Table 2.1. Receptor list

Receptor reference	Location	Land use e.g. house, school, hospital, commercial	Direction from Site	Approximate distance to Site boundary (m)	Sensitivity to odour
R1	Proposed EVCS development including restaurant and playground	Commercial/ Recreational	South	120	Medium
R2	The Pringle Group/ Concrete 247	Aggregate/ Recycling	Southwest	155	Low
R3	Three Maids Bungalow	Residential	East	250	High
R4	Lower Farm Cottages	Residential	West southwest	530	High
R5	Worthy Down	Residential	Northeast	730	High
R6	Down Farm	Residential	Southeast	750	High
R7	Off Down Farm Lane (Static caravans)	Residential	Southeast	750	High
R8	Winchester Golf Academy	Recreational	Southeast	815	Medium
R9	Littleton Stud	Residential	Southwest	890	High
R10	Drovers Way	Residential	West southwest	960	High
R11	Church Lane, St Catherines (Littleton)	Residential	Southwest	[illegible]	High
R12	Flowerdown Barracks	Residential/ Recreational	South	1,120	Medium

Figure 2.1 Map of Site location and receptors

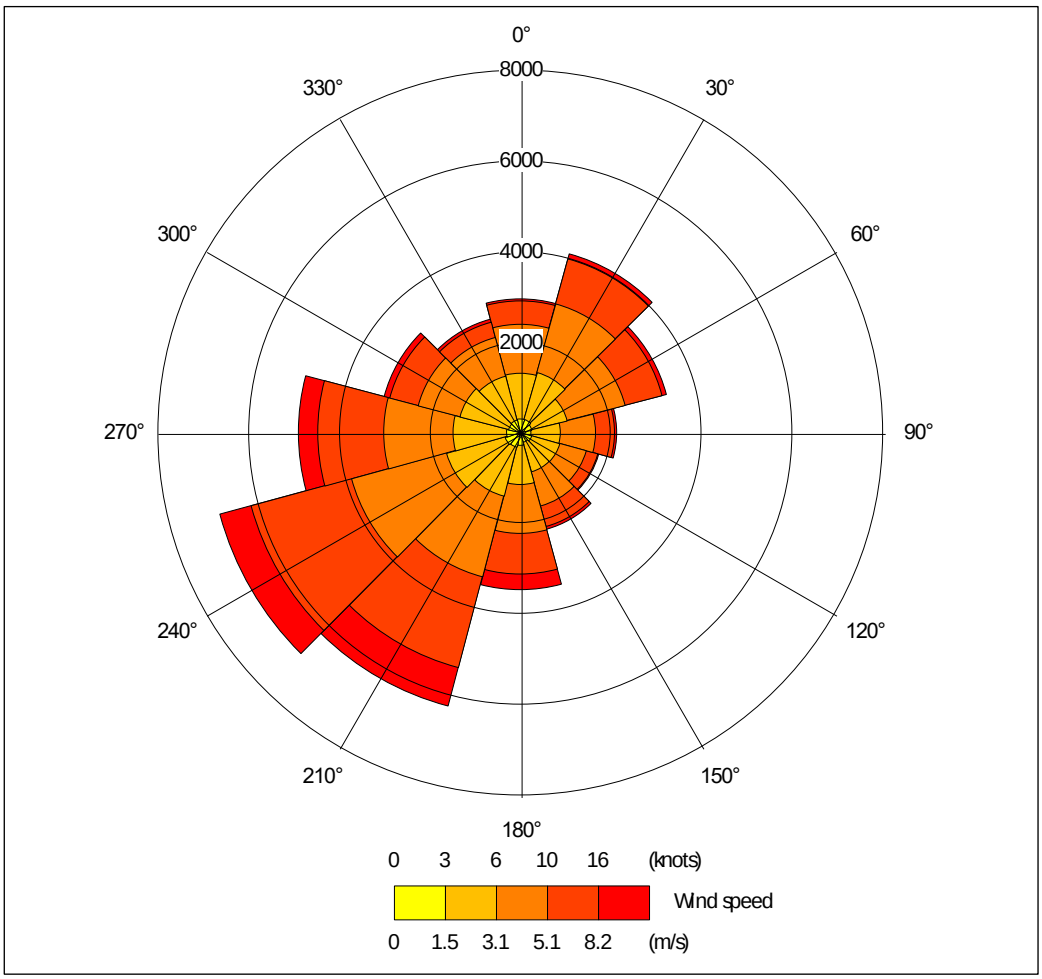


2.2. Wind rose and source of weather data

A wind rose of the Global Forecast System (GFS) meteorological data of the Site for a 5-year period shows the prevailing wind direction is from the south-west (Figure 2.2). The prevalence of winds from these directions means that those receptors that lie to the northeast of the site will be those most frequently 'downwind' of the site and therefore most likely to be impacted by odour emissions from the operation.

Site operatives will record daily weather conditions in an electronic Site Diary (**THR-MP-02**) using information from online resources as part of the routine monitoring on-site. Meteorological data will be considered during routine odour surveys and prior to and during operations that have the potential to give rise to off-site odour impacts.

Figure 2.2 - Wind rose (GFS derived data for 51.102N, -1.342 W, 2018 – 2022)



Data source: AS Modelling & Data Ltd

3 Sources of odour and Site processes

3.1. Odorous materials entering and leaving site

All feedstock material will be transported to and from the proposed AD plant by road.

Solid Feedstock delivery

All vehicles delivering solid manures (waste) will be covered/ sealed. Manure will be delivered when required for use within the Manure reception building for use within the plant. As a worst-case, there will be a maximum of 400 tonnes stored within the Manure reception building at any time, following the periodic clearance of livestock housing for example, associated with a maximum of approximately 20 solid manure feedstock deliveries per day (assuming 70% is delivered via 27 tonne HGV, 30% by tractor and trailer). All energy crop (non-waste) and waste feedstock deliveries are weighed over the weighbridge and recorded within weighbridge system.

A Feedstock Loading and Management Procedure (**THR-SOP-04**) will be in place to ensure that the fast-acting roller shutter doors are only opened to allow vehicles in and out of the Manure reception building. All manure feedstock vehicles will be washed down prior to exiting the reception building.

All waste accepted on site will be subject to pre-acceptance checks in accordance with the Waste Pre-Acceptance Form (**ABL-FT-02**). This procedure includes routine waste sample pre-analysis and verification analysis to check for potentially toxic elements (PTEs) and physical contaminants. The Feedstock & Digestate Manager is responsible for these checks and for booking feedstock into site, in consultation with the Site Manager. Only waste that has passed pre-acceptance checks and is booked in will be accepted on site.

When feedstock is delivered to site further checks will be carried out in accordance with the Feedstock Acceptance and Rejection Procedure (**ABL-SOP-06**). This includes paperwork checks by the Weighbridge Operator, visual checks by Site Operatives and verification feedstock sampling and analysis when necessary.

If an abnormally odorous load is received at the site i.e., a load with a ‘very strong’ odour (i.e., odour intensity 5 and above), it will either be rejected and removed or immediately used and the delivery vehicle will be washed down prior to leaving the enclosed reception building.

The Feedstock Acceptance and Rejection Procedure (**ABL-SOP-06**) is in place to ensure rejection of highly odorous feedstocks and that a first in first out (FIFO) procedure for feedstock is followed. Solid manure feedstock will be delivered when required for use, with a maximum storage time of up to 7 days within the Manure reception building, based on an average feedstock processing rate of 55 tonnes per day. Odours from feedstock delivery will be treated in the building’s air extraction and emissions abatement system prior to release via a single stack (emission point **A6** on Figure 3.2 - Permit boundary and odour emissions point plan).

Liquid Feedstock delivery

Liquid feedstock will be delivered in sealed tankers. There will be up to approximately 10 deliveries per week, assuming 70% is delivered via 27 m^3 tanker, and 30% by 14 m^3 tractor and slurry tanker. When liquid feedstock (slurry) is delivered to the site, checks that include verification of feedstock European Waste Catalogue (EWC), description, sampling and analysis will be carried out, in accordance with the Feedstock Acceptance and Rejection Procedure (**ABL-SOP-06**).

Reception of slurry is carried out in accordance with the Liquid Waste Reception Procedure (**ABL-SOP-07**). Tankers containing cattle and pig slurry reverse up to the Liquid Loading Point, couple up and discharge the load via sealed pipework into the Liquid feedstock tank (400 m^3 capacity). All tanks are labelled, and unloading is supervised by site operatives.
The headspace of the Liquid feedstock tank will be linked to the Manure reception building emissions abatement system to ensure any displaced air from the tank is contained and treated.

Solid Digestate storage and removal

Digestate separation and the storage of separated solid fibre will be contained within a three-sided structure that incorporates a retractable top and front cover.

The separated fibre will fall into the concrete storage bay below the enclosed separators and will then be removed to destination field heaps on farms using a tractor and large trailer and/or tipper lorry. Approximately 69,218 TPA of solid fibre digestate will be produced. Solid fibre digestate will be removed from site up to 11 times per working shift, based on 50% of the digestate removed via 27 tonne HGVs, and 50% via 13 tonne farm tractor and trailer.

Liquid Digestate storage and removal

Separated liquor digestate will be pumped from the separators enclosed within the Digestate separation bunker to:

- the digestate storage bag with working capacity of 7,344 m^3.
- the Process water buffer tank (100 m^3) which feeds the premix system for the manure and the premix systems on the 2 No. Primary digesters.

Digestate liquor will be removed via a Digestate off-take bay that includes a concrete apron, 3 m^3 spill collection sump, and a carbon filter and associated ductwork on the liquid digestate off-take point to treat displaced air during off-take (emission point **A22**). Approximately 40,388 TPA of digestate liquor will be produced that will be transferred for spreading and/or to dedicated offsite storage on destination farms. It is expected that liquid digestate will be removed from site up to 6 times per day during key spreading campaigns in spring and autumn (a 4-month period in total), and up to 5 times per day otherwise, based on 60% of the liquor removed daily via an HGV vehicle (capacity 27 m^3) and 40% via tractor & trailer/ slurry tanker (capacity 14 m^3), subject to availability.

Table 3.1 - Odorous Materials, below lists all material delivered to site and those materials with the potential to become odorous as a result of processes on-site.

3.2. Odorous materials (without mitigation)

Table 3.1 Odorous Materials

Odorous and potentially odorous material (any solid, liquid or gas)	Odour potential (High Risk / Medium Risk / Low Risk)	Maximum quantity on site at any given day	Maximum time held on site (hours or days)	Location of odorous materials on site	Additional comments
Maize silage	Medium Risk	Approx. 26,000 tonnes	12 months	• Clamp 1 - 28,534 m^3 • Clamp 2 - 25,080 m^3 Total: 53,614 m^3	Grown under farm contracts
Wholecrop silage	Medium Risk	Approx. 17,500 tonnes	12 months	• Clamp 1 - 28,534 m^3 • Clamp 2 - 25,080 m^3 Total: 53,614 m^3	Grown under farm contracts
Straw	Negligible	4,000 tonnes	10 weeks	• Straw treatment building, containing storage bay for crushed wet straw; 2 No. straw extruders with 1 No. feed hopper • 1 No. external set down bunker • Clamps	Grown under farm contracts. Straw will be treated on a daily basis and temporarily stored in the set-down area or on the clamps. Straw will be used in the process at a rate of 55 tonnes (110 bales per day 7 days a week).
Farmyard manure	High Risk	Approx. 400 tonnes total solid manure in building	7 days	• Manure reception building	Local farms, contracts in place with suppliers. Manure will be used in the process as a rate of 55 tonnes per day.
Chicken manure	High Risk				
Cattle slurry/ Pig slurry	High Risk	Approx. 400 m^3 (Liquid feedstock tank capacity)	14 days	• Liquid feedstock tank (and Slurry pretreatment system)	Local farms, contracts in place with suppliers. Displaced air from the Liquid feedstock tank headspace during filling will be passed via a connection to the Manure reception building.
Dirty water	Low / Medium Risk	850 m^3 in storage	7 days (b)	• Buffer water tanks (2 x 400 m^3) • Underground Silage leachate tank (50 m^3)	Sealed storage systems that include surface run-off / dirty water

Odorous and potentially odorous material (any solid, liquid or gas)	Odour potential (High Risk / Medium Risk / Low Risk)	Maximum quantity on site at any given day	Maximum time held on site (hours or days)	Location of odorous materials on site	Additional comments
					from drainage systems which is fed back into the process.
Digester contents undergoing treatment	High Risk	Total 30,970 m^3	Primary digesters - 40.1 days Secondary – 20.2 days Tertiary – 10.2 days	• 2 No. Primary digesters (5,840 m^3 each) • 2 No. Secondary digesters 6,430 m^3 each) • 1 No. Tertiary digester (6,430 m^3)	Sealed tanks: biogas released only during digester tank pressure and vacuum relief valve (PVRV) operation in over-pressure scenarios only.
Biogas	High Risk	Approximately 7,500 m^3	Max. storage volume is in excess of 3 hours of production	• 2 No. Primary digesters • 2 No. Secondary digesters • 1 No. Tertiary digester • 5 No. digesters PVRVs	Sealed tanks. The digesters will have PVRVs. Biogas released from PVRVs in over-pressure scenarios only.
Liquid digestate	Medium Risk	7,344 m^3	66 days (2 months' worth)	• 1No. Digestate storage bag (7,344 m^3)	Residual emissions from 3 vents on storage bag.
Solid fibre digestate	Medium Risk	190 tonnes	36 hours	• Digestate separation bunker	Stored within the Separation bunker following separation. Approx. 190 tonnes produced per day.
'Cleaned' biogas	Negligible / Low Risk	1,249 Nm^3/hr biomethane (maximum production capacity)	n/a	• Biogas Upgrade Unit (BUU) PVRV • CO_2 recovery stack and PVRV	Off-gas directed to carbon capture equipment; residual CO_2 emission from stack.
Combusted biogas	Low Risk	2,329 Nm^3/h (maximum AD plant production capacity)	n/a	• 2 No. CHPs (1.2 kWe each) • Emergency flare (2,500Nm^3/hr of biogas) • Emergency biogas boiler	Low residual odour from unburnt Non-methane Volatile Organic Carbon (NMVOCs).
Emissions from air treatment	Low - Medium Risk	Continuous (18,500 m^3/hr)	Sufficient extraction rate to maintain	• 15.5m stack on Manure reception building	Emissions abatement system designed to reduce/ eliminate

Odorous and potentially odorous material (any solid, liquid or gas)	Odour potential (High Risk / Medium Risk / Low Risk)	Maximum quantity on site at any given day	Maximum time held on site (hours or days)	Location of odorous materials on site	Additional comments
(Emissions abatement system for Manure reception building)			negative pressure within the building.		odorous compounds prior to discharge.
Emissions from air treatment (Digestate off-take bay)	Low - Medium Risk	81 m^3/hr	/	• Liquid Digestate off-take bay	Carbon filtration abatement system to reduce/ eliminate odorous compounds
Notes: (a) Solid feedstock delivered just in time for use and stored for no longer than 7 days. (b) Storage times will be highly dependant on rainfall.					

3.3. Overview of odorous processes and emissions

Process Description

This section provides a summary of the process which should be read in conjunction with the Process Flow Diagram provided in Appendix A, Figure A4: Process Flow Diagram **(THR-OD-03)**.

The Site plan showing the Permit boundary and odour emissions points under normal operating conditions is shown in Figure 3.2 - Permit boundary and odour emissions point plan.

The operation of the AD plant is fully automated from an on-site central control panel; the Supervisory Control and Data Acquisition (SCADA) system.

The facility will treat around 94,000 TPA of liquid and solid feedstock: comprising livestock waste (chicken manure, farmyard manure, cattle slurry, and pig slurry); energy crops and straw (a crop residue), and dirty water.

Energy crops are ensiled within the silage clamps and covered with an impermeable cover. Cereal straw is provided by local farms and temporarily stored and processed on site within the dedicated Straw treatment building. Dry straw is fed into a Straw mill with water injection. The crushed wet straw may be stored in a bay within the building prior to being fed into the 1 No. feed hopper of the 2 No. straw extruders. The extruded straw lands into an external set down bunker and is the fed into the 2 No. external feed hoppers twice per day during the two principle loading phases.

The only waste feedstocks accepted are manure and slurry. Solid chicken and farmyard manure are to be delivered within covered/ sealed vehicles to a dedicated Manure reception building which benefits from fast action roller shutter doors and an air handling and emissions abatement system. The manure is conveyed via a hopper inside the building for treatment. The manure is mixed with separated liquor in an enclosed pre-mix system ready for pumping into the 2 No. Secondary digesters.

Tankers containing cattle/ pig slurry discharge into the enclosed Slurry pre-treatment system which macerates and screens the slurry prior to being stored in the Liquid feedstock tank pending transfer into the digesters.

Twice daily a front loader is used to load the energy crops from the silage clamps and prepared straw from the set down bunker outside the Straw treatment building into the 2 No. external feed hoppers. Dirty water is pumped from the Buffer water tanks, and slurry is pumped from the Liquid feedstock tank to the mixing pumps and mixed with the solid feedstocks to make a pumpable mixture which is then fed to the 2 No. Primary digesters.

The Manure reception building contains a storage area for manure, a conveyor hopper and a premix system which enables the manure to be blended with separated digestate liquor to be

pumped directly into the 2 No. Secondary digesters. This is carried out in an enclosed system accordance with the daily feed plan and controlled via the SCADA control panel. A front loader will be used to load manure into the conveyor hopper within the Manure reception building. Therefore, there will be no unnecessary removal of waste, just deliveries into the Manure reception building.

There will be five digesters (two Primary digesters (PD1 & PD2), two Secondary digesters (SD1 & SD2) and one Tertiary digester (TD1). 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 automatic operation of the flare (emission point **A3**) before the PVRVs.

Whole digestate from the Tertiary digester will be pasteurised before being cooled and pumped to the Suspension buffer tank (400 m^3). Any displaced air during the pasteurisation process is recycled back to into the gas system.

Whole digestate is pumped to the 2 No. Borger type mechanical separators. The separators are covered within the Digestate separation bunker. Separated fibre collects in the enclosed concrete storage bay below the separator and is then periodically removed to destination field heaps on farms for use as a soil improver.

Separated liquor is pumped from the separator to either: the 7,344 m^3 Digestate storage bag where residual emissions are released via 3 vents (emission points **A19** to **A21**; or the sealed 100m^3 Process water buffer tank. Tankers will be filled with digestate liquor at a tanker off-take point with a carbon filter emissions abatement system (emissions point **A22**).

Biogas will be stored in the double membrane gas storage domes above the two Secondary digesters and the Tertiary digester. There will be oxygen injection on all of the digesters. To reduce hydrogen sulphide (H_2S) in the biogas, a small amount of oxygen is injected into the digester to increase the oxidising capacity of the system, thus inhibiting sulphate-reducing bacteria activity and promoting sulphide oxidation.

Oxygen is generated from air via pressure swing absorption unit and injected into the tank headspace. The oxygen concentration to be included within detailed engineering average of 0.5% and ≤1%. Ferric hydroxide powder will be used to further control H_2S levels if needed.

Biogas (60% CH_4 by volume) will enter the Biogas upgrade unit (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 (2 No. carbon filters to remove H_2S and 1 No. filter for Volatile Organic Compounds (VOCs), compression prior to three-stage membrane filtration which separates the biogas into methane (CH_4) and carbon dioxide (CO_2). Biogas will be released from the PRVs on the BUU in over-pressure scenarios only (emission point **A7**).

Biomethane is transported offsite for injection at a central gas to grid injection point or used within a CHP engine (emission point **A1**) on site to supply the heat and electricity required to run and maintain the AD process.

The BUU will be fitted with carbon capture equipment so the remaining output stream, CO_2 with traces of CH_4, H_2S and TVOC, will not be vented to air but captured prior to liquefaction of the CO_2. CO_2 captured in the gas upgrading process will be cleaned, liquefied using equipment to upgrade the CO_2 to 99.9% purity. Upgraded CO_2 would be transported via tankers for industrial use. Residual CO_2 emissions will be released via a stack (emissions point **A8**). Cleaned gas will be released from the CO_2 recovery process PRVs in over-pressure scenarios only (emission points **A9** and **A10**).

Two CHPs burn either biogas or natural gas and may emit pollutants (SO_2, TVOC, NOx and CO) from 7m stacks. The CHPs will be used to provide heat and power to the proposed AD plant; power on-site will be managed by power management system. Emissions from the combustion of biogas and natural gas are not expected to be a source of odour.

The emergency dual fuel biogas boiler (emission point **A4**) will be used to generate heat for the proposed AD plant when the CHPs are unavailable. The boiler will release emissions to air of SO_2, NOx and CO from the 7m stack. Combustion emissions from the boiler are not deemed to be a source of odour.

Biogas may be burnt under abnormal operating conditions such as during extended maintenance or malfunction of the BUU by the proposed AD plant emergency flare (emission point **A3**).

The emergency flare ignites automatically and is sized appropriately; it can burn between 500 to 2,500 Nm^3/hr of biogas. The flare should operate for a limited number of hours per year as it is only used under abnormal operating conditions. Waste gas may arise in the form of biogas during periods of extended breakdown and maintenance. Waste biogas will be burnt in the flare. In the case of off-specification biomethane being produced by the BUU, it will be blended back together with the associated CO_2, (which will also be off- specification), and this blended pure biogas stream will be returned to the gas storage domes. In the unlikely event that this causes any over pressure, biogas would be flared. Emissions from the combustion of biogas/ biomethane are not expected to be a source of odour.

An emergency diesel generator (770kVA) (emission point **A5**) will provide power when the CHPs are not operational and if power is not available from the grid. It is anticipated to operate for a few hours per year under emergency conditions and is not expected to be a source of odour.

Some of the water for the AD process will be provided from dirty water collected on site and from within the secondary containment system with sealed drainage back to the AD process. Clean water from hard surfaces is collected separately and the excess is discharged via the underground crate system. The recirculation of clean and dirty water is shown in Appendix A Figure A5: Drainage Process Flow Diagram (**THR-OD-04**).

Silage leachate is produced from storage of silage. The leachate runs forwards within the clamps into drainage channels, then to an underground leachate storage tank, from where it is pumped into the Process water tanks and then used in the AD process. The leachate storage tank will be fitted with one vent (emissions point **A13**). There is the potential for silage effluent to reside in drainage channels and cause odour in hot periods. Therefore, daily checks and, if required, clearing/ flushing the clamp drainage channels will be included within the clamp maintenance procedures.

Rainwater is separated through flow off the silage clamp covers where possible reducing the volume of leachate. Manures are stored within a fully enclosed Manure reception building and are typically high dry matter. Any leachate from solid manures within the Manure reception building is captured within the sealed drainage system and used in the AD process as a feedstock.

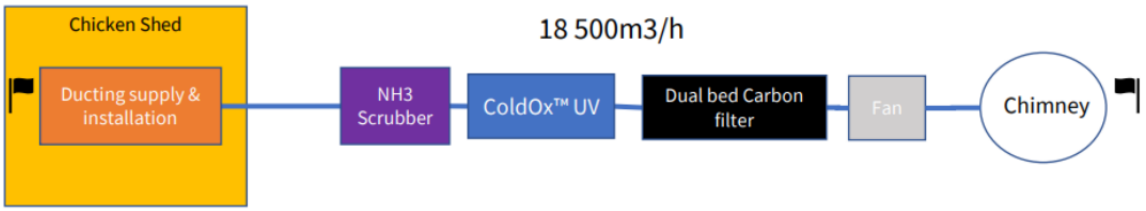
Odour control of emission in the Reception Building

In the Manure reception building waste manure feedstock will be received, stored, and transferred into the hopper. Odour emissions from the Manure reception building are controlled using an air handling and emissions abatement system and fast-acting roller shutters on the vehicle access doors of the building. The air handling system will maintain a negative pressure in the building to ensure effective treatment within the emissions abatement system. Louvres will be installed in the external wall of the Manure reception building to allow ambient air to be drawn in, to help to maintain a negative pressure inside the building at all times.

The design of the emissions abatement system for the Manure reception building has been informed by characterisation of emissions from the surface of chicken manure, (the principal solid manure feedstock material), and is designed to abate the odorous compounds anticipated. The air handling and emissions abatement system, provided by Centri-Air AB, utilises a multi-stage treatment process including chemical treatment to reduce odorous compounds. The stages are shown in Figure 3.1 and include:

- Sulphuric acid scrubber, principally to remove ammonia
- High intensity ultraviolet (UV) light which performs cold oxidation of VOCs a treatment termed ‘ColdOx UV’. This provides two wavelengths of UV light to both breakdown complex compounds and to produce ozone, which is used to reduce odour, VOCs, H_2S, mercaptans, and dimethyl sulphide (DMS).
- Double layer carbon filter as a final polishing step. The carbon media is a catalyst for ozone which ensures there is no carryover of ozone to the exhaust gas and this reaction prolongs the life of the carbon media.
- The treated air is released via the emission stack (15.5 m high) to meet the BAT-AEL of 1,000 ou/m^3.

Figure 3.1 - Flow diagram of proposed Centri-Air AB abatement system



The scrubber stage for NH_3 removal consists of a reaction vessel with packing and distributor. The packed column includes a demister; water conditioned with sulphuric acid reacts with the NH_3 to form ammonium sulphate. The process water is drained when the ammonium sulphate concentration reaches approximately 25%. The process water would then be recirculated for reuse within the AD plant. The combination of fast-acting roller shutter doors, constant negative pressure and an emissions abatement system will minimise fugitive odour emissions from door opening; fugitive emissions are, therefore, assumed to be negligible.

Technical information and drawings for the proposed emissions abatement system are provided in Appendix B.

System safeguards

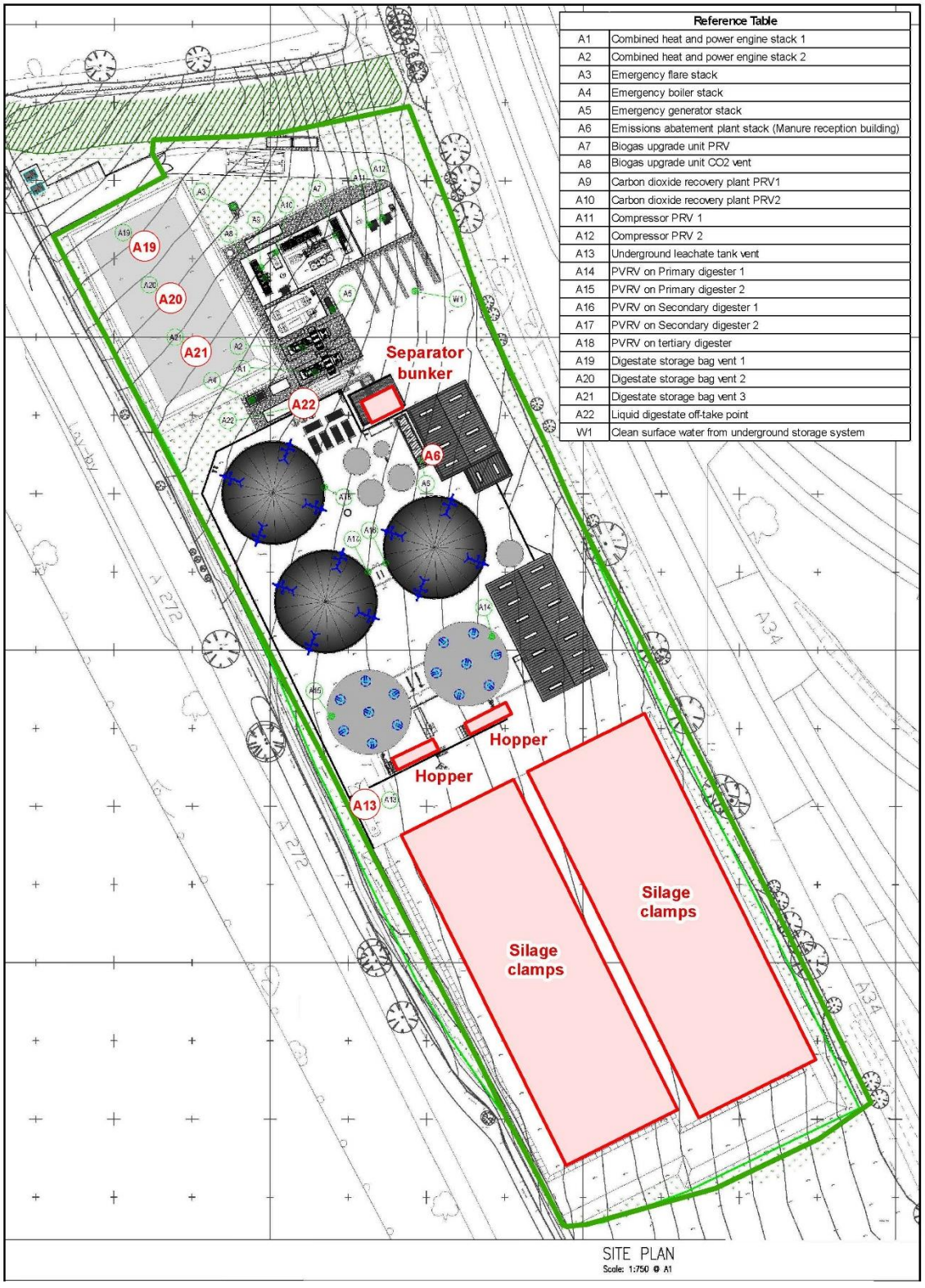
To ensure the system is compliant (i.e., below 1,000 ou/m^3) over time, there are safeguards in place. The system has been designed by Centri-Air AB based on previous measurements and reference values for expected concentrations at the inlet to the system. However, Centri-Air AB state there is a degree of tolerance factored into the design; if the inlet values are higher than expected there is spare capacity in the UV power, and retention time in the carbon filter to increase the capacity if necessary.

To ensure odour treatment system performance and compliance over time there are operating safeguards, that include:

- Regular inspection of the emissions abatement system for the Manure reception building in accordance with the Maintenance Planner (**THR-MP-01**);
- System sensors will log parameters that indicate if an error has occurred, or if there is a need for carbon exchange or replacement of lamps. For example, there will be UV power monitoring, to determine when the UV lamps fail;
- A planned preventative maintenance programme will be in place for the Centri-Air AB system with the manufacturer's inspection and maintenance recommendations and as per the monitoring and maintenance schedules of the EMS (**THR-MP-01, THR-MP-04**). This will include prescribed actions to maintain the system's performance. With the service and maintenance agreement, the system has an extended warranty of 5 years. Critical parts will be held on site.

An example of a service and maintenance schedule is provided in Appendix B.

Figure 3.2 – Permit boundary and odour emissions point plan



Base plan produced by GGP Reference: Acorn-29348-C-202-E Site Emissions Plan. Updated by Earthcare Technical Ltd March 2024.

4 Control measures and process monitoring

4.1. Appropriate Measures / BAT

Table 4.1 lists the odorous and potentially odorous materials held or odorous processes undertaken on-site and the relevant controls and actions that the operator will take to prevent or minimise odour from these sources that include containment, abatement, Appropriate Measures, and BAT.

Table 4.1 also sets out: how often these control measures on site are monitored; the process parameters that are monitored (including the optimum performance levels for each parameter); associated trigger levels (that will help identify that the process is under control and there is potentially a higher risk of odour); and actions to be taken if the monitoring shows results outside of the optimum performance levels.

In each case, the following trigger limits will also apply that indicate that an aspect of the site is operating outside of optimum performance levels, that will initiate an investigation as to the odour source and implementation of appropriate remedial action(s):

1. Receipt of an odour complaint (Section 5.1)
2. Boundary and/or off-site odour (odour intensity 3 or above) as detected during routine (daily) odour monitoring ('sniff test' method) (Section 5.3)
3. Strong odour (odour intensity 4 or above) reported by staff/ visitors on arrival at the site (Section 5.3)

The details of all monitoring carried out in response to the above will be recorded accordingly.

Table 4.1 Monitoring procedures for Appropriate Measures/ BAT

Odorous and potentially odorous process / material	Control measures (Appropriate Measure / BAT)	Monitoring frequency	Monitoring procedure and optimum process parameters	Trigger level	Action taken if outside optimum process parameters
Vehicle Movements (imports/ exports)	**Containment** • Liquid feedstock transferred in sealed tankers • Solid manure feedstock transferred in covered vehicles to enclosed reception building • Energy crops transferred to silage clamps and covered. • Fibre digestate transferred via covered vehicle/ trailer • Liquid digestate is transferred in sealed tankers. **Management** • Adherence to Waste Pre-Acceptance Procedure (**ABL-SOP-05**) • Adherence to Feedstock Acceptance and Rejection Procedure **(ABL-SOP-06**) • Adherence to Liquid Waste Reception Procedure **(ABL-SOP-07)** • Any spilled material will be immediately cleared (**THR-SOP-08**) • Routine cleaning schedule for operational areas in accordance with Housekeeping Procedure **(THR-SOP-07)** • Pressure wash backs of tipping vehicles and wheels inside the reception building before they leave site	**Constant** • Dynamic visual and odour observations by staff • SCADA (feed quantity) **Daily** • AD Plant daily checks (**THR-MP-04**) • Routine odour monitoring (**THR-SOP-02**) **Periodic** • Housekeeping Procedure **(THR-SOP-07)**	Visual inspection (of vehicles). Daily visual checks to ensure operational areas kept clear of debris/ clean. Feedstock & Digestate Manager: feedstock and feedstock records through the Feedstock Acceptance and Rejection Procedure (**ABL-SOP-06**) and Feedstock Management & Loading Procedure (**THR-SOP-04**) to ensure site treatment and storage capacity not exceeded. Odour 'sniff tests' (Section 5.3).	Very strong odour from vehicle prior to unloading manure (intensity 5 or above) causing the Manure reception building ambient H_2S or NH_3 readings to go above the safe working limits (8hr). Odour complaints attributed to this source.	Rejection of highly odorous feedstock in accordance with Feedstock Acceptance and Rejection Procedure (**ABL-SOP-06**). The supplier will be contacted to advise of non-compliance and to understand why the abnormally odorous load occurred. In the event of re-occurrence, the contract arrangements with the supplier will be reviewed/ terminated as necessary. Review cleaning frequency of transfer vehicles.
Solid feedstock receipt	**Containment** • Solid manure feedstock transported in sealed/ covered vehicles	**Constant** • Supervised unloading	Visual inspection (of feedstock)	Door(s) stuck open.	Call door engineer if Operator unable to resolve.

Odorous and potentially odorous process / material	Control measures (Appropriate Measure / BAT)	Monitoring frequency	Monitoring procedure and optimum process parameters	Trigger level	Action taken if outside optimum process parameters
	• All deliveries of manure undertaken in enclosed Manure reception building under negative pressure controlled by an air handling and emissions abatement system and with fast-action roller shutter doors shut prior to load discharge. • Energy crops are delivered to silage clamps and covered for ensilement. **Management** • Adherence to Waste Pre-acceptance Procedure (**ABL-SOP-05**) • Highly odorous feedstocks will not be accepted in accordance with the Feedstock Acceptance & Rejection Procedure (**ABL-SOP-06**). • Feedstock tonnages will be monitored and controlled through the Feedstock Tracking Spreadsheet and verified through a Daily checks (**THR-MP-04**) • The Manure reception building will be cleaned down daily in accordance with the Housekeeping Procedure **(THR-SOP-07).** **Abatement** • The air extraction and emissions abatement system will maintain negative pressure within the Manure reception building • Emissions abatement system stack will be 15.5m high to ensure effective dispersal.	• Visual checks by the Feedstock & Digestate Manager to ensure site does not become over-supplied • Dynamic odour observations by staff **Daily** • Tracking of feedstock receipt • AD Plant Daily checks (**THR-MP-04**) • Routine odour monitoring (**THR-SOP-02**) **Periodic** • Feedstock sampling	Feedstock Tracking Spreadsheet Representative samples of feedstocks will be undertaken in accordance with Sampling & Analysis Procedure **(ABL-SOP-10)** which includes the planned frequency and method of sampling for each feedstock types. Odour 'sniff tests' (Section 5.3).	Feedstock booked in for next 24 hours exceeds storage capacity in Manure reception building. Feedstocks with high odour concentrations (intensity 5 and above). Decreased efficiency of emissions abatement system. Odour complaints attributed to this source.	If manure reception storage is reaching capacity, feedstock deliveries will be ceased until process back under control. Extremely odorous feedstocks (intensity >5) will be rejected. The supplier will be contacted to advise of non-compliance. In the event of re-occurrence, the contract arrangements with the supplier will be reviewed/ terminated as necessary.

Odorous and potentially odorous process / material	Control measures (Appropriate Measure / BAT)	Monitoring frequency	Monitoring procedure and optimum process parameters	Trigger level	Action taken if outside optimum process parameters
Opening of access doors to the Manure reception building	**Management** • Fast acting roller shutter doors (60 seconds opening/ closing time) will be installed on vehicle access / egress points on the Manure reception building. • Odour awareness and contingency measures included within staff inductions and training. • Maintenance and service contract in place with supplier **Containment** • Manure reception building will benefit from an air handling system which will keep the building air under negative pressure.	**Constant** • Dynamic visual observations by staff during shift **Daily** • AD Plant Daily checks (**THR-MP-04**) • Routine odour monitoring (**THR-SOP-02**)	Roller shutter door speed (TBC) The appropriate hang time for each access door will be set once operational. Odour 'sniff tests' (Section 5.3)	Door shutter speed (TBC) The appropriate hang time for each access door will be set once operational. Door(s) stuck open. Odour complaints attributed to this source.	Hang time for doors can be adjusted as required. Call engineer if Operator unable to resolve. Cease taking manure feedstock in the event of plant/ door failure to prevent build-up of material.
Solid Feedstock treatment/ storage	**Containment** • Manure stored and transferred into dedicated feed hopper inside the building with air extraction and emissions abatement system • The silage clamps remain covered and sheeted with just the working face open when material is not being loaded. **Abatement** • The air extraction and emissions abatement system will maintain negative pressure within the Manure reception building • Emissions abatement system stack will be 15.5m high to ensure effective dispersal. **Management**	**Constant** • Visual checks by Feedstock & Digestate Manager • Dynamic odour observations by staff **Daily** • Tracking of feedstock receipt • AD Plant Daily checks (**THR-MP-04**) • Routine odour monitoring (**THR-SOP-02**)	Visual/ odour inspection of feedstock for signs of degradation. Feedstock Tracking Spreadsheet Odour 'sniff tests' (Section 5.3).	Feedstock booked in for next 24 hours exceeds storage capacity in Manure reception building. Feedstocks with high odour concentrations (intensity 5 and above). Odour complaints attributed to this source.	If Manure reception building storage is reaching capacity, feedstock deliveries will be ceased until process back under control. Increase the frequency of cleaning. In the event of abatement plant failure, feedstocks would not be delivered to site to prevent build-up of feedstock.

Odorous and potentially odorous process / material	Control measures (Appropriate Measure / BAT)	Monitoring frequency	Monitoring procedure and optimum process parameters	Trigger level	Action taken if outside optimum process parameters
	• Manure types are stored in separate piles. • FIFO procedure will be adopted in accordance with the Feedstock Loading & Management Procedure (**THR-SOP-04)** however, odorous materials that are deemed acceptable will be processed first. • The manure is conveyed via a hopper and front-end loader inside the building for treatment in the process. • Quarantined feedstock can be stored separately. • Feedstock tonnages will be monitored and controlled through the Feedstock Tracking Spreadsheet and verified through a Daily checks (**THR-MP-04**) • Implementation of housekeeping regime **(THR-SOP-07)** inside and outside the building • Odour awareness and contingency measures included within staff inductions and training.				
Liquid Feedstock receipt, Pre-treatment/ storage (slurry)	**Containment** • Liquid feedstock transported in sealed tankers and discharged into the sealed slurry pre-treatment system prior to being stored in the Liquid feedstock tank. • The headspace of the Liquid storage tank is linked to the Manure reception building to ensure any fugitive emissions are contained and abated.	**Constant** • Supervised unloading • Dynamic odour observations by staff **Daily** • Tracking of feedstock receipt • AD Plant Daily checks (**THR-MP-04**)	Feedstock Tracking Spreadsheet.	Liquid feedstock spillage. Odour complaints attributed to this source.	Initiate Spill Control Procedure (**THR-SOP-08**)

Odorous and potentially odorous process / material	Control measures (Appropriate Measure / BAT)	Monitoring frequency	Monitoring procedure and optimum process parameters	Trigger level	Action taken if outside optimum process parameters
	• Liquid feedstocks are transferred in sealed pipework into the digesters. **Management** • Receipt of liquid feedstock managed in accordance with Liquid Waste Reception Procedure (**ABL-SOP-07**) • Compliance with spill control procedure (**THR-SOP-08**) in event of a spill	• Routine odour monitoring (**THR-SOP-02**) **Periodic** • Liquid feedstock sampling	Representative samples of liquid feedstocks will be undertaken in accordance with Sampling & Analysis Procedure **(ABL-SOP-10**) which includes the planned frequency and method of sampling for each feedstock types. Odour 'sniff tests' (Section 5.3).		
Feedstock loading (external)	**Management** • External loading of silage and straw feedstocks only • The clamps will incorporate a polythene sheeting covering system to ensure that rainwater and oxygen are kept out and any odours generated are kept in. • The clamps will be inspected daily to ensure the sheeting is intact and provides effective coverage of the silage. • The silage clamps will be covered with an impermeable clamp cover will be weighted down and will help to reduce rates of evaporation by: - containing humidity, reducing the release of dissolved odorous chemicals; and	**Constant** • Supervised loading • Dynamic odour observations by staff **Daily** • Tracking of feedstock • AD Plant Daily checks (**THR-MP-04**) • Routine odour monitoring (**THR-SOP-02**) Periodic • Housekeeping Procedure **(THR-SOP-07)**	Daily visual checks to ensure operational areas kept clear of debris/ clean. Feedstock Management & Loading Procedure (**THR-SOP-04**) Odour 'sniff tests' (Section 5.3).	Feedstocks with high odour concentrations (intensity 4 and above) Odour complaint received in relation to this activity.	Silage/ straw should not have a high odour intensity; investigate process failure.

Odorous and potentially odorous process / material	Control measures (Appropriate Measure / BAT)	Monitoring frequency	Monitoring procedure and optimum process parameters	Trigger level	Action taken if outside optimum process parameters
	- eliminating airflow over the surface of odour-releasing materials to reduce the rate of evaporation. • The exposed surface area of the clamp for removal of silage will be limited: by removing a relatively small section of the clamp cover to reveal a working face from which silage can be cut. • The time the silage is agitated for will be limited: the silage will be removed from the clamp on a twice daily basis and transferred over short haulage distance using a large front loader bucket from the clamp to the feed hopper such that the period of time agitated material is exposed to air is kept to a minimum before loading. • There are weigh cells in each feed hopper to ensure that the correct tonnages of silage from the clamps and treated straw are added. The tonnages are recorded on SCADA. • Straw feedstock is not expected to emit odour. Extruded (wet) straw will be placed within the hoppers. • Operational areas shall be checked and maintained in a clean condition and regularly scraped/ swept/ washed using hoses/ grey water.				If an odour complaint is received an investigation will be undertaken as to the cause. If the odour complaint is confirmed to have been caused by feedstock handling, checks should incorporate the clamp cover, adherence to feedstock handling procedures and meteorological conditions at the time of the complaint/ transfer activity. Contingency measures will be confirmed as effective through an additional documented odour survey at the on-site odour source, at the downwind site boundary and at the affected off-site receptor location(s).

Odorous and potentially odorous process / material	Control measures (Appropriate Measure / BAT)	Monitoring frequency	Monitoring procedure and optimum process parameters	Trigger level	Action taken if outside optimum process parameters
	• Meteorological monitoring and forecasting at the site will be performed daily to identify times when plant conditions and/or odour abatement techniques silage cutting and loading operations need to be adjusted to account for adverse conditions that may result in an off-site odour impact. A dynamic risk assessment would be carried out by the Operator taking into account the wind direction.				
Emissions Abatement System/ stack	**Management** • A planned preventative maintenance programme will be in place with the manufacturer's inspection and maintenance recommendations and as per the monitoring and maintenance schedules of the EMS **(THR-MP-01, THR-MP-04)**. • Critical parts held on site **Process Control Monitoring** • There will be a sampling point on the discharge stack to audit the performance of the system based upon the emission levels to atmosphere. • Emission parameters set by the technology provider will be at or below BAT-associated emission levels (BAT-AELs) for channeled emissions of odour (200 - 1,000 ou_E/Nm^3) and NH_3 (0.3 – 20 mg/m^3).	**Constant**: • Dynamic visual and odour observations by staff during shift • H_2S sensor (on carbon filter) **Daily** • Inspection of fan, filters, process parameters • AD Plant Daily checks (**THR-MP-04**) • Routine odour monitoring (**THR-SOP-02**) **6-monthly** • Inspection of filters, system fans • MCERTS monitoring of NH_3 or odour concentration **Quarterly**	**Process gas flow** 18,500m^3 **UV specification** UV Lamp life: approx. 16,000 hours. UV max. operating temp: 45°C **Packed acid scrubber** Pressure drop: Approx. 500 Pa Filter media volume: TBC **Active Carbon Specification** Filter renewal period: interval of approx.18-24 months (3500 kg) Residence time: TBC	Optimum process parameters are out of range MCERTS emission monitoring results exceed limit: TBC Odour complaints attributed to this source.	On detection of notable odour from the emissions abatement stack/ off-site odour impact check emissions abatement system inspection record to diagnose the cause e.g., fault in system/ filter media expiry. If problem cannot be rectified by site staff, the technology provider will be contracted to investigate the integrity of emissions abatement system and remedial actions taken immediately where necessary.

Odorous and potentially odorous process / material	Control measures (Appropriate Measure / BAT)	Monitoring frequency	Monitoring procedure and optimum process parameters	Trigger level	Action taken if outside optimum process parameters
		• Site measurement of gases relevant to odour to evaluate performance.	MCERTS monitoring (emission parameters specified by technology provider): TBC Odour 'sniff tests' (Section 5.3)		In the event that odour complaints are attributed to this source, the Operator will, through discussion with the technology provider and the EA, prepare a programme of improvements for agreement with the EA.
Fibre digestate storage and transfer	**Containment** • The digestate is separated via mechanical separators enclosed in a bunker; the fibre will be stored in a dedicated bay below the separators. • The covered bunker is a 3-sided structure with a top and front cover; the front will be opened for digestate loading only. **Management** • Loading of the fibre will be carried out in accordance with Digestate Handling Procedure (**THR-SOP-05**). • Fibre digestate will be produced to PAS110 standard. Process Monitoring Procedure (**THR-SOP-01**) and management to ensure stable digestate produced with low residual biogas potential.	**Constant** • Dynamic odour observations by staff **Daily** • Visual inspection • AD Plant Daily checks **(THR-MP-04)** • Routine odour monitoring (**THR-SOP-02**) **Periodic** • Samples of fibre digestate prior to seasonal use in accordance with Sampling & Analysis Procedure **(THR-SOP-07)** • Housekeeping Procedure **(THR-SOP-07)**.	Visual inspection of separator bunker to ensure operational areas kept clear of debris/ clean. Odour 'sniff tests' (Section 5.3).	Digestate spillage Very strong odour from fibre digestate (intensity 4 or above). Odour complaints attributed to this source.	Halt the operation. Remove the malodorous load from site and investigate why the fibre is particularly odorous.

Odorous and potentially odorous process / material	Control measures (Appropriate Measure / BAT)	Monitoring frequency	Monitoring procedure and optimum process parameters	Trigger level	Action taken if outside optimum process parameters
	• The digestate separation area will be regularly cleaned and maintained in accordance with observations made during the daily checks (**THR-MP-04**). • Minimum (weekly) cleaning of operational areas next to bunker.				
Liquid digestate storage	**Containment** • Digestate is separated within mechanical separators enclosed within a covered bunker • Following separation liquid digestate is fully contained and the liquor pumped from the separator to either: - the digestate storage bag with working capacity of 7,344m^3 (residual emissions from the digestate storage bag is released via 3 passive vents); or - the Process water buffer tank (100m^3) which feeds the premix system (Residual gas within the Process water buffer tank is passed via pipework to the gas treatment system). **Management** • Process Monitoring Procedure (**THR-SOP-01**) and management to ensure stable digestate produced with low residual biogas potential. • There is a digital level indicator inside the bag which indicates the volume of digestate liquor stored and which is linked to SCADA.	**Constant** • Dynamic visual observations • Dynamic odour observations by staff **Daily** • AD Plant Daily checks (**THR-MP-04**) • Routine odour monitoring (**THR-SOP-02**) **Quarterly** • Sampling of digestate liquor	Process monitoring of fill levels linked to SCADA. The digestate storage bag sits within a lined bund with leak detection. Liquid digestate will be produced to BSI PAS110: 2014 Specification; sampled and analysed to determine appropriate spreading rates in accordance with the Digestate Management Plan (**THR-OD-07**). Odour 'sniff tests' (Section 5.3)	Very strong odour (intensity 4 or above). Odour complaints attributed to this source.	Check pipework/ cover for damage. Initiate Spill Control Procedure **(THR-SOP-08)**

Odorous and potentially odorous process / material	Control measures (Appropriate Measure / BAT)	Monitoring frequency	Monitoring procedure and optimum process parameters	Trigger level	Action taken if outside optimum process parameters
	• The volume within the digestate storage bag is restricted to 7,344 m^3 so as to maintain a 300mm freeboard at all times.				
Liquid digestate transfer	**Containment** • Liquid digestate tanker off-take point: liquid digestate is transferred off-site via sealed tankers. • Loading of the liquor will be carried out via a pipe coupling and in accordance with Digestate Handling Procedure (**THR-SOP-05**). • The risk of major liquid release is checked, and isolator valves activated. • The drainage design is such that any spillage resulting from collection of digestate liquor would be contained within the dirty water drainage system and be used in the AD process. • Any spillages arising during digestate off-take will be contained within a sump at the offtake point and managed promptly in accordance with the Spill Control Procedure (**THR-SOP-08**). **Abatement** • Emissions to air from the empty tanker during filling will be exhausted via connection to the on-site carbon filter emissions abatement system (emission point A23).	**Constant** • Dynamic visual observations • Dynamic odour observations by staff **Daily** • Routine odour monitoring **Weekly** • Monitor NH_3 at carbon filter outlet (during digestate loading) using hand-held gas meter or NH_3 Draeger tubes	Visual inspection during tanker filling (signs of damaged hoses/ connections, leaks during filling etc.) Liquid digestate will be produced to BSI PAS110: 2014 Specification; sampled and analysed to determine appropriate spreading rates in accordance with the Digestate Management Plan (**THR-OD-07**). Odour 'sniff tests' (Section 5.3)	Very strong odour from tanker vent(s) (intensity 5 or above). Odour complaints attributed to this source.	Check pipework/ seals/ connections for damage. Initiate Spill Control Procedure (**THR-SOP-08**). Advise the EA of the circumstances.

Odorous and potentially odorous process / material	Control measures (Appropriate Measure / BAT)	Monitoring frequency	Monitoring procedure and optimum process parameters	Trigger level	Action taken if outside optimum process parameters
	Management • To prevent "tanker drive-off", site operatives will be trained and provide training and oversee the first delivery or dispatch for a new driver. • Site operatives will check and replace hose couplings as required. • Minimum (weekly) cleaning of operational areas next to off-take points.				
Drainage system	**Containment** • Dirty water is contained within sealed site drainage system and recirculated back into process **Monitoring** • Drainage system water levels **Management** • Facility to turn pumps off e.g., if spillage • Emptying and cleaning of the drainage system is undertaken as required	**Daily** • Ensure drains are clear, including clamps. • Routine odour monitoring • Annual drainage integrity and inspection report in line with GGP recommendations	Visual inspection (of dirty water level, debris in channels) Odour 'sniff tests' (Section 5.3)	Odour from drainage system (intensity 4 or above)	Investigate reason. The drainage system will be cleared out using vacuum tankers if required. Clamp drainage channels to be cleared/ flushed.
'Raw' biogas (gas storage above digester tanks, digestate storage tanks)	**Containment** • Odour abatement is a key feature of the design as capture and recovery of the biogas is central to the plant's efficiency. The likelihood of gas leaks is therefore very low. • All digester tanks are bonded to the biogas stores to ensure digestion process takes place in sealed, airtight vessels and that there are no fugitive emissions.	**Constant** • Monitoring via SCADA • Personal gas alarms worn by site operatives • Dynamic odour observations by staff **Daily** • AD Plant Daily checks (**THR-MP-04**)	Continuous systems monitoring (SCADA) including excess gas use in the CHPs, flare systems or operation of PVRVs. Monitoring gas flow/ quality to the engines: - MCH_4 - O_2 - H_2S	Personal gas alarm alert. DSEAR limits observed for explosive atmospheres. 'Raw' biogas odour detectable on-site (intensity 3 or above).	Follow Biogas Leak Response Procedure (**THR-SOP-11**) Notify Site Manager immediately. Check operation of PVRVs on all tanks.

Odorous and potentially odorous process / material	Control measures (Appropriate Measure / BAT)	Monitoring frequency	Monitoring procedure and optimum process parameters	Trigger level	Action taken if outside optimum process parameters
	Abatement • There will be oxygen injection on all of the digesters. To reduce hydrogen sulphide (H_2S) in the biogas, a small amount of oxygen is injected into the digester to increase the oxidising capacity of the system, thus inhibiting sulphate-reducing bacteria activity and promoting sulphide oxidation. • Oxygen is generated from air via pressure swing absorption unit and injected into the tank headspace. The oxygen concentration to be included within detailed engineering average of 0.5% and ≤1%. Ferric hydroxide powder will be used to further control H_2S levels if needed. **Process Control** • The AD process is fully regulated using a SCADA process control monitoring system. **Monitoring** • The gas in the gas holder roofs of the Secondary digesters and the Tertiary digester will be monitored (SCADA). • Releases from the PVRVs will be recorded on SCADA • After commissioning the operator will establish a Leak Detection and Repair (LDAR) programme to measure diffuse emissions of ammonia, VOCs including methane and odour from all sources identified in the LDAR. This may include but not be limited to gas storage membrane and PVRVs.	• Routine odour monitoring (**THR-SOP-02**) **Periodic** • Annual Leak Detection & Repair surveys will be carried out in accordance with permit requirements.	- CO_2 Gas concentrations may be checked using a hand-held gas monitor. Odour 'sniff tests' (Section 5.3) Site 'Sign-in App' for visitors/ contractors.	Odour complaints attributed to this source.	Portable monitors will be used to check gas type and concentration. If required, the plant engineers will be contacted to resolve the issue immediately.

Odorous and potentially odorous process / material	Control measures (Appropriate Measure / BAT)	Monitoring frequency	Monitoring procedure and optimum process parameters	Trigger level	Action taken if outside optimum process parameters
	Management • Routine inspection and maintenance schedule for the AD tanks and integrity of associated infrastructure. • Training and authority to work is required. Risk assessment undertaken when work is required. Contractor technician will oversee work. • In the event of planned plant outages for maintenance or repair, the production of biogas is slowed down in advance by reducing the quantity of feedstock into the digester and by halting the stirrer activity. • Any excess gas will be flared in preference to releases of raw biogas to ensure that there will be no fugitive emissions of odorous gas.				
Biogas upgrade unit (BUU) vent	**Abatement** • The BUU will be fitted with carbon capture equipment so there will be residual emissions of CO_2 only. **Monitoring** • There will be continuous process control monitoring to ensure the plant is operating at optimum efficiency. **Process Control** • The regulation of gas flow to the gas upgrading plant will ensure that its capacity is not exceeded, and that gas is not released direct to the atmosphere.	**Constant** • SCADA • Dynamic odour observations by staff • Personal gas alarms worn by site operatives **Daily** • Routine odour monitoring (**THR-SOP-02**) • AD Plant Daily checks (**THR-MP-04**) **Weekly**	Continuous systems monitoring (SCADA). Gas analyser used to measure and allow control on the quality of incoming gas: - CH_4 - H_2S - CO_2 - O_2 Odour 'sniff tests' (Section 5.3)	Personal gas alarm alert. DSEAR limits for explosive atmospheres. 'Raw' biogas odour detectable on-site (intensity 3 or above). Odour complaints attributed to this source.	Notify Site Manager immediately. Check operation of PVRVs on BUU. Portable monitors will be used to check gas type and concentration. If required, the plant engineers will be contacted to resolve the issue immediately.

Odorous and potentially odorous process / material	Control measures (Appropriate Measure / BAT)	Monitoring frequency	Monitoring procedure and optimum process parameters	Trigger level	Action taken if outside optimum process parameters
	• The upgrading plant will incorporate a PVRV for over-pressure situations. When operated, there would be an intermittent release of odorous biogas.	• BUU (draining of the condensate vent pipe) **Bi-annual** • Annual leak detection checks or as otherwise stipulated by the environmental permit			
CHP stack emissions	**Process Controls** • The combustion of biogas by the CHP engines will destroy any potential odorous compounds. • AD plant automated systems (process control) monitoring (SCADA) • The emergency flare will be used to combust excess biogas under abnormal operating conditions. **Abatement** • Desulphurisation of biogas via oxygen injection into the digesters and, if required, ferric hydroxide powder into the feed hoppers to reduce H_2S in the process. **Dispersion** • CHP emissions released from 7m stacks to ensure effective residual odour dispersal. **Monitoring** • The gas flow will be regularly inspected to ensure that combustion capacity is not exceeded	**Constant** • SCADA - gas quality analysis • Dynamic odour observations by staff • Personal gas alarms worn by site operatives. **Daily** • Routine odour monitoring (**THR-SOP-02**) **Annual** • MCERTS emissions monitoring • Leak detection checks	Continuous systems monitoring (SCADA) (process control monitoring / periodic gas quality analyses). Odour 'sniff tests' (Section 5.3) MCERTS monitoring of emissions to air to check compliance with limits: NOx – 500 mg/m^3 CO – 1,400 mg/m^3 TVOCs – 1,000 mg/m^3 SO_2 – 107 mg/m^3 Third-party leak detection survey.	SCADA alert 'Raw' biogas odour detectable on-site (intensity 3 or above). Odour complaints attributed to this source.	Combusted biogas emissions from the CHP engine will not give rise to an off-site odour impact. In the event that 'raw' biogas is detected, rather than combusted biogas, refer to the above procedure for 'raw biogas'. If the nature of the combusted emissions gives cause for concern i.e., become odorous, Site Manager to call CHP service contractors to further investigate and undertake remedial action if required.

Odorous and potentially odorous process / material	Control measures (Appropriate Measure / BAT)	Monitoring frequency	Monitoring procedure and optimum process parameters	Trigger level	Action taken if outside optimum process parameters
	• MCERTS monitoring of stack emissions conform to emission limit values (ELVs) specified by the manufacturer and are within the site's permit. **Management** • CHPs subject to routine services and maintenance schedule (**THR-MP-01**), that includes leak detection and MCERTS emissions testing undertaken by specialist contractors. • Excess gas will be re-directed to the gas upgrade plant. If this is not possible, the gas will be flared to ensure that there will be no fugitive emissions of odorous gas.				Upgrade or flare all biogas until issue resolved.
Emergency Flare stack emissions	**Process Controls** • The combustion of excess biogas by the flare will destroy any potential odorous compounds. • The flare will start up automatically at a set pressure / gas storage volume. **Monitoring** • There will be continuous process control monitoring. Hours of operation of the flare will be recorded on SCADA. • The gas flow to the flare will be regularly inspected by the service engineer. • In the event that the flare is operated >10% of the year (876 hours) MCERTS monitoring of stack emissions will be undertaken to check compliance with permit limits.	**Constant** • SCADA - gas quality analysis • Dynamic odour observations by staff • Personal gas alarms worn by site operatives. **Daily** • Routine odour monitoring (**THR-SOP-02**) **Annual** • MCERTS emissions monitoring (if flare operated >876 hrs).	Continuous systems monitoring (SCADA) (process control monitoring / periodic gas quality analyses). Odour 'sniff tests' (Section 5.3) MCERTS monitoring of emissions to air to check compliance with limits: NOx – 150 mg/m^3 CO – 50 mg/m^3 TVOCs – 10 mg/m^3	SCADA alert 'Raw' biogas odour detectable on-site (intensity 3 or above). Odour complaints attributed to this source.	If the nature of the combusted emissions gives cause for concern i.e., become odorous, Site Manager will call the relevant contractor for an emergency call-out to further investigate and undertake remedial action.

Odorous and potentially odorous process / material	Control measures (Appropriate Measure / BAT)	Monitoring frequency	Monitoring procedure and optimum process parameters	Trigger level	Action taken if outside optimum process parameters
	Management • Combustion emissions released at height that will ensure effective odour dispersal.				

5 Odour reporting

5.1. Complaints reporting

Complaints data is recognised by the EA as the most direct and reliable form of monitoring which odours are causing a problem outside of the site boundary. The Operator will address both internal and external complaints in a prompt and comprehensive manner to resolve any issue as quickly as possible.

All complaints will be collected, registered, and validated following the Complaints Procedure (**ABL-SOP-02**). If an odour complaint is received, the Site Manager or deputy will complete an Odour Complaint Form (**ABL-FT-06**).

In order that odour complaints can be substantiated it is imperative that the Site is immediately informed either by the complainant themselves or by the EA. Local residents will be encouraged to immediately contact the site in the event of an off-site odour to enable site personnel to verify the presence, extent, and cause of the odour. The Site Manager's telephone number will be displayed at the site entrance.

A stepwise approach to odour complaint investigation and reporting is presented in Figure 5.1. The complaint investigation will start with an initial screening exercise to verify the odour incident to screen out those odour complaints that are unlikely to be due to the facility. The initial screening exercise will consider the following:

- potential odour sources at the facility (Table 3.1);
- routine/ additional odour monitoring data; and
- meteorological conditions considered in relation to the location of the complainant.

If the Site Manager can attend the complaint location quickly, it may be possible to carry out effective appraisal of the complaints independently by a 'sniff test'. This is further described in Section 5.4 'Reactive Odour Monitoring'.

After recording the complaint on the Odour Complaint Form (**ABL-FT-06**) and completing the appropriate level of investigation the Site Manager will discuss the matter with the Director.

The Odour Complaint Form (**ABL-FT-06**) will be forwarded to the EA together with the outcome of the checks within 24-hours of investigation and validation and any corrective and preventative actions taken in response to the complaint.

The Operator will maintain a system of complaints monitoring and analysis. Complaints will be registered on a database, validated where possible and reviewed monthly.

All complaints forms/records will be kept until the surrender of the Permit. All records will be available for inspection by EA representatives.

Problem resolution

The complaint investigation will involve identifying the odour source and implementing measures to bring the source under control. The corresponding odour investigation report will detail the actions taken to minimise the potential for re-occurrence. In order to bring the process back under control the following will be considered:

- Cease the activity causing the abnormal situation and/or if necessary, arrange for the immediate removal of any odorous materials giving rise to the problems;
- Take immediate steps to eliminate the cause of the abnormal situation;
- If necessary, contact the relevant maintenance contractor;
- Record the response to the situation and the remedial actions taken; and
- Advise the EA of the complaint(s), details of the problem, and mitigation/improvement measures undertaken.

Temporary problem rectification

If the default procedure does not provide a satisfactory resolution, the following actions will be considered until the problem is resolved:

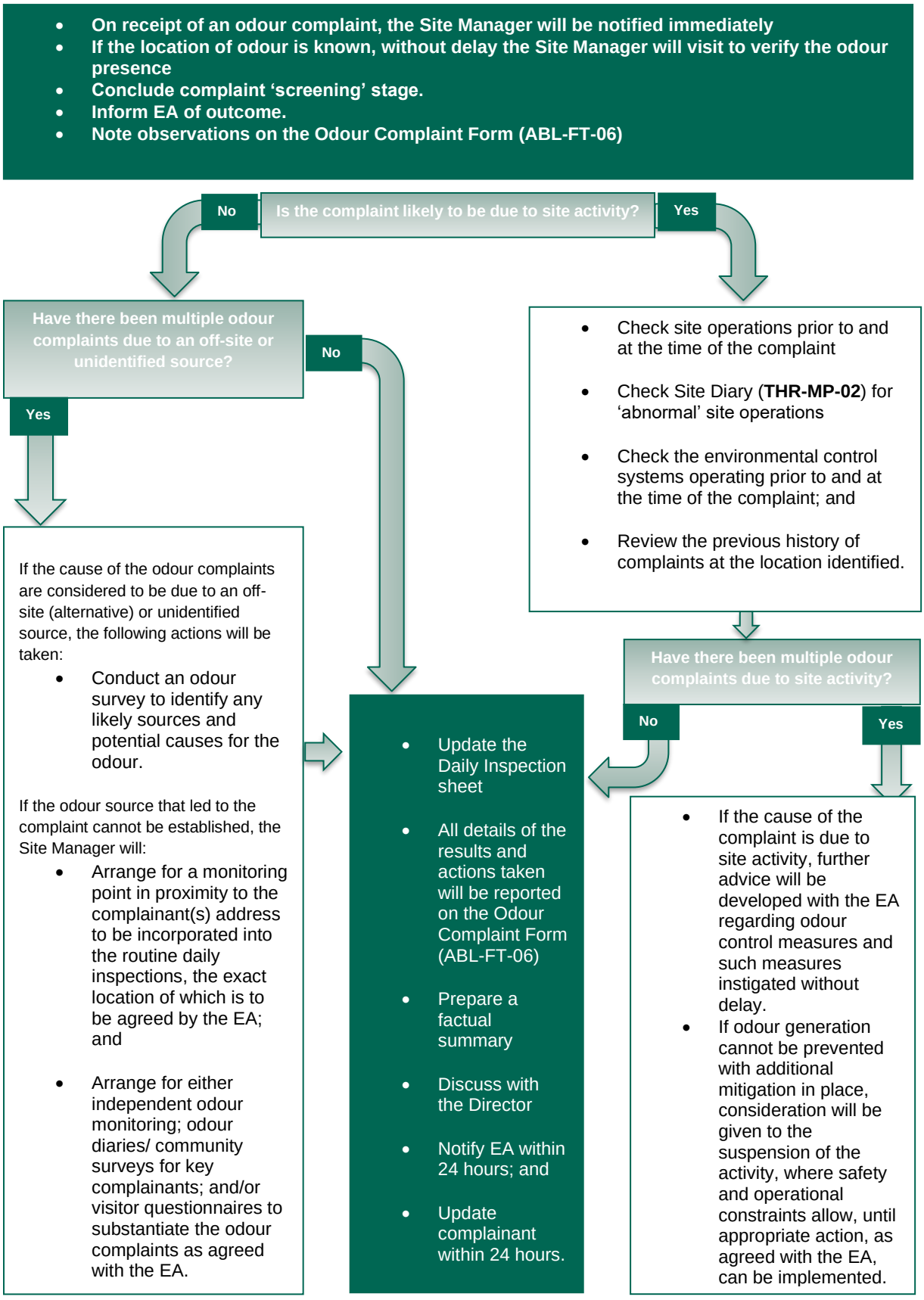
- Temporarily restrict feedstock acceptance at the site; and/or
- Temporarily reduce the feedstock throughput.

Review and improvement following complaints

Once the cause of the problem is identified and the improvements implemented, the following actions will be undertaken:

- A further odour survey will be completed to assess if the improvements have addressed the source of the elevated levels.
- If the cause is due to inadequately followed odour management controls, then re-training of employees will take place to ensure that all employees operate to the required standards.
- If the odour management controls are determined to be inadequate it will be raised as part of the review of control measures detailed in the OMP; and
- All parties affected will be notified of the cause, actions, and resolutions by the Site Manager.

Figure 5.1 Odour Complaints Procedure – Stepwise Procedure



5.2. Community engagement

The Operator will ensure that they are always approachable and open to discussion, the primary objective is to encourage feedback and also for complainants to feel comfortable to contact the Operator in the first instance so that problems can be identified and rectified at the earliest opportunity.

Liaison with local residents in closest proximity to the site operations (subset of the receptors given in Table 2.1) and the EA will be co-ordinated through the Site Manager. Both parties will be notified of activities that have the potential to generate significant odour emissions, and of any activities programmed to take place outside of normal site operating conditions or hours.

In circumstances where, over an extended period, odour complaints from the community do not match the results of the regular sniff-test monitoring the Operator will engage with members of the community, in key locations, to participate in a period of community monitoring. These designated residents would perform offsite surveys, recording the data in an 'Odour Diary' for an agreed length of time. The Operator will maintain logs of community involvement and keep all completed odour diaries for future reference.

5.3. Pro-active odour monitoring

Meteorological Monitoring

Meteorological conditions are key to understanding the potential odour impacts to receptors. Meteorological monitoring at the site will therefore be performed:

- During routine odour monitoring;
- To predict periods when conditions for the dispersion of odour are likely to be poor, enabling planned maintenance operations to be re-scheduled to avoid such times;
- At the time of abnormal events to predict where odour impacts could potentially occur;
- To identify times when plant conditions and/or odour abatement techniques need to be adjusted to account for adverse conditions; and
- For the investigation of odour complaints.

Meteorological data will be sourced by site operatives from on-line resources.

Monitoring Odorous Releases

Site staff will be trained to be continuously aware of odour during the working shift and to report any issues to the Site Manager. This section of the OMP sets out the additional monitoring procedures that will be implemented, during normal operations.

Questionnaire System

Visitors to site are required to complete a 'site odour evaluation' when signing-in. An alert is sent to the Operator Site Manager if a strong odour (intensity 4 or above) is reported by visitors.

The Site Manager will direct an investigation to establish the source and identify the requirement for remedial measures. The details of the odour will be recorded using the Odour Monitoring Form (**THR-FT-01**).

Routine (Daily) Olfactometry Monitoring

The Operator will carry out routine daily odour checks in accordance with the Odour Monitoring Procedure (**THR-SOP-02**). Observations will be recorded on Odour Monitoring Form (**THR-FT-01**).

Predetermined monitoring locations (that includes locations listed below from number 1 to number 6 inclusive) should be surveyed on every occasion.

Two flexible downwind monitoring locations (locations numbered 7 and 8 below) will be chosen at the time of the survey.

An additional survey location (OMP9) will be visited once weekly at the nearest downwind off-site receptor location(s) even if odours are not detected at Site boundary. This is to acknowledge that odours may ground beyond the site boundary even where no on-site or site boundary odour is detected.

As a minimum monitoring will be undertaken at the following (with upwind locations to be surveyed first):

To be undertaken daily:

- **OMP1** - Proposed AD Plant, NE boundary
- **OMP2** - Proposed AD Plant, NW boundary
- **OMP3** – Proposed AD Plant, W boundary
- **OMP4** – Proposed AD Plant, SW boundary
- **OMP5** – Proposed AD Plant, SE boundary
- **OMP6** – Proposed AD Plant, E boundary
- **OMP7** – Flexible location: a location on the downwind site boundary (if this is not already included as a fixed monitoring location listed above)
- **OMP8** – Flexible location: the nearest downwind receptor if the odour intensity at the site boundary is >3)

To be undertaken weekly:

- **OMP9** - Flexible location: the nearest off-site downwind receptor location(s) (even if odours are not detected at site boundary).

An Odour Monitoring Locations Plan is included in Figure 5.2.

Monitoring will be undertaken at different times each day during operational hours to capture a range of conditions and at times when there is a risk of off-site odour impact, for example due to operational changes or due to weather conditions. Additional odour monitoring surveys will be undertaken during the following circumstances:

- During operational hours, where the risk of odour dispersion is towards off-site receptors. This may be due to prevailing wind direction and/or during periods of still air conditions. During these periods an odour survey will be conducted at the downwind site boundary and at the downwind off-site receptor location(s). Any off-site odours will be traced to their potential source which may include a full inspection on-site of the area of operations.

- During routine operations where there is an increased risk of odour release.

- During periods of maintenance and/or abnormal operating conditions (Table 6.1) where there is increased risk of odour release. During these periods an odour survey will be conducted at the downwind site boundary and at the downwind off-site receptor location(s) to establish the presence of odour off-site.

- In order to verify to success of any contingency measures implemented on-site to control odour in response to either the detection of abnormal odour release during routine odour monitoring (Section 5.3) or as a result of measures implemented in response to verified odour complaint(s). The survey will be undertaken on-site at the location of the verified odour source(s), at the downwind site boundary and at the off-site affected receptor location(s).

- In order to qualify the presence or absence of odour from other sources beyond the site boundary if there is no established pathway between the site but odour has been detected at a potential offsite sensitive receptor.

- The results will be recorded on the Odour Monitoring Form (**THR-FT-01**) and Site Diary (**THR-MP-02**). This data can be used to inform proactive odour management.

The Odour Assessor

Monitoring staff must not be desensitised to odour. A variety of trained odour monitoring personnel should be used and, where possible, selected from office-based staff who are unlikely to have been exposed to on-site odours.

The odour assessor must not be subject to significant odour in the 30-minutes prior to the assessment or consume strongly flavoured food or drink within this time period. This is to ensure that the assessor is not suffering from odour fatigue and will be sensitive to on-site odours. If odour complaints are received, and the results of routine odour testing suggest that site personnel are unable to detect odour whilst on-site the Operator will consider using

independent contractors for sniff testing until the source of the odour is established and/or issue is resolved.

It is important to note that olfactory monitoring ('sniff tests') are subjective and both the hedonic tone and intensity may be experienced differently by different people. The Hedonic Scale and Odour Intensity Scale is included in the Odour Monitoring Procedure (**THR-SOP-02**), Appendix C.

Routine Monitoring Inspection Methodology

1. Monitoring personnel will walk slowly, breathing normally, and starting at points with least expectation of odour (e.g., off-site and/or upwind). If an odour cannot be detected in this way, the inspector will periodically stand still and inhale deeply facing upwind.

2. If no odour is perceptible in this manner, then the intensity will be 0. If odour is detected but there is some doubt as to whether an odour is present, then the intensity will be recorded as 1 (very faint). If odour is detected but cannot be described using precise words or terms, then intensity will be recorded as 2 (faint). If odour is detected while walking and the odour character is recognisable, the intensity will be recorded as at least 3 (distinct). If the odour character is easily recognisable then the intensity is 4 (strong). If the odour is considered offensive the intensity is 5 (very strong) and if the odour is offensive and possibly nauseous i.e., an instinctive reaction is to reduce personal exposure to the odour, then the intensity is 6 (extremely strong). The score used to classify odour are provided on the Odour Monitoring Form (**THR-FT-01**). Other supporting classification systems and information are provided in Appendix C.

3. If a recognisable or 'distinct' odour or stronger (i.e., intensity of 3 and above) is detected at the downwind site boundary and/or at off-site receptor locations, an on-site inspection of operations will be carried out to trace any observed off-site or site boundary odour to the source, or identification of the direction of an off-site odour, so that appropriate corrective action can be taken.

4. On reporting results, it is important that additional observations including time, date, weather conditions, odour type, location, intensity, extent, and sensitivity are recorded in the Odour Monitoring Form (**THR-FT-01**).

5. Abnormal site operating conditions at the time of the survey e.g., maintenance to process equipment will also be recorded.

5.4. Reactive Odour Monitoring

Actions in the Event of Abnormal Emissions

Investigate Pollution Incident and Cause

If odour monitoring or odour complaint(s) indicates that abnormal emissions from the facility are taking place the Site Manager (or deputy) will investigate the complaint as soon as possible on receipt of the odour survey results/ complaint.

The Site Manager will check relevant items of odour abatement equipment to identify the possible cause of the abnormal emission and/or attend the complaint location to carry out a 'sniff test'.

The Operator will liaise with the EA immediately to inform of the outcome of the screening assessment (Figure 5.1) and whether any action is to be taken. If the Site is not confirmed to be the odour source, then the investigation will stop at that point.

If the screening process confirms the odour incident, then a more detailed investigation will be carried out. The actions outlined in Figure 5.1 will be followed if the site is identified as the origin/cause of the odour complained about. Figure 5.1 also outlines the actions that will be undertaken by the Operator in circumstances where the source of the odour cannot be confirmed. If the odour complaint is received during operational hours the complaint will be investigated immediately.

Table 5.1, Schedule of Odour Monitoring ('Sniff Tests'), summarises the schedule for proactive and reactive odour monitoring.

Figure 5.2 – Site plan showing odour monitoring locations

Table 5.1 Schedule of Odour Monitoring ('Sniff Tests')

Frequency	Person Responsible	Method	Reason	Records	Actions
Proactive (daily)	Trained office-based staff or non-operational staff or, if unavailable, by operational staff at the start of a working shift	Perform sniff test at locations indicated on **Figure 5.2**	Routine monitoring to establish normal working conditions and check for odour emissions/ issues	Odour Monitoring Form (**THR-FT-01**)	If a distinct odour (intensity 3 or above) is detected at site boundary/ at off-site receptor investigate and establish source during the survey and identify the requirement for remedial measures. Record the details of the odour using the Odour Monitoring Form.
Proactive (ad-hoc)	Site visitors and site personnel	Site visitors - perform sniff test on arrival at site. Site personnel – dynamic odour monitoring during shift.	To establish odour emissions/ issues; or during operations where there is an increased risk of odour release	Sign-in App (Site Office) Odour Monitoring Form (**THR-FT-01**)	An alert is sent to the Site Manager if a strong odour (intensity 4 or above) is reported by visitors. Investigate and establish source and identify the requirement for remedial measures. Record the details of the odour using the Odour Monitoring Form.
Reactive (ad-hoc)	Site Manager (or deputy)	Perform sniff test at relevant receptor locations, boundary locations and at suspected on-site sources	In response to odour complaint	Odour Monitoring Form (**THR-FT-01**) Odour Complaint Form (**ABL-FT-06**)	Follow stepwise approach (Figure 5.1).
Reactive (ad-hoc)	Trained office-based staff or non-operational staff	Perform sniff test at relevant receptor locations, boundary locations and at suspected on-site sources	To establish/ confirm odour source in the event of an odour release	Odour Monitoring Form (**THR-FT-01**)	If a distinct odour (intensity 3 or above) is detected at off-site receptors identify appropriate remedial measures. If odour generation cannot be prevented with additional mitigation in place, consideration will be given to the suspension of the activity, where safety and operational constraints allow, until appropriate action, as agreed with the EA, can be implemented. Record the details of the odour using the Odour Monitoring Form.

6 Abnormal events

Table 6.1 provides a summary of the foreseeable situations that may compromise the Operator's ability to prevent and/or minimise odorous releases from the process. The response requirements to minimise the impact to abnormal event scenarios are also summarised in Table 6.1.

Potential odour sources under abnormal operating conditions, may include:

- AD plant infrastructure compromised (leading to gas/ liquid release from storage tanks, pipework)
- Plant breakdown
- Absence of key staff
- Flood
- Fire/ explosion
- Unavailability of transfer vehicles

It is expected that, any emissions arising due to abnormal operations, incidents and/or due to periods of maintenance at the site would not occur frequently and would not be sustained or of prolonged duration.

When maintenance work is undertaken, there is the potential that the facility is more vulnerable, or there is a risk of a small odour release, e.g., removing a pump, replacing a pipeline, or rodding/flushing a pipe/chamber etc. Suitably qualified and competent contractors will complete maintenance works. Rules/work permits will be required for all contractors working on site. Sections of the plant which require maintenance will be sealed off from the main process to control and limit the potential release of odours during maintenance works.

The Operator will immediately inform the EA when planned or emergency maintenance of plant items must be carried out and there is a likelihood of odour being released to atmosphere to the degree that an adverse off-site impact may occur. The Operator will provide details of the event, actions being taken to resolve the issue and likely timescale to rectify.

A list of contingency contacts in the event of abnormal operations/ critical failures is provided in the Accident Management Plan (AMP) Manual (**THR-OD-06**).

In the event of a critical failure of the facility which results in restricted feedstock reception capacity, additional mitigation measures will be put in place to minimise the impact of the incident. These will include:

- Stop receipt of feedstock
- Containment of spillages or odour releases **(THR-SOP-08)**
- Clean-up/ wash-down procedures in accordance with Housekeeping Procedure **(THR-SOP-07)**
- Containment of feedstock either into sealed containers/by covering or removal to an alternative facility within 24 hours

In the case of operational difficulties, feedstock would be prevented from travelling to and/or diverted to an alternative facility before arriving at site. In the event of serious odour issues and disaster or emergency situations, measures are also in place to divert or remove feedstocks for landfill disposal as a last resort.

An emergency diesel generator is available on-site to avoid power failure impacting the operation. The generator will be subject to routine servicing. Mains water supply will be available.

Deputies are available for any individual key staff member should they be unavailable for any reason.

Table 6.1 Abnormal events

Abnormal event	Recovery steps
AD plant infrastructure compromised (gas / liquid release)	• The SCADA system, that includes level sensors on all tanks, will enable identification of the issue. Systems alerts, and overrides are integral to the automated system. The system fitted with fail-safes for blockages, high or low pressure stops and valve interlocks. • Member of Site personnel always on duty to attend (e.g., to stop pumps/ close valves etc. as necessary). Portable monitors will be used to check gas type and concentration. • Supply of critical spare parts held on-site. • Support to be provided by Acorn engineers and pre-approved third-party engineers for emergency breakdown/ repairs. • A suction puddle pump is available on-site at all times and a vacuum tanker can be called in to retrieve liquids. Clean affected area with squeegee, apply absorbents. Clean equipment surfaces. • Feedstock will be diverted to authorised disposal facility until repaired.
General plant/ equipment Breakdown/ unplanned maintenance	• Invoke Mechanical Failure Procedure (**THR-SOP-15**) • Routine and emergency maintenance contracts in place with associated contractor for plant/ equipment (**THR-MP-01**). • Member of Site personnel on duty at all times to attend e.g., to stop pumps/ close valves as necessary. • Supply of critical spare parts held on-site. • Feedstock will be diverted to authorised disposal facility until repaired.
Manure reception building emissions abatement system breakdown	• Routine and emergency maintenance will be undertaken by suitably trained and competent personnel to minimise likelihood of breakdowns. • In the event of a breakdown, actions will depend on the specific situation or significance of the breakdown/ malfunction, likely to be limited to mechanical failure of fan, accidental damage to a system component (ductwork, fan, filters), exhaustion of filter media. Actions may include: - Replacement/ repair of parts/ filter media by trained personnel (refer to Table 4.1 for Action Levels) - If required, repair/ replacement of components by specialist engineer(s) • In the event of a breakdown that prevents the emissions abatement system functioning as intended, there will be a temporary cessation of manure inputs until emissions abatement system is repaired/ fully operational. Manure already within the Manure reception building will be fed into the system. Door openings will be kept to a minimum during this time.
Power failure	• In the case of failure, power is provided by the on-site emergency diesel generator. • Feedstock will be diverted to authorised recovery or disposal facility until repaired.
Absence of key staff	• Deputy/ technically competent personnel will be available at all times. • The Operator's primary point of contact will be the Site Manager for the site on all matters associated with site operations and its environmental performance. • Odour awareness and contingency measures included within all staff inductions and re/training, including that for drivers (Training Procedure, **ABL-SOP-04**). • System processes will be automated and monitored remotely by technology provider. • In the short-term, other staff members will be reassigned to critical operations. • In the event of prolonged absence of staff members, temporary staff will be recruited and appropriately trained to fulfil non- critical roles whilst other more experienced staff members are reassigned.

Flood (the site is situated in a location which has a low probability of flooding)	• The site is situated in a location which has a low probability of flooding. In the event of a flood, invoke Flood Response Procedure (**THR-SOP-16**) as appropriate. • If due to a man-made incident, follow Spill Control Procedure (**THR-SOP-08**). Use suction tanker to retrieve liquids from sumps and subsequently load to process as appropriate.
Fire and/or explosion	• Follow Fire & Explosion Response Procedure (**THR-SOP-10**) • Contact the Fire and Rescue services. • If safe to do so, attempts should be made to extinguish the fire using fire response equipment held on-site.
Unavailability of transfer vehicles	• The Site Manager is responsible for overseeing the supplier policy and a contingency plan. • The Operator can work with local farmers to arrange for use of farm trailers or for off-site contingency storage for fibre digestate if required.

Appendix A – Drawings

Figure A1: Site Layout Plan (GGP)

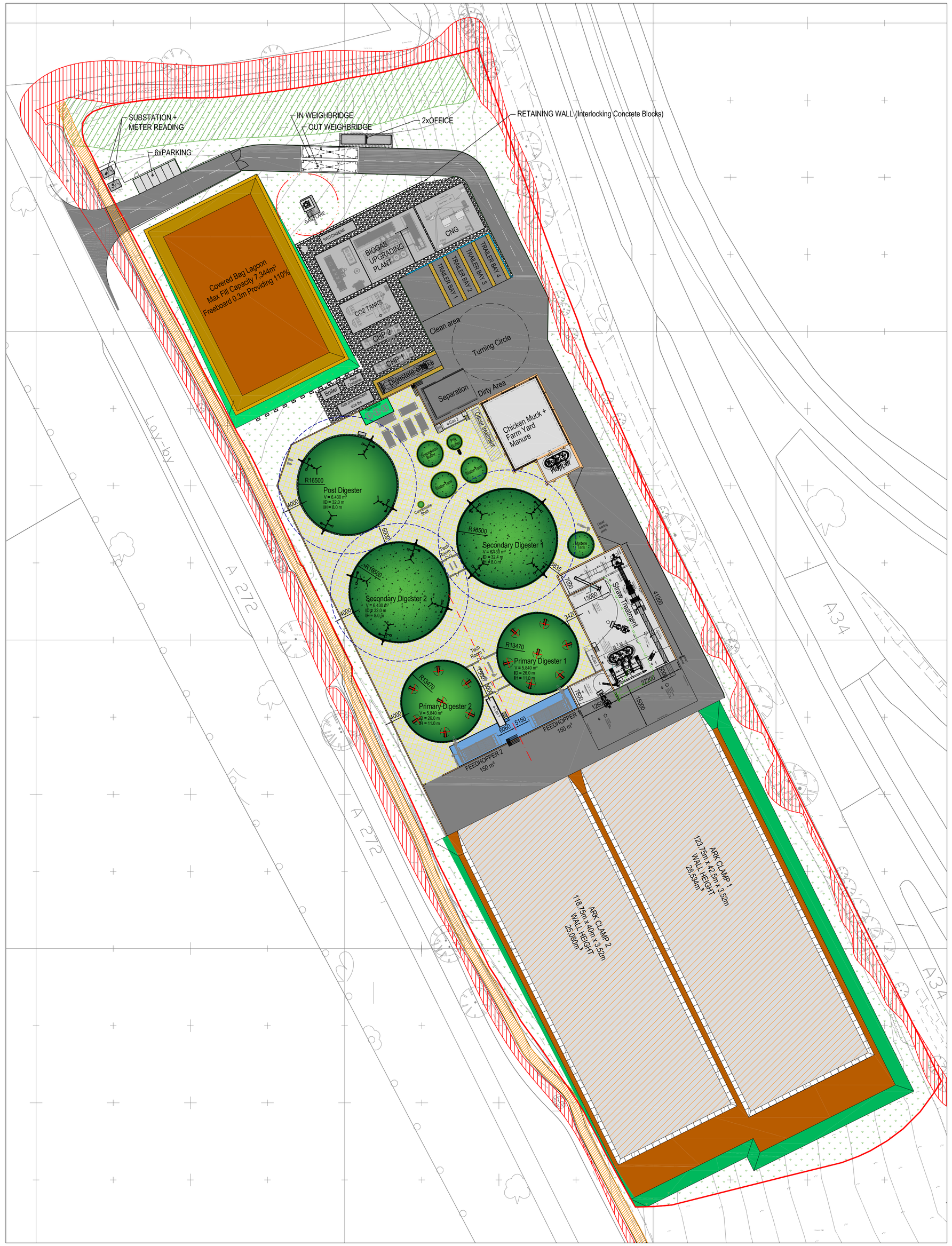
Figure A2: Permit Boundary & Emission Point Plan (GGP)

Figure A3: Drainage Layout Plan (GGP)

Figure A4: Process Flow Diagram (**THR-OD-03**)

Figure A5: Drainage Process Flow Diagram (**THR-OD-04**)

AS NOTED ON A1 FRAME



0 50m 100m 150m 200m 250m
Scale 1:5000 @ A1

SITE LOCATION PLAN
Scale: 1:5000 @ A1

SITE PLAN
Scale: 1:750 @ A1

FOR CONSTRUCTION

NOTES:-

1. All dimensions must be checked on site and not scaled from this drawing.
2. The Contractor shall make a survey of the site and shall be responsible for obtaining all dimensions and levels necessary for the proper fabrication of the structure as indicated.
3. All levels shown on this drawing are relative to Agreed Topographic survey
4. This drawing is to be read in conjunction with 29348/100 Series Drawings.
5. All existing invert levels are to be confirmed by contractor prior to construction. Connection subject to approval.

Site Red Line Boundary (4.453ha)

15m Woodland Easement

Tree Easement

Rev	Date	Description	DR	CH
C6	26/01/24	Tanking Layout amended	MK	JHC
C5	15/01/24	Odour moved	MK	JHC
C4	11/01/24	Switchgear updated to 40ft	MK	JHC
C3	11/01/24	Separation changed	MK	JHC
C2	18/12/23	ISSUED FOR CONSTRUCTION	MK	JHC
C1	08/12/23	ISSUED FOR CONSTRUCTION	MK	JHC

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Client: acorn BIOENERGY

Job Title
AD Plant.
Three Maids

Drawing Title
Site Layout Plan

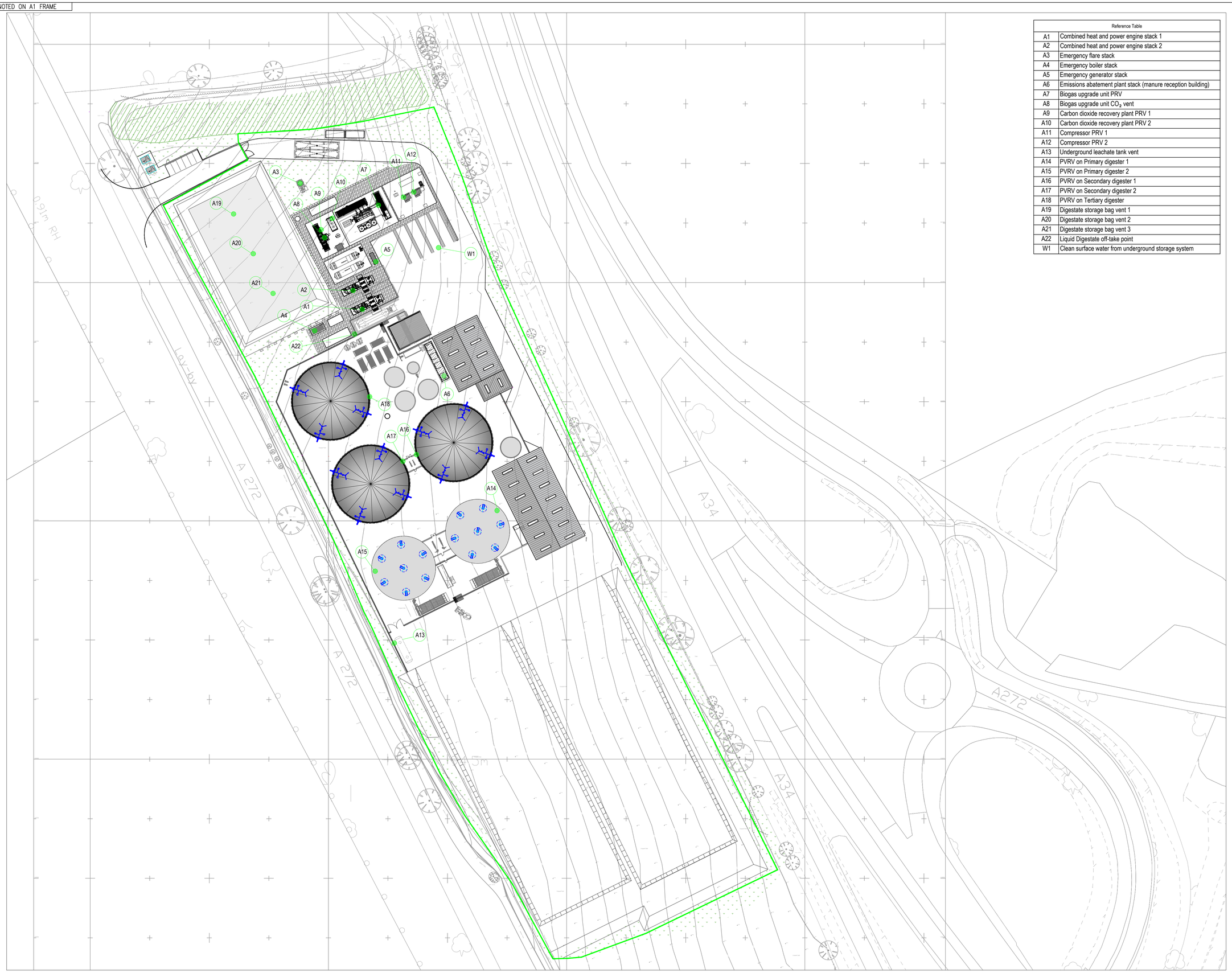
Status: For Construction

Scale: AS NOTED @ A1
Date: DEC' '23

Drawn By: MK
Checked: JHC
Approved: JHC

Drg. No.: 29348/C/101
Rev: C6

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 (manure reception building)
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 Primary digester 2
A16	PVRV on Secondary digester 1
A17	PVRV on Secondary digester 2
A18	PVRV on Tertiary digester
A19	Digestate storage bag vent 1
A20	Digestate storage bag vent 2
A21	Digestate storage bag vent 3
A22	Liquid Digestate off-take point
W1	Clean surface water from underground storage system

SITE PLAN
Scale: 1:750 @ A1

NOT FOR CONSTRUCTION

NOTES:-

1. All dimensions must be checked on site and not scaled from this drawing.
2. The Contractor shall make a survey of the site and shall be responsible for obtaining all dimensions and levels necessary for the proper fabrication of the structure as indicated.
3. All levels shown on this drawing are relative to Agreed Topographic survey
4. This drawing is to be read in conjunction with 29348/100 Series Drawings.
5. All existing invert levels are to be confirmed by contractor prior to construction. Connection subject to approval.

Perimeter Fence
Permitted Area Boundary (4.453ha)
Emission Release Location
15m Woodland Easement

Rev	Date	Description	DR	CH
E	21/02/24	Issued For Information	SJC	JHC
D	14/02/24	Issued For Information	SJC	JHC
C	01/02/24	Issued For Approval	SJC	JHC
B	31/01/24	Issued For Approval	SJC	JHC
A	17/01/24	Issued For Approval	SJC	JHC

UVDB Achieving Excellence Registered
Link-up Qualified via Audit
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Client: acorn

Job Title: AD Plant. Three Maids

Drawing Title: Site Emissions Plan.

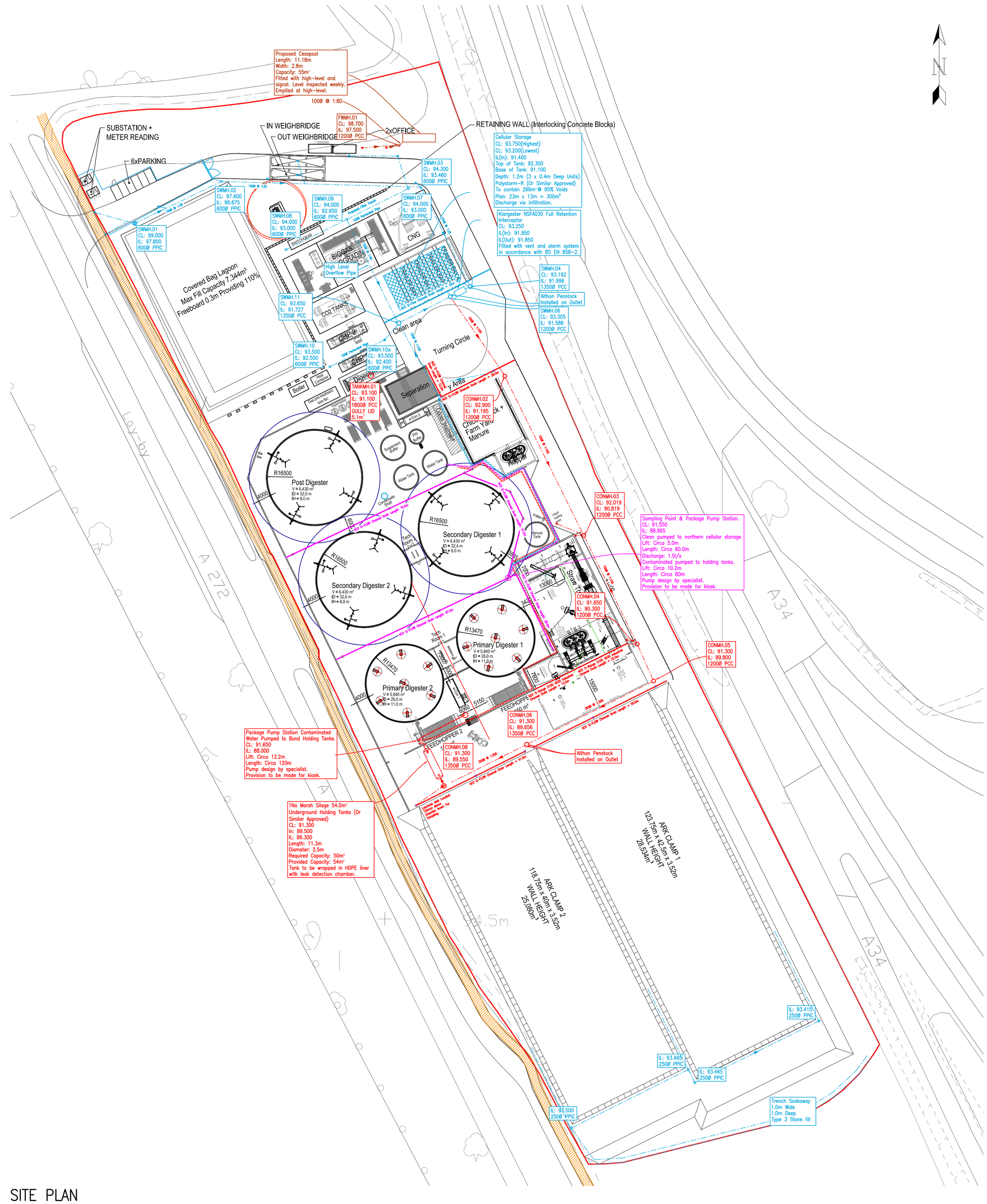
Status: Approval

Scale: As Shown | Date: Jan '24

Drawn By: SJC | Checked: JHC | Approved: JHC

Drg. No.: 29348/202 | Rev: E

DRAWN AT 1:1 ON A1 FRAME



SITE PLAN
Scale: 1:750 @ A1

FOR EA PERMIT

NOTES:-

1. All dimensions must be checked on site and not scaled from this drawing.
2. The Contractor shall make a survey of the site and shall be responsible for obtaining all dimensions and levels necessary for the proper fabrication of the structure as indicated.
3. All levels shown on this drawing are relative to Agreed Topographic survey
4. This drawing is to be read in conjunction with 29348/100 Series Drawings.
5. All existing invert levels are to be confirmed by contractor prior to construction. Connection subject to approval.

- Site Red Line Boundary
- Clean Surface Water Sewer
- Clean Surface Water Chamber
- Clean Surface Water Headwall
- Clean Surface Water Drainage Channel
- Clean Surface Water Rainwater Pipe
- Clean Surface Water Rising Main
- Contaminated Surface Water Sewer
- Contaminated Surface Water Chamber
- Contaminated Surface Water Drainage Channel
- Contaminated Surface Water Rising Main
- Bund Surface Water Sewer
- Bund Surface Water Chamber
- Bund Surface Water Channel Drain
- Foul Water Sewer
- Foul Water Chamber
- Soil Vent Pipe

All pipes to be encased in concrete.

All Clean manholes to be double sealed

Rev	Date	Description	DR	CH
EA1	26/02/24	ISSUED FOR COMMENT	WS	JHC

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Client: acorn

Job Title
AD Plant.
Three Maids

Drawing Title
Proposed Drainage Layout

Status: EA Permit

Scale: 1:750 @ A0
Date: DEC' '23

Drawn By: W.GRANT
Checked: JHC
Approved: JHC

Drg. No. 29348/C/110
Rev EA1

STRAW TREATMENT BUILDING

BALES OF STRAW

INPUT SOLIDS

Belt conveyor | String remover | Bale breaker | Screw conveyor | Straw mill | Humidification screw conveyor 1 | Humidification screw conveyor 2 | Belt conveyor | Storage area for humidified straw | Feedhopper | Metal detection belts | Extruders | Storage area for extruded straw

EXHAUST AIR

EMERGENCY FLARE

CONDENSATE SHAFT

BIOGAS UPGRADING UNIT

BIOMETHANE

BIOGAS CONDITIONING

CHP 1

CHP 2

BY CLIENT

THERMAL POWER

ELECTRICAL POWER

CONDENSATE PIT

S 01

S 02

S 03

FEED HOPPER 1

PRIMARY DIGESTER 1
5,800 m³

SECONDARY DIGESTER 1
6,430 m³

GAS HOLDER

BUFFER TANK WATER 2
400 m³

BUFFER TANK WATER 1
400 m³

SILAGE CLAMPS

FEED HOPPER 2

PRIMARY DIGESTER 2
5,800 m³

SECONDARY DIGESTER 2
6,430 m³

POST DIGESTER
6,430 m³

HOT WATER FLOW

HOT WATER RETURN

HEAT EXCHANGERS

TO WASTE AIR TREATMENT

SANITATION

INPUT LIQUIDS

MANURE TANK
400 m³

PW BUFFER TANK
100 m³

INPUT SOLIDS

CHICKEN MUCK + FARM YARD MANURE

SUSPENSION BUFFER TANK
400 m³

SEPARATOR 1

SEPARATOR 2

SOLID DIGESTATE

LEACHATE TANK

LAGOON

LIQUID DIGESTATE

CONFIDENTIAL

PRELIMINARY

REV.	DATE	REVISION DETAILS	DRAWN	CH'K	APP'D
A	-	-	-	-	-

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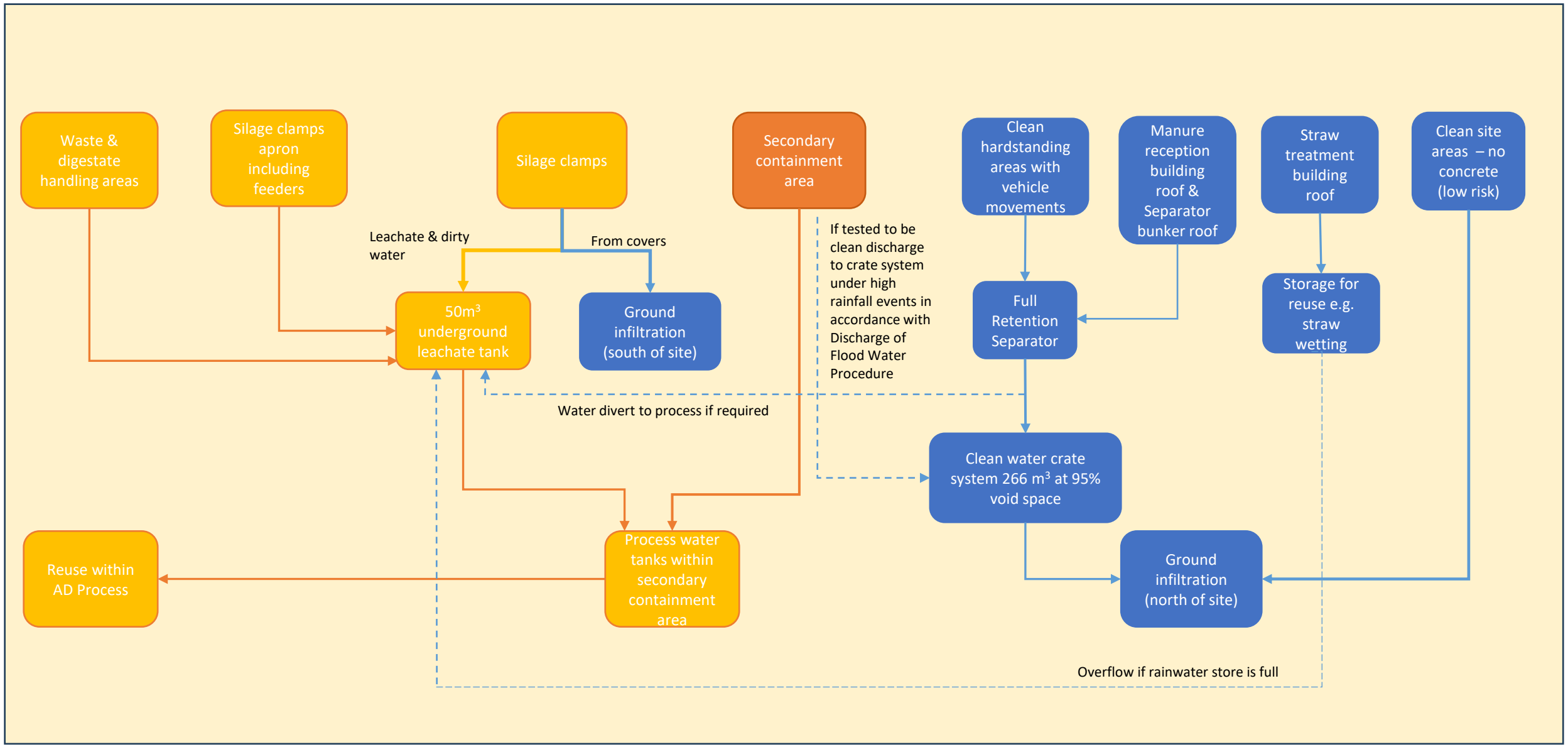
PROJECT	Three Maids
ORDER NO.	A2878UK
TITLE	Process Flow Diagram
DATE	09.01.2024
DRAWN	SKa
CH'K	-
APP'D	-
DRAWING NO.	-
REVISION	-
VERSION	01
SHEET	A1
SCALE	-
PAGE	-
DOCUMENT NO.	-
DWG NO.	A2878UK Three Maids_PFD.dwg

THR-OD-04 Three Maids AD, Drainage Process Flow Diagram V1.0, March 2024



Appendix B – Manure Reception Building Emissions Abatement System

- Technical Description
- Table B1 Example Annual Service and Maintenance Schedule

Quotation no:	Ver3.1119	Valid through:	2024-01-22	Customer:	Acorn Bioenergy
Date	2023-12-22	Our ref:	Emanuel Andersson	Your ref:	Roger Hammett

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.

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E-mail info@centriair.com
Reg. number 556737-9374

Introduction

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

The following design is suggested to be designed for the application. The outlet gas will meet the following criteria:

- Odour concentration less than 1 000 OU/m3 from the chimney.

No	Component
1	Packed Acid Scrubber – treating 18 500 Nm3/h.
1	UV reactor of model Frej with 10 lamp frames – treating 18 500 Nm3/h.
1	Carbon filter 2x6 - treating 18 500 Nm3/h.
1	Main fan - treating 18 500 Nm3/h.
1	Standalone Chimney 16.5 meters high – treating 18 500 Nm3/h.
1	Ducting supply and installation.
1	Piping between equipment
1	Drainpipes with water trap
1	Instrumentation for control and monitoring

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Planned feedstock

Chicken manure and farm yard manure (poultry litter) from the table below:

Feedstock (Inputs)	Category	Mass Required (T/yr)	Dry Matter (%)	Volatile Solids (%)
Wholecrop	Energy Crop/Product	17,500	35.00%	95.00%
Maize Silage	Energy Crop/Product	26,000	32.00%	97.00%
Straw	Residue/Waste	20,000	86.88%	91.56%
Farm Yard Manure	Residue/Waste	9,000	25.00%	80.00%
Dairy Slurry (south lynch spec.)	Residue/Waste	6,000	11.00%	90.00%
Pig Slurry	Residue/Waste	4,500	6.00%	80.00%
Botanical waste	Residue/Waste	-	78.72%	95.34%
Poultry Litter (three maids av spec.)	Residue/Waste	11,000	68.00%	72.00%
Water	Dilution	42,000	0.00%	0.00%
		94,000	45.19%	

Process description

The expected performance from the ColdOx system is illustrated below.

Inlet air streams		
source no. 1	air from chicken shed	
air flow	18,500	m^3/h
temperature min.	10	°C
temperature max.	35	°C
humidity	80-90	%rH
O2 content	21	Vol%
dust content	TBD	mg/m^3
pressure at connection point	500	Pa

Inlet air pollutants		
source no. 1	air from chicken shed	
odour	< 20,000	OU/m^3
NH3	<100	ppm
H2S	2	ppm
VOC	not defined	ppm
other	not defined	

Target values for exhaust air		
odour	<1000	OU/m^3
NH3	<5	ppm
H2S	0	ppm

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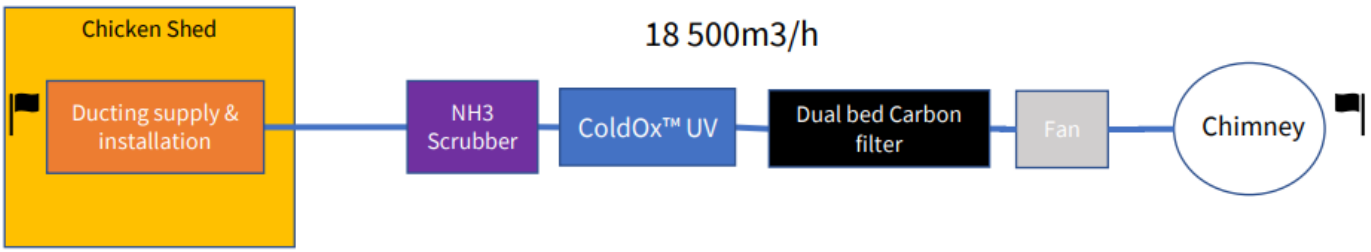
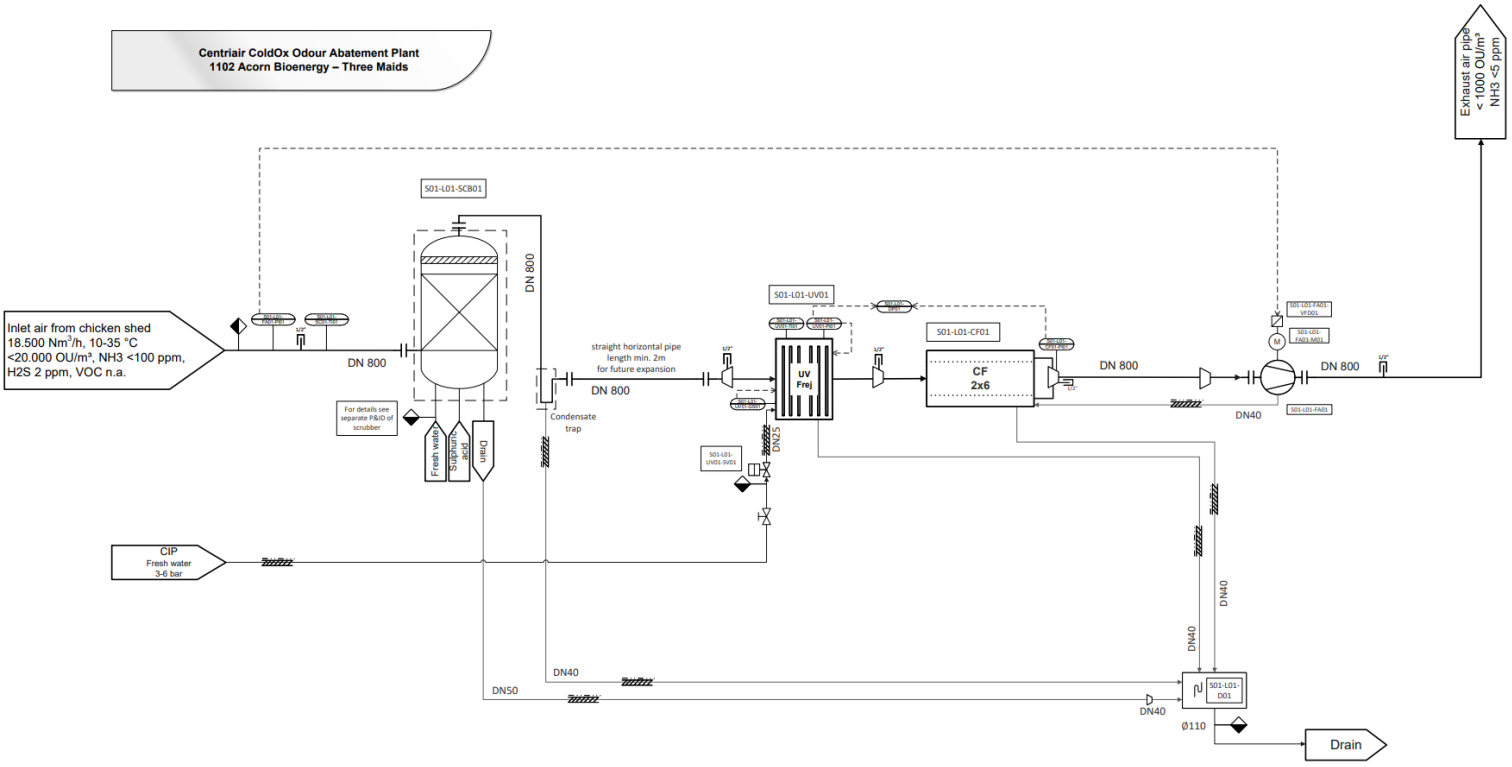
Odour mapping & Conceptual design



P&ID Odour treatment system



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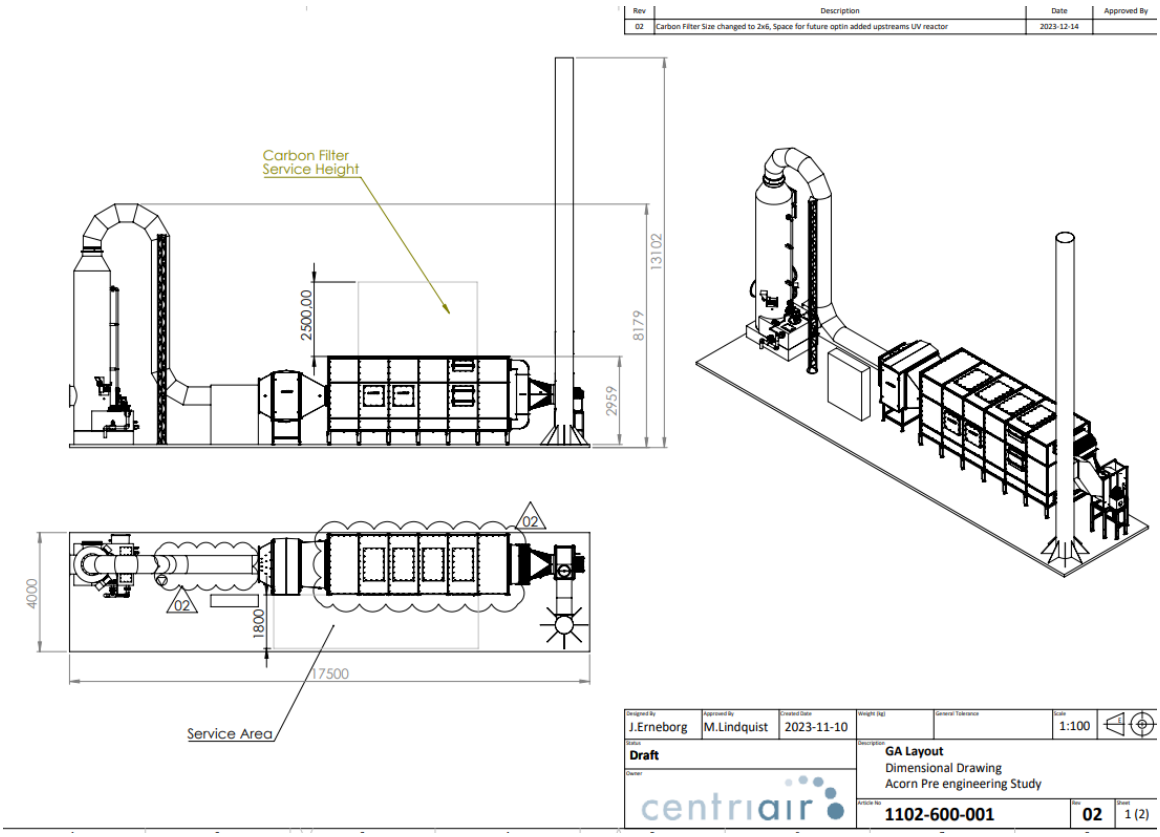
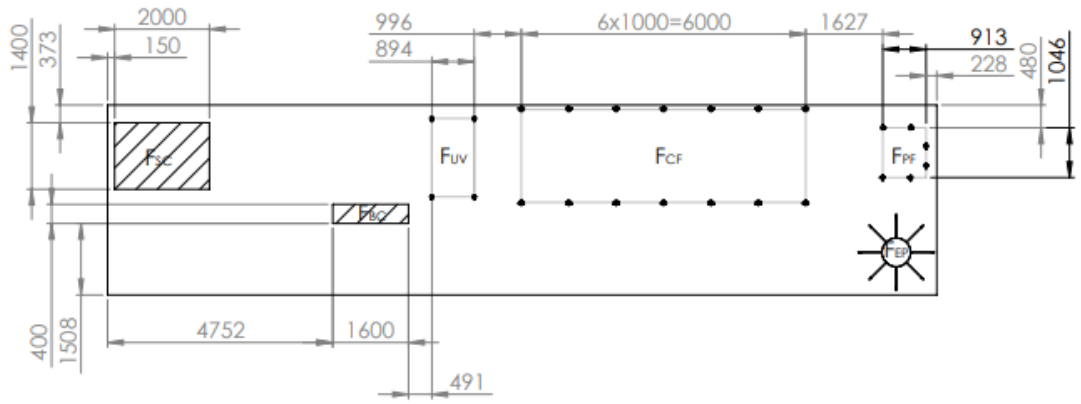
Reg. number 556737-9374

Overall footprint

Below is the preliminary footprint of the odour treatment system.





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Equipment Loads

Equipment Loads		
Equipment	**Tag**	**App. Weight [kg]**
Scrubber	F_{SC}	2500
UV Reactor	F_{UV}	450
Carbon Filter	F_{CF}	9600
Process Fan	F_{PF}	300
Exhaust Pipe	F_{EP}	750
Ballast Cabinet	F_{BC}	300

Overall consumptions

The information about the consumption is conservative.

Total power consumption

Fans come with VFD system to regulate the airflow changes. Thus, the fan can be set to run at a lower frequency, (e.g., 50 %) during less active periods to save power.

Main fan ColdOx :	15.0 kW
UV reactors system:	13,5 kW
Packed Cross-flow scrubber	approx. 5 kW
Summary	**33,5 kW**

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Water consumption UV reactor

The CIP from the UV reactors: 22 l/day

Consumables ColdOx system

Maintenance work	Quantity	Type	Interval (months)	TOTAL GBP	Total per year GBP
Carbon Filter					
Change of carbon	3 500	[kg]	~ 18-24	10 900	5 450
UV lamps					
Replacement of lamps	90	[pcs]	~ 24	4 920	2 460

Water consumption Packed Crossflow Scrubber

The water consumption assuming 18 500 m3/h @ 100 ppm NH3 24 hours each day drift hours. 25% blowdown concentration.

NH3 Scrubber: 20 L/hour + Evap. losses

Consumables Packed Crossflow Scrubber

The total cost of consumables is included in the appendix with the estimated lifetime and cost for the carbon media.

Type	kg/Day	GBP/kg		
75% Acid				
	125	0,19		

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Detailed system specification

UV Specification:

Description :	The UV reactors is in the first treatment stage, built together with the active carbon filter. Lamp life is approximately 16 000 hours. Basic control setup is start/stop signal from your system and running and error signal back to your system. Control and safety solution includes pressure guard for the UV as well as door switches. Equipment prewired with “plug and play” to minimize site wiring. Automatic flushing system of lamps, CIP (Clean in Place). Safety switches with alarm system in case of lamp failure. Controls and signaling see Appendix D.
Note:	The ballast panel should be positioned within 20 meter cable length from the UV reactor.
Electrical connection:	380-400 V/50 A three phase + Neutral 50 Hz
Weight:	Total weight of one reactor including support and lamp frames is 580 kg.
Process gas flow:	18 500 m^3/h
Maximal operating temp:	45 °C.
Control system:	PLC Siemens S7 1200

Active Carbon Specification:

Description:	Active Carbon filter with medium residence time due to the initial treatment and combination effects from oxidation + carbon. Dual carbon beds to minimize pressure drop.
Material:	Stainless steel AISI 304
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.
Other:	Centriair has the right to decide which type of activated carbon that operates.

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Main Fan Specification:

Description:	Industrial centrifugal fan (1) from stainless steel driven by frequency inverter. Fans come with VFD system to regulate the airflow changes. The exact pressure drops in the ducts to our system must be specified before ordering the final fan. This will have to be done already at the detailed design stage. Please revert if additional pressure capacity is needed. For more detailed specification see appendix.
Capacity:	18 500 m^3/h
Electrical connection:	380-400 V
Installed Power:	18,5 kW

Packed Acid Scrubber:

Description:	Scrubber stage for an efficient NH3 removal consisting of a reaction vessel with packing and distributor. Exit from the packed column includes a demister. Water conditioned with sulphuric acid is used in the system. The water reacts with the NH3 to form ammonium sulphate. The process water is drained when concentration reaches for instance 25% and the chemical should be possible to reuse in the customer's process.
Material:	FRP
Capacity:	18 500 m^3/h
Pressure drop:	App. 500 Pa

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Chimney:

Description:	Steel Chimney System
	Single flue Stack Height: 12m manufactured in 2No flanged sections. Structural Shell Diameter: 700mm. Flanged Inlet Dimensions: 550mm wide x 700 deep complete with necessary compensation bars. Inspection Hatch 400mm x 300mm at base level complete with necessary compensation bars. Sample Ports: 2No 125mm dia flanged sample ports. 1No internal drain plate 1No 50N/B drain connection. 2NO Earthing Bosses welded to base plate 1 set of steeplejack access points @ 1.5m centres. 1no drilled base plate complete with gussets to suit foundation bolts. 2No lifting points at the top of each chimney section.
Material.	According to EN10025 grade 304 stainless steel as a minimum

Ducting supply and installation:

Description:	See appendix for detailed information

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Appendix E Fan specification

Project:	1102 Acorn Bioenergy
Fan ID:	**Main Fan S01-L01-FA01**

Description of function and process

A frequency controlled fan used to keep a constant pressure upstream in the system. Fan will be used in an odour treatment process. Low concentrations of residual ozone may be present in the exhaust air. Fan is operated without stopping all year.

Design data, gas

Type of gas	Ventilation air
Dust content inlet	Low (normal outdoor air)
ATEX	No Ex-Zone

Mode of operation	**Normal**
Gas flow inlet, Nm3/h	18.500 Nm³/h
Gas density inlet, kg/m3	1,1
Gas temperature inlet, °C	10 to +35 °C
Static Pressure increase over fan, Pa	2.100 Pa

Design data, surroundings

Environment	Outdoor
Temperature	-20 to +40 °C
Corrosion protection (for painted surfaces)	C3-M (ISO 12944)

Fan Specification and scope

Maximum fan speed, rpm and Hz	*Specified by supplier*
Materials, in gas contact	AISI 304 (1.4301)
Materials, not in gas contact	AISI 304 (1.4301)
Drainage	2"
Inspection hatch	Placed in outer radius of housing
Outlet direction	ISO LG-315
Drive type	Direct driven
Fan wheel type	*Specified by supplier*
Sound level limits, surroundings	<65 dB(A), at 1m distance from fan (while inlet/outlet pipes are connected)

Motor Specification and scope

Motor voltage, V	400
Net frequency, Hz	50
No of Poles, motor	*Specified by supplier*
Motor efficiency class	IE3 or higher
Insulation class	F
Protection class	IP55
Frequency converter driven	Yes

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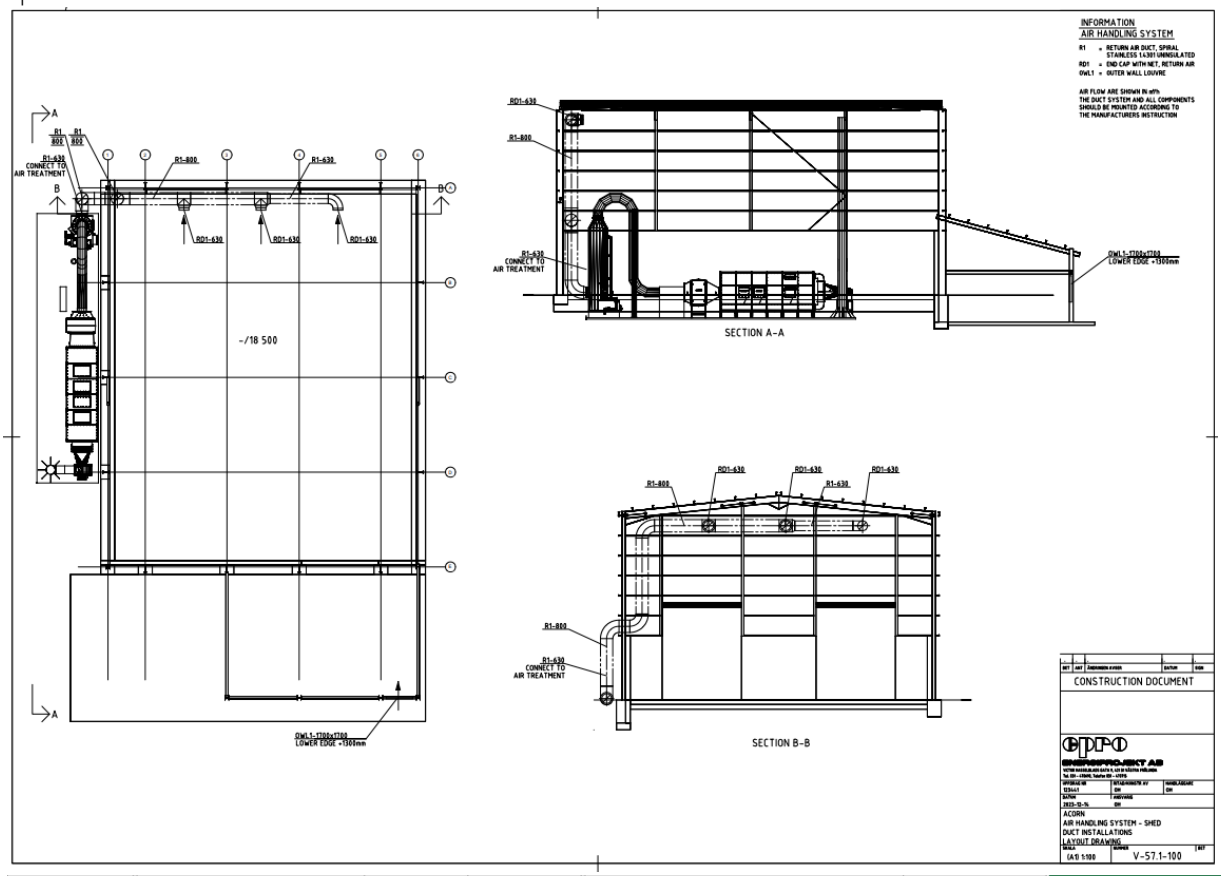
Appendix F Ducting supply and installation

Specification ductwork from shed.



COMPONENT NR.	COMPONENT DESCRIPTION	QUANTITY NO.	CONNECTION SIZE	REMARK 1	REMARK 2	MATERIAL
AIR DUCT SYSTEM						
RETURN AIR			**Ø (mm)**			
RD1-630	END CAP WITH NET	3	630	BIRD SCREEN		STAINLESS STEEL(1.4301)
FRESH AIR			**BxH(mm)**			
OWL1-1700x1700	FRESH AIR LOUVRE	1	1700 x 1700			STAINLESS STEEL(1.4301)
AIR DUCT SYSTEM						
R1-800	Straight duct	20 meters	800	DUCT SIZING ACCORDNING TO DRAWING	SPIRAL TUBE	STAINLESS STEEL(1.4301)
R1-800	Elbow 90 deg	4 pieces	800	DUCT SIZING ACCORDNING TO DRAWING	SPIRAL TUBE	STAINLESS STEEL(1.4301)
R1-800	T-piece	2 pieces	800	DUCT SIZING ACCORDNING TO DRAWING	SPIRAL TUBE	STAINLESS STEEL(1.4301)
R1-800	Reduction 800-630	4 pieces	800/630	DUCT SIZING ACCORDNING TO DRAWING	SPIRAL TUBE	STAINLESS STEEL(1.4301)
R1-630	Straight duct	6 meters	630	DUCT SIZING ACCORDNING TO DRAWING	SPIRAL TUBE	STAINLESS STEEL(1.4301)
R1-630	Elbow 90 deg	1 pieces	630	DUCT SIZING ACCORDNING TO DRAWING	SPIRAL TUBE	STAINLESS STEEL(1.4301)

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Table B.1 Example of an Annual Service and Maintenance Schedule

Item	Unit	Description	Frequency
1.1	**UV Reactor**		
	Inspection	Lamps and ballasts (replaced if needed)	6 months
		Gaskets, CIP nozzles and drainage	6 months
		Function check of pressure sensor and door switches	6 months
	Activities	Replacement of gaskets	6 months
		Replacement of lamps	2 years
		Replacement of ballasts	5 years
		Replacement of CIP nozzles	5 years
1.2	**Carbon Filter**		
	Inspection:	Gaskets around the hatches	6 months
		Hatches	6 months
		Drainage	6 months
	Activities	Replacement of gaskets	6 months
1.3	**Fans**		
	Inspection:	Gaskets	6 months
		Impeller	6 months
		Drainage	6 months
		Vibration	6 months
	Activities	Replacement of gaskets	2 years
		Replacement of vibration-damping connectors	3 years
		Inlet/Outlet connections	2 years
1.4	**Media-Activated Carbon/Iron- Oxide**		
	Inspection	Visually verify status of media	6 months
	Activities	Replacement of activated carbon/iron oxide media – cost of media not included	1-2 years

Appendix C – Odour Monitoring Procedure (THR-SOP-02)

THR-SOP-02
Odour Monitoring Procedure

Issue 1 – March 2024

Version Control

Issue	Date	Revision Details / Summary of Changes	Author	Approved by
1	March 2024	Odour Monitoring Procedure	Earthcare Technical Ltd	

Document owner

[Department i.e., Engineering & Delivery]

Management approval

[i.e., Director of Engineering and Delivery]

ROUTINE ODOUR MONITORING (DAILY)

1. The Odour Assessor

You must only undertake routine odour monitoring if you are not desensitised to odour i.e., you have not been subject to significant odour in the 30-minutes prior to the assessment or have not consumed strongly flavoured food or drink within this time.

2. Recording

The reporting forms used will depend on the level of odour investigation required. Observations should be recorded on:

Odour Monitoring Form (THR-FT-01)

- Record weather conditions and time
- Record details of the routine (daily) odour survey at the 'fixed' monitoring locations (nos. 1 – 6) using the Odour Monitoring Form

Site Diary

- The Site Diary is filled in every day
- On completion of the odour survey at the 'fixed' monitoring locations enter either 'OK' or 'not OK' if odour issues are noted e.g., odours of moderate intensity (i.e., a score of 3 and above) are detected at receptor locations

3. Weather

Site operatives are responsible for recording the weather conditions before/ during the survey using an online resource that can be cross-checked against field observations during the survey. Observations should include wind direction, wind speed, and air temperature.

4. Odour 'sniff tests'

Routine (daily) monitoring should be undertaken at the 'fixed' locations shown in Figure 5.1 in the **Odour Management Plan**. Additional monitoring (i.e., at other locations or at another time during the working shift) may need to be undertaken:

- At the relevant downwind site boundary
- If a distinct odour (intensity of 3 and above) is detected at the downwind site boundary a sniff test should also be undertaken at the nearest downwind receptor location (if not already covered by the fixed monitoring locations)
- In the event of an odour complaint

- During any on-site operations where there is an increased risk of odour release

If a distinct odour (intensity of 3 or above) is detected at a receptor location the source of the odour should be traced and investigated.

If the source of the odour is found to be due to site activities, measures should be implemented to bring the odour release back under control and/or the activity should be stopped until the issue is resolved and/or prevailing weather conditions are more suitable.

Record data using both the Odour Monitoring Form and the Daily Check sheet.

Table 1 - Routine (Daily) Odour Monitoring Locations – see Figure 5.2 in OMP

Daily ('fixed') Proposed AD Plant boundary locations	
OMP1	NE boundary
OMP2	NW boundary
OMP3	W boundary
OMP4	SW boundary
OMP5	SE boundary
OMP6	E boundary
Daily Flexible locations	
OMP7	Flexible location: a location on the downwind site boundary (if this is not already included as a fixed monitoring location listed above)
OMP8	Flexible location: the nearest downwind receptor if the odour intensity at the site boundary is >3)
Weekly Flexible location	
OMP9	Flexible location - nearest off-site downwind receptor location(s) (even if odours are not detected at site boundary)

4.1 Sniff test method

Start at off-site locations and/or upwind locations. Walk slowly, breathing normally. If an odour cannot be detected in this way, periodically stand still and inhale deeply facing upwind.

Use the guidelines below to compete the odour sniff test and record findings on the **Odour Monitoring Form:**

Odour intensity is scored between 0 - 6 as follows:

0	**No detectable odour**
1	**Very faint odour** e.g. if odour is detected but there is some doubt as to whether an odour is present
2	**Faint odour** e.g. if an odour is detected but cannot be described using precise words or terms
3	**Moderate odour** e.g. odour is detected while walking and the odour character is recognisable
4	**Strong odour** e.g. if the odour character is easily recognisable
5	**Very strong** e.g. very strong but bearable
6	**Extremely strong** e.g. an instinctive reaction is to reduce personal exposure to the odour

Odour duration is scored between 1 – 5 as follows:

1	**No detectable odour**
2	**Transient odour** e.g. whiff (only detectable for brief intermittent spells).
3	**Sporadic discrete odour** <5 to 10 minutes or <50% of total assessment time at that location if less than 30 minutes
4	**Persistent odour** greater than 50% of the assessment time but not continuous, fairly localised
5	**Continuous** present throughout the assessment period

Receptor sensitivity is scored between 1 – 3 as follows

1	**Low** e.g. footpath, road
2	**Medium** e.g. industrial or commercial workplaces
3	**High** e.g. housing, pub/hotel, etc.

Description of odour

Provide a **description** of what the odour smells like. These include, for example:

- Raw biogas (pungent, sulphurous/ eggy, sweet)
- Silage (fruity/ sweet/ floral)

State the **hedonic tone** of the odour.

The hedonic score refers to the type of smell and how pleasant or unpleasant it is irrespective of its strength (intensity) and can help to decide how offensive an odour may be. As shown in Table 2, the hedonic scale ranges from +4 (pleasant) through zero (neutral) to -4 (unpleasant).

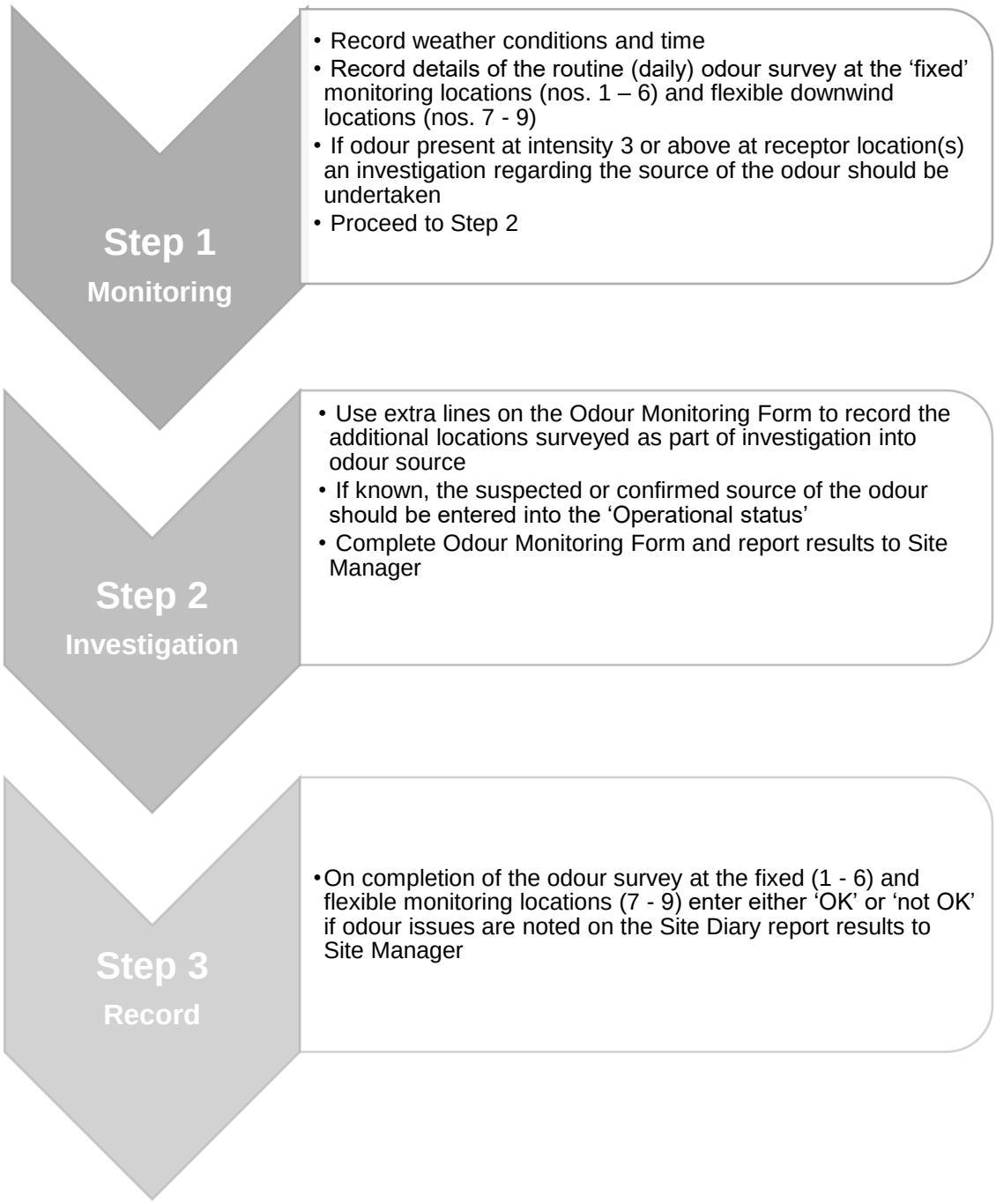
Table 2 – Hedonic Tone

Hedonic Tone	Verbal Description
-4	Extremely unpleasant
-3	Moderate unpleasant
-2	Unpleasant
-1	Slightly unpleasant
0	Neutral
+1	Slightly pleasant
+2	Pleasant
+3	Moderate pleasant
+4	Extremely pleasant

If known, the suspected or confirmed source of the odour should be entered into the **'Operational status'** section.

Abnormal site operating conditions at the time of the survey e.g., maintenance to process equipment should also be recorded.

5. Odour Monitoring - Flow Diagram



Appendix D – Forms

- Odour Complaint Form (**ABL-FT-06**)
- Odour Monitoring Form (**THR-FT-01**)

Three Maids AD Plant - Odour Complaint Form (ABL-FT-06)	
Time and date of complaint:	Name and address of complainant:
Telephone number of complainant:	
Date and time of odour:	
Location of odour, if not at the above address:	
Weather conditions (*i.e.*, dry, rain, fog, snow):	
Temperature (very warm, warm, mild, cold or degrees if known):	
Wind strength (none, light, steady, strong, gusting):	
Wind direction (*e.g.* from the NE):	
Complainant's description of odour: • What does it smell like?	
• Intensity (see below)	
• Duration (time)	
• Constant or intermittent in this period:	
• Does the complainant have any other comments about the odour?	
Are there any complaints relating to the installation, or to that location? (either previously or relating to the same exposure):	
Any other relevant information:	
Do you accept that odour is likely to be from your activities?	
What was happening on site at the time that the odour occurred?	
Operating conditions at the time that the odour occurred	
Actions taken:	
Form completed by:	Date:
Signed:	

Intensity

0	No odour	3	Moderate odour	6	Extremely Strong odour
1	Very faint odour	4	Strong Odour		
2	Faint odour	5	Very strong odour		

Survey Locations	THREE MAIDS AD PLANT	Version: 1
	Odour Monitoring Form (THR-FT-01)	Week Commencing:

Date	Time	Location	Odour Intensity (0 – 6)	Odour Duration (1 – 5)	Sensitivity (1 – 3)	Odour Description	Wind direction	Ave. wind Speed (mph)	Temp. (°C)	Operational Status/ Comments	Assessor
Mon		1									
		2									
		3									
		4									
		5									
		6									
		7									
		8									
		9									
Tue		1									
		2									
		3									
		4									
		5									
		6									
		7									
		8									
		9									

Odour Intensity Scale is from 0 – 6

0. No detectable odour
1. Very faint odour (odour detectable but doubt as to whether present)
2. Faint odour (need to inhale facing into the wind)
3. Moderate odour (easily detected)
4. Strong odour (bearable)
5. Very strong odour
6. Extremely strong odour (e.g., possibly causing nausea)

Odour Duration Scale is from 1 – 5

1. No detectable odour
2. Transient odour e.g., whiff (only detectable for brief intermittent spells).
3. Sporadic discrete odour: <50% of total assessment time at that location
4. Persistent odour greater than 50% of the assessment time but not continuous, fairly localised
5. Continuous, present throughout the assessment period

Sensitivity

1. Low (e.g., footpath, road)
2. Medium (e.g., industrial or commercial workplaces)
3. High (e.g., housing, pub/hotel, etc.)

Monitoring Locations:

1. OMP1 – NE boundary
2. OMP2 – NW boundary
3. OMP3 – W boundary
4. OMP4 – SW boundary
5. OMP5 – SE boundary
6. OMP6 – E boundary
7. OMP7 – A location on the downwind site boundary (if this is not already included as a fixed monitoring location as above)
8. OMP8 – The nearest downwind receptor (if the odour intensity at the site boundary is >3)
9. **OMP9 - Weekly only:** Flexible location - nearest off-site downwind receptor location(s) (even if odours are not detected at site boundary)

Date	Time	Location	Odour Intensity	Odour Duration	Sensitivity	Odour Description	Wind direction	Wind speed	Conditions/ Temp.	Operational Status/ Comments	Assessor
Wed		1									
		2									
		3									
		4									
		5									
		6									
		7									
		8									
		9									
Thurs		1									
		2									
		3									
		4									
		5									
		6									
		7									
		8									
		9									
Fri		1									
		2									
		3									
		4									
		5									
		6									
		7									
		8									
		9									
Sat		1									
		2									
		3									
		4									
		5									
		6									

		7									
		8									
		9									
Sun		**1**									
		2									
		3									
		4									
		5									
		6									
		7									
		8									
		9									

Additional Survey Locations	THREE MAIDS AD PLANT	Version: 1
	Odour Monitoring Form (THR-FT-01)	Week Commencing:

Date	Time	Location	Odour Intensity	Odour Duration	Sensitivity	Odour Description	Wind direction	Wind speed	Conditions/ Temp.	Operational Status/ Comments	Assessor