Odour Management Plan

Anaerobic Digestion Facility, Kirkburn, East Yorkshire

Version 13

Prepared For:

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GWE - Odour Management Plan – August 2023

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1. INTRODUCTION

GWE Biogas Ltd (GWE) operate an anaerobic digester (AD) for the treatment of organic materials, production of biogas and the generation of electricity at Sandhill, Kirkburn, Driffield, East Yorkshire.

The AD plant treats approximately <211,000 tonnes per annum of organic waste and has the capacity to generate up to 4.5MW of renewable energy for export to the national grid (although the plant generally produces around 3.5MWH). Digested material that is produced by the digestion process (digestate) is used as a valuable bio-fertiliser by local arable farming businesses.

The original planning permission for the development was issued by East Riding of Yorkshire Council (ERYC) on the 06/05/2009 (reference: DC/09/00511/STPLF/ STRAT), and included a number of conditions that were to be discharged before development could commence.

Condition 11 dealt with odour and stated:

No development shall take place until a detailed method statement for the assessment and control of odour from any part of the process hereby approved has been submitted to and approved in writing by the Local Planning Authority.
In particular the scheme shall address:

1. *The storage of untreated raw materials at the site;*
2. *Measures to be taken to control odour during the delivery of raw materials and during the handling / removal/ storage of digestate and liquids from the process; and,*
3. *Methodology for dealing with odour complaints.*

On approval the method statement shall be implemented and its provisions maintained for the duration of the development unless otherwise approved in writing by the Local Planning Authority.

This condition is imposed to control odours in the interests of the public amenity of the area.

ADAS were initially appointed by the applicant (GWE) to prepare an Odour Management Plan (OMP) in accordance with this condition. The plan has subsequently been reviewed and updated by WRM, through various issues, with

the first being in July 2017 as consented and approved by the Directors of GWE. GWE will implement the plan in its future operation of the site to ensure that all reasonable measures are taken to ensure that an odour impact is not caused, and, in the event that an impact is caused, then prompt action is taken to identify the source and apply corrective measures.

The OMP has been designed in accordance with Best Available Technology (BAT) as defined by the Environment Agency's Sector Guidance Note IPPC S5.06: Guidance for the Recovery and Disposal of Hazardous and Non-Hazardous Waste (hereafter referred to as IPPC S5.06). The OMP document should be revised on a regular basis (at least annually) throughout the ongoing operation of the plant.

A description of the process and engineered odour controls is included at Appendix 1, along with an assessment of the scope of these measures.

2. PURPOSE OF THE ODOUR MANAGEMENT PLAN

This OMP is a working document, intended to be used as a reference document for operational staff on a day-to-day basis. It provides a schedule of actions that will be taken to minimise odour impact, and details site management procedures for the management and monitoring of odour.

The OMP will be printed and available on-site to the local authority, Environment Agency and all site personnel.

The remainder of this document is structured according to aspects of the operation and management of the proposed site, which are categorised as follows:

- Roles & responsibilities
- Odour Inventory
- Waste acceptance procedures
- Handling and storage of raw materials (Waste Reception Building)
- Processing of waste
- Handling and storage of digestate and biogas

- Transport
- Monitoring and complaints procedure
- Site management
- Contingency procedures

3. ROLES & RESPONSIBILITIES

The implementation of this OMP is the responsibility of the Directors of GWE, supported by the Site Manager and site supervisors. The Site Manager can delegate certain tasks to site supervisors as required, although ultimate responsibility will remain with the Directors.

4. ODOUR INVENTORY

The site operates a waste recovery operation through the anaerobic digestion of source-segregated biodegradable waste to produce quality digestate that will be quality assured to PAS110[1] and the digestate Quality Protocol[2]. The food waste digestion process treats biodegradable materials which have the potential to produce odour.

4.1. Feedstock Inventory

In order to understand the odour potential of the different waste streams that enter these processes, a feedstock inventory has been provided for the various waste types.

Table 1 below provides an assessment of each potentially odorous material, identifying the typical and abnormal compositions of those materials and providing

[1]BSi (2010) *PAS 110: Specification for whole digestate, separated liquor and separated fibre derived from the anaerobic digestion of source-segregated biodegradable materials.* British Standards Institution: London.
[2]WRAP (2009) *End of waste criteria for the production and use of quality outputs from anaerobic digestion of source-segregated biodegradable waste.* Waste and Resources Action Programme: Oxon.

and overall odour potential of that material based upon the likelihood of abnormal compositions being encountered at site.

Table 1 - Assessment of Odour Potential from Feedstock Inventory

Waste Type	Waste Source	Typical Composition	Abnormal Composition	Likelihood	Odour Potential
Food Waste	Commercial	Mixture of different types of food waste in singular form and mixed type.	Mixture of food waste with a high moisture content that is several days old and has started to degrade.	Material is sometimes received from these sources which is several days old.	**Med/High** - Material is often wet and may have already started to degrade given the potential age of material.
	Municipal	Mixture of different types of food waste in singular form and mixed type.	Mixture of food waste with a high moisture content that is several days old and has started to degrade.	Material is typically received from these sources which is several days old.	**High** - Material can be wet and may have already started to degrade given the potential age of material.
Liquid Food Wastes	Commercial	Usually singular liquid food waste with a low solids content.	Singular liquid food waste with a higher organic content that is several weeks old and been stored in anaerobic conditions.	Low potential for large variation between deliveries given the typical source and constituents.	**Low/Med –** Liquid wastes typically have a lower odour potential than solids given the lower organic matter content.
Whole crop silage	Agriculture	Whole crop solid waste.	If material has been deposited for too long, then it may have started to grow mould.	Material is often delivered fresh in a single form. If mould is observed then material will be rejected.	**Med -** Nature of the material means odorous potential is medium as it has some gas generation potential in its natural exposed state.

4.2. Odorous Materials Inventory

In addition to raw feedstock to the AD facility there are materials in process and storage that have an odour potential. This primarily includes digestate as it passes through the system from intake tank, through active digestion and into storage. The storage arrangements and quantities of these materials are identified in the table below.

Table 2 – Odorous Materials and Quantities

Process Stage	Material	Maximum Quantity (tonnes)	Odour Potential/Mitigation
Packaged Solid Waste Reception	Raw solid food waste feedstock	250	Material is stored within a reception building under negative pressure with air extracted via biofiltration.
Clean Solid Waste Reception	Unpackaged solid feedstock materials	250	Material is stored within a reception building under negative pressure with air extracted via biofiltration.
Liquid Waste Reception Tanks	Raw liquid food waste feedstock	430	Material is stored within 3 enclosed liquid waste reception tanks with no free venting to atmosphere under normal operation.
Intake Tank	Prepared food waste ready for digester loading.	85	Material is held within an enclosed tank with no free venting to atmosphere under normal operation.
Primary Digesters 3,4,5 and 7 (for packaged food line)	Food waste fed from the intake tank and actively digested over a typical 52-day residency period.	18,300	Material is digested within 4 enclosed digestion tanks with no free venting to atmosphere under normal operation.
Primary Digesters 1,2 and 6 (for unpackaged clean material)	Non-food waste fed from the mixing pump and actively digested over a typical 59-day residency period.	10,700	Material is digested within 3 enclosed digestion tanks with no free venting to atmosphere under normal operation.
Secondary Digester	Digestate having completed the required retention time during primary digestion	2,500	Material is digested within 1 enclosed secondary digestion tank with no free venting to atmosphere under normal operation.
Storage Lagoon	Liquid wash water from the neighbouring freeze facility.	40,000	Material is of low odour potential from the freeze facility.

Process Stage	Material	Maximum Quantity (tonnes)	Odour Potential/Mitigation
Silage Clamp	Whole Crop silage	15,000	The potential for odour emissions from the silage is low as material is sheeted and kept airtight.

5. WASTE ACCEPTANCE PROCEDURES

5.1. Pre-acceptance procedures

The site operator issues to all potential waste suppliers, clearly defined categories of waste that can and cannot be received by the site as set out by the waste codes listed in the Environmental Permit.

From all potential waste suppliers, the following information is obtained prior to the entering into any formal agreement to receive waste at the site:

- The nature of the process producing the waste;
- The composition and form (e.g., liquid, solid etc) of the waste;
- Typical quantities; and,
- Duty of Care requirements, such as the waste's EWC code and APHA category.

Where insufficient information on the waste characteristics exists, the site operator arranges for a sample of the waste to be taken and tested or analysed to verify it's suitability for acceptance by the site.

Where necessary, such as situations where the characteristics are not fully known or insufficient data is available, a representative of GWE visits the premises of potential waste suppliers to verify the suitability of the proposed waste stream prior to an agreement for the site to receive it being reached.

5.2. Waste acceptance

The reception of waste input is the first activity with the potential to produce odour. All waste that is received is handled in accordance with IPPC S5.06, indicative BAT requirements for acceptance procedures when waste arrives at the installation.

This includes the following best practice measures:

- The site operators ensure that capacity is available on-site before accepting waste. Waste loads are booked in to site prior to arrival to ensure capacity is available.
- Upon arrival, loads are not accepted unless they are weighed; sufficient storage capacity exists; the facility is adequately manned; and all documents are checked and approved, or any discrepancies resolved.
- A unique reference number (weighbridge ticket) is applied to each load as part of the process tracking/auditing system.
- The site operators ensure that waste delivered to the installation is accompanied by a written description of the waste.
- Visual inspection is conducted, where possible, before offloading or carried out or immediately upon offloading. Note that visual inspection, prior to offloading, is not be carried out if doing so is likely to lead to emission of odour due to the exposure to the air of enclosed or sheeted wastes.
- Following inspection, solid wastes are unloaded into the respective dedicated reception area inside the reception/mixing buildings. Liquid waste is discharged directly into holding tanks via hose connections and at no point is liquid waste exposed to the atmosphere.
- The site operators follow clear, unambiguous criteria for the rejection of wastes, together with a written and computerised procedure for tracking and reporting such non-conformance, including the notification of the customer/waste producer and the Environment Agency.
- If wastes fail to meet the acceptance criteria, which includes heavily decomposed and/or malodourous properties then such loads are not accepted and are rejected before tipping.

6. TRANSPORT

6.1. Deliveries to the site

All deliveries of material to the site is in either enclosed tankers, or sealed and / or sheeted HGVs. This is to control fugitive emission of odours during transport.

Vehicles are not un-sheeted or unloaded until they have entered the reception building and the rapid roll doors have been closed.

Pea wash water from the neighbouring vegetable facility is delivered via underground pipes and is stored in a lagoon on site.

7. HANDLING AND STORAGE OF RAW MATERIALS (WASTE RECEPTION BUILDING)

7.1. Waste handling and tipping

Solid waste materials are transported to and tipped inside the respective reception/mixing buildings by waste vehicles for preparation prior to processing. This involves de-packaging of waste if necessary and the loading of waste into the digester feed hopper. This is potentially the most odorous part of the process due to the transfer, agitation and mixing of waste. For this reason, this aspect of the process takes place within sealed waste reception buildings with air extraction to a biofilter (more detail in following sections). The buildings are maintained under negative pressure and is equipped with automated doors.

Odour production during waste reception and preparation is minimised by processing the waste as soon as possible after it arrives on site to reduce the amount of waste stored, and to avoid the development of odorous conditions within the waste. In the event that the temporary storage capacity within the reception buildings are exceeded then no more waste is accepted until the stockpiles are cleared.

Routine high standards of housekeeping will be maintained. This will include:

- Prompt clearance of any spillages;

- Maintenance of roadways and turning areas to make good any potholes and avoid pooling of water;
- High standards of cleanliness and hygiene within working areas;
- Regular and high-quality maintenance to all plant and equipment;
- Vehicle washing; and,
- Site litter picks.

Liquid wastes are fed directly from the reception tanks into the digestion feeding (packaged) line and at no point in this feeding process are liquid wastes exposed to the atmosphere. Any air purged from the liquid feed reception tanks and/or connecting pipework is passed through the on-site biofilter prior to release to atmosphere, thereby minimising any odour.

7.2. Ventilation and Odour Abatement Plant Design

The packaged food reception building is 14,600 m^3 in volume (gross), meaning that a ventilation rate of 12.17 m^3/s is required to achieve the target ventilation rate of three air changes per hour. This ventilation will be targeted with higher rates of localised odour extraction over the higher odour risk plant within the building, to provide enhanced control of potential fugitive emissions, as set out in Appendix 1.

The clean (unpackaged) reception building is approximately 5,750m^3 in volume (gross), meaning a ventilation rate of 4.79m^3/s is required to achieve the target ventilation rare of three air changes per hour ((5,750 x 3) / 3600)). The building is square shaped with a floor space of approximately 500m^2, measuring 22.37m in width and 22.39m in length. The height of the extension is approximately 11.4m at its peak.

GWE Biogas operate a biofilter system (700m^3 packing) with a two-stage scrubber. Air extracted from the plant reception building is ducted to a Biofilter for treatment. The biofilter contains suitable biofiltration media (chopped spruce wood and heather/fibrous peat 120mm); the dimensions of the biofilter are 28m (L) x 8.5m

(W) x 3.5m (H). The biofilter is designed to hold sufficient volume of media, to provide a residence time of 60 seconds. The media is formed from chipped tree roots (heather) and it will be refreshed on at least once every 24 months. The long biofilter residence time maximises contact time between the ventilated air and the biofilter media ensuring high levels of odour removal, especially of low solubility odorants, prior to discharge of treated air to atmosphere. A "conservative" estimate of treated odour concentrations of 1,200 ou_E/m^3 has been used in a simple assessment of odour impact carried out at section 10.5 below.

The high building extraction rate, together with enclosure of the most odorous processes and plant within it, provides effective control of fugitive odour emissions through the building structures. There is some escape of air and odour from the buildings when the main doors are opened to allow vehicle access, although the rapid closure of the doors combined with the internal negative pressure works to minimise this. The magnitude and impact of these escapes is limited because the enclosed nature of the processing plant (i.e. the bag splitting and shredding phases are enclosed items of plant and equipment) within the building helps to keep internal odour concentrations down, and because vehicle access only occurs intermittently and for short time periods.

7.2.1. Abatement Concentration Levels

The system has been designed to handle a total volume flow of 40,000 Bm3/h at a maximum odour concentration of 25,000 OU/m^3 and provide a clean air concentration of <500 OU/m^3 in line with applicable regulations. The maximum pollutant concentration values which the biofilter system can handle are listed below:

Hydrogen Sulfide (mean)	<10 ppm	<15 mg/m^3
Hydrogen Sulfide (maximum, temporary)	<27 ppm	<40.5 mg/m^3
Ammonia (mean)	<10 ppm	<7 mg/m^3
Ammonia (maximum)	<15 ppm	<10 mg/m^3

Mercaptans	<3 ppm	

The exhaust air directed to the abatement system is characterised as approximately 40,000 Bm^3/h at a temperature of 10-30^{0}C with a relative humidity of ≥50%. The absolute humidity is calculated to be between 98% and 100% with a temperature between 6 and 22^{0}C prior to entering the biofilter having passed through the scrubbers. The operating temperature of the biofilter will therefore be between 10 and 22^{0}C. Please note, during winter months, ambient temperature will be lower, so the exhaust air emitted from the biofilter will appear over the biofilter as a fog.

The biofilter is continuously supplied with exhaust air of at least 16,000m^3/h to ensure a continuous supply of air to the microorganisms within the biofilter bed. The target pH value for the filter bed material is 6-8. As this is the case the two-stage scrubber is equipped with pH and temperature measurement devices linked to the SCADA system. The two-stage scrubber is also equipped with H_2SO_4 and NaOH dosing possibilities.

7.2.2. Biofilter System with Two-stage Scrubber.

The biofilter system has been constructed as a concrete filter (side walls lined with PE and grates made of PP) with a separate plant room made from PE-HD, situated next to it. The plant room contains the fan, scrubbers and blower, etc).

The exhaust air flows are sucked in and are conveyed to the two-stage scrubber by a 45kW integrated stainless-steel fan (RE 77-1000 supplied by Berliner Luft). The fan has been equipped with a frequency converter so that the fan can be operated with a delivery rate of 40,000 Bm^3/h as well as with a delivery rate of approximately 16,000 Bm^3/h. The suction line to the fan has been designed with a nominal width DA=900. Exhaust air velocities <20m/s arise from this nominal width. When choosing the fan, a pressure loss of 6-8 mbar as the suction side was taken into account. The pressure loss has to be measured and then documented regularly (at least once a month).

For the scrubber element of the system, the exhaust air first passes through the first stage scrubber (alkaline scrubber) where the acid constituents are dosed with NaOH. Following this step, the air then passes through the second stage scrubber (acidic scrubber) where the alkaline constituents are dosed with H^2SO^4 and washed out. Please note, at present GWE Biogas do not perform dosing of the scrubbers as they have found this unnecessary to reduce the odour concentrations from the biofilter (zero complaints received at site reinforces this). In order to desludge the scrubbers regularly and protect them from salt and dust deposits, the electric plastic ball valves are activated and opened via a timer, so that each scrubbing stage of the process is drained at preset time.

After having passed the scrubbers, the exhaust air (saturated with water vapour) is directed to the biofilter through a PE-HD pipeline (DA=1000). The air passes through the biofilter from bottom to top. The moisture content of the biofilter media should be between 45-65%. The biofilter has an active, biofilter area of approximately 224m^2 with a reaction volume of approximately 700m^3, at a height of 3.15m. Water content of the biofilter can be adjusted via nozzles fitted to the top of the biofilter. The biofilter is equipped with 30 nozzles along the surface of the biofilter which are evenly spaced. The nozzles supply fresh water to the biofilter. This ensures that there is even irrigation across the surface of the biofilter. The water pipe is made of the PVC and the nozzles are of PP and have been dimensioned for a nominal width of DN=40.

It should be noted that further to the original odour abatement design specification detailed above, the newly added clean (unpackaged) reception building, and hall pallet storage has been added to the existing abatement system. The design of the aeration system has been modified to account for the incorporation of the new hall sections. To avoid an unnecessary increase in the total amount of air supplied to the biofilter, the ventilation grills that previously provided air supply to the processing hall for food waste have been closed. As very low odour concentrations are to be expected from the clean (unpackaged) reception building and hall pallet storage area, the exhaust air from these hall sections will act as supply air for the main reception hall. To accommodate the addition of the clean (unpackaged) reception building and hall pallet storage areas to the odour abatement design, the

new sections will have corresponding supply air openings for the supply of outside air. This ensures that the existing biofilter is subjected to only a very small increase in exhaust air and ensures that residence times within the biofilter (60 seconds) remain uncompromised.

For control or regulation of the complete abatement system, the parameters in section 7.3 have to be measured by operatives on site.

7.3. Monitoring and maintenance

During operation, the abatement system usually runs fully automated. Operatives on site complete a biofilter daily check sheet to check operating parameters.

A daily visual inspection of the condition of the biofilter media shall be conducted by a trained operative, to identify areas of drying, weed growth, shrinkage of the bed, cracks and fissures, etc. There shall also be daily monitoring of temperature, moisture levels, etc of the biofilter (see table 3 below). Results will be recorded physically, on the biofilter daily check sheet.

Table 3 - Abatement Monitoring

Potential Odour Issue	Monitoring	Critical Limits	Process Controls	Records
Biofilter not in optimal moisture content.	Air humidity within plenum chamber.	>45% <65%	Air entering the biofilter is constantly measured for humidity to ensure that the correct moisture content is delivered to the biofilter to keep consistently within operation critical limits. This is backed up with daily visual inspections of the media for clefts, cracks and lumps to ensure humidity critical limits are still appropriate. In case of overly dry filter material, longer spraying of the filter layer from the top with sprinkler system is implemented.	Process Computer Records.

Potential Odour Issue	Monitoring	Critical Limits	Process Controls	Records
Biofilter not in optimal temperature range for performance.	Temperature Monitoring.	>22^{0}C for more than 48hrs <operating temperature	Elevated temperature readings indicate that biodegradation of biofilter media is occurring. Should temperature become elevated above critical limits water will be added to the biofilter media. The media will also be inspected and replaced if required, as soon as reasonably practicable. Temperature at the biofilter is controlled by a hot water heating circuit. The temperature of this system is monitored by the SCADA system. If the temperature drops then more hot water will automatically be pumped to the biofilter. Hot water is always available, however, if for some reason hot water supply ran out, then the site will use its emergency boiler to provide heat.	Biofilter Daily Check Sheet.
Biofilter degraded closing structure preventing airflow through biofilter.	Back pressure at inlet to biofilter.	>10 mbar	Should backpressures be elevated above critical limits then the biofilter media will be inspected and replaced as appropriate with clean media as soon as practicably possible.	Biofilter Daily Check Sheet.
Wet scrubber not processing airflow leading to elevated concentrations of ammonia to the biofilter.	Pressure of water entering the wet scrubbing chamber.	>1.4 Bar <1.6 Bar	Pressure of water entering the scrubbing chamber is monitored to ensure optimum conditions within the scrubber prior to the biofilter. If pressure is outside of critical limits, then the air extraction system is shut down for inspection and repaired as soon as practicably possible. If the system cannot be repaired/replaced within 5 days then waste materials are removed from the reception hall and taken off site to an alternative facility for processing within 24hrs.	Process Computer Records.
Growth of plants on biofilter leading to inefficient use of the biofilter.	Daily inspection for weed growth on biofilter.	Weeds present.	If weeds are present, they have to be removed manually with the entire root.	Biofilter Daily Check Sheet.

For completeness, the parameters recorded on the biofilter daily check sheet are as follows:

- Water Meter Washer. (m^3).
- Water Meter Sprinkler. (m^3).
- Washer 1 Temp. (°C).
- Washer 1 Pump Pressure. (Bar).
- Washer 1 Pump Flow. (m^3/hr).
- Washer 2 Temp. (°C).
- Washer 2 Pump Pressure. (Bar).
- Washer 2 Pump Flow. (m^3/hr).
- Air Volume. (m^3/hr).
- Air Pressure in. (bar).
- Air Pressure out. (bar).
- Comments.

In the event a process control has to be implemented, the corrective actions shall be assessed when monitoring the parameter during the next operational day (24 hours after issue). In the event that operational control of the biofilter cannot be promptly re-established as part of the actions in table 3, contingency measures at section 12 shall be implemented. Once any fault has been remedied following the implementation of the emergency response, the full abatement monitoring included in table 3 above as well as the completion of the biofilter daily check sheet shall be completed to resume normal operation.

The pH and temperature measuring devices inside the two scrubbers have to be calibrated at least once per annum.

The extract ventilation system is maintained routinely to ensure vents are not blocked and the ventilation fan is operating correctly. The fan is checked on a daily basis and a pressure sensor in the fan delivery duct work detects any deterioration in airflow through the systems and trigger an alarm.

Spare parts for all key ventilation components are kept on site in the event of a breakdown or failure.

7.4. Odour Abatement Controls – Pre-Biogas Upgrading

Prior to the biogas-to-biomethane upgrading process, the biogas is fed through the desulphurisation system to remove hydrogen sulphide.

The desulphurisation process consists of a heat scrubber – which takes heat from the CHP engines' water jacket – which heats the gas to greater than 30^{o} via a hot spray loop. The hot spray loop also saturates the gas to 100% humidity. The biogas is then passed into the biological reactor, where it passes up the reactor through active biological media, against a counter current of digestate slurry injected into the top of the reactor.

The active microorganisms are seeded on SESSIL media, made of polyethylene, located within the reactor tank, which has a volume of 89m3. Microorganisms of the species Thiobacillus and Sulfolobus have been used in both commissioning and operation of the reactor. These species are highly selective in their ability to oxidise sulphur containing compounds in the presence of oxygen and at temperatures above 30^{o} and subsequently remove them from the gas stream via conversion to an elemental sulphur solution.

The plant is monitored and controlled via a control panel mounted locally within the technical centre (Siemens HMI) and also connected to the existing SCADA system via Modbus TCP.

7.5. Lagoon

The lagoon is used to store pea wash water from the neighbouring vegetable processing facility. Pea wash water is delivered from the neighbouring facility to the lagoon via underground pipework.

The majority of pea wash water is produced over a 2-month period from mid-June to mid-August. Outside of this period only approximately 5m^{3}/day of pea wash water shall be produced. Pea wash water is moved daily into the AD process.

Pea wash water is stored for a maximum of 9-months due to the amount of water required by the AD process. Approximately 120 tonnes of water from the lagoon is drawn into the AD plant per day. Therefore, if the lagoon is filled over the 2-month

period (mid-June to mid-August), it is possible for some pea wash water to be retained within the lagoon for a period of up to 9-months.

The pea wash water has been sampled by a laboratory (NRM) to determine levels of BOD and COD, which are the odour generating components of the material. Pea wash water produced between mid-June and mid-August is relatively high in BOD and COD. This water is piped into the lagoon and then immediately drawn into the AD. This minuses the time that this potentially odorous material can create a possible nuisance. The storage time of the pea wash water, relatively high in BOD and COD, is kept to a minimum.

The pea wash water produced outside this 2 month window is relatively low in BOD and COD and therefore, has a low odour generating potential. This is the water than can be stored in the lagoon for up to 9-months.

8. PROCESSING OF WASTE

8.1. Odour control under normal operating conditions

The processing of waste by anaerobic digestion relies on the maintenance of anaerobic conditions. This requires the exclusion of oxygen from the process and hence all processing takes place in sealed airtight vessels with no exchange of gases between the vessels and the outside air. Under normal operating conditions, the processing of waste therefore does not lead to the emission of odour.

When empty reception tank vessels are being filled with feedstock, biogas or digestate, dispelled air, that may be odorous, is discharged via the biofilter.

9. HANDLING AND STORAGE OF DIGESTATE AND BIOGAS

9.1. Odour control under normal operating conditions

Collection and transport of whole digestate to spreading ground is undertaken in sealed tankers which are filled via a hose connection, ensuring that there is no contact with the outside air at the point of filling. Separated fibre is loaded into

trailers via shovel loaders. This material has already been digested so the risk of odour is reduced.

Liquid digestate should in any event be biologically stable and therefore relatively odourless, as will separated solid fibre. Stability tests are undertaken on the digestate as part of the PAS110 anaerobic digestate standard process which provide evidence of digestate stability.

Displaced air is vented from the top of the tanker during this process, but due to the remote location of the site, there have never been any odour emission detected, on or off the site.

10. MONITORING AND COMPLAINTS PROCEDURE

10.1. Site monitoring

The effectiveness of the measures outlined in this OMP are monitored daily using subjective odour monitoring (sniff testing). This is carried out at the site boundary by a dedicated site operative upon first arrival at the site. Further sniff testing and observations are conducted around the various activities on site to identify potential odour risks and sources. Particular attention is paid to specific potential odour release points, such as treated air off the biofilter and downwind of the waste reception building. The results of these assessments are recorded in site management systems. Sniff tests will be undertaken at the locations identified below and shown in Figure 1:

1. Site Entrance
2. Downwind Reception Buildings (movable with wind direction)
3. Biofilter/CHPs and Gas to Grid
4. Digesters
5. Storage Lagoon

Prevailing weather conditions and processing activities being carried out on site at the time of the assessment are also recorded. A logging weather station, including wind vane is permanently stationed at the site to continuously record weather conditions. Historical records are retained for a period of at least one year to enable retrospective reviews of weather conditions, such as may be required if complaints about any odour source are received from neighbouring residents.

Any significant odour incidents, problems and complaints are reported to the Environment Agency as soon as possible, as is required by the sites Environmental Permit.

Figure 1 – Typical Odour Sniff Check Locations

10.1.1. Monitoring Procedure

During daily testing, the operative completes the monitoring at the following times:

- Through Monday to Friday, GWE operate two shifts with the second shift starting at 10am. An operative shall perform the sniff test once onsite at 10am. The plant operates continuously so this should not be an issue for time of sniff test and loads are received on site throughout the day, so it is GWE's view that 10am Monday to Friday provides a representative sample.

- During Saturday and Sunday, GWE only operate one shift which starts at 07:30am. GWE therefore propose to conduct daily sniff tests at 07:30am at weekends. As stated above, the plant does operate continuously so it is GWE's view that odour at 07:30am will be no different to odour at midday.

By conducting the monitoring once arriving on site, operatives minimise the risk of become accustomed to any potential odour on site. The Site Manager will be principally responsible for the monitoring being undertaken on site. Checks will be undertaken and scored in line with Appendix 2.

Detection of a "distinct odour" will initiate a more extensive olfactory survey to determine the extent of the odour plume, within 24 hours of detection. The Site Manager (or trained operative) will be notified immediately and the olfactory survey will continue to attempt to determine the scope and extent of the odour plume, as follows:

- A suitable location downwind of the site and potentially sensitive receptor at which the odour plume is unlikely to extend will be selected for assessment;
- Survey will continue toward the AD facility until an odour is perceived; and
- Assessment points perpendicular to the plume axis and equidistant from the AD site will then be monitored, subject to access requirements.

An investigation will be initiated into the cause of the odour. This shall involve the following actions:

- A review of the site activities on site and other nearby potential sources at the time of the olfactory survey;
- A review of the meteorological conditions at the time of the olfactory survey; and
- A review of the effectiveness of process operations and odour control procedures.

10.2. Record Keeping

The site has a range of management systems that incorporate record keeping that documents the following information:

- Duty site manager;
- Activities taking place on site;
- Results of odour monitoring; and,
- Summary of weather station records, and most significantly, wind speeds and direction.

These management system records and historical archive, are retained on site and made available for inspection by the Environment Agency on request.

10.3. Odour Complaints Procedure

The primary role of the odour complaint procedure is to ascertain whether the odour complaint is associated with the anaerobic digester and associated operations, to identify the cause(s) and to ascertain what action may be taken to prevent or minimise the probability of recurrence if complaints are justified.

It is important to stress at the outset the need for sharing of information with the Environment Agency throughout any investigation, and to ensure that all steps and decisions are documented.

It is the responsibility of the Site Manager to deal with any complaints that may be received by the site. The name and contact phone number of the Site Manager has been made freely available, displayed at the site entrance and provided to the residents of neighbouring properties.

It has been made clear to local residents that odour management and dealing with any complaints is a key responsibility of the Site Manager, and they were encouraged to contact him or her in the first instance. The standard procedure for dealing with these complaints is then as follows:

Stage 1 Complaint Received

The process operator or Environment Agency receives a complaint alleging potential odour from the installation.

Stage 2 Communicate

The primary reason for investigation of complaints is to identify the likely cause and source of the odour.

The Environment Agency officer responsible for regulating the site will be informed of any complaint without delay by telephone, by fax or by e-mail.

Stage 3 Record

The complaint's details and the investigation shall be recorded in accordance with the requirements below on an odour complaint report form (Appendix 2).

All completed complaint forms will be retained in a file on site indefinitely and made available for inspection by the Environment Agency on request.

Stage 4 Respond

The Site Manager, his deputy, or a director of GWE shall respond as soon as possible after a complaint is received so that they may be able to carry out an effective appraisal of the alleged odour by a subjective assessment. Where possible, this assessment shall be conducted at the location of the complainant to help improve the identification of the odour in terms of waste material types and or site operations.

GWE will be willing to accompany an Environment Agency officer during any odour complaint investigation procedures it may instigate. The intention of this is to facilitate the precise identification of the odour source if at all possible. If it is not the Environment Agency officer's preference to carry out such odour investigations with GWE staff then this will be complied with, although it may be more difficult to precisely identify the source of the odour and make appropriate remedial action to prevent future odour impacts without GWE staff being present.

Stage 5 Identify the source and cause of complaint odours, and take remedial actions

In order to successfully resolve odour problems, it is essential that GWE and the Environment Agency fully understand the source and cause of the odour and the operational conditions that lead to the complaint.

The first step will be to investigate the odour complaint and reference the time of the complaint to the site log book, in particular to the nature of the operations ongoing at the time, the results of any odour monitoring carried out on site and the wind and weather conditions. This will allow a broad assessment to be made of whether the site was likely to be principally responsible, or whether other sources were involved.

If the odour in question is still detectable at the complainant's location or property, then additional sniff testing will be made around the area to characterise the odour and its likely source. This could include "back-tracking", by walking into an odour plume on the ground, or as a desk exercise with a site map and wind direction data (recorded or observed at the time of the incident).

10.4. On-going Community Liaison

GWE previously formed a liaison group to ensure that any local residents' concerns or complaints were fed back directly to the senior management and that action could be promptly agreed. This included providing access to weather monitoring information and a hotline number to report any problems. The contact telephone number was also advertised locally on informative signboards and on the applicant's website which also advised of spreading plans etc. Since implementation, the liaison group ceased due to lack of local demand. GWE remains open to local engagement should the need arise.

10.5. Odour Exposure at Potentially Sensitive Receptors

The closest potentially sensitive receptors are as follows:

a) Eastburn Warren Farm – this property includes dwellings and a pig unit, so there are both residential and (less sensitive) occupational receptors. The farm is approximately 400m to the west or west north west of the proposed AD plant.

b) High Battleburn – there are five cottages (residential receptors) to the south south west of the plant at a distance of approximately 500m.

c) Yorkshire Greens Processing Facility – facility to the south of the plant at a distance of approximately 70m. This facility supplies GWE biogas with feedstock for their plant.

There are no other fixed receptors within 1,300m of the proposed development as identified in the sensitive receptors map below.

Figure 2 – Location Map identifying Sensitive Receptors within 1km of the site boundary

Analysis of local wind frequency data from the most suitable local weather recording station at Leconfield (see Table 4), originally undertaken by ADAS in the initial Odour Management Plan, shows that there are low frequencies of wind

directions which could potentially carry odours from the proposed development towards the receptors identified above.

In the case of Eastburn Warren Farm, an easterly wind or east south east wind would be required to carry odours from the site to this receptor. The frequency of winds from these directions is around 4.7-4.9 %

A north north east wind would be required to carry odours towards the High Battleburn Cottages, and these winds have a frequency of only 5.8 %.

Taking account of the substantial separation distances, the odour controls outlined at Appendix 1 and the low frequency of winds which could carry odours towards these potential receptors, it was concluded in the previous version of the Odour Management Plan (original) that there is a low risk of odours from the proposed development affecting these properties.

Table 4 - Percentage Wind Directions by Month - Leconfield (5 Year Period)

	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW
Jan	1.9	1.1	0.2	1.3	2.2	5.3	16.3	21.5	24.2	12.7	7.2	3.3
Feb	1.9	2.5	2.3	7.8	9.0	3.0	12.0	16.3	15.5	12.9	5.4	5.6
Mar	2.8	2.0	2.3	1.7	3.2	6.0	11.1	17.1	20.5	19.6	5.8	3.5
Apr	13.6	4.5	3.1	3.2	5.6	4.6	9.6	11.8	14.1	15.8	4.6	4.7
May	11.7	16.8	7.6	8.4	6.0	3.1	7.5	6.8	9.0	8.9	2.7	4.0
Jun	12.3	9.8	5.8	6.2	4.6	1.9	3.7	6.3	11.5	17.4	5.2	6.4
Jul	5.2	5.9	7.9	7.5	5.1	3.7	5.5	9.4	15.7	15.1	3.5	4.3
Aug	6.8	5.7	4.6	4.8	4.1	3.1	8.7	11.6	14.5	15.3	6.3	6.1
Sep	8.3	7.9	6.2	4.6	6.0	4.5	6.8	8.3	11.7	12.6	5.4	8.3
Oct	9.2	6.4	1.5	2.3	4.7	4.7	14.3	12.9	14.2	9.2	5.3	4.9
Nov	2.7	2.0	2.2	3.7	7.1	9.5	12.0	15.7	15.0	16.5	5.5	2.6
Dec	2.8	2.7	4.1	4.2	3.0	5.3	12.4	19.9	14.4	10.7	6.9	4.9

	N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW
Year	6.9	5.8	4.1	4.7	4.9	4.5	9.8	12.9	14.8	13.9	5.3	4.9

Calm winds were recorded for 7.5% of hours.

The potential for odour impact at the Eastburn Warren and High Battleburn can also be assessed using the simple "Dmax" odour exposure relationship developed by Warren Springs, based on the assumption that all potentially significant odorous emissions are captured by the odour extraction and abatement system. This Dmax calculation was conducted by ADAS as part of the previous version of the Odour Management Plan (original). The results of this calculation and the literature research are expressed below. The Warren Springs formula can be used to estimate the maximum distance at which odour impact can be expected. Practical experience from more detailed odour modelling and "real" cases suggests that the Dmax equation is very conservative.

For example, in the UKWIR (UK Water Industry Research) technical guidance on odour, a correlation between dispersion modelling is set out at Dmax multiplied by a factor of one half in rural areas. A less cautious correlation factor of one quarter is suggested by UKWIR for urban areas. The UKWIR factors are based on work carried out by the WRC (formerly the Water Research Council).

The Dmax formula is expressed as $Dmax = (2.2 \times OE)^{0.6}$ where:

Dmax = maximum impact radius (m) and OE = emissions rate in odour units per second (ou_E/s).

Applying the UKWIR rural correction factor, then $Dmax = 0.5 \times (2.2 \times OE)^{0.6}$

If in this case the biofilter treats an airflow of 12.17 m^3/s down to a treated or outlet odour concentration of, say, 1,200 ou_E/m^3, then the emission rate would be 14,600 ou_E/s. The maximum impact radius without the UKWIR correction would be would be 505m, and with the UKWIR rural correction it would 252m. The separation distances in this case are around 500m to High Battleburn and 400m to Eastburn Warren.

The Dmax formula takes no account of wind directions and relative orientation of the odour emissions and the receptors in relation to prevailing winds. Thus, if account is taken of both the Dmax calculations and the wind frequency analysis, then there is a very low risk of odour impact at High Battleburn, and a low risk of any impact at Eastburn Warren. More distant receptors are at negligible risk.

11. SITE MANAGEMENT SCHEDULE

Based on the provisions of this OMP, the following schedule of site management tasks are implemented at the appropriate intervals. Adherence to this is the responsibility of the duty site manager.

Daily

Operational

- Verification that all deliveries to the site accord with the odour management plan in respect of sheeting / enclosure.
- All potentially odorous wastes to be checked on arrival for malodours and are rejected if unsuitable, e.g. due to unacceptable levels of decay and odour. Suppliers will be notified of these rejections and advised of the requirements for deliveries to be in good (free from malodours) condition.
- Supervision to ensure that no raw materials handling takes place until the reception area doors are closed.
- All doors in the waste reception buildings will be closed at all times, other than when vehicles and site operatives are entering/leaving the buildings.
- Clearance of all spillages within the reception buildings (to be cleared up or removed before the end of the working day).
- Sweep around feed bays and unloading areas and return sweepings to the feed hopper.
- Report and take remedial action on any faults or failures in odour critical equipment, including the reception buildings ventilation system, fan, biofilter and any ducting or pipework.

Monitoring

- Carry out routine upwind and downwind boundary odour sniff testing by a member of the site management or technical staff on a daily basis.
- Carry out sniff tests at the discharge point of the biofilters, and in the area immediately downwind of the reception buildings.

- The odour control system is subject to routine checks at prescribed intervals to ensure that the fans are running, that the biofilter media irrigation system is operational when required, that the biofilter media is moist, and that it is not in need of replacement or replenishment.

Weekly

- The Site Manager to carry out routine checks on the effectiveness of all cleaning and site hygiene procedures. These checks are based on a walk-over inspection of the entire site and the results are recorded in the daily site checklist, located in the plant control room.

Monthly

- Review odour monitoring records for any trends;
- Review any complaints to establish any trends; and,
- Check that adequate spare parts for repairs to the odour treatment system are available on site.

Six Monthly/Annually

- Review odour monitoring records for any trends;
- Review any odour complaints records;
- Environment Agency and residents liaison meetings (if required);
- Review and update Odour Management Plan; and,
- Review and update Site Management Schedule.

12. CONTINGENCY PROCEDURES FOR ABNORMAL OPERATING CONDITIONS.

On sites such as this anaerobic digestion plant, it is often the case that odour can be effectively controlled under normal operating conditions, and that the most significant risk of an adverse impact arises due to unforeseen events such as spillages, accidents or equipment failure.

Staff training is a key aspect of ensuring that unforeseen events can be dealt with without causing an adverse impact. All site operatives are therefore trained on induction with “tool-box talks” to deal with a range of operational emergencies. Examples include breakdowns in mechanically operated doors in the main process building or odour abatement plant breakdowns.

There is also a clear structure of responsibility which allows operational staff to call in specialist contractors to deal with emergencies and unplanned events. Such events, and appropriate remedial measures are normally the responsibility of the Site Manager, but lines of responsibility and delegation have been clarified in case the manager is off site when an unplanned event occurs. A list of approved repair contractors is maintained in the site office and all staff with delegated responsibility should be aware of this list.

Procedures for dealing with reasonably foreseeable abnormal events, such that the risk of an odour impact is minimised are detailed in Table 4 below.

There are daily olfactory sniff tests, so any contingency measures will have their effectiveness tested within 24 hours.

The point at which operatives will know that the contingency measures have effectively mitigated the odour source will be after the performance of the next olfactory sniff test.

The duration of time after which back-stop contingency measures would be implemented, in the event that odour control cannot be promptly re-established is 5 working days.

Should odour be detected coming from the lagoon, a contingency plan shall be established in order to outline corrective actions / contingency measures that will be taken to mitigate this odour generation. These measures include the mobile aeration of the pea wash water (within 24-hours of odour being detected) and the prioritisation of pea wash water for use within the AD plant. If odour cannot be controlled via aeration, then the pea wash water shall be either spread to land or injected into land.

In the event that the contingency plan does not allow for odour control to be re-established, then more of the pea was water will be emptied from the lagoon. This shall be facilitated via mobile aeration and the spreading of the pea wash water to land. These measures shall be employed within 1-week, starting from when the initial contingency plan is deemed to be ineffective.

Table 5 - Measures to Address Abnormal Events

Possible failures or abnormal situations	Potential outcome	Measures to prevent / reduce the risk / actions to take
Spillages of waste during delivery and tipping.	Increased concentration of odour within reception building, possibly exceeding the treatment capacity of the biofilter and increased risk of fugitive escapes.	- Prompt removal of all spillages and re-incorporation into digester.
Poor performance of biofilter (e.g. media drying out, degradation or depletion of media, or impediment to air flow).	Escape of untreated odour. May cause odour to be detected at sensitive receptors.	- Routine monitoring and maintenance. - Spare media stored on site and training of personnel to rectify blockages. - Upon detection of fault the air handling system is switched off to prevent air forced through the system which could release odorous compounds. - Engineers are called to repair/replace fault. If fault cannot be fixed within 5 days from identification, then the emergency action plan is implemented. **Emergency Action** - If breakdown prevents effective air extraction, then the air handling system will be switched off, material reception will cease, and material will be exported from the site to a suitably licensed facility within 5 days. The Site Manager will divert any

Possible failures or abnormal situations	Potential outcome	Measures to prevent / reduce the risk / actions to take
		further incoming waste from the sites to neighbouring facilities that are able to process the same types of waste until such a time when the site can resume operations within its normal operating parameters. The time period is from point of fault alarm. The alarm is automatically triggered by the process computer with a message sent to the Site Manager.
Failure of ventilation fan due to mechanical or power failure.	Escape of odour from main storage area. May cause odour to be detected at sensitive receptors.	- Routine maintenance procedures. - Spares, e.g. drive belts, on site - Automatic pressure sensing detection equipment installed to notify operatives of fan failure. - Engineers are called to repair/replace fault. If fault cannot be fixed within 5 days from identification, then the emergency action plan is implemented. **Emergency Action** - If breakdown prevents effective air extraction, then the air handling system will be switched off, material reception will cease, and material will be exported from the site to a suitably licensed facility

Possible failures or abnormal situations	Potential outcome	Measures to prevent / reduce the risk / actions to take
		within 5 days. The Site Manager will divert any further incoming waste from the sites to neighbouring facilities that are able to process the same types of waste until such a time when the site can resume operations within its normal operating parameters. The time period is from point of fault alarm. The alarm is automatically triggered by the process computer with a message sent to the Site Manager.
Failure of roller shutter doors to close due to mechanical or power failure or human error.	Escape of odour from main storage areas. May cause odour to be detected at sensitive receptors.	- Routine maintenance procedures. - Manual over-ride possible. - Operator training. - Key spare parts kept on-site or available through 24-hour maintenance contract.
Damage causing breach of building integrity.	Escape of odour from main storage area. May cause odour to be detected at sensitive receptors	- Negative pressure ventilation system. - Designated vehicle routes and turning areas to avoid risk of collision.

Possible failures or abnormal situations	Potential outcome	Measures to prevent / reduce the risk / actions to take
Leakage or overflow of digestate storage vessels.	Leakage of material and exchange of odorous gases with the outside air.	- Automatic monitoring of digestate levels and alerting of potential overflow.
Gas to grid plant failure	Potential for odourous gases to escape from the plant and affect nearby sensitive receptors	- Stringent preventative maintenance procedures in place to ensure all machinery remains functioning **Emergency Action** - Inform management. - Inform Operations and Maintenance Contactor. - Establish time frame for repairs to be undertaken. - Cease processing of biogas. - Inform the EA if necessary. - Record and review the incident.
Carbon Capture and Storage Plant failure	Potential for odourous gases to escape from the plant and affect nearby sensitive receptors	- Stringent preventative maintenance procedures in place to ensure all machinery remains functioning **Emergency Action** - Inform management. - Inform Operations and Maintenance Contactor.

Possible failures or abnormal situations	Potential outcome	Measures to prevent / reduce the risk / actions to take
		- Establish time frame for repairs to be undertaken. - Cease processing of biogas. - Inform the EA if necessary. - Record and review the incident.

APPENDIX 1 PROCESS DESCRIPTION & ODOUR CONTROL

Waste Reception & Preliminary Treatment

Commented [JH1]: How will silage be fed into the system? Via a solid feeder unit and screw conveyor.

1. Typical feedstocks include commercial waste from the food retailing and manufacturing industry, waste from agricultural industries such as rejected vegetables, food wastes collected from restaurants and schools, as well as source segregated food wastes from domestic premises which are collected by local authorities and whole crop silage. The site aims to forge long term partnerships with 'waste' producers so that the feedstocks coming into the site can be carefully controlled.

2. Materials are delivered to the site in large capacity vehicles of typically 20 tonnes net weight, in covered, roll-on-off containers, tanker lorries or on pallets. Deliveries, once weighed for the purposes of waste regulations (Duty of Care requirements etc), drive into the appropriate reception buildings where they will be unloaded. All unloading activities take place within the buildings so as to contain any noise and odour that may be created.

3. Liquid feedstocks are pumped directly into holding tanks where they are held until introduced into the process. Palletised and packaged feedstocks (containing liquid or solid food wastes) are put through specialised machinery to remove the packaging from the organic product and to allow specific types of packaging such as cans, glass and plastics to be recycled. The packaged food wastes will typically comprise food in tins, jars, plastic bottles, plastic sachets, sandwich packets etc. The de-packaging equipment is designed to remove 98% of the food waste from packaging. Each batch of packaging materials are kept separate to increase the opportunities for recycling.

4. For the packaged food processing line, the organic materials extracted from the de-packaging equipment are then mixed with any liquid feedstocks and put though the equivalent of a large liquidiser or blender to create a

consistent liquid material that is capable of being pumped through the remainder of the processing equipment. This material is macerated and screened to reduce particle size to less than 12 mm to comply with the Animal By-products Regulations.

5. The feedstock is pumped into a tank where the first stage of the biological process, known as hydrolysis, begins. This hydrolysis tank also acts as a buffer store to even out varying feedstock supply and allow automated feeding overnight, and over weekends and holidays. The material leaving the hydrolysis tank then flows onto the Pasteurisation process.

6. For the clean (unpackaged) line, feedstock is added into a hopper where it travels through a mixing pump containing a macerator to achieve the 12mm validation requirement. The material is mixed with recirculated material from digesters 1 & 2 to achieve a homogenous blend.

7. Silage will be directly inputted into the digestion system via solid feeder unit and screw conveyor configuration.

Pasteurisation

8. The Animal By-products Regulations are a strict set of rules designed to ensure that any catering waste or waste food which contains meat is treated in such a way as to eradicate any pathogens that may be contained within it. This ensures the complete safety of the process as all material passing through the plant will be pasteurised. For the packaged food waste line, hydrolysis is undertaken, within the plant building, as soon as possible after reception.

9. The mixture from this line is pasteurised in one of three heated tanks in a batch process. This process involves the mixture being heated to more than 70ºC for at least one hour in accordance with EU and UK standards. The three tanks are equipped with a system of sequential heat exchangers so that the mixture leaving one tank at 70°C is used to heat the mixture being fed to another tank at 40°C. The three tanks are operated to effectively

provide continuous pasteurisation between them. The material from the clean (unpackaged) line is pasteurised after the separate digestion process.

Digestion

10. For the packaged food processing line, the sterile, pasteurised mixture is then split equally and pumped to one of three main tanks in the process which are known as the primary digesters.

11. Within these large sealed digester tanks, anaerobic bacteria digest the feedstock to produce biogas under controlled conditions. The process is designed to run 'mesophillically' at a temperature of approximately 38-42°C, with temperatures regulated by the temperature of the incoming substrate.

12. The contents of each digestion vessel tank are stirred to ensure that the material remains in suspension and is homogenous. The combination of warmth and agitation encourages the bacteria to digest the biomass in the waste materials.

13. It is during this stage that the vast majority of the decomposition occurs and the majority of the gas is produced and collected, before being directed to the gas to grid upgrade system and also used as fuel for the plant's 4 gas engines.

14. After a retention time of approximately 54 days, the digested feedstock is then pumped to a secondary digester or dual purpose storage tank.

15. For the clean (unpackaged) food processing line, material is directed to primary digesters 1 & 2 to undergo digestion. The same process/monitoring parameters as above are enforced. After a retention time of approximately 54 days, the digested feedstock is then directed through a separator where a separated fibre fraction is created. Separated liquor is from this process is added to the dual process storage tank.

Dual purpose tank and gas store

16. For the packaged food processing line, this tank acts as both a secondary digester and also the gas holder. The residence time is approximately 10 days within this stage of the process. After that time the digestate is then considered fully digested and ready for spreading to land. A small element of gas continues to be produced from the digestate whilst it is being stored within the dual-purpose tank and this gas is captured and delivered to the onsite engines for combustion. Sedimentation is avoided though the use of more stirrers to keep the material in movement and suspension.

Combined heat and power (CHP)

17. The biogas collected is "scrubbed" (cleaned), dried and cooled before being used as fuel for the four CHP units. In each CHP unit, housed in its own soundproof container, the biogas will be compressed and burnt in a high efficiency gas engine which will drive an electric generator. Electricity produced will be used to power the plant, with the option to export surplus to the national grid (please note, gas to grid is the primary means of utilising the biogas produced).

Odour Extraction and Abatement by Biofiltration

18. Air/odour is continually extracted from the main plant building at an overall rate of two air changes per hour, but localised odour extraction will be focused on the most odorous parts at higher rates as follows:

    - Five air changes per hour in the de-packaging area with direct extraction from the de-packaging equipment.
    - Five air changes per hour in the digestate separator plant (separator is not currently used).
    - Three air changers per hour over the raw material reception bunkers.

19. Air/odour is continually extracted from the most recently added clean (unpackaged) waste processing reception building. This has been

incorporated into the existing odour abatement technology as described in section 7.2.2

20. Extracted air from the main plant buildings, along with air extracted from enclosed liquid waste tanks is delivered via sealed ducts and pipework to a biofilter employed for odour abatement. As ‘dirty’ air is extracted, clean air is drawn in to the building from outside, to control the potential for fugitive odour emissions.

21. The localised extraction rates are comparable with guidance in other waste industry sectors where rates of 3-6 air changes per hour are commonly used as benchmarks (e.g. UKWIR guidance on odour controls in sludge processing buildings).

22. Biofilters treat odours by passing the air stream through a media such as wood chips or bark which is kept moist and supports a population of natural micro-organisms which colonise the media and biologically oxidise odours in the air stream blown through the media for treatment.

23. Biofilters are particularly well suited to the treatment of organic and waste related odours, especially with long air residence times (45-60 seconds or more) which facilitate abatement of relatively low solubility compounds.

24. In this case the temperature and moisture content of the biofilter media is monitored and controlled by the main plant control system, to ensure that a suitable environment is provided for the micro-organisms.

25. Daily olfactory sniff tests are conducted next to the biofilter If the results of the sniff tests show increased odour, then the biofilter will be checked in order to determine if there has been a deterioration in abatement performance of the biofilter.

APPENDIX 2 ODOUR COMPLAINT FORM & INTENSITY SCALE

Date:		**Ref No.**	
Name, address and phone number of complainant.			
Time and date of complaint.			
Date, time and duration of offending odour.			
Weather conditions (dry, rain, fog, snow, sunshine).			
Cloud Conditions (quarter, half etc.).			
Wind strength and direction (e.g. light, steady, strong, gusting).			
Complainant's description of odour -What does it smell like -Intensity (use intensity scale) -Duration -Constant or intermittent			
Has complainant any other comments about the offending odour.			
Any other previous known complaints relating to installation (all aspects, not just odour).			

Any other relevant information.			
Location of Odour Source.			
Potential odour sources that could give rise to the complaint.			
Operating conditions at the time offending odour occurred.			
Action taken			
Final outcome			
Form completed by (signed):		**Date**	
Intensity Scale	1: Very faint odour	3: Distinct Odour	5: Very Strong Odour
0: No Odour	2: Faint Odour	4: Strong Odour	6: Extremely Strong Odour