Lower Reule Bioenergy Ltd
Brookfields Depackaging Facility and Anaerobic Digestion Plant
Brookfields Anaerobic Digestion Plant
Brookfields Farm
Lower Reule
Church Eaton
Stafford
Staffordshire
ST20 0BG

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Contents

1 Introduction

This Odour Management Plan (OMP) applies to all processes and activities undertaken by the Operator Lower Reule Bioenergy Limited (LRBE) with respect to the operation of a Depackaging Facility and Anaerobic Digestion (AD) Plant installation located at Brookfields Farm, Lower Reule, Church Eaton, Stafford, Staffordshire, ST20 0BG, herein termed the 'Site'.

The plant has a treatment capacity of more than 100 tonnes per day. Historically food waste was brought to the site from an off-site facility, in addition to other liquid wastes including Category 2 and 3 Animal by-product wastes from other sources. That off-site facility has now closed, and the new depackaging building was constructed specifically to prepare feedstock materials from a variety of waste streams.

This OMP has been developed to support a permit variation application to:

- add the depackaging facility operation to the existing permitted activities and reflect wider site improvements;
- increase the size of the permitted area;
- approve the use of all three digester tanks at the same time as fermenter tanks;
- add a third combined heat and power (CHP) engine and BAT-compliant flare;
- remove the European Waste Catalogue Code 07 01 08 from permitted wastes.

The additional infrastructure following site upgrading work is:

- pre-pasteurisation storage tank (500m^3);
- post pasteurisation storage tank (1,000m^3);
- new secondary containment or 'technical area' around pasteurisers and pre and post pasteurisation tanks;
- 4 x 40m^3 bulk liquid storage tanks;
- 50m^3 tank for storage of blood;
- depackaging building including two depackaging lines with fast acting roller shutter doors and a biofilter for odour abatement;
- a separate section of the building containing a dryer for packaging waste (utilising waste heat from AD process) with own odour abatement system;
- a water recycling plant to treat water from washing of depackaging;
- external waste storage bunker for palletised packaged food wastes;
- a new pasteuriser system;
- two digestate storage tanks with gas collection (each with working capacity of 2,368m^3);
- updated and improved secondary containment at the AD site;
- internal storage for digestate fibre; and
- third CHP engine (600kW).

The Operator is required by the Environment Agency (EA) to update the OMP to ensure that the management plan accurately reflects the new site layout and the activities undertaken at the site.

1.1 Purpose

This OMP sets out the appropriate measures that LRBE undertake to control odour emissions from the facility to ensure that odour emissions do not extend beyond the permit boundary. The OMP will enable the Operator to assess and where possible prevent emissions of odour from the site that may result in annoyance and/or adverse environmental impacts.

The OMP is written for all operational staff. Staff receive training in the aims and requirements of the OMP. A paper copy of the OMP is held in the Site Office such that all employees have access to the latest version. A copy will also be maintained electronically.

The OMP will ensure that odour emissions are considered throughout all operations, as part of routine inspections, controlled by good operational practices, that all appropriate measures are taken to prevent and/or minimise odour emissions including those from incidents or accidents.

The scope of the OMP includes all on-site works, and consideration of the sensitivity and potential impacts on nearby receptors.

The OMP is to be implemented as part of the site's overall Environmental Management System (EMS). It will be updated accordingly such that it continues to remain relevant to the site activities and in line with current guidance.

This OMP has been produced in accordance with Environment Agency (EA) guidance on OMPs and EPR H4 Odour Management.[1]

The OMP will be reviewed on an annual basis or immediately following any incident, complaints or a change in the operation or infrastructure to ensure that it remains fit for purpose. In the event of a revision to the OMP the EA will be notified, and a copy will be submitted for approval by the EA.

It is the responsibility of the Operator and the Site Management to be fully aware of the contents of the OMP and to provide relevant training to staff.

1.2 Site Location

The site is located approximately 2km from the centre of the village of Gnosall in Staffordshire, at National Grid Reference (NGR) SJ 83650, 19600. The surrounding land uses are agricultural, and field grown horticulture with scattered dwellings. There is one access road into the site, from Gnosall. A Site Location Plan is included in Appendix 1.

1.3 Process Overview

The Process Flow Diagrams (Figure A1.1 and Figure A1.2 in Appendix 1) show the steps of waste pre-treatment and they are summarised in brief in this section. Appendix 1 also details a Site Layout Plan.

1.3.1 Feedstock Reception and Storage

The feedstock will be brought to the site by road in lorries and tankers. All vehicles entering site are inspected and weighed at the weighbridge as part of adherence to specified Waste Acceptance Criteria (WAC). Waste streams will be accepted into the enclosed depackaging building except for sealed IBCs (intermediate bulk containers) and palletised packaged food wastes which may be temporarily stored in

[1] Environment Agency (2011) H4 Odour Management – How to Comply with your Permit. Horizontal Guidance Note IPPC H4.

the external bunker prior to processing within the depackaging building. The material will be sealed within packaging and therefore there will be no emissions to air from the temporary storage of palletised waste.

1.3.1.1 Solid Waste / Liquids in Small Containers

The building comprises three main areas: the main hall containing the depackaging equipment (two depackaging lines); offices; and a separate area which contains a dryer for the packaging waste produced from the process.

The main hall within the depackaging building will have seven bays. Each bay has a maximum storage capacity of 100 tonnes. Packed or non-packaged food waste is prepared for anaerobic digestion feedstock material into a separated liquid food soup, by being macerated, shredded, washed, by either of two depackaging lines. The two depackaging lines which are designed to process solid waste by two different methods. In combination the two lines will process up to 192 t/day or 20-24 t/hr.

Both lines lead to the grit separator where metals, grits and heavy materials will be screened out via a 10mm screen. Grit will be placed into a separate skip within the depackaging building and sent for disposal.

If the residual waste is a single source product such as cans or glass, the conveyor will send the waste material directly to a skip. If it is mixed packaging (usually plastic) then the conveyor will be in its default position to send it to a 40m^3 accumulation bunker. This material builds up over an 8-hour shift but then slowly feeds a continuous belt dryer (within a separate drying room) which will operate 24 hours a day. Packaging material is dried for recovery at a suitable Energy from Waste plant. Air from the dryer will be treated via an acid scrubber odour abatement system. The location of the acid scrubber emission point (EP8) is shown on the Boundary and Emission Point Plan (Appendix 1).

The separated food soup is pumped to the pre-pasteurisation storage tank.

Odour emissions from the depackaging building will be captured and treated in a woodchip biofilter which uses a process of microbial decomposition to break down odorous compounds under aerobic conditions. Details of the biofilter, its operator manual and a diagram of its construction are given in Appendix 2. The open biofilter surface area emission point is represented as EP7 on the Boundary and Emission Point Plan (Appendix 1).

1.3.1.2 Bulk Liquid Waste

Liquids will be delivered into one of the four 40m^3 bulk storage liquid tanks located outside the depackaging building in a bunded area. Liquid deliveries will be directed into the appropriate tank depending upon storage capacity and feedstock properties. Blood will be delivered to and stored in a dedicated 50m^3 storage tank also located outside the building.

All tanks are connected to a 'pipe in pipe' system and therefore there will be no emissions to air from loading into storage tanks from tankers.

1.3.2 Pasteurisation

The prepared feedstocks are held in the 500m^3 pre-pasteurisation tank which acts a buffer storage tank prior to the pasteurisation step. Abattoir blood is pumped directly into the pipe between the pre-pasteurisation tank and the pasteurisers, where it is mixed with the food soup and then pasteurised as

a whole. The pumping arrangement is a closed system and therefore the material will not be exposed to atmosphere during transfer.

The prepared feedstock is then pumped from the pre-pasteurisation tank to twin tube pasteurisers. All substrate is pasteurised at greater than 70 ^{o}C for at least one hour. Pasteurised product will be delivered at approximately 40^{o}C to the 1,000m^3 post pasteurisation tank. The substrate will then be pumped through a mixing pump and macerator (Rotacut) to the primary digesters.

1.3.3 Digesters

Substrate is fed from the mixing pump into the two primary digester tanks (Digesters 1 and 2) operating in parallel so that the fermentation process can commence. Digester 3 will function as a secondary digester.

The digesters all have pressure and vacuum relief valves (PRVs) which will release biogas or take in air in the event of an overpressure or under pressure biogas situation respectively. Digesters 1 and 2 have two PRVs each and Digester 3 has three PRVs. The PRVs are a necessary safety feature for an AD plant; but will only be used as a contingency. During normal operation the PRVs will not operate. The PRVs are checked daily, to ensure they are seated correctly, in accordance with daily checks. The location of the PRVs emission points (EP4, EP5 and EP6) are shown on the Boundary and Emission Point Plan (Appendix 1).

1.3.4 Separator Buffer Tank

Digested material is pumped from the secondary digester into a 500m^3 sealed storage tank or separator buffer tank which equates to approximately 4 days storage.

1.3.5 Digestate Separation and Storage

The whole digestate is pumped up to a separator header tank (10m^3) and from there passes through a carrier drum separator capable of processing up to 10m^3/hr of whole digestate. The digestate separator is situated next to the fibre storage building. The fibre fraction is discharged via an enclosed chute to the enclosed fibre storage building and the digestate liquor fraction is transferred to the sealed digestate storage tank via an enclosed pipe.

1.3.6 Digestate Loading

Digestate liquor will be loaded via sealed piping directly into tankers for transportation. Vacuum pumps will be used rather than positive displacement pumps which will prevent the displacement and release of air and therefore odour as the tanker is filled. Fibre digestate will be loaded from the fibre digestate store onto a tractor and trailer.

The digestate (liquor and fibre) is to be produced to the BSI PAS110 Specification and certified under the Biofertiliser Certification Scheme. The odour potential of the digestate is low as it is deemed stable and meets the PAS110:2014 residual biogas potential limit of 0.45 l biogas/g volatile solids.

1.3.7 Biogas Treatment

1.3.7.1 Desulphurisation

The biogas is stored in the gas storage domes on top of the digesters and the digestate storage tanks. These tanks have desulphurisation nets and low-level oxygen injection to encourage microbial growth to reduce hydrogen sulphide (H_2S) levels and precipitate sulphur.

Once out of storage the biogas passes through a condensate pit to remove the moisture and then through one of two biological scrubbers to remove further H_2S. The biological scrubbers are tall vessels with a large internal surface area into which water mist and heat (from the CHPs) is injected to encourage microbial growth.

The biogas then passes through a chiller to cool the temperature of the gas down again and finally through a carbon filter to remove any excess H_2S.

1.3.7.2 Utilisation

The two CHP engines include an MWM v12 (600kW) and an MWM v16 (800 kW). It is proposed to install a third CHP (600kW). Heat from the CHP engines is used to maintain the temperatures in the digesters, to heat the pasteurisers to the required temperature, to provide heat to the biological scrubbers and to dry the residual packaging waste.

The location of the CHP emission points (EP1, EP2 and EP9) are shown on the Boundary and Emission Point Plan (Appendix 1).

An emergency gas flare (Emission Point EP3 on the Site Boundary and Emission Point Plan, Appendix 1) will be used to combust surplus biogas when required under certain operating conditions (e.g. extended maintenance of the CHP) or malfunctions (e.g. malfunction of the CHP).

1.3.8 Dirty Water System

All areas for the storage, handling and treatment of waste benefit from an impermeable surface and sealed drainage system i.e. all dirty water is routed back through the process.

1.4 Odour Pathways - Dispersion

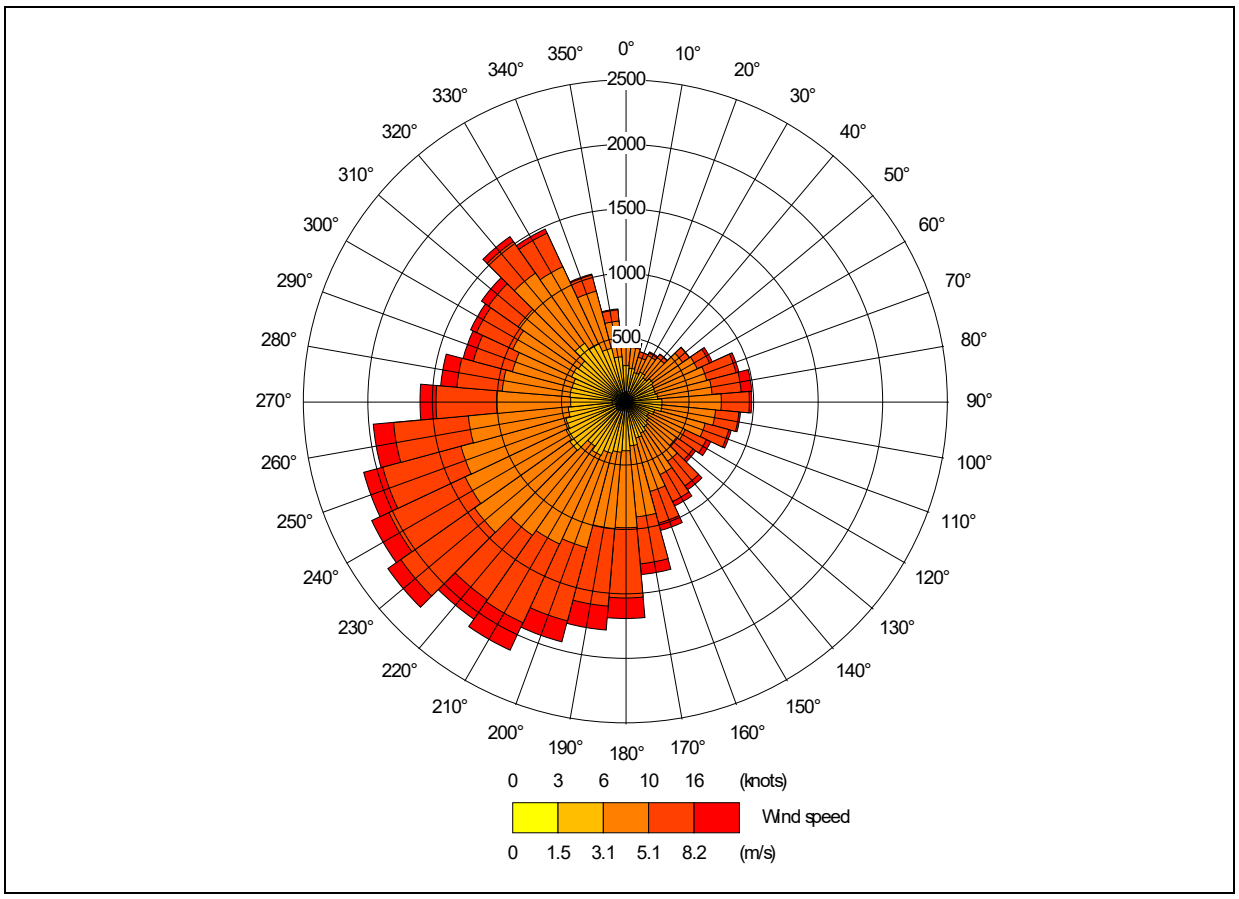
Odour impacts are generally dependant on the prevailing weather conditions. The wind strength and direction help to predict the path of likely aerial dispersion of odours generated on site.

A wind rose of the meteorological data from UK Met Office modelled data (GFS data) for a 5-year period shows the prevailing wind direction is from the southwest (including the south-southwest and west-southwest) (Figure 1.1). There is also a moderately high frequency of winds from the northwest. The prevalence of winds from these directions means that those receptors that lie to the northeast and to a lesser extent, the southeast, of the site will be those most frequently ‘downwind’ of the site and therefore most likely to be impacted by odour emissions from the site.

Site operatives will record daily weather conditions in the **BioDiary (LRBE-MP-03)** using information from online resources as part of the routine monitoring on site.

Meteorological data should be considered during routine odour surveys and prior to and during operations that have the potential to give rise to off-site odour impacts, for example the levelling and out loading of digestate fibre.

Figure 1.1 Windrose from GFS (1 January 2015- 31 December 2019)



1.5 Receptors and Impacts

Table 1.1 details the location of sensitive (human) receptors identified up to 1.5km from the site. They are shown on the Receptor Location Plan, Appendix 1.

The nearest sensitive receptors, Brookfield Farm Cottage and Willowend are located approximately 96m and 161m to the west of the site. Both are residential premises and they are not downwind of the prevailing wind directions. The nearest receptors downwind of the prevailing winds are the residential receptors R3, R4, R5 and R21 which are between 558m and 640m from the site. The nearest dwellings in the main part of the village of Gnosall and in Gnosall Heath are approximately 1,250m away to the north-west; they are not downwind of a prevailing wind direction.

The factors that will determine the degree of odour pollution at sensitive receptor locations are summarised by the FIDOR acronym as follows:

- **Frequency** of detection (frequent odour incidents are more likely to result in complaints).
- **Intensity** as perceived (intense odours are more likely to result in complaints).
- **Duration** of exposure (more complaints are likely with prolonged exposure).
- **Offensiveness** (with increased risk of complaints associated with more offensive odours).
- **Receptor** sensitivity (tolerance to odours will be reduced in areas where high levels of amenity are expected).

Table 1.1 Sensitive Receptors

Receptor ID	Representative receptor	Easting	Northing	Distance from site (m)	Direction from site
R1	Brookfield Farm Cottage	383632	319540	96	West
R2	Willowend	383572	319445	161	Southwest
R3	2 Cottages, Lower Reule Farm	384406	319621	531	East
R4	New Springfield Farm	383621	320238	582	North
R5	Keepers Cottage	384299	319073	609	Southeast
R6	Lower Reule Farm	384508	319599	633	East
R7	Cowley House Farm	382988	319727	703	West
R8	The Grange	382839	319417	883	West
R9	Lower Cowley Farm	382766	319000	1,079	Southwest
R10	Home Farm	383272	318498	1,098	Southwest
R11	Outlook Cottage	383547	320752	1,101	North
R12	51 Fountain Fold	382604	320009	1,139	West Northwest
R13	Moat Farm	383527	320824	1,175	North
R14	Bank Top Cottage	382990	320621	1,188	Northwest
R15	Reule Cottage	384981	320136	1,222	Northeast
R16	Quarry Cottage	382436	319890	1,273	West
R17	Pear Tree Bank Farm	384256	320956	1,392	North Northeast
R18	Upper Reule Farm	384888	320641	1,442	Northeast
R19	Torrewood	382200	319947	1,515	West
R20	Fairview Cottage	385380	319150	1,569	East Southeast
R21	Static caravans, Lower Reule	384350	319738	492	Northeast

1.6 Dispersal Control

The nearest sensitive receptor is located predominantly upwind of the facility, approximately 96m to the west. Should it be identified that additional restrictions need to be implemented based on wind direction and/or strength then an investigation into appropriate controls will be made and documented in this OMP.

2 Feedstock Description

The anaerobic digestion process treats biodegradable materials which have the potential to produce odour. An overview of the AD process is presented in Figures A1.1 and A1.2 in Appendix 1. Appendix 1 also shows the Site Layout Plan.

2.1 Feedstock Quantities

The quantities of feedstocks to be used are listed in Table 2.1. The balance of quantities between feedstock types may be adjusted annually. The new depackaging facility will produce up to 45,000 tpa of prepared feedstock with 35,000 tpa going to the adjacent AD plant and 10,000 tpa to be exported elsewhere for treatment in other AD plants.

Table 2.1 Approximate Annual Tonnages of Feedstock Materials

Feedstock	Tonnes (t)
Manure, cattle and possibly horse	150
Grain	1,000
Pet food	1,500
Kitchen household	7,800
Canteen	3,000
Alcohol	6,500
Vegetables	5,200
Coffee	3,900
Bakery	2,600
Cat 3 Blood	2,600
Sludge	3,900
Dairy waste	1,000
Packaged supermarket	3,900
Dirty water from AD Plant secondary containment area	1,000
Total (annual)	**44,050**

2.2 Feedstock Inventory

Table 2.2 provides an assessment of each potentially odorous material, identifying the feedstock source, form, waste classification, storage (location and maximum tonnages), typical and abnormal compositions of those materials and providing an overall odour potential of that material based on the likelihood of abnormal compositions being encountered at site.

Table 2. 2 Feedstock Inventory - Assessment of Odour Potential

Type	Source	Form	Waste classification European Waste Catalogue code[2]	Storage location	Maximum storage / tonnage volume at any one time	Typical composition	Abnormal composition	Likelihood of abnormal composition	Odour potential of material (without controls)
Manure (cattle, possibly horse)	Local farms	Solid	02 01 06	Brought into site on as required basis	10 tonnes	Manure, cattle and possibly horse	Variance of type of manure, feed nutrient density, bedding material and amount, time in use.	Supply subject to contract from a limited number of local suppliers therefore should be consistent. Manure shall be transported to site as required via trailer and is used daily.	Medium
Grain	Local farms	Solid	Not applicable	Bay in depackaging hall	100 tonnes	Grain	If not stored correctly may degrade.	Minimal. Composition checked to ensure sufficient quality for use.	Negligible – Very Low
Pet food	The Real Pet Food Company	Liquid	02 02 03	Liquid bulk tank	40m^3	Pet food	Variance in mixture/ composition within the limits of the process.	Minimal. Supply subject to contract from one supplier.	High

[2] See Appendix 5 for the European Waste Catalogue code

Type	Source	Form	Waste classification European Waste Catalogue code[2]	Storage location	Maximum storage / tonnage volume at any one time	Typical composition	Abnormal composition	Likelihood of abnormal composition	Odour potential of material (without controls)
Kitchen Household	Various	Solid	20 01 08	Bay in depackaging hall	100 tonnes	Kitchen Household	Inherent variability (fresher food wastes to older material)	May be more degraded with older material and/or warmer ambient temperatures. Wastes checked for compliance with acceptance criteria.	High
Canteen	Various	Solid	20 01 08	Bay in depackaging hall	100 tonnes	Canteen	Inherent variability (fresher food wastes to older material)	May be more degraded with older material and/or warmer ambient temperatures. Wastes checked for compliance with acceptance criteria.	High
Alcohol	Various	Liquid	02 07 04	Liquid bulk tank	40m^3	Alcohol	Composition consistent	Unlikely	Medium
Vegetables	Various	Solid	02 03 04	Bay in depackaging hall	100 tonnes	Vegetables	May degrade if not stored correctly and securely.	Minimal as product will be received ‘fresh’ from source and in undegraded form.	Negligible / Very Low

Type	Source	Form	Waste classification European Waste Catalogue code[2]	Storage location	Maximum storage / tonnage volume at any one time	Typical composition	Abnormal composition	Likelihood of abnormal composition	Odour potential of material (without controls)
Coffee	Various	Solid	02 03 04	Bay in depackaging hall	50 tonnes	Coffee	If not stored correctly may degrade.	Minimal as product will be received in undegraded form.	Low and not unpleasant
Bakery (chocolate/ dough/ bread)	Various	Solid	02 06 01	Bay in depackaging hall	100 tonnes	Bakery	If not stored correctly may degrade.	Minimal as product will be received in undegraded form.	Low and not unpleasant
Cat 3 Blood	Various	Liquid	02 02 02	Dedicated liquid bulk tank	$50m^3$	Cat 3 Blood	If not stored correctly may degrade.	Minimal as product will be received in undegraded form.	High
Sludge	On-site food waste processing effluent	Liquid	02 02 04	Liquid bulk tank	$40m^3$	Sludge	Inherent variability	Minimised by on-site waste acceptance checks and processing controls	High
Dairy waste	Various	Liquid	02 05 01	Liquid bulk tank	$40m^3$	Dairy waste	If not stored correctly may degrade.	Approved suppliers. Stored and transported as liquid in enclosed tanks.	High

Type	Source	Form	Waste classification European Waste Catalogue code[2]	Storage location	Maximum storage / tonnage volume at any one time	Typical composition	Abnormal composition	Likelihood of abnormal composition	Odour potential of material (without controls)
Packaged supermarket food	Various	Solid	02 02 03/ 02 03 04	Bay in depackaging hall	100 tonnes	Packaged supermarket processed and unprocessed food	If not stored correctly may degrade.	Minimal as product will be received in undegraded form.	Low
Dirty water from AD Plant secondary containment area	On-site drainage of dirty areas	Liquid		Liquid bulk tank	$40m^3$	Composition will vary with rainfall.	May become stronger during periods of low rainfall or if collection areas become soiled.	Product is consistent and can be diluted with clean roof water.	Negligible - Very Low. Dependent on degree of rainwater dilution and degree of soiling of yard

3 Normal Operating Conditions

3.1 Odour Sources

The primary source of odour generation is from the storage and handling of waste. These odours will be contained within the depackaging building that benefits from negative air extraction and odour management system. Air from the building will be treated through a woodchip biofilter that will remove odorous compounds before the air is discharged to atmosphere.

The depackaging building is the dedicated reception area for all solid waste except for sealed IBCs (intermediate bulk containers) and palletised packaged food waste which may be temporarily stored in the external bunker prior to processing within the depackaging building. Liquid waste is also delivered into sealed storage tanks.

The odour sources from the on-site processes that have the potential to cause an off-site odour impact during **normal** operating conditions include:

1. Feedstock materials – abnormally odorous wastes with high odour concentrations within the building that may increase the odour loading to the biofilter.
2. Opening of access doors to the depackaging building.
3. Opening of access doors to the drying room.
4. Inefficient operation of the air extraction system and/or biofilter.
5. Inefficient operation of the drying room odour abatement.
6. Opening of access doors to the fibre storage building and out loading of fibre digestate.

Table 3.1 provides an inventory of potential odour sources and controls under normal operating conditions.

3.2 Odour Controls

LRBE has put in place a series of measures that have been designed to ensure that odours created during the processing of food waste are:

- prevented from occurring, where possible;
- are contained within premises;
- are treated at source when produced;
- are not emitted by vehicles transiting to or from site;
- do not transgress the site boundaries.

The controls are described in further detail in Sections 3.3 to 3.7.

Table 3.1 summarises the odour process control measures and contingency measures to be followed if the critical limits are breached or an odour complaint is received.

The general approach to receipt of an odour complaint is that an investigation by LRBE will be undertaken, as described in Section 5.

Table 3.1 Summary of Odour Sources and Control – Normal Operating Conditions

ODOUR SOURCE	NORMAL CONTROL	PROCEDURE(S)	CONTINGENCY MEASURES	MONITORING SCHEDULE/ RECORD SYSTEM
Feedstock materials – abnormally odorous wastes with high odour concentrations within the building	**SECTION 3.5.1 - 3.5.3 – Waste Acceptance and Feedstock Handling** • Adherence to waste acceptance/ rejection procedures. Highly odorous waste may be rejected. Odour awareness and contingency measures included within staff inductions and training. • Control and monitoring of inputs using the Feedstock Management Tool. A first in first out principle will be applied but any particularly odorous waste will be treated as a priority. • All food waste deliveries undertaken inside building, the doors are interlocked such that the entrance and exit doors cannot be opened simultaneously to minimise the escape of odour, is under negative pressure and has odour abatement (biofilter). There are 5 fans to provide 5 acph, but only 3 fans are required to achieve the minimum number of acph for BAT (3 acph). • Diversion of food waste in the event of plant/ door failure to prevent build-up of material. • Ensure once waste vehicles have tipped, they immediately vacate. • Pressure wash backs of tipping vehicles and wheels inside the units before they leave the premises. • Regular maintenance of depackaging plant to prevent build-up of food waste material. • Implementation of strict housekeeping regime inside and outside the units and a daily clean floor policy followed. • Ensure drains are free-flowing and no dirty water is allowed to collect on hardstanding inside units.	**LRBE-SOP-01 Waste Acceptance Rejection Procedure** **LRBE-SOP-04 Feedstock Management Procedure** **LRBE-SOP-21 Company Training Procedure**	On detection of abnormally odorous wastes with high odour concentrations within the building: 1) Prepare and treat immediately and where this is not possible arrange for it to be removed from site and immediately clean the bay following removal. 2) The waste 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. 3) Increase the frequency of cleaning. In the event that odour complaints are attributed to this aspect of site operations, the Operator will, through discussion with the EA, reduce the quantity of material stored within the bays. Contingency measures will be confirmed as effective through additional documented odour surveys at the on-site odour source, at the downwind site boundary and at the affected off-site receptor location(s).	Daily inspections and daily odour monitoring **LRBE-MP-03 BioDiary**

ODOUR SOURCE	NORMAL CONTROL	PROCEDURE(S)	CONTINGENCY MEASURES	MONITORING SCHEDULE/ RECORD SYSTEM
Opening of access doors to the depackaging building	**SECTION 3.3.1.1 – Depackaging building** • Follow strict door opening procedure • Entrance and exit doors cannot be opened simultaneously, thus minimising potential fugitive emission • Building is held at negative pressure by 5 air extraction fans. • Odour awareness and contingency measures included within staff inductions and training.	**LRBE-SOP-01 Waste Acceptance Rejection Procedure** **LRBE-SOP-21 Company Training Procedure**	1) Hang time for doors can be adjusted, default is set to 30 seconds. 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).	Daily inspections and daily odour monitoring **LRBE-MP-03 BioDiary**
Opening of access doors to the drying room	**SECTION 3.3.1.3 – Drying room** • Follow strict door opening procedure. • Access doors opened infrequently (material is transferred within depackaging building). • Room is held at negative pressure. • Odour awareness and contingency measures included within staff inductions and training.	**LRBE-SOP-09 Process Monitoring Procedure** **LRBE-SOP-21 Company Training Procedure**	2) Hang time for doors can be adjusted, default is set to 30 seconds. 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).	Daily inspections and daily odour monitoring **LRBE-MP-03 BioDiary**
Inefficient operation of the air extraction system and/or biofilter	**SECTION 3.4.1.1– Biofilter** • Biofilter depth maintained by raking and addition of media; moisture maintained by damping; temperature maintained (near ambient, 15-35°C or 15-40°C); pH maintained (7 to 8.5) by choice of media; drainage maintained. • Daily, weekly, monthly and 6-monthly inspections should ensure problems do not occur (Appendix 2) • Residence time should be 43 seconds. It can be adjusted by varying the operation of the fans, their number and speed. • There are 5 fans to provide 5 acph (only 3 fans are required to achieve the minimum number of 3 acph for BAT).	**LRBE-SOP-09 Process Monitoring Procedure** **LRBE-SOP-21 Company Training Procedure**	On detection of notable odour above the biofilter surface: 1) Check biofilter inspection record to diagnose the cause. 2) If problem cannot be rectified by site staff call biofilter contractor (Mike Thompson Partnership Ltd). In the event that odour complaints are attributed to this aspect of site operations, the Operator will, through discussion with the biofilter contractor and the EA, prepare a programme of improvements for agreement with the EA.	**LRBE-MP-04 Biofilter Manual and details** Daily inspections and daily odour monitoring **LRBE-MP-03 BioDiary**

ODOUR SOURCE	NORMAL CONTROL	PROCEDURE(S)	CONTINGENCY MEASURES	MONITORING SCHEDULE/ RECORD SYSTEM
	• Odour awareness and contingency measures included within staff inductions and training.		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).	
Inefficient operation of the drying room odour abatement outlet	**SECTION 3.4.1.2– Acid scrubber** • pH of the acid tank is checked and adjusted automatically • the temperature of the dryer room is maintained and monitored	**LRBE-SOP-09 Process Monitoring Procedure** **LRBE-SOP-21 Company Training Procedure**	1) Check temperature into and out of the dryer. 2) Check the pH of the acid tank. 3) Contact BioG for further support. 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).	Daily inspections and daily odour monitoring **LRBE-MP-03 BioDiary**
Opening of access doors to the fibre storage building	**SECTION 3.3.1.3 – Fibre Storage Building** • Doors opened for approximately 1 hour each week to level the digestate fibre deposited from the chute. • Doors opened approximately 4 hours every 3 months for loading onto a trailer. • The intermittent/ short period of opening should limit any odour emissions. • Enough storage capacity such that operations will be timed to avoid periods when the wind direction is towards the nearest receptors (easterly winds). • Fibre digestate to meet PAS110 standard i.e. Residual Biogas Potential below 0.45 l biogas/g volatile solids.	**LRBE-SOP-23 Digestate Handling Procedure** **LRBE-SOP-21 Company Training Procedure**	On detection of odour at the downwind site boundary and corresponding off-site receptor location: 1) Halt the operation, staff exit and shut the door 2) Investigate whether the fibre is particularly odorous 3) Recommence operations when meteorological conditions, in particular wind direction, are less likely to cause on odour nuisance to nearby sensitive receptors. 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).	Daily inspections and daily odour monitoring **LRBE-MP-03 BioDiary**

3.3 Physical Controls

3.3.1 Containment

Odour containment and control is a key feature of the installation layout and operation. The key containment and abatement measures are described in sections 3.3.1.3 to 3.3.1.5.

3.3.1.1 Depackaging Building

Waste streams will be accepted into the enclosed depackaging building which benefits from rapid action roller shutter doors and an air management system. Wastes will be managed on a first in first out basis.

There is no air lock in place for the depackaging building however the doors are interlocked such that it will not be possible to have both the entrance and the exit doors open at one time. The hang time for the fast action roller shutter door of the depackaging building is set to 30 seconds and can be adjusted. These procedures together with building air extraction rates (5 acph) will significantly limit the potential for fugitive emissions during the opening/ closing of the roller shutter doors for vehicular access.

The depackaging building is the dedicated reception area for all solid waste except for sealed IBCs and palletised packaged food waste which may be temporarily stored in the external bunker prior to processing within the depackaging building. Liquid waste will also be delivered into sealed storage tanks.

Waste is only loaded into hoppers within the enclosed building. Wastes are therefore protected from most ambient conditions. If wastes are affected by ambient temperatures i.e. heat, they will be prioritised and managed accordingly or may cease to be accepted if ambient conditions are unfavourable.

The building will be maintained under negative air pressure via an extraction system that exhausts via the woodchip biofilter. The air extraction system operates at a rate of 5 air changes per hour (acph) although only 3 fans are required to achieve the minimum number of acph in accordance with Best Available Techniques (BAT). There is therefore a measure of redundancy in case one of the fans malfunctions or requires maintenance.

3.3.1.2 Drying Room

The washed packaging material will be transferred within the depackaging building and dried within a dedicated enclosed drying room within the building. The room will be fitted with fast action roller shutter doors although the requirement for external access will be infrequent. The operation of the dryer will accommodate a minimum of three air changes per hour within the drying room.

The dryer is a Dorset Drying System 450kWth horizontal belt dryer. The drying process is controlled by temperature sensors in the incoming and outgoing air flows. The process is undertaken in a dedicated room such that residual heat can be contained within the room.

Emissions from the dryer outlet will be directed via a stack to an acid scrubber, situated directly above the dryer on the first floor of the drying room. Further detail on the acid scrubber is provided in section 3.4.1.2.

The dried residual waste will be stored inside a skip in the depackaging building and then taken off site for recovery via incineration (energy from waste).

3.3.1.3 AD Plant

The AD process is anaerobic and by definition has to be maintained without a direct link to air and as such the process is within a fully enclosed system. Capture and recovery of the biogas is central to the plant's efficiency as the gas is extracted from all digestion process tanks to the CHP engine and the gas upgrading plant. Therefore, any biogas generated in the process will be contained within the sealed chambers so that there will be no external emissions.

The material within the system will be gravity fed via pipes and valves from one tank to another. The displacement that this may cause is taken up in the headspaces of the tanks, and the biogas storage vessel which is designed to rise and fall in capacity to absorb displacement within the tanks, and to absorb any variations in the biogas production rate and consumption rate (e.g. to the CHP). Under normal operating conditions, the combustion of odorous biogas in the CHP engines will result in an emission that will be insignificant in terms of an off-site odour impact.

The only possible connection with ambient air will be via a series of hydraulic or mechanical safety valves within the digester tank systems. PRVs will vent biogas to atmosphere or take in air in the event of an overpressure or under pressure. Apart from during service and maintenance checks, the PRVs should not operate as the emergency flare is designed to will operate at a lower set pressure than the pressure relief valves to burn excess biogas. The flare has a greater capacity than maximum biogas production.

3.3.1.4 Fibre Storage Building

Whole digestate enters the sealed carrier drum separator unit and is separated such that the fibre fraction is discharged via an enclosed chute to the enclosed fibre storage building and the digestate liquor fraction is transferred to the digestate storage tank via an enclosed pipe. Whilst the process is not fully enclosed within a building under negative air pressure, ammonia and odour emissions to open air from the activity are significantly mitigated. In addition, the odour potential of the digestate is low as it is deemed stable and meets the PAS110:2014 residual biogas potential limit of 0.45 l biogas/g volatile solids.

Emissions from the storage of digestate fibre are controlled by virtue of the fact that the fibre is stored inside an enclosed building and remains largely undisturbed until removed for onward storage/application to land.

The fibre digestate store has capacity for a years' worth of fibre. It will be entered once a week (maximum) to level out the fibre pile where it is delivered into the building via the chute, and to make checks on the storage facility and to take routine fibre digestate samples. It is anticipated that this activity will take up to one hour.

Prolonged opening of the doors (between 2 to 4 hours) will be infrequent, and approximately every 3 months, to enable effective removal and onward storage/use of the fibre digestate.

Digestate may also be stored at additional satellite storage facilities prior to use.

3.3.1.5 Liquid Storage

Leachate is contained in the sub-surface system, transportation is in the pipeline to the pre-storage tank and digesters, i.e. in an entirely contained system. There should be little or no odour release from the sealed leachate system.

The underground pipes are all pressure tested every 3 years for their structural integrity. All pipework underground on the depackaging site are lined with impermeable membrane and has leak detection monitors continuously monitored by SCADA.

3.4 Abatement

3.4.1.1 Biofilter

Odour emissions from with the depackaging building are treated in an open biofilter which will capture odorous compounds and uses aerobic conditions to encourage microbial decomposition on the surface of woodchip media. The incoming waste storage areas are located directly below the exhaust louvres to the biofilter. Odour generated above these areas will be drawn straight into the biofilter.

The biofilter will comprise approximately 1125m^3 of chipped or shredded clean wood (30 – 50mm). The airflow rate through the biofilter will be 94,162 m^3/hr. The system design should achieve a residence time of 43 seconds to ensure effective odour treatment.

The biofilter will be monitored and maintained in accordance with the Biofilter Manual and Details (**LRBE-MP-04)** to ensure effective odour abatement performance.

The checks will be recorded in the BioDiary **(LRBE-MP-03**). A summary of the inspection regime is provided in Table A2.1 and Table A2.2, Appendix 2 which includes daily, weekly, monthly and 6 monthly checks.

Timescales for the biofilter media renewal will be adjusted in accordance with the biofilter performance. The performance of the media will depend on the media internal environment, weather conditions, odour loading, airflow characteristics and biofilter maintenance. In general terms, the media will be replaced when/ if the extent to which the woodchip media has broken down into smaller particles is such that it creates a system back-pressure that reduces effective aeration of the depackaging building. The media should require a partial change at around 3 years after commissioning and a full change 6 years after commissioning if the media and air flow are maintained well.

3.4.1.2 Acid Scrubber

Odour emissions from the dryer for the packaging material are treated via an acid scrubber. The acid is sulphuric acid and the off gas from the dyer will bubble through the acid which will capture and eliminate ammonia, dust and associated odour.

The operating manual for an acid scrubber of similar specification to that which is proposed is provided within Appendix 3. The scrubber is of a specification sufficient to abate odours from the drying of digestate material; that would give rise to higher concentrations of ammonia and odour than that of the packaging materials for which it is employed to dry here.

The sulphuric acid tank capacity is approximately 5,000 litres and, typically for digestate drying operations, would be sufficient for between 10 – 12 months (six months as a worst case). For the proposed application, it is likely that the acid will need to be renewed annually.

3.5 Management Controls

3.5.1 Waste Acceptance

All feedstock will be delivered to the site in sealed tankers or containers (liquid food waste and animal slurries) except for animal manure, to minimise odour generation. Manure will be brought to site when required and transferred using a front-end loader to the feed hopper within the depackaging building.

LRBE is authorised to receive waste types in the European Waste Catalogue (EWC) categories listed in Appendix 4.

All incoming loads will be weighed and recorded appropriately at the weighbridge office. All solid waste received at the site will be visually inspected during tipping within the depackaging building to confirm that the description and composition conform to the EWC.

Waste is subject to Waste Acceptance Rejection Procedure **(LRBE-SOP-01)** and will only be accepted if:

- It conforms to the type and maximum quantity that is specified in the Environmental Permit.
- It conforms to the description in the documentation supplied by the producer and holder.

All imported feed stock materials will be required to be pre-booked following Waste Pre-acceptance Procedure (**LRBE-SOP-07**). This will enable the site to control the quantities of material scheduled to arrive at the site and ensures that the facility will not exceed storage capacity.

There will be a waste tracking system and inventory aims to track the location and quantity of waste in the plant. The Feedstock Management Tool (FMT) **(LRBE-OD-08**) is designed to control the types and tonnages of feedstock accepted on site.

3.5.2 Feedstock Handling

All feedstock handling and processing is undertaken within the enclosed depackaging building that benefits from fast acting roller shutter doors and negative air extraction system such that odours generated from feedstock handling and processing are contained within the building.

The Feedstock Management Procedure (**LRBE-SOP-04**) details the feedstock handling procedures which are followed by LRBE prior to the use of the feedstocks in the AD process.

The depackaging area will be cleaned down daily in accordance with the Depackaging Hall Cleaning Procedure (**LRBE-SOP-34**). Bales of washed, dried packaging are stored within skips in the depackaging building prior to removal off-site in an enclosed roll-on-roll-off container.

The tanker connection point for the collection of prepared feedstocks and the dispatch of digestate (point 14 on the Site Layout Plan) is in a dedicated concrete area within the building which drains to an underground horizontal pump chamber.

3.5.3 Depackaging Building: Waste Storage

The sizing of the building allows for 13 days of processing volume to be stored. Under normal operating conditions, solid food waste will not be stored for longer than 7 days, but the building has been sized to allow for contingency.

Waste will be managed using a first in first out principle in accordance with the Feedstock Management Procedure (**LRBE-SOP-04**) and the Feedstock Management Tool (**LRBE-OD-08**).

The storage bays within the depackaging building will be numbered 1-7 for traceability through the Feedstock Management Tool (**LRBE-OD-08**).

Liquid waste may be stored for in excess of 7 days within dedicated tanks.

3.5.4 Pasteurised Food Soup Removal

LRBE-SOP-08 Prepared Feedstock Dispatch Procedure details the dispatch of pasteurised food soup from the offtake point via sealed vacuum tankers. Loading is not undertaken unless the tanker pipe and valve are coupled correctly. A dynamic check will be made to ensure odour is not released during loading. Cleaning and maintenance will be performed as required in accordance with observations made during the daily checks.

Sealed vacuum tankers are used to remove material and all gasses are collected held within a pipe in pipe enclosed system.

3.5.5 Biogas Desulphurisation

The biogas is stored within in the gas storage domes on top of the digesters and the digestate storage tanks. These tanks have desulphurisation nets and low-level oxygen injection to encourage microbial growth to reduce hydrogen sulphide (H_2S) levels and precipitate sulphur.

From storage the biogas passes through a condensate pit to remove the moisture and then through one of two biological scrubbers to remove further H_2S. The biological scrubbers are tall vessels with a large internal surface area into which water mist and heat (from the CHPs) is injected to encourage microbial growth. The biogas then passes through a chiller to cool the temperature of the gas down again and finally through a carbon filter to remove any excess H_2S and VOCs.

The biogas treatment is designed to protect the CHP units and minimise the potential risk of odour in the CHP emissions.

3.5.6 Management of Excess Biogas

Pressure in the tanks and gas volume are monitored continuously via the SCADA system. If a failure is detected the biogas will be directed to the flare to prevent a build-up of raw biogas.

During emergency situations, or during scheduled down time, biogas can be directed to the emergency gas flare. The flare ensures that 'raw' (non-combusted) biogas is not released to the atmosphere during emergency situations, giving rise to odour. If the flare fails, the pressure relief valves (PRVs) will vent raw biogas to the atmosphere. These two processes will act as a backup to normal processing and, only should there be a failure of both systems, would odour release to atmosphere occur. Section 5 and Table 4.1 discuss emissions under abnormal conditions.

The flare is to be used as an emergency back-up to the other odour control procedures and will not be used under normal operating conditions or used with any regularity as a form of odour control.

The gas pressure is continuously monitored and parameters (e.g. feed rate and mixing) are changed to regulate gas production and reduce the likelihood of excess biogas and the need to operate the flare.

3.5.7 Digestate Storage and Handling

LRBE-SOP-23 Digestate Handling Procedure details dispatch of digestate liquor from the digestate storage tanks via sealed vacuum tankers and the solid fibre fraction from the separated fibre storage building via trailer.

Each loading area will be monitored both routinely and more often when in use, as part of the daily odour monitoring check. Cleaning and maintenance will be performed as required in accordance with observations made during the daily checks.

Sealed vacuum tankers are used to remove the digestate liquor offsite. The transfer of liquid digestate from the digestate storage offtake point to the tanker(s) will take place via direct connection sealed piping.

Digestate fibre is removed via a tractor and trailer.

3.5.8 Drainage System Control

All waste storage and treatment operations will be undertaken upon concrete surfacing benefitting from a sealed drainage system.

The General Manager or deputy will carry out a weekly inspection of external working surfaces, drainage channels and other on-site drainage systems. A record of the inspection(s)/ defects, damage and repairs will be made in the BioDiary (**LRBE-MP-03)**.

3.5.9 Maintenance of Other Plant and Equipment

Routine maintenance plans and inspection schedules for equipment and any mobile plant that may be in use on-site will be undertaken by the Operator in order to minimise the risk of breakdowns and operational delays which may increase potential for odour emissions.

Plant maintenance records will be kept at the site in the site office and shall be open to inspection.

A list of critical spares required and the procedure for reordering is included as part of the facility's maintenance plans.

3.6 Process Controls

3.6.1 Depackaging Building: Feedstock Monitoring

There will be a waste tracking system and inventory aims to track the location and quantity of waste in the plant. The Feedstock Management Tool (FMT) **(LRBE-OD-08**) is designed to control the types and tonnages of feedstock accepted on site as it is designed to track all waste accepted, rejected, stored, treated and dispatched). The function of the FMT is to ensure that:

- waste will not be booked in unless there is sufficient storage capacity for that waste stream within the depackaging building bays, the liquid waste storage tanks or the external storage bunker as appropriate;

- the correct types of waste are available to produce the optimum pre-treated waste blend (food soup) for the AD plant or to be dispatched for offsite treatment; and
- waste is handled in accordance with a first-in first out procedure to minimise the odour potential of waste stored pre-treatment and during treatment in the depackaging plant.

3.6.2 Biofilter

The biofilter will be monitored and maintained to ensure effective odour abatement in accordance with the Biofilter Manual and Details (**LRBE-MP-04**) which includes daily, weekly, monthly and 6 monthly checks, as summarised in Appendix 2.

The checks will be recorded in the **BioDiary** (**LRBE-MP-03**).

3.6.3 Drying System

The drying process will be controlled by temperature sensors in the incoming and outgoing air flows.

In addition to daily checks, the acid scrubber is monitored and regulated via automated controls that include:

- the periodic spraying of the slats of the chemical washing part;
- maintaining the required level of solution; and
- maintaining optimum pH levels (acidity between pH 0.5 and pH 4).

The system will be automatically adjusted to ensure the effective abatement of emissions from the dryer.

Daily checks and the status of operating parameters will be recorded in the **BioDiary** (**LRBE-MP-03**).

An operating manual for a chemical scrubber system of similar specification to that which will be installed is provided in Appendix 3.

3.6.4 AD Process

The AD process and use of biogas and other outputs will be closely controlled by management systems and technical devices. These systems are continually monitored and checked by computer systems (SCADA) on-site and remotely. The systems have back-up systems that can be used when required.

Process monitoring can be sub-divided into:

- Automated monitoring via (Supervisory control and data acquisition system or 'SCADA')
- Visual checks of the surface and contents of the digesters
- On-site testing
- Off-site testing at an external laboratory

All process data is acquired from the relevant parts of the process continuously by specialised monitoring and measurement devices, including:

- Feedstock quality – physical and chemical (analytical) measurements and electronic measurements for pH, conductivity, chemical constituents, volatile solids.
- Biogas flow and pressures including, biogas holder capacity and system pressure, biogas flow rates.

- Volumetric metering, pipe and process pressures, safety system pressures and status, compressor pressures (mixing systems and CHP systems); and
- Biogas operating pressure, CH_4 content and chemical composition, H_2S, NH_3.

The SCADA system will alert the General Manager and technology provider if any part of the system goes out of the normal working range.

Parameters will be checked each day by the Operator and there will be a routine for daily and weekly visual inspections of the mechanical systems and leak detection checks made to determine any fugitive biogas escape.

Process monitoring is key to ensure a stable anaerobic digestion process, to minimise the risk of abnormal events which may lead to abnormal emissions of odour.

3.6.5 Pasteurisation

All substrate is pasteurised at greater than 70°C for at least one hour. This process is controlled by the SCADA system. The system is enclosed and therefore no odours are released to the atmosphere during this process.

3.6.6 Digesters

The SCADA system ensures that the digesters operate in the mesophilic temperature range at ~40°C (+-1°C) and that the minimum hydraulic retention time of approximately 43 days is observed in all tanks. The entire process is enclosed and therefore no odours are released to the atmosphere during this process.

3.6.7 Biogas Treatment - Desulphurisation and Utilisation

The biogas cleaning process is carried out within an enclosed system. The SCADA system manages the desulphurisation process. The odour abatement performance testing procedure of the carbon filters includes in-line gas analyser measurements for H_2S concentrations. The SCADA system will also regulate gas flow to ensure that the capacity of the filtration system is not exceeded. The carbon filtration system will be subject to planned maintenance. There should therefore be no odorous emissions to air from this process.

3.6.8 CHP Engines

The CHPs are subject to routine (every 1,500 hours) services and maintenance plan that includes leak detection and emissions testing. Specialist contractors will undertake leak detection investigation. There will be continuous process control monitoring / periodic gas quality analyses. Combustion emissions will be released at height that will ensure effective emissions dispersal. Emissions to air from the CHP stacks are monitoring annually, by an external contractor, in line with environmental permit conditions. Emissions from the combustion of biogas should not give rise to an off-site odour impact.

3.7 General Housekeeping

3.7.1 Washing and Cleaning Procedures for Reception

Once materials have entered the AD processing system, there is the potential for the residues of any odorous material on the depackaging building floors, surfaces and equipment to carry on generating odours even after the main mass of material has been taken into the enclosed system.

Where moderate to high odour materials e.g. permitted wastes, have been offloaded and then accepted and the floor surfaces, equipment or hoppers have been fouled, then these will be cleaned quickly and effectively, in order to remove remnants of the material and so minimise the further release of malodour. Where necessary, the cleaning procedures may include the use of a steam pressure washer in order to ensure that thorough cleansing is achieved. The following management of processes and cleaning procedures will be employed to minimise evaporation of odorous chemicals from materials:

- early removal of odorous wastes into the processing system;
- removal of odorous wastes and the residues of that waste, using mechanical cleansing followed by;
- water based wash-down procedures;
- containment and enclosure of the wastes and residues. Skips and other containers will be used for packaging waste and residual waste and stored within the building;
- quarantined waste e.g. contrary material removed from the feedstock will be removed within 5 days.

3.7.2 General Housekeeping Measures

The following measures will be undertaken to reduce the potential for odour:

- Carry out daily inspection, monitoring and maintenance of abatement equipment (chemical scrubber, carbon filters, biofilters) to ensure working effectively and operational.
- Carry out daily inspection of all pipework and process storage tanks to ensure that they are sound.
- Ensuring that all entrance and exits to the building are in full working order and closed.
- Auditing housekeeping and maintenance records.
- All litter/ debris shall be removed from working areas, around the interior perimeter walls/ underneath pipe work, etc.
- Any faults/ damage to be recorded on the relevant maintenance form and the BioDiary **(LRBE-MP-03).**
- Carry out regular housekeeping to ensure any spills cleaned up immediately and wash-down of all hardstanding areas inside and outside of the depackaging building and around the AD site itself.
- Fugitive emissions to air shall be dealt with in accordance with the Fugitive Emissions Plan **– LRBE-SOP-17**. The procedure is in place to ensure that as far as possible, fugitive emissions from the operations at the AD plant do not impact on the local environment or amenity.

4 Abnormal Operating Conditions

4.1.1 Odour Sources

Table 4.1 provides a summary of the foreseeable situations that may compromise the Operator's ability to prevent and/or minimise odorous releases from the process (including emergencies, maintenance, breakdowns, weather anomalies, etc.).

Potential odour sources under abnormal operating conditions, may include:

1. AD plant infrastructure compromised (leading to gas/ liquid release from storage tanks, pipework).
2. CHP failure/ reduction in performance (incomplete combustion, gas over-pressure).
3. Emissions from the operation of the PRVs on the digesters.
4. Depackaging building containment compromised (structural damage, mechanical failure of the doors when open).
5. Ineffective performance of dryer room odour control.
6. Ineffective performance of biofilter (due to abnormal loads of waste received within the building, extended storage times of waste, inadequate maintenance of the biofilter, biofilter fan failure, fire)
7. Periods of maintenance.
8. Absence of key staff.
9. Flood.
10. Fire/ explosion.
11. 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.

4.1.2 Control Measures

The control measures and response requirements to minimise the impact to abnormal event scenarios are also summarised in Table 4.1.

4.1.2.1 Maintenance Works

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.

4.1.2.2 Critical Failure(s)

A list of contingency contacts in the event of abnormal operations/ critical failures is provided in **LRBE-OD-03** Accident Management Plan (AMP).

Since LRBE operates two depackaging lines and has two loading machines it is considered unlikely that complete failure of the system would occur. 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.
- Clean-up/ wash-down procedures; and
- Containment of waste either into sealed containers/by covering or removal to an alternative facility within 24-hours.

In the case of operational difficulties, capacity limits, serious odour issues and disaster or emergency situations, measures are in place to divert or remove wastes to:

Anaerobic Digestion

Biffa
Poplars Landfill Site
Cannock
WS11 8NQ

Fernbrook Bio Limited
Rushden
Northamptonshire
NN10 6AA

In Vessel Composting

Jack Moody Limited
Hollybush Farm
Snareshill
WV10 7LX

Landfill

Biffa
Poplars Landfill Site
Cannock
WS11 8NQ

Veolia
Tyseley
Birmingham
B11 2BA

Mains electricity failure would critically impact on business operation. However, provision is in place for a backup generator to be installed should this occur. The backup generator is located at Crescent Farm, Waters Upton, Telford, TF6 6NP (approximately 25 minutes / 15 miles from site). The generator is two years old and is maintained. Water supply is available from the mains. There is no business-critical gas usage on site. Deputies are available for any individual key staff member should they be unavailable for any reason.

Table 4.1 Contingency for Odour Control during Maintenance and Abnormal Events

LOCATION OF EMISSION	CONTINGENCY EVENT	CONSEQUENCES OF ABNORMAL EMISSION	MEASURES TO PREVENT/ REDUCE LIKELIHOOD OF EVENT	ACTIONS AND RESPONSIBLE PERSON(S)
AD PLANT INFRASTRUCTURE COMPROMISED	**Small odorous gas release from digester pipework or tanks, or odorous liquid release**	Odour emitted from release of odorous air, gas, or biogas. Odorous gas may contain H_2S, which is toxic even in low concentrations, e.g. in confined spaces. Biogas is potentially explosive and is an asphyxiant.	Operations management: AD plant automated systems monitoring (SCADA) - continuous technological measurements and data acquisition is made automatically for the parameters that are designed to the control system and includes leak detection. Systems alerts, and overrides will be integral to the automated system. In addition, there will be a number of daily checks and measurements required by management personnel. System fitted with fail-safes for blockages, high or low pressure stops and valve interlocks. Area will be within containment and will be bunded. Maintain spill-kit supplies on-site (absorbent materials to include absorbent granules, absorbent boom). Staff training and inductions - everyone to be aware of spillage clean-up procedure. Odour awareness and contingency measures included within staff inductions and training.	• General Manager to be notified immediately in order to investigate and rectify the problem without delay. • Invoke **LRBE-OD-03 AMP** as appropriate. • General Manager to provide direction regarding safety of working in the affected area. PPE including personal gas alarms will be worn by site operatives. • Portable monitors will be used to check gas type and concentration. Isolate the affected section of pipe. • Call Maintenance Technician. • Stop pumps/ close valves as necessary • Use suction tanker to retrieve liquids and subsequently load to process. • Clean affected area with squeegee, apply absorbents. Clean equipment surfaces. • The General Manager will advise the EA of the circumstance and corresponding odour monitoring results no later than by the end of the working shift.
CHP	**CHP failure or reduction in performance**	If odour strength or nature varies at the plant and or the following checks reveal a problem, then a qualified engineer will be contacted.	Routine maintenance contract with supplier (or associated contractor: Finnings and GenV) for equipment. Continuous system checks (SCADA system) undertaken to validate function biogas treatment technology.	• General Manager to be notified immediately to investigate and rectify the problem without delay. • General Manager to provide direction regarding safety of working in the affected area. PPE including personal gas alarms will be worn by site operatives. • Portable monitors will be used to check gas type and concentration. Isolate the affected section of pipe. • Call technology provider for support. The General Manager will advise the EA of the circumstance and corresponding odour monitoring results once the situation has been resolved and no later than by the end of the working shift.

LOCATION OF EMISSION	CONTINGENCY EVENT	CONSEQUENCES OF ABNORMAL EMISSION	MEASURES TO PREVENT/ REDUCE LIKELIHOOD OF EVENT	ACTIONS AND RESPONSIBLE PERSON(S)
DIGESTERS	**Emissions from the operation of the PRVs**	Odour emitted from release of odorous air, gas, or biogas. Odorous gas may contain H_2S, which is toxic even in low concentrations, e.g. in confined spaces. Biogas is potentially explosive and is an asphyxiant.	Operations management: AD plant automated systems monitoring (SCADA) - continuous technological measurements and data acquisition is made automatically for the parameters that are designed to the control system and includes leak detection. Systems alerts, and overrides will be integral to the automated system. In addition, there will be a number of daily checks and measurements required by management personnel.	• General Manager to be notified immediately in order to investigate and rectify the problem without delay. • Invoke **LRBE-OD-03 AMP** as appropriate. • General Manager to provide direction regarding safety of working in the affected area. PPE including personal gas alarms will be worn by site operatives. • Portable monitors will be used to check gas type and concentration. Isolate the affected section of pipe. • Call Maintenance Technician.
DEPACKAGING BUILDING	**Containment compromised**	Gaseous release due to structural damage or mechanical failure when doors are open.	Daily odour monitoring will detect leaks due to structural damage. The entrance and exit doors cannot be open at the same time and therefore any failure of the doors to close will be detected rapidly.	• General Manager to be notified immediately to investigate and rectify the problem without delay. • Invoke **LRBE-OD-03 AMP** as appropriate, possibly halting deliveries to site. • Rectify structural damage. • Call Maintenance Technician for doors.
DEPACKAGING BUILDING	**Ineffective performance of drying room odour control**	Release of odorous emissions from the drying room stack.	Automatic pH tests and adjustment will be undertaken on the acid to ensure the correct pH is maintained for operational efficiency. Daily odour monitoring will detect reduced performance. Complaints notified by the Council, EA or the public may also indicate an odorous release.	• General Manager to be notified immediately to investigate and rectify the problem without delay. • Invoke **LRBE-OD-03 AMP** as appropriate. • Check temperature into and out of the dryer. • Check the pH of the acid tank.

LOCATION OF EMISSION	CONTINGENCY EVENT	CONSEQUENCES OF ABNORMAL EMISSION	MEASURES TO PREVENT/ REDUCE LIKELIHOOD OF EVENT	ACTIONS AND RESPONSIBLE PERSON(S)
DEPACKAGING BUILDING	**Ineffective performance of biofilter**	Release of odorous emissions from the biofilter.	Scheduled daily/weekly, monthly and 6-monthly tests should detect reduced abatement performance. Daily odour monitoring will detect reduced performance. Complaints notified by the Council, EA or the public may also indicate an odorous release.	• General Manager to be notified immediately to investigate and rectify the problem without delay. • Invoke **LRBE-OD-03 AMP** as appropriate. • Check biofilter inspection record and SCADA system to diagnose the cause. • If problem cannot be rectified by site staff call contractor Mike Thompson (biofilter designer / installer)
ENTIRE FACILITY	**Periods of maintenance**	Affect the ability of the site to operate effectively.	Maintenance can be planned and scheduled in order not to impair the plant performance. Daily odour monitoring will detect reduced performance. Complaints notified by the Council, EA or the public may also indicate an odorous release.	• General Manager to be notified immediately to investigate and rectify the problem without delay. Measures may include: • Stopping maintenance activities. • Implement **LRBE-OD-03 AMP** as appropriate. • The General Manager will advise the EA of the circumstances immediately. Corresponding odour monitoring to be undertaken. Progress updates to be provided to EA until resolved.
ENTIRE FACILITY	**Absence of key staff**	Affect the ability of the site to operate effectively	Deputy/ technically competent personnel will be available at all times. LRBE's primary point of contact will be the General 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 training, including that for drivers. In the short-term, other staff members can be reassigned to critical operations. System processes will be automated and monitored remotely by technology provider.	• 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.

LOCATION OF EMISSION	CONTINGENCY EVENT	CONSEQUENCES OF ABNORMAL EMISSION	MEASURES TO PREVENT/ REDUCE LIKELIHOOD OF EVENT	ACTIONS AND RESPONSIBLE PERSON(S)
ENTIRE FACILITY	**Flood**	Affect the ability of the site to operate effectively.	The site is not located within a flood risk area. Any flood giving rise to a pollution incident on-site would therefore be because of a man-made incident and is covered under the spillage procedure (**LRBE-OD-03 AMP)**.	• General Manager to be notified immediately to investigate and rectify the problem without delay. Invoke **LRBE-OD-03 AMP** as appropriate. • Stop pumps/ close valves as necessary/ contain liquid. • Use suction tanker to retrieve liquids from sumps and subsequently load to process. • Clean affected area apply absorbents. Clean equipment surfaces. • The General Manager will advise the EA of the circumstances immediately. Corresponding odour monitoring to be undertaken. Progress updates to be provided to EA until resolved. Odour monitoring results provided to EA before the end of the working shift.
BIOGAS STORE AND ENTIRE FACILITY	**Fire and/or Explosion**	Odour and gas release	No wastes shall be burnt on site. There will be no smoking within the waste handling, storage, and treatment areas. The use of welding/cutting tools (i.e. with naked flame) should be sanctioned first by the General Manager/ competent person. Appropriate fire extinguishers shall be kept within the site boundary and made easily accessible. All site operatives shall be trained in accordance with the Company Fire and Evacuation Procedure. **Biogas storage:** AD system fitted with fail- safes for blockages, high or low pressure stops and valve interlocks. The process is continuously monitored for signs of increased heat. Routine (annual) assessments are completed in accordance with DSEAR and action taken as identified necessary. Use of PPE at all times including personal gas alarms H_2S and CH_4.	• Invoke **LRBE-OD-03 AMP**. • The General Manager shall make an immediate assessment of the situation before informing the Operator for advice. The fire shall be extinguished as soon as practicable in accordance with **LRBE-SOP-25** Call out Fire Alarm Procedure, **and LRBE-SOP-26** Fire Alarm Procedure.

LOCATION OF EMISSION	CONTINGENCY EVENT	CONSEQUENCES OF ABNORMAL EMISSION	MEASURES TO PREVENT/ REDUCE LIKELIHOOD OF EVENT	ACTIONS AND RESPONSIBLE PERSON(S)
DIGESTATE STORES	**Unavailability of Transfer Vehicles**	Poor weather, road closures or strikes prevent vehicles removing digestate from the facility.	Meteorological monitoring and forecasting at the site will be performed daily to identify times when plant conditions and/or odour abatement techniques need to be adjusted to account for adverse conditions. The fibre digestate store has the capacity for a years' worth of fibre.	• The General Manager is responsible for overseeing the supplier policy and a contingency plan. • Contingency storage for liquid digestate will be secured.

5 Odour Monitoring

5.1 Odour Monitoring Under Normal Conditions

5.1.1 Meteorological Monitoring

Meteorological conditions are key to understanding the potential odour impacts to downwind 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 the on-line resources e.g. metcheck.com.

5.1.2 Monitoring Odorous Releases

This section of the OMP sets out the monitoring procedures that will be implemented, during normal operations.

5.1.2.1 Routine (Daily) Olfactometry Monitoring

LRBE will carry out routine daily odour checks (**LRBE-MP-01** Odour Monitoring Form).

The prevailing wind directions are southwest, south and west as shown in the wind rose at Figure 1.1. The nearest two receptors lie within 100m and 200m respectively to the west of the site and these are the key receptors. The next nearest receptors are over 490m from the site. Appropriate downwind monitoring locations (locations numbered 8 and 9 below) will be chosen at the time of the survey. Other predetermined on-site monitoring locations (that includes locations listed below from number 1 to number 7 inclusive) should be surveyed on every occasion.

The majority of odour checks shall be undertaken at the areas deemed to be most at risk of odour release with two flexible points to be assessed downwind of site. As a minimum monitoring will be undertaken at the following (with off-site locations to be surveyed first):

1. Adjacent to External Storage Bunker
2. Adjacent to access to Drying Room (Depackaging Building)
3. Adjacent to western access to Depackaging Building
4. Adjacent to Biofilter
5. Adjacent to eastern access to Depackaging Building
6. Adjacent to north-eastern access to Depackaging Building
7. Adjacent to access to Digestate Fibre Store Building
8. Flexible downwind boundary location
9. Flexible downwind off-site receptor location (if odours are perceived at the downwind site boundary)

An Odour Monitoring Locations Plan is included in Appendix 1.

Monitoring will be undertaken during operational hours and at times when there is a risk of off-site odour impact. 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.

- 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 7.3) 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 in the BioDiary **(LRBE-MP-03).** This data can be used to inform proactive odour management.

5.1.2.2 The Odour Assessor

Monitoring staff must not be desensitised to odour. A variety of 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. In the event that 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. A copy of the Hedonic Scale and Odour Intensity Scale is included in Appendix 2.

5.1.2.3 Routine Monitoring Inspection Methodology

1. The tester will walk slowly, breathing normally, and starting at points with least expectation of odour (at the downwind boundary). 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 sensitivity 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 **BioDiary (LRBE-MP-03).** Other supporting classification systems and information are provided in Appendix 5.

3. Following an odour inspection at the downwind site boundary in addition to potentially sensitive off-site locations in the vicinity (see Receptor Locations Plan, Appendix 1) if required, an on-site inspection of operations will be carried out to trace any observed odour from the site boundary 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 (cloud cover, wind direction, wind speed, atmospheric pressure, air temperature, and air stability), odour type, location, intensity, extent, and sensitivity are recorded in the **BioDiary (LRBE-MP-03) .**

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

5.1.3 Dynamic Olfactometry Monitoring

BAT is to monitor channelled emissions of odour. The monitoring of ammonia and hydrogen sulphide can be used as an alternative to the monitoring of the odour concentration.

This OMP will be updated in accordance with the requirements of the permit variation regarding odour monitoring method and frequency.

5.2 Actions in the Event of Abnormal Emissions

5.2.1 Investigate Pollution Incident and Cause

If odour monitoring indicates that abnormal emissions from the facility are taking place the General Manager will be informed immediately and will check relevant items of odour control equipment in order to identify the possible cause of the abnormal emission.

5.2.2 Bring the Process back under Control

1. 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;

2. take immediate steps to eliminate the cause of the abnormal situation;
3. contact the relevant maintenance contractor if necessary;
4. record the response to the situation and the remedial actions taken; and
5. advise the EA with regards to the possibility of complaints, details of the problem, and mitigation/improvement measures undertaken.

5.2.3 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.

5.2.4 Problem Resolution

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

1. A further odour survey will be completed to ensure that the improvements have addressed the source of the elevated levels.
2. If the cause is due to inadequately followed odour management controls re-training of employees will take place to ensure that all employees operate to the required standards.
3. 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
4. All parties affected by the problem event will be notified of the cause, actions, and resolutions by the General Manager.

Table 5.1 summarises the routine odour monitoring the responsive monitoring following an odour release.

Table 5.1 Schedule of Odour Monitoring

Type of Monitoring	Frequency	Person Response	Method	Reason	Records	Actions
Sniff test	Daily	AD Plant Manager or Plant Operative	Walk around installation boundary and perform sniff test at locations indicated on **Odour Monitoring Locations Plan**	General monitoring to establish normal working conditions and check for odour emissions/ issues.	**LRBE-MP-03 BioDiary**	If odour is detected investigate and establish source and take appropriate remedial action. Record the details of the odour using the **LRBE-MP-03** BioDiary
Sniff test	On request	AD Plant Manager or Plant Operative	Walk around installation boundary and perform sniff test at locations indicated on **Odour Monitoring Locations Plan**	In response to complaint.	**LRBE-MP-03 BioDiary** **LRBE-FT-13 Odour Complaint Form**	If odour is detected investigate and establish source and take appropriate remedial action. Record the details of the odour using the **LRBE-MP-03** BioDiary If required, refer to Complaints Procedures.
Sniff test	In the event of odour release	AD Plant Manager or Plant Operative	Walk around installation boundary and perform sniff test at locations indicated on **Odour Monitoring Locations Plan**	To establish and confirm odour source.	**LRBE-MP-03 BioDiary**	Establish source and take appropriate remedial action. Record the details of the odour using the **LRBE-MP-03** BioDiary

6 Odour Complaints

6.1 Odour Complaints Management and Investigation

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. LRBE understands the importance of addressing 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 **(LRBE-SOP-15).** If an odour complaint is received, the General Manager or deputy will complete form **LRBE-FT-13** Odour Complaint Form.

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 and/or EA in the event of an off-site odour to enable site personnel to verify the presence, extent and cause of the odour. LRBE's General Manager's telephone number will be displayed at the site entrance.

The General Manager will investigate the complaint as soon as possible on receipt of the complaint. If the General Manager feels that their deputy is better placed to deal with the response, then control of the issue may be handed over to the relevant personnel.

A stepwise approach to odour complaint investigation and reporting is presented in Figure 6.1.

6.2 Complaint Screening

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:

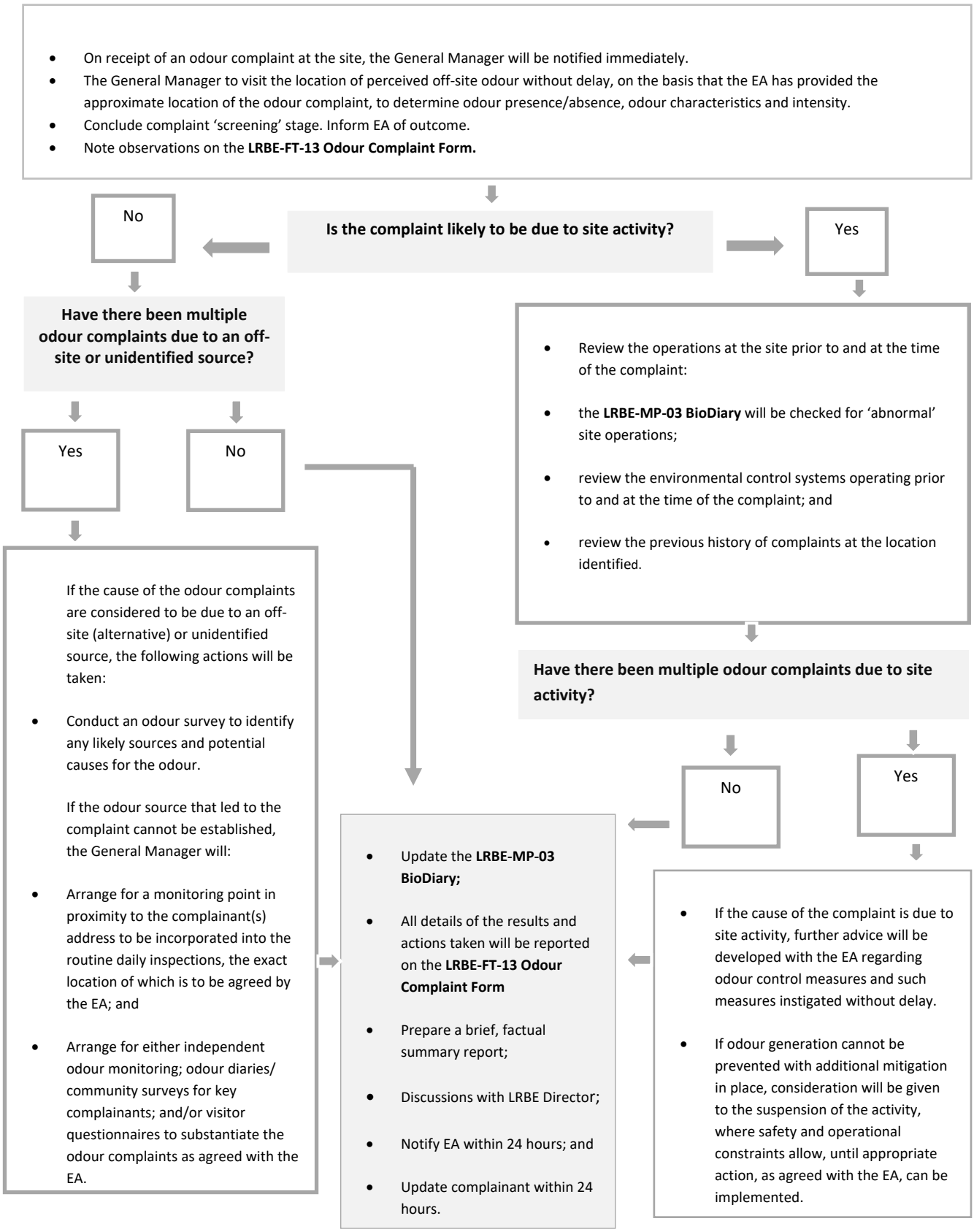
- potential odour sources at the facility (Table 3.1, Table 4.1);
- routine/ additional odour monitoring data; and
- meteorological conditions considered in relation to the location of the complainant.

If the General Manager can attend the complaint location quickly, it may be possible to carry out effective appraisal of the complaints independently by a 'sniff test'.

LRBE will liaise with the EA immediately to inform of the outcome of the screening assessment 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.

Figure 6.1 Odour Complaints Procedure – Stepwise Procedure



6.3 Odour Complaint Investigation

The actions outlined in Figure 6.1 will be followed if the site is identified as the origin/cause of the odour complained about. Figure 6.1 also outlines the actions that will be undertaken by LRBE 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. The 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.

After recording the complaint on **LRBE-FT-13** Odour Complaint Form and completing an appropriate level of investigation the General Manager will discuss the matter with LRBE Director.

The **LRBE-FT-13** Odour Complaint Form will be forwarded to the EA together with the outcome of the investigation by the end of the working shift to enable timely review in addition to complaint validation results and any corrective and preventative actions taken in response to the complaint.

The Operator will summarise the details of validated complaints to the EA within 24-hours of investigation and validation.

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

6.4 Complaints Monitoring

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

6.5 Community Engagement

The Operator will ensure that they are approachable and open to discussion at all times, the primary objective being to encourage 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 1.1) and the EA will be co-ordinated through the General 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.

6.5.1 Odour Diaries and Community Surveys

In circumstances where, over an extended period, odour complaints from the community do not match the results of the regular sniff-test monitoring LRBE 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 **LRBE-FT-14** Odour Diary for an agreed length of time. LRBE will maintain logs of community involvement and keep all completed odour diaries for future reference.

7 Management and Document Review

7.1 Policy and Commitment

LRBE is committed to managing any potential off-site odour impacts from the proposed AD facility. This commitment extends from company policies produced at Director level (Managing Director) through to managing odour-critical work-based activities on-site.

7.2 Overarching Management Responsibility

The key roles and responsibilities of site personnel are summarised in Table 7.1 with specific regard to odour prevention and control.

Site staff will be responsible for maintaining an awareness of general site performance during their daily activities and will report any unusual odour occurrences to the General Manager.

Table 7.1 Key Roles and Responsibilities - Odour Control

ROLE	RESPONSIBILITIES
DIRECTORS	• Overall responsibility for implementation of the OMP. • Responsibility for ensuring compliance with environmental legislation.
GENERAL MANAGER SUPPORTED BY AD PLANT MANAGER	• Overall responsibility for implementation of the OMP including maintenance of odour control equipment. • Will prepare and manage dissemination of information on project programme, site contacts and health and safety information to site neighbours. • Responsibility for ensuring compliance with environmental legislation. • Oversight of site audits. • Day to day responsibility for public liaison, and complaints handling. • Completion of the daily inspection. • Responsibility for delivering environmental aspects of site inductions. • Carry out any environmental awareness training and work with contractors to ensure implementation of good practice.
MAINTENANCE TECHNICIANS	• CHP Contractor: Finnings and GenV • Flare: Uniflare • Biofilter: Mike Thompson Partnership Ltd • Acid scrubber: BioG • Biological scrubbers: BCNE provide service and cleaning
ELECTRICAL TECHNICIAN	• Contractor

7.3 Records

The Operator will maintain records of all monitoring carried out under this OMP, including details of maintenance of plant and/or equipment including odour abatement equipment, the results of calibration tests performed on plant/ equipment, odour monitoring surveys and any assessment or evaluation made based on such data.

Details of odour non-conformances, including subsequent investigations, timescales and remedial measures taken, and notifications of the relevant internal and external bodies will be recorded by the General Manager and copies will be maintained within the site office.

All records will be kept for a minimum of six years as specified in the permit conditions; however, if the records involve any off-site impacts then those records must be kept until the surrender of the permit. All complaints forms will be kept until the surrender of the permit(s). All records will be available for inspection by EA representatives.

7.4 Reporting

The requirements for the reporting of monitoring undertaken at the site are set out within the Site's environmental permit. If an odour complaint is received, the investigation of each individual complaint and subsequent report to the EA is to be undertaken without delay.

7.5 OMP Update and Review

This OMP sets out the appropriate measures that LRBE will undertake in controlling any odorous or potentially odorous activities from the facility.

In urgent circumstances where the Operator requires the immediate implementation of changes to the OMP to prevent or reduce significant odorous emissions, these changes will be discussed with the EA without delay but may be implemented by the Operator ahead of formal agreement.

Where the Operator proposes changes to the OMP that involve a longer-term phased approach, a proposal will be submitted by LRBE to the EA that outlines the approach within an updated OMP. Once agreed, the required changes will then form the future measures for the site about odour management and control.

7.6 Review Timescales

While 'normal' operations continue at the site that could give rise to the generation of odour, this OMP will be formally reviewed by LRBE annually, as a minimum, to ensure the stated management controls and conditions continue to reflect best available techniques and the operational requirements/ sensitivities at the site. Any technical and managerial changes on site will also initiate a review of the OMP.

An updated copy of the OMP will be submitted to the EA following review, as required. Any required changes to the conditions set out within this document will be formally agreed with the regulator prior to their implementation.

Following a period of abnormal operations (i.e., immediately following an accident/incident at the facility) the OMP will be reviewed immediately and further advice may need to be developed regarding odour control measures and such measures instigated without delay.

Appendix 1 Drawings

Drawing Reference: ETL378/SPC0079/LAC62/EPR01 – Site Location Plan

Figure A1.1 – Process Flow

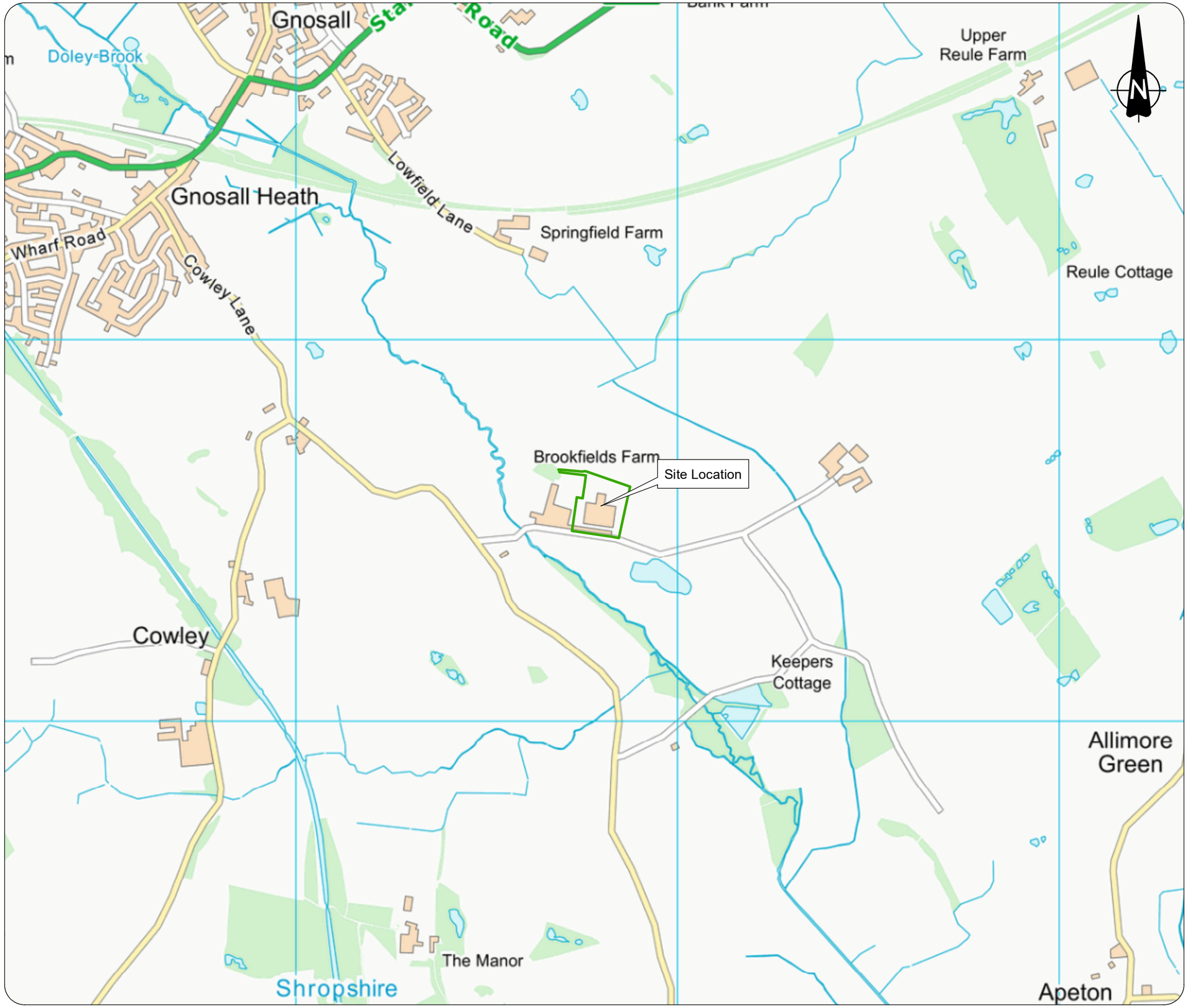
Figure A1.2 – Process Flow (continued)

Drawing Reference: ETL378/SPC0079/LAC62/EPR03 – Site Layout Plan

Drawing Reference: ETL378/SPC0079/LAC62/EPR02 – Boundary and Emission Point Plan

Drawing Reference: ETL378/SPC0079/LAC62/AQA01 – Human Receptor Location Plan

Drawing Reference: ETL378/SPC0079/LAC62/OMP01– Odour Monitoring Locations Plan



REVISIONS

REV	DATE	DESCRIPTION	DWN	CHK	APP
-	12/03 2020	First Issue	JJ	MF	MF

LEGEND

Proposed permitted boundary

0 100 200 300 400 500 600 m

Scale at A3: 1:10,000

Client
Lower Reule Bioenergy Limited

Project
Normal Variation Installation Permit

Title
Site Location Plan

Earthcare TECHNICAL
Manor Farm
Chalton
Waterlooville
Hants PO8 0BG
Tel: 02392 290488
enquiries@earthcaretechnical.co.uk
www.earthcaretechnical.co.uk

Drawn	Checked	Approved	Revision
JJ	MF	MF	

Date	Scale	Sheet Size
March 2020	1:10,000	A3

Drawing Number	File Reference
ETL378/SPC0079/LAC62/EPR01	ELT-00369.dwg

Figure A1.1 Process Flow

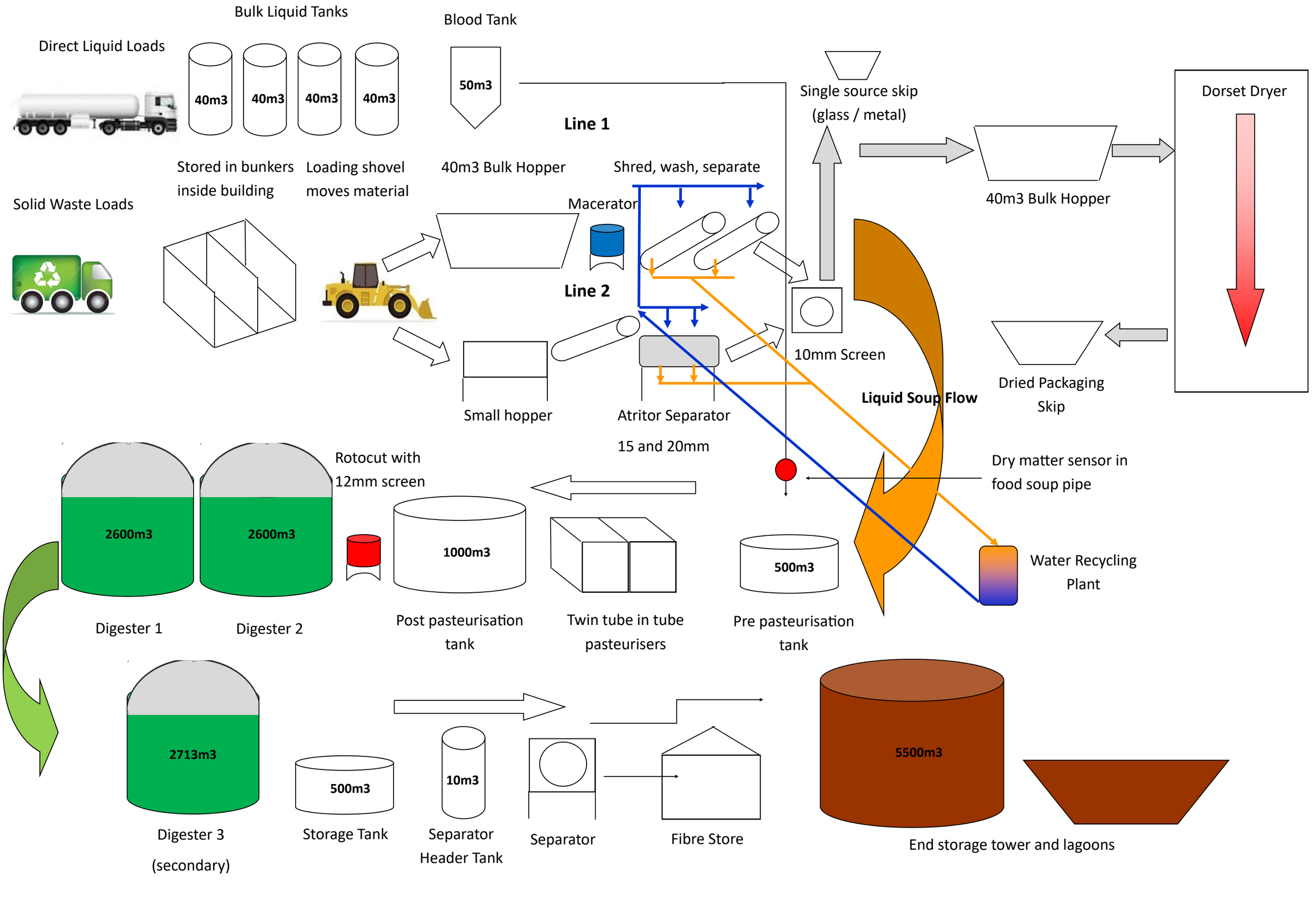
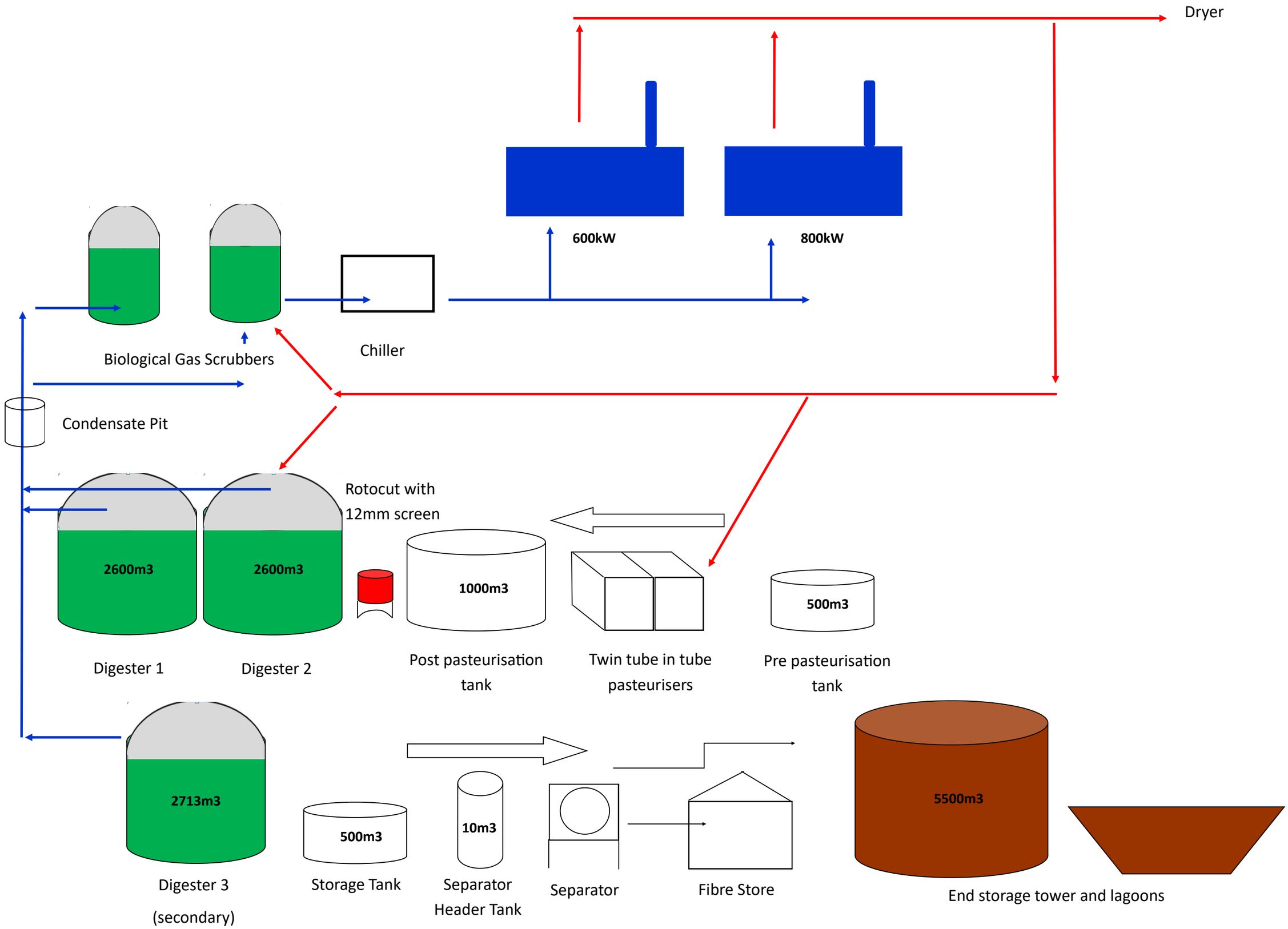


Figure A1.2 Process Flow Continued



REVISIONS

REV	DATE	DESCRIPTION	DWN	CHK	APP
-	12/03 2020	First Issue	JJ	MF	MF

LEGEND

Proposed permitted boundary

1. Digester 1
2. Digester 2
3. Digester 3
4. Proposed end store
5. Proposed end store
6. Pre pasteurisation store
7. Post pasteurisation store
8. Proposed rainwater storage
9. End store pre separated
10. End store
11. Pasteurisers
12. Drying room - packaging waste
13. Delivery of liquid food waste and Digestate dispatch
14. Take off of pasteurised food soup
15. CHP 800kW
16. CHP 600kW
17. Proposed CHP3
18. Blood tank
19. 4 x Liquid food waste tanks
20. External storage bunker
21. Biofilter
22. Separated fibre store
23. Carbon filter scrubbers
24. Weighbridge
25. Weighbridge office
26. Transformer
27. Separator

0 m — 400 m

Scale 1:7500 @ A3

Client
Lower Reule Bioenergy Limited

Project
Normal Variation Installation Permit

Title
Site Layout Plan

Earthcare TECHNICAL
Manor Farm
Chalton
Waterlooville
Hants PO8 0BG
Tel: 02392 290488
enquiries@earthcaretechnical.co.uk
www.earthcaretechnical.co.uk

Drawn	Checked	Approved	Revision
JJ	MF	MF	

Date	Scale	Sheet Size
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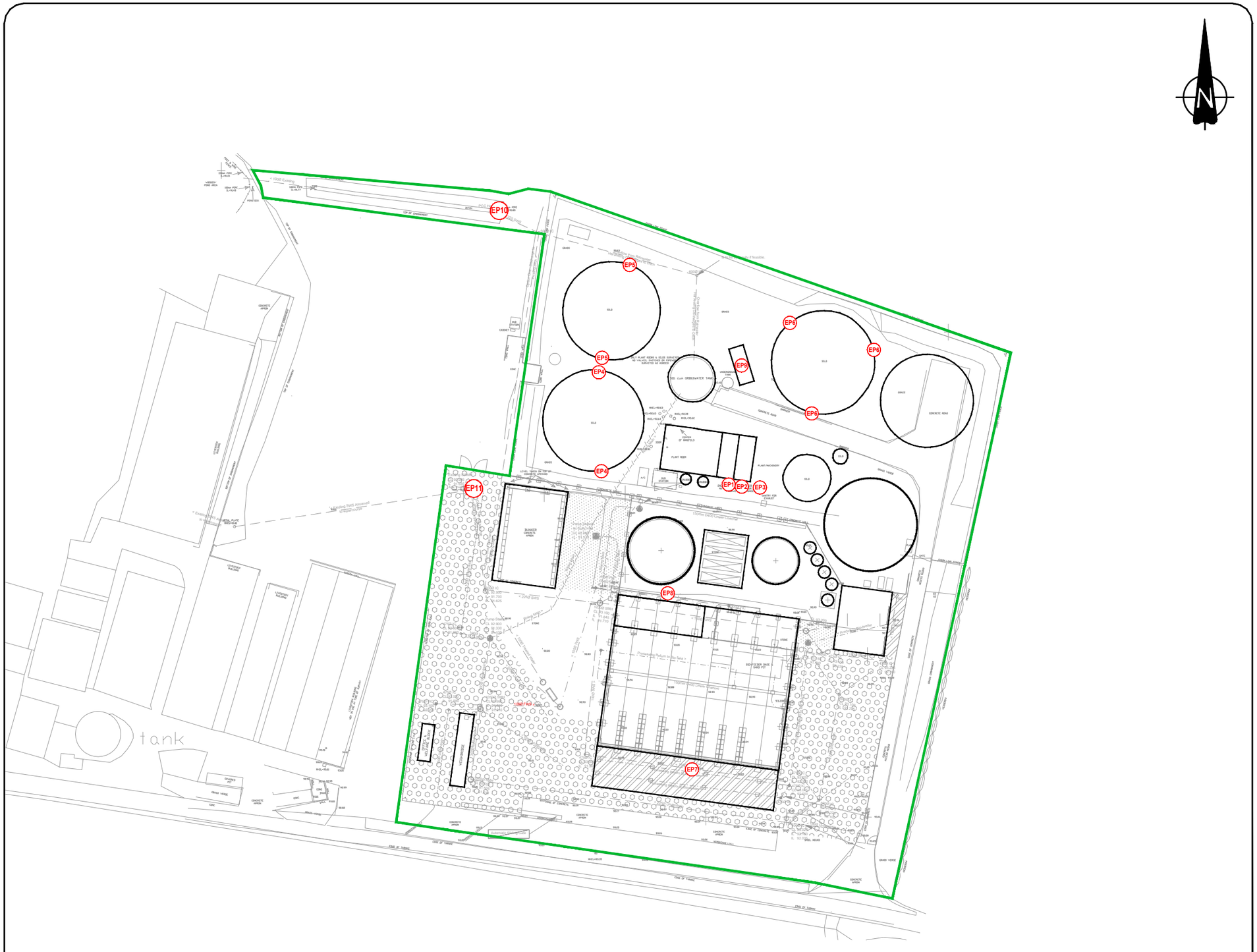
Drawing Number	File Reference
ETL378/SPC0079/LAC62/EPR03	ETL-00378.dwg

Reproduced from Engineering Strategy drawing B19135-200 C0 drawn by Patrick Parsons



REVISIONS

REV	DATE	DESCRIPTION	DWN	CHK	APP
-	12/03 2020	First Issue	JJ	MF	MF

LEGEND

- Proposed permitted boundary
- EP1. 800W CHP stack
- EP2. 600W CHP stack
- EP3. Flare
- EP4. Digester 1 PRVs
- EP5. Digester 2 PRVs
- EP6. Digester 3 PRVs
- EP7. Biofilter
- EP8. Drying room odour abatement outlet
- EP9. CHP3 (proposed) stack
- EP10. Excess rainwater discharge
- EP11. Excess surface water discharge from Truck Pave area

0 m 500 m

Scale 1:10,000 @ A3

Client
Lower Reule Bioenergy Limited

Project
Normal Variation Installation Permit

Title
Site Boundary and Emission Point Plan

Earthcare TECHNICAL
Manor Farm
Chalton
Waterlooville
Hants PO8 0BG
Tel: 02392 290488
enquiries@earthcaretechnical.co.uk
www.earthcaretechnical.co.uk

Drawn	Checked	Approved	Revision
JJ	MF	MF	

Date	Scale	Sheet Size
March 2020	1:10,000	A3

Drawing Number	File Reference
ETL378/SPC0079/LAC62/EPR02	ETL-00378.dwg

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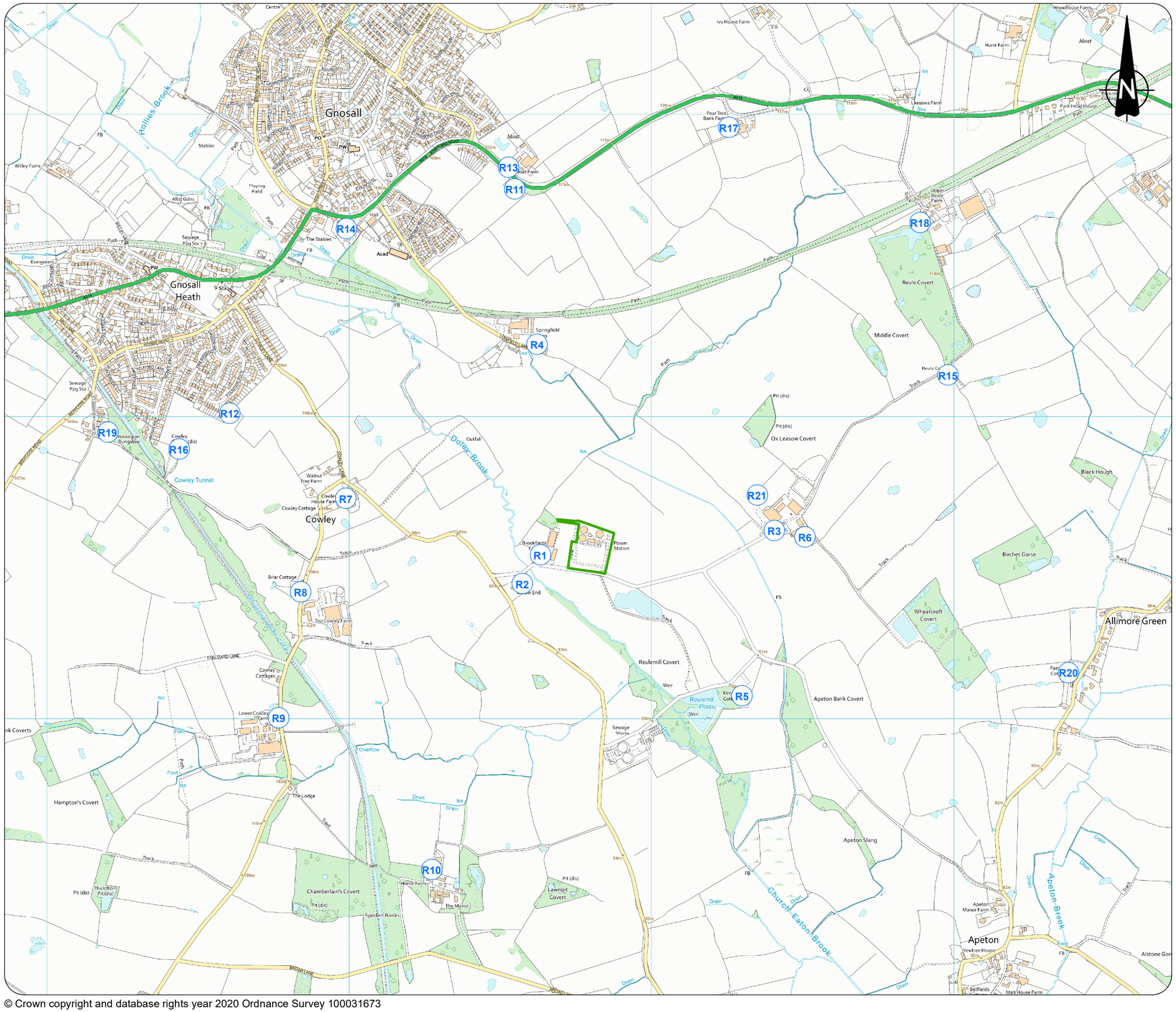

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REVISIONS

REV	DATE	DESCRIPTION	DWN	CHK	APP
-	26/03 2020	First Issue	JJ	MF	MF

LEGEND

Proposed permitted boundary

(R) Human receptor

0 100 200 300 400 500 600 700 m

Scale at A3: 1:12,500

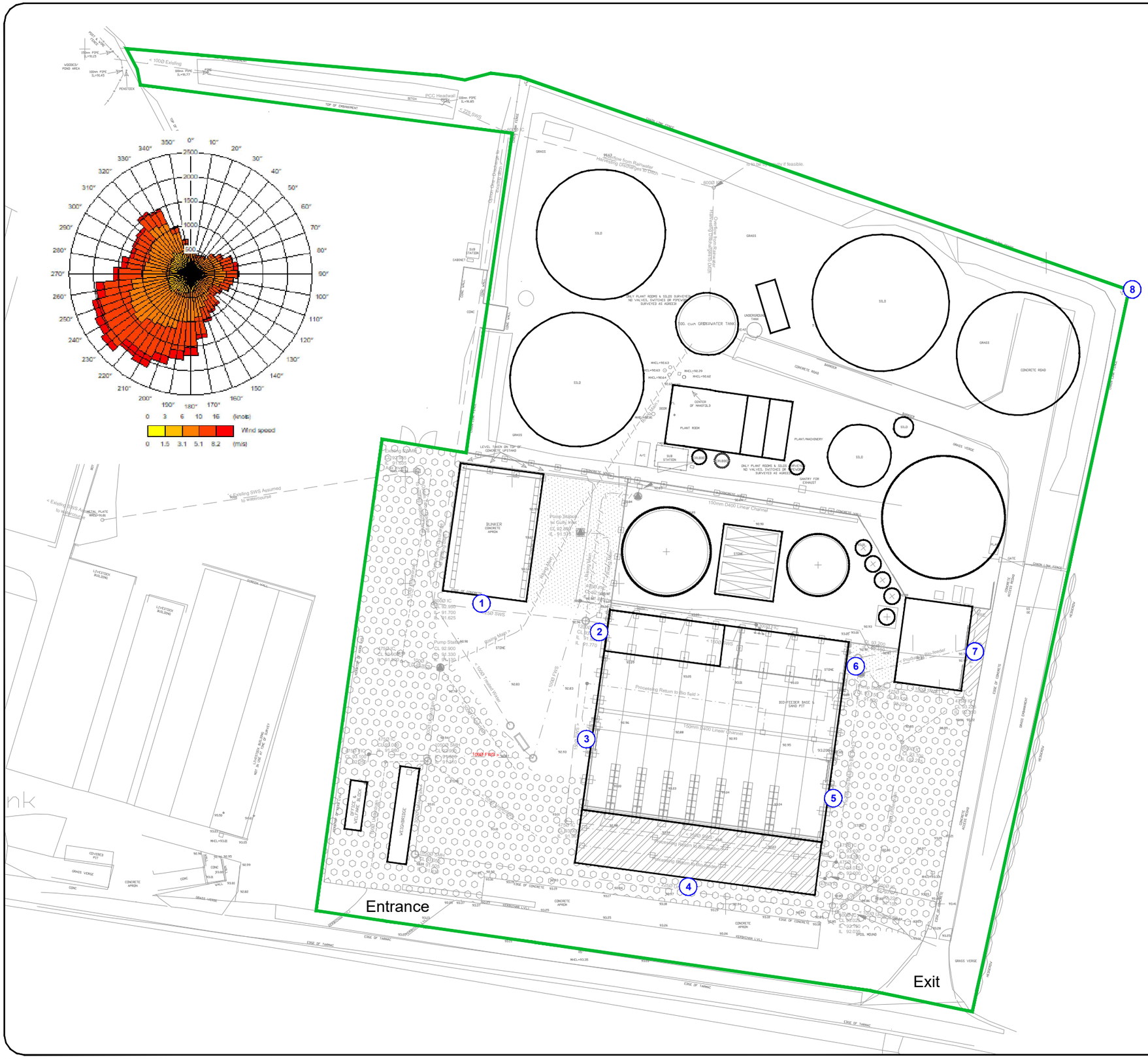
Client: Lower Reule Bioenergy Limited

Project: Air Quality Assessment

Title: Human Receptor Location Plan

Earthcare TECHNICAL
Manor Farm
Chalton
Waterlooville
Hants PO8 0BG
Tel: 02392 290488
enquiries@earthcaretechnical.co.uk
www.earthcaretechnical.co.uk

Drawn	Checked	Approved	Revision
JJ	MF	MF	
Date: March 2020		Scale: 1:12,500	Sheet Size: A3
Drawing Number: ETL378/SPC0079/LAC62/AQA01			File Reference: ELT-00369.dwg



REVISIONS

REV	DATE	DESCRIPTION	DWN	CHK	APP
-	21/03 2020	First Issue	JJ	MF	MF

LEGEND

- Proposed permitted boundary
1. Adjacent to External Storage Bunker
2. Adjacent to access to Drying Room (De-Packaging Building)
3. Adjacent to western access to De-Packaging Building
4. Adjacent to Biofilter
5. Adjacent to eastern access to De-Packaging Building
6. Adjacent to north-eastern access to De-Packaging Building
7. Adjacent to access to Digestate Fibre Store Building
8. Flexible downwind boundary location
9. Flexible downwind off-site receptor location (if odours are perceived at the downwind site boundary)

0 m 400 m

Scale 1:7500 @ A3

Client
Lower Reule Bioenergy Limited

Project
Odour Management Plan

Title
Odour Monitoring Locations Plan

Earthcare TECHNICAL
Manor Farm
Chalton
Waterlooville
Hants PO8 0BG
Tel: 02392 290488
enquiries@earthcaretechnical.co.uk
www.earthcaretechnical.co.uk

Drawn	Checked	Approved	Revision
JJ	MF	MF	

Date	Scale	Sheet Size
March 2020	1:7,500	A3

Drawing Number	File Reference
ETL378/SPC0079/LAC62/OMP01	ETL-00378.dwg

Reproduced from Engineering Strategy drawing B19135-200 C0 drawn by Patrick Parsons

Appendix 2 Depackaging Building Biofilter

Contents:

Table A2.1 BioDiary - Biofilter Control Limits

Parameter	Frequency	Method	Critical Limit	Action
Moisture content/ humidity	Daily (visual inspection at surface) Weekly (inspection at depth)	Media moisture content should be assessed by visual inspection at surface and at c.600mm depth	Moisture content maintained by the direct application of water to the biofilter support medium via irrigation system operated on a timer control. The suggested optimum moisture content is 50-80 per cent water by weight. The media should not be: • visibly too wet (saturated); or • dry to the touch (squeeze test); • display tracking (wet or dry patches) • have evidence of visible venting (holes) or • draughts at surface	• If dry, apply water • If wet, check bed drainage • The media irrigation system should be checked for operation and leaks. Should media drying become an issue, atomisers can be placed into the exhaust air stream between the fans and plenum. These can be timer controlled to give the cover required.
Thatching/compaction using back-pressure measurement	Daily	Sniff tests next to biofilter Building extraction rate (inlet flow rate to biofilter)	• Odour present above the filter High pressure drops may occur in water-logged media, lower pressure drops may occur in drier media. High pressure differential across the media will lead to flow reduction across the bed and reduced extraction rates from building. Limits to be confirmed on commissioning.	Advice should be sought from contractor Mike Thompson (biofilter designer / installer). A change and/or blending of the filter media may be required.
pH	Weekly	Media and leachate pH to be monitored at different locations and depths across the media	pH should be 7 to 8.5.	Advice should be sought from contractor Mike Thompson (biofilter designer / installer).
Temperature	Weekly	Temperature probe once at 10 different locations at depth of between 300 – 1000mm	The media temperature should be: • close to ambient (15 - 35°C) or 40°C • Some rise or fall is allowable in summer and winter	Should the media show a temperature of >50°C, then: conduct a full suite of temperature probing (a 2m x 2m grid across the biofilter) at depth of between 300 – 1000mm to ascertain the extent of any localised heating. A temperature increase well above ambient will denote the media is beginning to compost. A temperature drop will denote the media has become anaerobic due to blocking through excess fines or dust and is biologically dead. Advice should be sought from contractor Mike Thompson (biofilter designer / installer). Both changes will necessitate a change and blending of the filter media.
Abatement efficiency	Periodic (defined in permit)	Comparison of biofilter air inlet and outlet NH_3, H_2S and/or odour concentration.	95% odour removal efficiency. • Review odour removal efficiency rate; and • review of empty bed residence time (EBRT); media health (e.g. bacterial viability, acid growth; depth; air-flow distribution.	Report to be submitted to EA and any actions to be agreed with EA.

Table A2.2 BioDiary - Biofilter Inspection Regime

Daily and/or weekly inspection regime	
Parameter	**Method/ Action**
Fans	• Check functioning
Biofilter Ducting	• The ducting should have no damage, leaks or blockages.
Biofilter Media	• The media should be free from matting, surface holes, dust or weeds. • It should have no visible venting (holes) or tracking (wet or dry patches or noticeable draughts at surface). • It should not be visibly too wet (saturated) or dry to the touch. • The media should be temperature probed once per week, at 10 differing locations and at depth of between 300 – 1000mm. • The media irrigation system should be checked for operation and leaks and any issues noted and rectified. The media temperature should be close to ambient. Some rise or fall is allowable in summer and winter. • Should the media show a temperature of >50oC, then a full suite of temperature probing must take place (a 2m x 2m grid across the biofilter) at depths as above to ascertain the extent of any localised heating.
Biofilter Drainage System	• Inspect drainage system • The drainage system should show no evidence of leaking or blockages.
Biofilter Structure	• The structure of the biofilter should be checked for damage from impact or degradation.
De-packaging Building Odour Control	• Inspect all grids, one-way louvres, fans and air movers.
Monthly Inspection Regime	
Fans	• Check inverter operation if fitted.
Biofilter Ducting	• Open ducting inspection hatches and inspect duct interiors.
Biofilter Media	• Dig four 600mm deep check pits in the biofilter media to check for sub-surface blocking, soaking, drying or excessive fines.
Biofilter Drainage System	• Open the drainage system pumping chamber covers to check for airflow into the chambers (so proving the filter discharge clear), condition of the chambers and the pumps.
Biofilter Structure	• As per the daily and weekly checks.
De-packaging Building Odour Control	• As per the daily and weekly checks. • Pooling, eddies and odour hot-spots within the building also need to be checked for. • With all systems in operation, an operator (or external consultant) must walk round the barn with a calibrated gas monitoring set. • The operator (or consultant) will check for any noticeable odour hot-spots whilst the monitoring set will detect raised levels of gas present.
De-packaging Building Structure	• The structure of the de-packaging building should be visibly checked for damage or openings due to age, weather damage, etc. • Vehicle doors and doors into offices and non-odour control areas should be checked for closing and sealing efficiency.
6-monthly Inspection Regime	
De-packaging Building Structure	• The overall seal of the de-packaging building structure and the effectiveness of the air flow system should be checked on a quarterly basis.
Biofilter Efficiency	• The inflow and exhaust to and from the biofilter can be sampled to check of the efficiency of the system. This OMP will be updated in accordance with the requirements of the site Permit. • To be undertaken by an external consultant. Requires air samples to be taken immediately before and after the biofilter. This testing gives a measure of objective analysis of the biofilter's performance but should not be required if the filter is monitored and maintained properly.

Requirements for Effective Biofilter System Design and Operation to meet BAT

1. **Effective system and biofilter design rationale**
   - 1.1. Minimum 3 air changes per hour for the building
   - 1.2. Minimisation of dead spaces
   - 1.3. Air & odour flows from low odour to high odour to biofilter
   - 1.4. High odour areas should be away from access, etc
   - 1.5. Residence time should be between 30 & 60 seconds
   - 1.6. Provisions must be made to add water and remove bed drainage
   - 1.7. Media depth of >1m and <2m
   - 1.8. Dust and aerosols absent from airflow
   - 1.9. Air flow distribution via plenum before passing to media
   - 1.10. Humidity of inlet air

2. **System Design, Construction & Operation Notes**
   - 2.1. Civils Works (Walls & Floor)
   - 2.2. Plenum and Drainage System
   - 2.3. Ducting
   - 2.4. Building Outlet Vents
   - 2.5. Building Inlet Vents
   - 2.6. Fans & Their Controls
   - 2.7. Irrigation System
   - 2.8. Misting System
   - 2.9. Air Control Within Building

3. **Media selection rationale**
   - 3.1. Demonstrate adequate residence times
   - 3.2. Sufficient sorption capacity for contaminants and microbiobial attachment
   - 3.3. Living space and reserve nutrients for micro-organisms
   - 3.4. Media water/moisture content – 50 to 80% by weight
   - 3.5. Structural support to maintain internal structure
   - 3.6. Media temperature – near ambient – 15- 35 or 40^{o}C
   - 3.7. Media pH – 7 to 8.5
   - 3.8. Biologically active, but reasonably stable
   - 3.9. Organic matter content >60%
   - 3.10. Porous and friable with 75 to 90% void volume
   - 3.11. Resistant to waterlogging and compaction
   - 3.12. Relatively low fines content to reduce gas head loss
   - 3.13. Relatively free of residual odour

4. **Inspection and maintenance procedures**
   - 4.1. Parameters to be checked and inspection frequency
   - 4.2. Critical limits and actions in the event of non-compliance

5. **Media renewal**
   - 5.1. Media source
   - 5.2. Media changing frequency
   - 5.3. Media changing methods
   - 5.4. Media disposal

6. **System Design Calculations**

These BAT requirements are discussed within the following pages.

1. Effective system and biofilter design rationale

1.1. Minimum 3 air changes per hour for the building

1.1.1. The system will give the Depackaging Shed 5 air changes per hour.

1.1.2. The system is equipped with 5 separate fans, each rated at 20,000m^3 per hour. This gives the required airflow and means that the Depackaging Shed has a measure of redundancy in case one of the fans goes down or needs maintenance. Even with 2 fans down, the minimum of 3 air changes can be maintained.

1.1.3. The number of air changes may be reduced by either slowing down the fans or turning a pair of fans off.
This may be appropriate for periods when waste processing is not taking place to reduce the power requirements of the system.

1.2. Minimisation of dead spaces

1.2.1. The main flow of air into the Depackaging Shed is through 9 one-way inlet louvres along the northern elevation of the building, located below the gutter line and above the roof of the northern "lean to".

1.2.2. The exhaust from the building is through 5 large one way louvres into fan ducts located along the southern elevation of the building. These fan ducts deliver the exhaust air to the plenum below the media bed of the biofilter.

1.2.3. The louvres are set to only allow air to flow through the building in one direction – north to south. Their spacing is such to promote air flow across the whole width of the building.

1.2.4. Odour pooling and air flow eddies may be an issue within large buildings such as the Depackaging Shed. This can be caused by dead spots in the building, flow obstruction from installed plant or air currents from the cooling fans on processing equipment.

1.2.5. Additional small one-way wall louvres (c.450mm x450mm) may be added to the building on the east and/or west sides, should this be necessary. If used, these will act as additional inlets to disrupt any pooling within the building close to the gable ends.

1.2.6. As well as or as instead of these additional vents, small air moving fans may be used within the building to amend the internal air currents and so promote a more effective cross flow through the building.

1.3. Air & odour flows from low odour to high odour to biofilter

1.3.1. The main flow of air throw the building will be from north to south – low odour to high odour (processing & storage) to biofilter

1.3.2. The incoming waste storage areas are located directly below the exhaust louvres to the biofilter. Odour generated here is drawn straight into the biofilter.

1.4. High odour areas should be away from access, etc

1.4.1. The internal layout of the Depackaging Shed means that some of the waste storage areas lie close to the main vehicle access doors.

1.4.2. To reduce open time, these doors use fast mechanisms.

1.4.3. The air flow control louvres ensure that, should the wind direction be against a vehicle door when it opens, any increase in air pressure within the building assists the airflow through the biofilter as opposed to working against it.

1.5. Residence time should be between 30 & 60 seconds

1.5.1. Residence time for biofilters is measured as Empty Bed Residence Time (EBRT).

1.5.2. BAT requires that a biofilter have a minimum EBRT of between 30 & 60 seconds, the longer EBRT being required for more odorous exhausts.

1.5.3. This system gives an EBRT of 43 seconds.
1.5.4. Combined with the relatively high air change rate so reducing the odour concentration in the exhaust airflow, this EBRT will be sufficient for this installation.

1.6. Provisions must be made to add water and remove bed drainage

1.6.1. The floor of the biofilter chamber (under the plenum) is profiled to assist drainage and also furnished with its own sealed drainage system.
1.6.2. The biofilter will also be fitted with an irrigation system to wet the media surface should this prove necessary.
1.6.3. As the air exiting the Depackaging Shed will be of high humidity, irrigation will only be required through the summer months when called for by regular inspections.

1.7. **Media depth of >1m or <2m**

1.7.1. The media in the biofilter will be c.2.5m deep, above a 400mm deep plenum.
1.7.2. This is deeper than the maximum 2m set down in BAT.
1.7.3. Woodchip media will support a 2.5m deep media bed. The deeper bed depth assists air flow and distribution.
1.7.4. This deeper bed depth also reduces the chance of tracking or bypassing within the media. Some tracking or differential flow may occur but the deeper media depth means the airflow has more time within the media, even if such instances take place.

1.8. Dust and aerosols absent from airflow

1.8.1. Dust and aerosols will not be present in the exhaust from the Depackaging Shed due to the nature of the material being processed within the shed.
1.8.2. The drier within the northern part of the building will not discharge via the biofilter.

1.9. Air flow distribution via plenum before passing to media

1.9.1. One-way louvres on the fan ducting ensure that, should a fan fail, the air pressure in the plenum will not drive exhaust from under the biofilter media back into the barn through the duct on the failed fan.
1.9.2. The plenum below the media will be formed of proprietary plastic soakaway crates. These have a large, unobstructed void space and are resistant to damp and chemical attack.
1.9.3. The plenum will be c.400mm deep, so allowing the exhaust air time and volume to dissipate evenly across the whole base of the biofilter, presenting an even flow and pressure to the base of the media.
1.9.4. All louvres are protected by grids to prevent the ingress of foreign matter that will either impede the louvre or plenum air flow.

1.10. Humidity of inlet air

1.10.1. The exhaust air going to the biofilter is relatively humid, coming from directly above the waste storage bays.
1.10.2. Should the humidity drop, the biofilter can be watered if required.
1.10.3. Wood chip media is very resistant to drying, especially as the air will be at ambient temperature.
1.10.4. However, should media drying become an issue, it is possible and practical to place atomisers into the exhaust air stream between the fans and plenum if needed. These can be timer controlled to give the cover required.

2. System Design & Construction Rationale & Notes

To be read in conjunction with the biofilter design drawings

2.1. Civils Works (Walls & Floor)

2.1.1. The walls and floor construction use the neighbouring building for support on the northern wall.

2.1.2. The walls are to be constructed using precast concrete panels, supported by steel columns. This is an efficient, effective method of instruction.

2.1.3. The floor will be profiled and cast on the main site surface to provide foundation support. The floor profile will promote drainage to the installed pumped drainage system.

2.1.4. All the civils works will follow the design of the project civil engineers.

2.2. Biofilter Floor

2.2.1. Floor to be cast concrete, with sealed expansion joints as required.

2.2.2. Floor to be flat, although minor fall is acceptable.

2.2.3. Floor level within biofilter to be c.330mm lower than site floor.

2.2.4. Floor design to be similar to site floor.

2.2.5. Design of floor and foundations for panel walls to be confirmed by Patrick Parsons.

2.3. Biofilter Wall Concrete Panels

2.3.1. Walls to be formed of 5m long x 1.5m high precast concrete panels, as used within main barn structure.

2.3.2. Wall panels to be 150mm thick.

2.3.3. Panels to be sealed (using Sikaflex or similar) top, base and sides to prevent air and moisture leakage.

2.3.4. Concrete panel retainer tags to be welded to column wherever possible and weld painted with galvanising paint.

2.3.5. Corner fixing methods for panels to be confirmed with building contractor. See attached drawings.

2.4. Biofilter Wall Steel Support Columns

2.4.1. Steel supports to be formed using 203 x 203 x 46kg/m Universal Columns. Columns to be galvanised.

2.4.2. Column and foundations to be as per attacked Patrick Parsons design.

2.4.3. Spacing to comply with bay spacing of Depack Barn.

2.4.4. Handrails to be bolted to column web to ensure 2 horizontal rails and a minimum top rail height of 1.2m above the biofilter media surface.

2.5. Personnel access to Biofilter Surface

2.5.1. Access is required for regular biofilter inspections.

2.5.2. Handrails to be placed around the edge of the biofilter (Interclamp or similar system).

2.5.3. Access to top of the biofilter to be by suitable permanent access ladder.

2.6. Biofilter Plenum and Drainage System

2.6.1. The plenum across the base of the biofilter will be built using either soakaway crates or biofilter air floor sections. These provide a good method of providing a stable base for the biofilter and facilitating even air dispersal across the base of the biofilter media.

2.6.2. The plenum system requires a minimum load bearing capacity of 40tonnes per sq.m. to allow for machine cleaning.
2.6.3. If soakaway crates are used, they must be covered with 1 layer of 15mm geotextile mesh to stop biofilter media falling into plenum

2.7. Biofilter Drainage

2.7.1. The drainage system to comprise a pair of 225mm dia. effluent pipe with 4 drain points along centre line of the biofilter.
2.7.2. Installation & fall as per standard sewage pipe.
2.7.3. Each drainage line is to be provided with a cleaning/rodding access at each end of the filter.
2.7.4. The pipes discharge into a pumping chamber. This pumps to the depackaging shed drainage system. It can be located at either the eastern or western end of the biofilter.
2.7.5. The pump and rodding chambers are all to have sealing lids to prevent surface water ingress, odour egress or air bypass from biofilter.
2.7.6. The pump chamber can be a standard preformed sewage or effluent pumping chamber of c.2.0cu.m. will suffice.
2.7.7. Chamber access to be sealed and bolted down to prevent
2.7.8. The pumping pipe from the chamber to the shed drainage system to comprise a 3" Black HDPE, laid as per standard practise.

2.8. Ducting

2.8.1. The vertical ducting for the biofilter must be formed using a single 2.6m length of twin wall culvert pipe (polypipe or similar) - 1.2m in diameter. This is proof against the moist air and is also strong enough to accommodate the vertical loading of the fan system and the horizontal pressure of the biofilter media.
2.8.2. The vertical twinwall pipe will sit on 30mm thick HDPE base plates, 1.5m x 1.5m in size, with a 1100mm dia hole cut through the centre of the plate to spread its weight on the underlying plenum. The ducts are to be bolted to the base plate using brackets formed from 75mm x 10mm stainless angle - 8 brackets per duct base.
2.8.3. The ducts are to be braced back to the building wall with two 50mm galvanised box section steel braces at 250mm from base and c.250mm from top of duct. Brace construction shown in drawings.
2.8.4. Resting on the top of the vertical twinwall pipe will be an adapter section of air ducting to carry the weight of the fan and air ducting system.
2.8.5. All ducting above the adapter section will be standard pressed steel galvanised ventilation ducting to facilitate easy replacement, maintenance and sourcing of the system.
2.8.6. Apart from the adapter section, all items in the air ducting and fan system will be standard units to ease supply and maintenance. Fan mounting adapter to vertical duct to be fashioned by fan/ducting supplier.
2.8.7. Ducting is drawn to 1m x 1m size with 900mm dia. fans. However, final sizes to be determined by supplier to give most efficient performance for overall system.

2.9. Building Outlet Vents

2.9.1. The air ducting enters the building through a set of louvres protected by grills to stop rubbish being drawn into the ducts themselves and damaging the fans.
2.9.2. The louvres also help cut down noise caused by air entering the duct and from the fan itself.

2.9.3. Within the duct is a non-return baffle, before the 90^{o} bend to take the duct down to the fan. This is to stop any exhaust returning back up the duct should a fan fail.

2.9.4. Should a fan need to be removed for maintenance, a flat blanking plate will be placed over the top of the adapter plate when the fan is removed to stop the plenum exhausting through the open vertical duct.

2.9.5. The depackaging shed outlet vents are located straight above the waste storage bays to ensure that the most concentrated odour are dealt with right at source.

2.10.Building Inlet Vents

2.10.1. The nine 750mm x 750mm inlet vent lourves are set into the depackaging shed along the northern side of the barn, 1 vent per bay. They are smaller in area than the outlet vents to ensure coverage when the vehicle doors are opened.

2.10.2. These vents will each have non-return baffles to ensure that once air is in the shed, it stays in the shed until exhausted through the biofilter.

2.10.3. The non-return baffles also ensure that, should a vehicle door open into the wind, the incoming wind will not exit the depackaging shed through the inlet vents but actually work to assist the flow of exhaust air through the biofilter.

2.10.4. The building intel vents will be grid protected to prevent damage to the non-return baffle installed in each vent.

2.10.5. There will also be other intakes around the barn but these will be determined once the final plant placement and size is determined so there is no gas or odour pooling within the building.

2.11.Fans & Their Controls

2.11.1. The fan system is sized to ensure that the airflow through the building is sufficient to provide the minimum of 3 air changes, as required by BAT.

2.11.2. The 5 fans, each of 20,000cu.m. per hour capacity, will provide 5 air changes per hour. This gives has a measure of redundancy and also ensures that the building will always have an inwards airflow when the main vehicle doors are open.

2.11.3. The system has separate fans, so 2 may be down at any one time and the system will still maintain the required level of air flow through the building.

2.11.4. The fans will be axial, duct-mounted units. The fans should be specified for extreme duty and the motors sealed for wet air operation.
If possible, the motors should be out-of-airflow.
Due to the size of the vertical twinwall duct, fan diameters of c.900-1000mm will be possible.

2.11.5. Fan cowls will be constructed of galvanised steel to ensure longevity without excessive cost.

2.11.6. Fan blades should be either heavy duty plastic, coated cast aluminium or stainless steel to avoid excessive damage or corrosion due to moist air or particulates.
Care should be taken to ensure the fans do not become unbalanced through damage to the fan blades.

2.11.7. The fans should be equipped with inverters to allow efficient control of each unit's speed and utilisation. The locations of these drives is to be agreed wit the electrical installation contractor.

2.12.**Biofilter Media**

2.12.1. Biofilter media to be formed of chipped or shredded clean wood.

2.12.2. Seasoned timber will allow for longer periods between cleaning as it takes longer to break down.

2.12.3. Media to be 30 - 50mm screened with no fines.
2.12.4. MTP to inspect and approve media prior to use.

2.13.Irrigation System

2.13.1. The biofilter requires an irrigation system to be installed to wet the surface of the filter, should it be required.
2.13.2. All the system needs to comprise is a set of small horticultural irrigators, supplied by temporary water hoses that can be removed in winter to prevent frost damage.
2.13.3. The system should be provided with enough irrigators to ensure adequate coverage for the whole of the surface of the biofilter media.
2.13.4. The system should also be provided with a timer control system to prevent people turning the system on and then forgetting to turn it off again.
2.13.5. Different atmospheric conditions will require different watering rates and regimes. These will be determined by the site operatives through observation of the biofilter media condition.

2.14.Misting System

2.14.1. Water atomisers can be mounted within the top of each vertical twinwall duct, below each fan.
2.14.2. Mounting in this location will ensure that the mist gets to the media, as required, without causing damage to the fans.
2.14.3. All the ducting, plenum and contact surfaces from this point onwards will be proof against contact with the moisture-laden air.
2.14.4. This can be used to add moisture to the air feed into the biofilter media if required.
2.14.5. This system also should be fitted with a timer control system to prevent it being inadvertently left on.
2.14.6. This system should be used sparingly, for short periods with long rests in between. Excessive use will cause the lower section of the biofilter media to rot, settle, generate fines and block. This will seriously impede airflow, harm the efficiency of the filter and necessitate changing the media a lot more often.

2.15.Air Control Within Building

2.15.1. To reduce uncontrolled airflow, the building should be sealed as far as is practical.
2.15.2. The main doors should be fast action units to reduce open time and chance of uncontrolled exhaust.
2.15.3. Personnel access doors should be fitted with auto-closure mechanism.
2.15.4. Eaves and changes in cladding should be sealed to be draught proof as well as vermin proof.
2.15.5. Once the Depacking Shed is operational, with waste being processed and plant in place, then the internal air flow will be assessed to ensure no eddies or pooling occurs.
2.15.6. This assessment will allow the placement of small air movers on processing plant and/or small extra inlet vents in the gable ends of the building, if required.
2.15.7. The intention is that these extra measures stop any eddies or pools being generated within the building and so causing localised build-up of odour.
2.15.8. These measures are to be assessed and reviewed regularly to ensure no changes of process or layout within the building cause potential issues.

3. Media selection rationale

3.1. Demonstrate adequate residence times

3.1.1. The system has an EBRT of 43 seconds.

3.1.2. With the specified wood chip media and the reduced odour loading of the exhaust air, this EBRT will be more than sufficient for this installation.

3.2. Sufficient sorption capacity for contaminants and microbiobial attachment

3.2.1. By its nature physical nature, woodchip has excellent sorption capacity and microbiobial attachment characteristics.

3.3. Living space and reserve nutrients for micro-organisms

3.3.1. Woodchip media has excellent living space for bacteria, due to the inherent rough surface and pores available within the media.

3.3.2. The media also provides an intrinsic source of nutrient for the bacterial colony through its organic nature and also as it slowly degrades.

3.4. Media water/moisture content – 50 to 80% by weight

3.4.1. The moisture content of woodchip is around 50% when unseasoned wood chip is used.

3.4.2. Seasoned woodchip has a lower water content but the water is at the surface of the woodchip, so bacteria can utilise the moisture whilst living on a stable core of material.

3.5. Structural support to maintain internal structure

3.5.1. Woodchip is light and its particle shape means that the media will lock, so preventing compaction and maintaining void space.

3.5.2. Woodchip is also strong enough to self-support at depth, maintaining the void space required for the successful operation of the biofilter.

3.6. Media temperature – near ambient – 15- 35 or 40ºC

3.6.1. Properly maintained and monitored woodchip media does not self-heat or readily compost, so the temperature of the media remains at ambient levels.

3.7. Media pH – 7 to 8.5

3.7.1. Woodchip media has a relatively neutral pH, as required.

3.8. Biologically active, but reasonably stable

3.8.1. The media is biologically active due to its nature and maintained colony.

3.8.2. It is also reasonably stable due to the colony existing on the surface of the particle, rather than through its core.

3.8.3. The mass and nature of the media also imparts physical and environmental stability to the biological colony.

3.9. Organic matter content >60%

3.9.1. Woodchip biomedia is of over 90% organic matter content, higher if virgin material is used.

3.10. Porous and friable with 75 to 90% void volume

3.10.1. Woodchip biofilter media is both porous and friable by nature.

3.10.2. The media also has a very high void volume as required by BAT and successfully demonstrated by the use of the material as biofilter media through the UK.

3.11. Resistant to waterlogging and compaction

3.11.1. Woodchip media does not self-pack or compact under its own weight as some other media is liable to do.

3.11.2. As the material is relatively light, and has a rough surface, it can self-support its own void space as it locks together.

3.11.3. Should the humidity drop, the biofilter can be watered if required.

3.11.4. Due to its high void space, the material will also self-drain relatively easily.

3.12. Relatively low fines content to reduce gas head loss

3.12.1. The media will be screened prior to use, so removing fines from the biofilter.

3.12.2. The lower 1m will be of courser grade to further assist with air dispersal through the media and reducing blocking or tracking.

3.12.3. Woodchip biofilter media is also relatively slow in generating fines from its own degradation with time.

3.13. Relatively free of residual odour

3.13.1. Woodchip media has no residual odour.

3.13.2. Should any residual process odour occur, the natural resins in the media will assist in countering any residuals.

4. Inspection and maintenance procedures

4.1. Parameters to be checked and inspection frequency

4.1.1. Daily &/or Weekly Inspection Regime

4.1.1.1. Fans

Are they operating? If they aren't – why not?

The fans should be completely free from vibration and metallic noise.
If there is noise or vibration, find out why & rectify.

The fans should have no visible damage to the casing or motor

4.1.1.2. Biofilter Ducting

The ducting should have no damage, leaks or blockages.
Any such should be recorded and rectified.

Any misting system installed below (downstream) of the fans should be checked for operation.

4.1.1.3. Biofilter Media

The media should be free from matting, surface holes, dust or weeds.

It should have no visible venting (holes) or tracking (wet or dry patches or noticeable draughts at surface).

It should not be visibly too wet (saturated) or dry to the touch. The woodchip should be damp at surface but not soaked.
Whilst over wetting at surface due to precipitation may appear to be a problem, this will rarely descend more than 300mm into the media and so will not be a major issue.
Should the media be too dry (dry to touch) at around 300mm deep, then the biofilter should be irrigated as necessary to maintain the efficiency of the bacterial colony.

The media should be temperature probed once per week, at 10 differing locations and at depth of between 300 – 1000mm.
The media temperature should be close to ambient. Some rise or fall is allowable in summer and winter.
Should the media show a temperature of >50^{o}C, then a full suite of temperature probing must take place (a 2m x 2m grid across the biofilter) at depths as above to ascertain the extent of any localised heating.
Should this be discovered, refer to Section 4 below.

The media irrigation system should be checked for operation and leaks and any issues noted and rectified.

Any such action should be recorded.

4.1.1.4. Biofilter Drainage System

The drainage system should show no evidence of leaking or blockages.
Any such should be recorded and rectified.

4.1.1.5. Biofilter Structure

The structure of the biofilter should be checked for damage from impact or degradation.

There should be no visible air bleed from the plenum out through joints in the wall structure.

Any such should be recorded and rectified.

4.1.1.6. Depackaging Shed Odour Control

Inspect all grids, one-way louvres, fans and air movers.

If they are blocked, damaged or not working properly, they should be rectified and the action recorded.

4.1.2. Monthly Inspection Regime

As per the daily and Weekly Inspection Regime, the following should be undertaken with only 2 biofilter fans operating to reduce the air pressure in the plenum.

4.1.2.1. Fans

Check inverter operation if fitted.

4.1.2.2. Biofilter Ducting

Open ducting inspection hatches and inspect duct interiors.

4.1.2.3. Biofilter Media

Dig four 600mm deep check pits in the biofilter media to check for sub-surface blocking, soaking, drying or excessive fines.

4.1.2.4. Biofilter Drainage System

Open the drainage system pumping chamber covers to check for airflow into the chambers (so proving the filter discharge clear), condition of the chambers and the pumps.

4.1.2.5. Biofilter Structure

As per the daily and weekly checks.
Any issues should be rectified.

4.1.2.6. Depackaging Shed Odour Control

As per the daily and weekly checks.
Pooling, eddies and odour hot-spots within the building also need to be checked for.
With all systems in operation, an operator (or external consultant) must walk round the barn with a calibrated gas monitoring set.
The operator (or consultant) will check for any noticeable odour hot-spots whilst the monitoring set will detect raised levels of gas present.
Should this occur (and dependant on the location or operation), extra small air movers (or vents if close to the building wall) may be required to break up the pool.

Any issues should be rectified.

4.1.2.7. Depackaging Shed Structure

The structure of the Depackaging Shed should be visibly checked for damage or openings due to age, weather damage, etc.

Vehicle doors and doors into offices and non-odour control areas should be checked for closing and sealing efficiency.

All airflow into the building should be controlled to assist the deodorising system as much as possible.

Any issues should be rectified.

4.1.3. 6 Monthly Inspection Regime

As per Monthly Inspection Regime as well as:

4.1.3.1. Depackaging Shed Structure

The overall seal of the Depackaging Shed structure and the effectiveness of the air flow system should be checked on a quarterly basis.

This may be done in 1 of 3 ways:

1. Seal all louvres and openings to non odour-controlled areas, seal all doors, pressurise the shed using a big impeller fan mounted in one of the vehicle doors and check the air pressure increase between the interior and exterior of the building.
   Should no pressure difference occur then the fabric of the building must be investigated and rectified, and the test repeated to prove air tightness.
   This must be undertaken by an external consultant and renders all odour management systems within the shed redundant for the period of the test, when the shed actively pressurised.
   Once the test has been completed, remove all the test equipment, unseal the louvres, doors & openings and recommence waste processing.

2. Seal all louvres and openings to non odour-controlled areas, seal all doors, exhaust the shed using a big extractor fan mounted in one of the vehicle doors and check the air pressure decrease between the interior and exterior of the building.
   Should no pressure difference occur then the fabric of the building must be investigated and rectified, and the test repeated to prove air tightness.
   This must be undertaken by an external consultant and renders all odour management systems within the shed redundant for the period of the test, when the shed actively being exhausted by the fan.
   Once the test has been completed, remove all the test equipment, unseal the louvres, doors & openings and recommence waste processing.

3. Leave the building and biofilter operating as normally, turn off all waste depackaging and processing plant, turn off the fire alarm system (fire marshals may be required), close and seal the vehicle doors and any other openings to non odour-controlled areas.
   Discharge the required number of proprietary smoke markers (Enola Gay or similar make) within the barn, sufficient to give a good, distributed smoke cloud within the building.
   The markers should be regularly across the building floor and a bright colour (blue, purple or red) should be chosen.
   Once the smoke markers have been set off and the smoke is developing, walk around the outside of the building with a camera. Any breaks in the

fabric of the building that allow draughts out will be shown up by tell-tale smoke wisps, visible outside.
Do not undertake this test in the rain or any smoke markers will not be visible.
Photographs of the outside of the building should be taken during the test to prove the building fabric and mark any areas for repair.
Once the fan systems have cleared the smoke, turn the fire alarm system back on and recommence waste processing operations.

All 3 test methods are satisfactory but method 3 allows the odour control system to remain active during testing, is less disruptive to operations and can be carried out without the use of external consultants. It is also much more of a real-world test that attempting to pressurise or exhaust the Depackaging Shed.

The tests must be recorded and any findings or rectification works noted within the site maintenance diary.

4.1.3.2. Biofilter Efficiency

The inflow and exhaust to & from the biofilter can be sampled to check o the efficiency of the system if this is required as part of the site Permit.
It has to be undertaken by an external consultant and requires air samples to be taken immediately before and after the filter.
This testing gives a measure of objective analysis of the biofilter's performance but should not be required if the filter is monitored and maintained properly.

4.2. Critical limits and actions in the event of non-compliance

4.2.1. The system is very simple and robust. Due to the higher airflow and low intensity odour source the odour loading on the biofilter will be relatively low.

4.2.2. Highly proscriptive, technical critical limits are not required for this system, apart from monitoring the media temperature, moisture content and surface condition, the monitoring required will be kept simple to assist the site to carry out its own checks as required.

4.2.3. Any intervention required for the biofilter should be kept as simple & low impact as possible to maintain the bacteriological colony within the media at good population levels.
Heavy handed or excessive media changes or the thoughtless use of heavy machinery on the filter media pack will harm the performance of the filter to a great extent.

4.2.4. The best, most effective and simplest check on the performance of the biofilter is for a site operative to walk the whole of the surface of the filter once a week as the first duty on shift, checking the condition of the surface of the filter media and whether any odour is apparent within the exhaust from the filter.
Walking the filter surface as first duty will ensure the operative's nose is "fresh" and so give the best check.
Traces or patches of odour above the filter will denote possible tracking within the filter, whilst a general scent across the whole surface will denote media that is too dry or is beginning to compost. Too much to be effective and requires changing (see section 4).

4.2.5. Media temperature should be monitored using a compost temperature probe, as set down in the maintenance checks above.
Temperatures within the media should be noted against their rough locations within the media bed.
These temperatures should be referenced to ensure the temperature within the media is not moving too far away from ambient.
A temperature increase well above ambient will denote the media is beginning to compost.
A temperature drop will denote the media has become anaerobic due to blocking through excess fines or dust and is biologically dead.
Both the above changes will necessitate a change and blending of the filter media.
With woodchip (especially seasoned woodchip) it would be expected to have the change some of the media, blending the remainder, approximately once every 3 years, depending on loading, media, maintenance and weather conditions.

4.2.6. Media moisture content should be assessed by visual inspection at surface and at c.600mm depth.
Unless during a period of heavy rain, the surface tends to be the driest part of a biofilter media pack, but still should be checked as a guide to conditions below.
At around 600mm depth, the conditions have become more uniform and will be indicative of the depth of the biofilter below.
The media should be excavated and a sample taken at depth. Only a handful of pieces are required.
These pieces should be squeezed to check what moisture is present on the particle's surface.
They should feel wet to the touch but not spongy or saturated.
Some discolouration is to be expected (woodchip media rapidly goes black in operation).
Most of the moisture content within woodchip biofilter media will be at the surface, especially when the media is comprised of seasoned woodchip.
If the particles are broken up and drier material lies at their centre, this is not an issue.
However, if the media sample is dry to the touch, the irrigation and/or misting system should be used for a set period each day and the condition monitored.
If the material is too wet, then any irrigation or misting system should be turned off.
The biofilter watering system should be checked for leaks.
The fans should be turned off and the inspection hatches in the ducting should be opened to look down through the blades to check that the biofilter base is not awash due to blocked drainage.
The drainage system should also be inspected to ensure there is no pooling at the base of the biofilter.
All 5 fans should be run continuously and the situation monitored.
If the media is saturated within the middle of a very wet winter, then the measures above will be enough o maintain the biofilter's performance through the winter and the media will dry as the weather improves.
However, if the media is saturated during the drier months, this means that the lower levels of the media are choked and the airflow is not easily passing through the media, so not evaporating moisture from the surface of the media. Should this occur, then the media will need to be partially changed and blended, as set out on Section 4.

4.2.7. The surface condition of the media should be monitored whenever the biofilter is walked over.
Choking, tracking or weed growth can be easily detected during a walk over. Surface matting and weeds should be removed and the local area forked over to reduce any sub-surface choking.
When the inspection pits are dug, matting should be checked for just below the surface. If this is present, then forking over the surface of the biofilter to break this up is all that is needed.
Deeper matting, heavy composting or severe degradation of the media will require a partial change and refreshing of the pack. Please see Section 4 for this.

5. Media renewal

5.1. Wood Chip Media Source

5.1.1. The wood chip media may be formed from either shredded or chipped clean timber. The term “Wood Chip” here is taken to mean either.

5.1.2. The media may be formed from either seasoned or unseasoned wood.
Seasoned wood composts more slowly and so prolongs the life of the biofilter bed between media changes.
Seasoned wood also has less moisture within the particle and so is slower to rot, maintaining structure more effectively.

5.1.3. The media will need to be screened before use to remove fines and prolong the media life.
If shredded wood is used, a screening trial must be undertaken to determine the optimum screening grades for the media.
A screening trial should also be undertaken for chipped wood media before use, to ascertain the final characteristics of the media pack.
The lower 1m of the biofilter will be formed of a coarser blend than the top 2.5m of the media pack. This will prolong the life of the filter pack as the lower 1m will take longer to clog with fines washed from above.

5.2. Wood Chip Media Changing Frequency

5.2.1. The media should only be changed when necessary. It is vital that the bacterial colony within the filter media be maintained in as good a condition as possible to maintain the biofilter’s performance.

5.2.2. The media should only be changed when it is choked to the point that air flow is not possible and odour is apparent above the filter, as are signs of tracking and venting from the media.
This will occur if the media begins to choke with fines, so blocking the void space.
This may also occur if the media starts to self-compost, so softening and losing structural integrity to the point that the settlement so caused obstructs air flow through the media.

5.2.3. If the media becomes saturated and anaerobic, it will also settle and choke and so will need changing if this happens.

5.2.4. As long as the media is maintained in a good condition and the airflow is maintained, so slowing degradation, the media should require a partial change at around 3 years after commissioning and a full change 6 years after commissioning.

5.2.5. This prediction depends on the media internal environment, weather conditions, odour loading, airflow characteristics and biofilter maintenance.

5.3. Wood Chip Media Changing Method

5.3.1. Media can be changed using a small (c.1.5tonne) low ground pressure 360^{o} excavator, lifted onto the top of the biofilter. This can be used to remove the media from within the filter bed in a controlled manner.

5.3.2. Media should be moved from around the vertical ducts only by hand. No excavator should work close to the vertical ducting in case of damage to the duct or fan system.

5.3.3. Care should also be taken when working close to the biofilter walls to prevent impact damage to the seals between the concrete panels.

5.3.4. The excavator should always work on top of a bed of at least 1.5m of media to prevent damage to the plenum from track and excessive compaction and matting.

5.3.5. Due to the nature of woodchip media, it can be handled by excavator with little compaction as long as the excavator works from the bed of media. Any compaction will only affect the top 300-500mm of media and then only mildly. The excavator should also work “backwards” breaking up any compaction as it goes.

5.3.6. When removing media, it should be cleared down to 300mm above the plenum to prevent damage, with the excavator working from a suitable pad. The fresh replacement media can then be added to this remainder and be blended with it to build up the media.

5.3.7. The upper biofilter media is to be made up of graded woodchip, to the specification as agreed with MTP.

5.3.8. Apart from when first loading the biofilter, any replacement biofilter media is to be blended 10:1 with media removed from the biofilter to provide a bacterial seeding for the new filter. The blending can be undertaken using machine bucket before loading into the biofilter. Loading and blending can be undertaken using a telehandler, feeding to the excavator within the biofilter.

5.4. Wood Chip Media Disposal

5.4.1. As long as the media is from a virgin wood source, it may be used as a mulch with no detrimental effects to the environmental, flora or fauna.

5.4.2. If any residual odour remains from the biofilter duty served, the media may be composted for a few weeks prior to use as a mulch.

5.4.3. To promote successful composting, it should be treated as any other green waste – blended, turned and monitored – to ensure a quality product.

5.4.4. The end-of-life media will perform well as a mulch, be it originally seasoned or unseasoned wood.

6. System Design Calculations

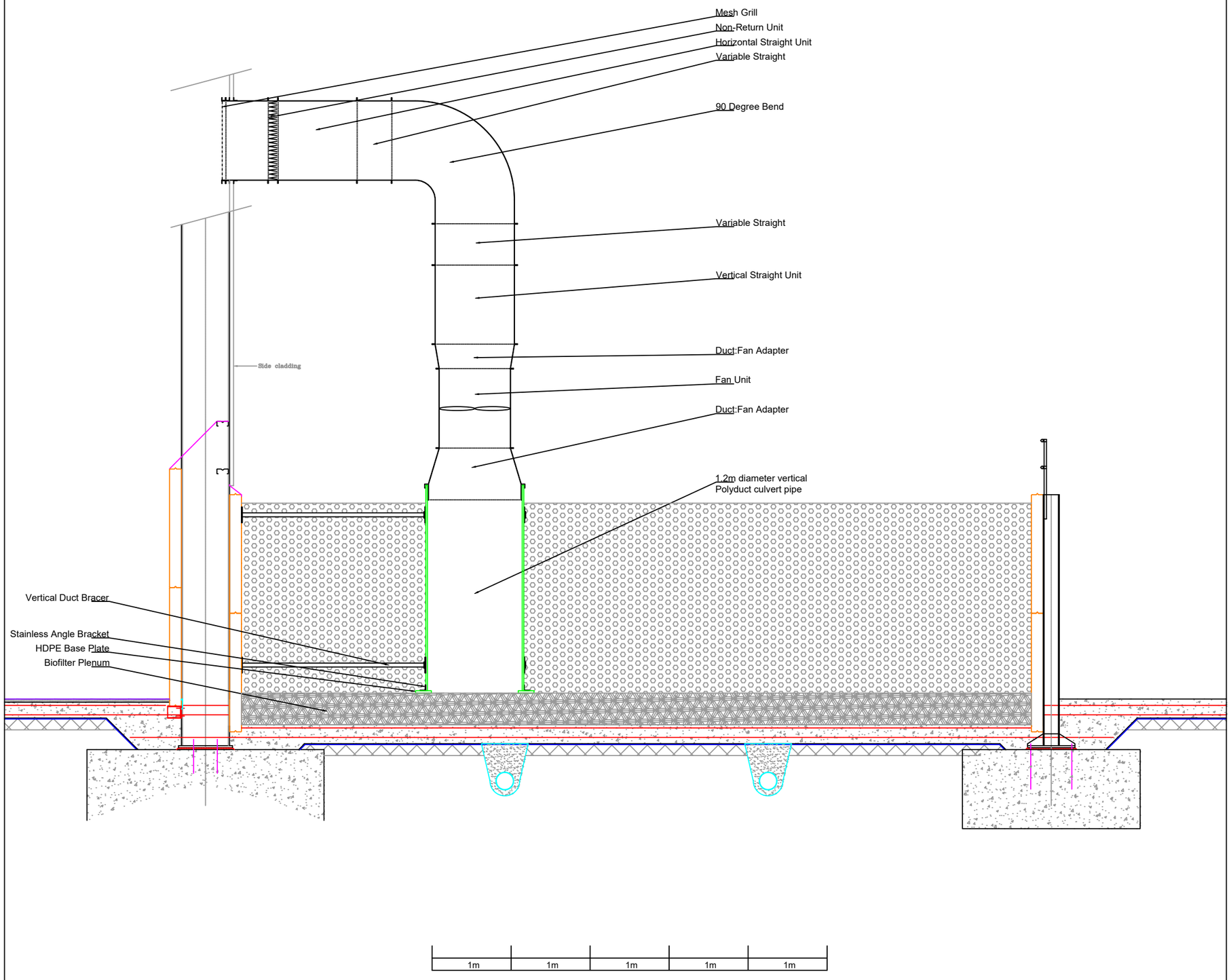
Depackaging Building Dimensions and Volumes	L m	W m	H (Av.) m	Volume m^3
Main Building Envelope	45	30	14.0	18832.5
Lean To Envelope	45	7	7.9	2480.6
Total Building Volume				21313.1
Effective Air Volume for Biofilter Calculations	**18832.5**		**cubic metres**	

Air Flow Requirements		
Effective Air Volume of Building	18832.5	cubic metres
Air changes per hour req'd	5	changes/hr
Air Flow Through Biofilter Per Hour	**94162.5**	**cubic metres/hr**

Biofilter Residence Time Requirement (EBRT)		
Minimum Empty Bed Residence time (EBRT)	43	Seconds

Biofilter Bed Volume Requirement to gain EBRT		
Hourly Air Flow Volume	94162.5	cubic metres/hr
Air Flow Volume per second	26.2	cubic metres/sec
Required Biofilter Volume	**1124.7**	**cubic metres**

Biofilter Dimensions		
Biofilter Media Bed Depth	2.5	metres (Av.)
Biofilter Installation Overall Depth	3.0	metres
Biofilter Length to Match Building	45.0	metres
Biofilter Bed Width	10.0	metres



Notes

Biofilter size:
Length x Width = 45m x 10m +/- 0.2m
Depth = 3.0m minimum

Northern wall of biofilter is southern wall of Depackaging Barn.

Top of biofilter concrete panel walls to be just below level of cladding on Depackaging Barn.

Safety barrier around top of biofilter wall to be formed using Interclamp or similar system. Safe access for weekly inspections also required.

South wall column & foundation incorporate comments from Patrick Parsons - 24/06/19 & 01/07/19.

Depackaging Barn design detailed elsewhere.

Site surface construction detailed elsewhere.

Each vertical duct through media to be formed using a single 2.6m length of 1.2m diameter twinwall Polyduct culvert pipe so as to withstand lateral loading from media.

Plenum formed using a 400mm flat plenum from either Polystorm PSM1 soakaway craates with a layer of 15mm geotextile mesh on top or Hahn plastic biofilter floor units.

Woodchip media to be as specified within construction notes.

For more detail on the construction of the biofilter, please see:
Biofilter Construction Notes - LRBLR19-01-V.01

REV.	DATE	DETAILS	BY
V03	10/07/2019	400mm Flat Plenum	MRT

Ordnance Survey Information:
None supplied.

Date Surveyed:	Surveyed By:	Drawn By:	Approved By:
N/A	N/A	MRT	

Scale: 1:50 on A3

Drawing No: LRBLR19-01 - Biofilter Details - V03CS.dwg

Mike Thompson Partnership Ltd

Quarry Barn, New Road, Temple Grafton,
Alcester, Warwickshire. B49 6NZ.

Tel: 07773 812410

mike.thompson@mikethompsonpartnership.co.uk

www.mikethompsonpartnership.co.uk

Client:
Lower Reule Biogas

Title:
Biofilter Design with flat 400mm Deep Plenum

Project:
Lower Reule Biofilter Design - LRBLR19-01

Appendix 3 Acid Scrubber - Manual

LAMELLA AIR FILTER

DORSET MILIEUTECHNIEK
GULDENWEG 21
7051 HT VARSSEVELD
TEL: 0031 315 640662 **FAX: 0031 315 640668**
info@dorsetbv.nl
www.dorsetbv.nl

1 Introduction

With the purchase of the plant you have made a good choice.
They have an excellent system that has been carefully designed and produced.
You will benefit most from this investment by following the safety, use and maintenance instructions provided in this manual.

Manual

The operating instructions musts be provided to the operator of the system and should be located at the place of use during the use of the system.
The instruction manual must be carefully read by anyone who works with/on the system and follow the instructions.

Liability

Dorset Milieutechniek B.V. is not liable for damage and indirect damage resulting from operating errors, lack of expert maintenance and other use as described below.

Dorset Milieutechniek B.V. guarantees the operation of the plant during one year after delivery, but is not liable for consequential damage to buildings, other machinery and surroundings caused by the installation of any kind.

The Liability of Dorset Milieutechniek B.V. also expires as soon as work such as adjustments or extensions to the plant or accessories is carried out by you or third parties without our written consent.

Dorset Milieutechniek B.V. is constantly working on improving products and services. That's why Dorset Milieutechniek B.V. the right to change the specifications specified in this manual at any time and without prior notice.

Definitions

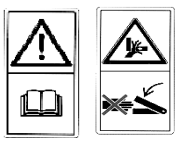
In this manual, it is meant with

Machine operator : The person who operates, controls, supervises and starts and stops the operation, etc.
The company is responsible for the appropriate training and training of the s operator.
Bediener

Dangerous places : Are theparts around the plant bei where you can get injuries.

Maintenance installer : The person who knows the entire system, can adjust the fuses and maintain the system.
The maintenance fitter knows the functions, safety standards and is trained to maintain the system.
The company is responsible for the appropriate training and training of the maintenance personnel.

SICHERHEITSSYMBOLE



At various points in the system you will find standardized safety pictograms (see illustrations).
The upper part warns of a general or specific danger.
The lower part indicates what kind of danger is being warned or what was you need to do. en.

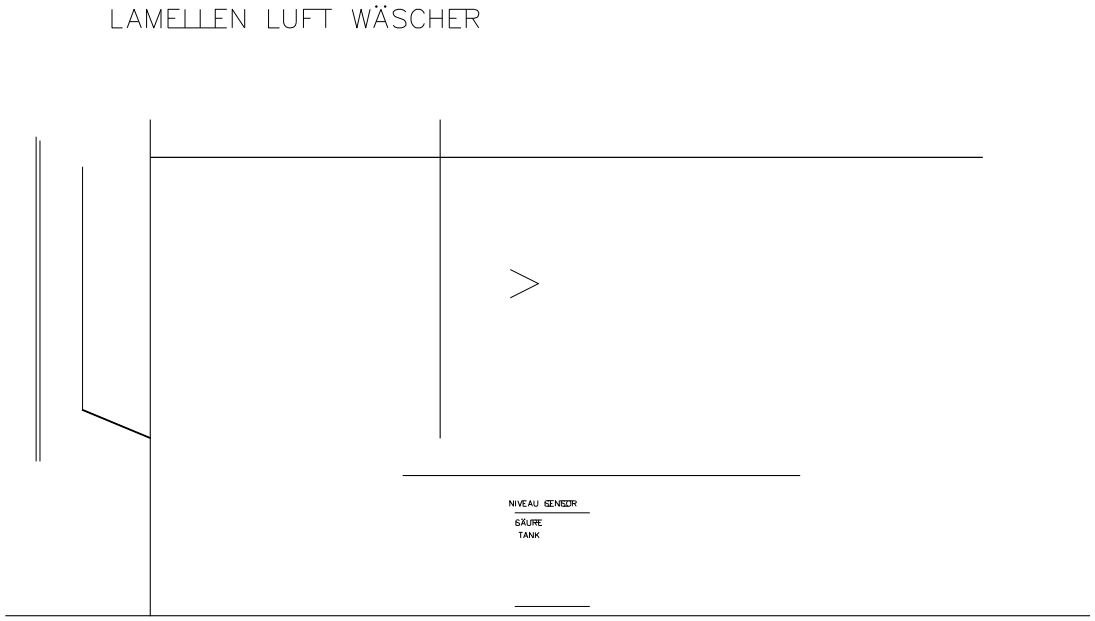
Guarantee

We guarantee the suitability of the items delivered by us with regard to material and/or design defects. Diese Garantie However, this warranty is limited in all cases to the free replacement or repair of the defective part or parts thereof for a period of one year after the delivery date.

Delivery

This product has been designed using Dorset B.V.'s general terms and conditions of delivery and payment. delivered.
For inspection, please contact the district court in Arnhem under number 09067486, according to the last text deposited there.

2 ARBEITSWEISE



- The pump sprays the washing water from the washing water tank via a filter, spray valve and flow meter against and over the chemical washing part (the slats)
- Depending on the level of the sensors, the washing water tank is kept on Levelau, the fresh water is fed from the water supply network via a water valve.
- Depending on the pH value measured from the pH sensor to the pump, the washing water is held to a previously set pH value. The acid pump pumps from the acid tank from sulphuric acid to the washing water tank as required (depending on the pH value)
- After the air leaves the chemical part, verlässt, it comes into a wash-up part consisting of plastic packages (2H plastic GMBH). There, the air is freed by water fromremaining dustparticles, possibly existing sulfuric acid parts, as well as a large part of the odour components.

The controller therefore regulates:

- The periodic spraying of the slats of the chemical washing part
- Keeping the washing water tank at a level
- Keeping the des pH (acid degree) at the level with a pH controller
- Draining the washing water
- Spraying the filter packages of the cleaning part

The slat filter consists of 2 main components: A
the chemical washing part (lamella filter) B
the cleaning part

The barn air is pressed through the above-mentioned filters and leaves the system filtered over the drop catcher, see arrows.

The barn air is passed through the slat filter by fans (not included in this delivery). The sprayers ensure the uniform moistening of the slats with a mixture of sulphuric acid and water.
With set intervals and spray times, the slats are automatically kept moist.
This mixture enters into a compound with ammonia and is bound to a neutral ammonia sulfate.

The effect of the mixture is optimal only at an acidity between pH 0.5 and pH 4.
In order to maintain the acidity level between these values, the pH value is automatically measured and, if necessary, automatically added sulfuric acid by an acid pump.
After 5x inflicting sulfuric acid, the entire contents of the reservoir are e.g. to a silo (does not belong to this delivery).
After removal, the reservoir is refilled with water and sulphuric acid is added up to a
Acidity of pH 0.5.

Due to the combinationof ammonia with sulfuric acid, the pH value rises slowly again.
As soon as the pH again comes back to 4, sulfuric acid is automatically added until the pH value has fallen back to 0.5.

This filtering repeat cycle is automatically controlled.
A pH sensor maintains the acidity level. If the acidity level rises to pH 4, a previously determined amount of sulfuric acid is added.

A pump sprays the mixture from the reservoir via the filter, spray valve and flow meter against and over the filters (slats).
Depending on the level of the sensors, the storage tank is kept at a level, the fresh water is supplied via the water supply.
Depending on the pH value measured from the pH sensor to the pump, the water / sulfuric acid mixture is held to a previously set pH value.

After the air leaves the chemical part, it is put in a wash-up part consisting of plastic packages
There, the air is freed by water von remaining dustparticles, possibly existing sulfuric acid parts, as well as a large part of the odour components.

Appendix 4 Hedonic Scale and Odour Intensity Scale from EA H4

Table A4.1 Hedonic scores for different odour types

Description	Hedonic score
Bakery (fresh bread)	3.53
Coffee	2.33
Hay	1.31
Raw potato	0.26
Rope (hemp)	-0.16
Kippery-smoked fish	-0.69
Paint	-0.75
Mothballs	-1.25
Disinfectant, fresh tar	-1.60
Wet wool, wet dog	-2.28

Table A4.2 Odour intensity scale

Description	Intensity
No odour	0
Very faint odour	1
Faint odour	2
Distinct odour	3
Strong odour	4
Very strong odour	5
Extremely strong odour	6

Source: German Standard VDI 3882, Part 14

Beaufort Scale – Observation based technique for the measurement of wind speed

WIND FORCE	DESCRIPTION	SPEED				EFFECT ON LAND
		KM/H	MPH	KNOTS	M/S	
0	**Calm**	<1	<1	<1	<0.3	Smoke rises vertically
1	**Light Air**	1-5	1-3	1-3	0.3–1.5	Direction shown by smoke drift but not by wind vanes
2	**Light Breeze**	6-11	4-7	4-6	1.6–3.3	Wind felt on face; leaves rustle; wind vane moved by wind
3	**Gentle Breeze**	12-19	8-12	7-10	3.4–5.5	Leaves and small twigs in constant motion; light flags extended
4	**Moderate Breeze**	20-28	13-18	11-16	5.5–7.9	Raises dust and loose paper; small branches moved.
5	**Fresh Breeze**	29-38	19-24	17-21	8.0–10.7	Small trees in leaf begin to sway; crested wavelets form on inland waters.
6	**Strong Breeze**	38-49	25-31	22-27	10.8–13.8	Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty.
7	**Near Gale**	50-61	32-38	28-33	13.9–17.1	Whole trees in motion; inconvenience felt when walking against the wind.
8	**Gale**	62-74	39-46	34-40	17.2–20.7	Twigs break off trees; generally impedes progress.
9	**Strong Gale**	75-88	47-54	41-47	20.8–24.4	Slight structural damage (chimney pots and slates removed).
10	**Storm**	89-102	55-63	48-55	24.5–28.4	Seldom experienced inland; trees uprooted; considerable structural damage
11	**Violent Storm**	103-117	64-72	56-63	28.5–32.6	Very rarely experienced; accompanied by widespread damage.
12	**Hurricane**	118 plus	73 plus	64 plus	≥32.7	Devastation

Information sourced from: The Royal Meteorological Society (https://www.rmets.org/weather-and-climate/observing/beaufort-scale)

Appendix 5 Classification System

Table A5.1 European Waste Catalogue classifications

European Waste Catalogue (EWC) Code	Description
20 01 20 01 08	Municipal Wastes (household waste and similar commercial, industrial and institutional wastes) including separately collected fractions. Separately collected fractions. Biodegradable kitchen and canteen waste.
02 02 02 02 02 03	Wastes from agriculture, horticulture, aquaculture, forestry, hunting and fishing, food preparation and processing. Wastes from the preparation and processing of meat, fish and other foods of animal origin. Materials unsuitable for consumption or processing.
02 02 03 02 30 04	Wastes from agriculture, horticulture, aquaculture, forestry, hunting and fishing, food preparation and processing. Wastes from fruit, vegetables, cereals, edible oils, cocoa, coffee, tea and tobacco preparation and processing; conserve production; yeast and yeast extract production, molasses preparation and fermentation. Materials unsuitable for consumption or processing.
02 02 05 02 05 01	Wastes from agriculture, horticulture, aquaculture, forestry, hunting and fishing, food preparation and processing. Wastes from the dairy products industry. Materials unsuitable for consumption or processing.
02 02 06 02 06 01	Wastes from agriculture, horticulture, aquaculture, forestry, hunting and fishing, food preparation and processing. Wastes from the baking and confectionary industry. Materials unsuitable for consumption or processing.
19 19 06 19 06 05	Wastes from waste management facilities, off-site wastewater treatment plants and the preparation of water intended for human consumption and water for industrial use. Waste from anaerobic treatment of waste. Liquor from anaerobic treatment of animal and vegetable waste.
19 19 06 19 06 06	Wastes from waste management facilities, off-site wastewater treatment plants and the preparation of water intended for human consumption and water for industrial use. Waste from anaerobic treatment of waste. Digestate from anaerobic treatment of animal and vegetable waste.

Appendix 6 Report Forms

LRBE-MP-03 BioDiary Odour Sniff Test Form

LRBE-FT-13 Odour Complaint Form

LRBE-FT-14 Odour Diary

LRBE-MP-03 BioDiary Odour Sniff Test Form

Day	Date	Time of test	Location of test refer to plan	Weather Conditions	Temp (degrees if known)	Wind Strength	Wind Direction	Intensity	Duration (of test)	Constant or intermittent	Describe odour	Receptor Sensitivity	Is the source evident	External activities	Any comments
Monday			1												
Monday			2												
Monday			3												
Monday			4												
Monday			5												
Monday			6												
Monday			7												
Monday			8												
Monday			9												
Tuesday			1												
Tuesday			2												
Tuesday			3												
Tuesday			4												
Tuesday			5												
Tuesday			6												
Tuesday			7												
Tuesday			8												
Tuesday			9												
Wednesday			1												
Wednesday			2												
Wednesday			3												
Wednesday			4												
Wednesday			5												
Wednesday			6												
Wednesday			7												
Wednesday			8												
Wednesday			9												
Thursday			1												
Thursday			2												
Thursday			3												
Thursday			4												
Thursday			5												
Thursday			6												
Thursday			7												
Thursday			8												
Thursday			9												
Friday			1												
Friday			2												
Friday			3												
Friday			4												
Friday			5												
Friday			6												
Friday			7												
Friday			8												
Friday			9												
Saturday			1												
Saturday			2												
Saturday			3												
Saturday			4												
Saturday			5												
Saturday			6												
Saturday			7												
Saturday			8												
Saturday			9												
Sunday			1												
Sunday			2												
Sunday			3												
Sunday			4												
Sunday			5												
Sunday			6												
Sunday			7												
Sunday			8												
Sunday			9												

LRBE-MP-03 BioDiary Odour Sniff Test Form - Continued

Notes for Odour Sniff Test

Odour Sniff Test Locations

1 Site boundary downwind
2 Downwind receptor (if odour detected at 1)
3 Biofilter
4 Entrance to depacking building
5 Exit to depackaging building
6 Door of fibre store
7 Adjacent to drying area / stack

Intensity (Detectability)

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

Location sensitivity where odour detected

Low (e.g. footpath, road)
Medium (e.g. Industrial or commercial workplaces
High (e.g. housing, pub/hotel

Notes

Staff normally exposed to the odours may not be able to detect or reasonably judge the intensity of odours off-site.
Staff performing sniff test should not have a cold, sinusitis or a sore throat.
To improve or to check data quality, use two people to do the test independently at the same time
Those doing the assessment should avoid strong food or drinks, including coffee, for at least half an hour beforehand and should also avoid strongly scented toiletries and deodorisers in any vehicle used during the assessment.

LRBE-FT-13 ODOUR COMPLAINT FORM

Time and date of complaint:	**Name and address of complainant:**	
Telephone number of complainant:		
Date of odour:		
Time of odour:		
Location of odour, if not at 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 NE):		
Complainant's description of odour: What does it smell like?		
Intensity (see below):		
Duration (time):		
Other comments from the complainant:		
Constant or intermittent in this period:		
Does the complainant have any other comments about the odour?		
Are there any other 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 likely to be from your activities?		
What was happening on site at the time the odour occurred?		
Operating conditions at time the odour occurred (e.g. flow rate, pressure at inlet and pressure at outlet):		
Actions taken:		
Form completed by:	Date	Signed

Intensity

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

LRBE-FT-14 ODOUR DIARY

					Sheet No		
Name: Telephone Number:	Address:						
Date of odour:							
Time of odour:							
Location of odour, if not at above address: (indoors, outside)							
Weather conditions (dry, rain, fog, snow etc):							
Temperature (very warm, warm, mild, cold or degrees if known):							
Wind strength (none, light, steady, strong, gusting):							
Wind direction (e.g. from NE):							
What does it smell like? How unpleasant is it? Do you consider this smell offensive?							
Intensity – How strong was it? (see below 1-5):							
How long did go on for? (time):							
Was it constant or intermittent in this period:							
What do believe the source/cause to be?							
Any actions taken or other comments:							

Intensity

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