Bioaerosols
Sampling Report

For the
Composting Facility
at

Crugmore Farm,
Penparc, Cardigan

M9 sampling
During Active Processes
July 2023

Prepared for:

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Sampling date **11th July 2023**
Report date **28th July 2023**

SUMMARY BIOAEROSOLS MONITORING AT THE COMPOSTING SITE

S1. The External Windrow Composting Operations

The composting facilities are located at the site at **MD Recycling Ltd, Crugmore Farm, Penparc, Cardigan, SA43 1RD.** The small-scale composting activities services local landscapers, and forms part of the earth and construction materials reclamation at the site. The throughput is approximately 2000 t/year.

The site is located in a rural agricultural setting. The composting area adjoins an Anaerobic Digester facility 120metres to the South. The overall site entails areas of aggregates and wood recycling and farther to the east is a Materials Reclamation Facility (MRF). The site access is a track at the north-western corner which joins the A487 main road. Beyond the site boundary, to the north and west is open grass farmland. To the north-east there is a farmhouse and farmstead. Further east beyond the MRF are fields of solar panels.

S2. Bioaerosols, composting and health effects

Bioaerosols are complex mixtures of airborne micro-organisms and their products, and are ubiquitous, particularly in rural environments. Composting relies on bacteria and fungi and so these are prevalent. Significant health effects may be attributable to prolonged and high concentrations of *Aspergillus fumigatus;* however, these can be minimised by temperature control, moisture and good management.

S3. Natural Resources Wales Requirements to Monitor Bioaerosols Emissions – M9 2018

The Environmental Permit shows the requirement to monitor Bioaerosols in the air around the site in accordance with the AfOR Protocol for Sampling Bioaerosols that was current at that time. In 2018 a new methodology (**2018 - M9 Technical Guidance Note**) was published and became the official Statutory Guidance and primary reference document regarding the sampling of bioaerosols. It replaced the AfOR Protocol. It includes guidance regarding the levels of Total Viable Bacteria and *Aspergillus Fumigatus* bioaerosols that should not be exceeded in the air at specified distances, downwind of composting sites.

The 2018 - M9 Technical Guidance Note provides a standardised approach for the monitoring of the bioaerosols. It describes how Bioaerosols are to be sampled and measured using a number of different techniques. One of the techniques is the use of Andersen type samplers (impaction method) as used in this instance. It describes how sampling should be carried out upwind and downwind using a 'fan-shaped' array of samplers in the downwind direction from the site. [see Appendix 1 to this report].

S4. This Report

The following may be concluded from the air quality results sampled **11th July 2023**:

1. The results show **VERY LOW** levels of Total Bacteria and **NEGLIGIBLE** Aspergillus Fumigatus (AF) in the samples taken **UPWIND** of the site. These values reflect the absence of bioaerosol sources in the upwind and the damp over-night weather conditions.

2. The results show **VERY LOW** levels of both Total Bacteria and Aspergillus Fumigatus (AF) in the samples taken **DOWNWIND** of the site. These values suggest that at this time of the year, the activities (the feedstock materials movement, screening or compost in process) were contributing **some** modest levels of bioaerosols into the air leaving in the Downwind.

3. All of the Median bioaerosol levels determined downwind of the site, were much less than 10% of the guideline levels advised by the EA/NRW and therefore it may be concluded based on this instance that there is minimal risk of adverse effect to the third-party receptors nearby to the site.

S5. Overall Conclusion

The results of sampling suggest that under these conditions, there were generally, **VERY LOW** levels of bioaerosols generated and released from the composting facility.

The **Maximum Median** Downwind Bioaerosol level of **Total Bacteria** was **57 cfu/m^3 and the Aspergillus Fumigatus** was **43 cfu/m^3** . The downwind Bioaerosols levels attributable to the compost site were therefore **VERY LOW** overall and **were less than 10%** of the EA/NRW Guideline thresholds.

It can be concluded that the composting activities pose minimal adverse risk to the health of persons nearby.

CONTENTS

This Report provides the results of a specific one-day session of sampling of bioaerosols at the Composting Facility. The report follows guidelines provided within the "M9 Monitoring Guidance" for monitoring bioaerosols. The results are compared to M9 Guideline values.

Reference to The M9 2018 Monitoring Guidance
The **M9 Monitoring Guidance** (Summary shown at Appendix 1.) is referred to throughout; and was used as the basis for the methodology employed during these sampling sessions because it is more rigorous and takes better account of variations with regard to wind direction changes during sampling.

Recogen Ltd. Environmental Quality Reporting – An Independent Assessor
For the purposes of quality assurance in undertaking this monitoring work, Recogen Ltd. is a recognised organisation with appropriately trained, qualified and experienced personnel; *independent* to the composting site operator. This monitoring work was undertaken by D J Baldwin, BSc (Hons) CEnv. MCIWM, Technical Director with Recogen Ltd. who has 39 years waste and environmental management experience. David is FACTS (fertiliser advice certification) qualified and has the Environmental Permit Operators Certificate and is WAMITAB Registered.

Recogen Ltd. is registered as a Quality Environmental Consultancy on the National Business Link Register and is a supplier of Technical Consultancy to DEFRA, The Waste and Resources Action Programme (WRAP) and to The Renewable Energy Association - Organic Recycling Group formerly known as 'The Composting Association'.

David has managed or contributed to many major projects on waste management for Government (**DEFRA, ETSU, DTI, WRAP, EA**) and The Waste Management Industry including Composting and Anaerobic Digestion processes, compost site design, product quality assurance (PAS100:2005, 2011 and 2018), PAS110, The Compost Quality Protocol, ISO9001, ISO14001, COSHH and H&S Risk Assessments.

The Laboratory used for provision and enumeration of the Collection Plates was: D&F Associates Limited, Shell Green House, Gorsey Lane, Widnes, Cheshire WA8 0YZ.

Box 1. Notes:
1. Culture media supplied by D and F Associates Laboratory (Widnes, Cheshire) is similar to that specified in the AfOR Protocol. The mediums used for the identification of bacteria and the *Aspergillus Fumigatus* type fungi species are in accordance with M9 .

2. D and F Associates Laboratory (Widnes, Cheshire) are UKAS accredited for many analyses and also runs its own internal Quality Management System. All media preparation and storage, whether for UKAS accredited analyses or otherwise, is carried-out in accordance with UKAS approved Standard Operating Procedures and fully recorded to appropriate standards.

3. D and F Associates Laboratory is on the approved list of Laboratories for the Environment Agency and is regularly called upon to undertake R&D work for the Environment Agency.

BIOAEROSOLS MONITORING - DEFINITIONS

Bioaerosols, composting and health effects

Bioaerosols are complex mixtures of airborne micro-organisms and their products, and are ubiquitous, particularly in rural environments. The most serious health problems appear to arise from *Aspergillus Fumigatus*, but there are other fungal spores and bacteria that cause problems. International studies have shown that there is a wide variability in individual susceptibility to bioaerosol exposure.

Commercial scale composting activities tend to generate large amounts of bioaerosols; and these are likely to contain human allergens and pathogens. They have potential effects on respiratory health and may cause headaches, nausea and fatigue. There has been very little investigation into the effects of community exposure to bioaerosols from composting, but there is some limited data that suggest that living close to a composting facility may be associated with an increased risk of adverse health effects. The consensus from various studies is that bioaerosols from composting activities decline rapidly within the first 100 metres from a site and generally decline to background levels within 250m.

Composting

Composting is the biological decomposition of biodegradable waste under conditions that are predominantly aerobic and that allow the development of thermophilic temperatures as a result of biologically produced heat. It may include associated waste storage and treatment operations carried out at the composting facility.

Operations

…likely to result in the uncontrolled release of high levels of bioaerosols
Include the shredding of waste and the turning of waste in the sanitisation, stabilisation and maturation stages of composting where these operations are not contained or are not subjected to exhaust ventilation and scrubbing/filtering.

Sensitive receptors (SR's)

'Sensitive receptors' refers to people likely to be within 250 metres of the composting operation for prolonged or frequent periods. This term would therefore apply to dwellings (including any associated gardens) and to workplaces where workers would frequently be present. It does not apply to the operators of composting facilities or their staff while carrying out the composting operation as their health is covered by Health and Safety legislation. M9 Technical Guidance Box 5.1 provides the following:

Box 5.1: definition of nearest sensitive receptor for composting and anaerobic digestion for standard rules permits

'Nearest sensitive receptor' means the nearest place to the permitted activities where people are likely to be for prolonged periods. This term would therefore apply to dwellings (including any associated gardens) and too many types of workplaces. We would not normally regard a place where people are likely to be present for less than 6 hours at one time as being a sensitive receptor. The term does not apply to those controlling the permitted facility, their staff when they are at work or to visitors to the facility, as their health is covered by Health and Safety at Work legislation, but would apply to dwellings occupied by the family of those controlling the anaerobic digestion facility.

Acceptable levels at the sensitive receptors

Refers to the concentrations of bioaerosols (as predicted or as derived from direct measurements) at the sensitive receptors that are attributable to the composting operations. EA Policy documents have determined that the acceptable (appropriate) levels (given as colony forming units per cubic metre of air) are:

Bioaerosol type	Threshold value	units
total bacteria	1000	cfu m^{-3}
Aspergillus Fumigatus	500	cfu m^{-3}

M9 Sampling and This Site

In 2018 the EA published M9 which provides guidance on more detailed standardised methods for the sampling of bioaerosols. Specifically, it provides guidance for using a downwind fan shaped array of samplers and takes account of the need for sampling at a distance downwind that equates to that to the Nearest Sensitive Receptor. A summary of M9 is provided at **Appendix 1**.

1.0 SITE LOCATION (M D Recycling - Composting Facility)

MD Recycling Ltd
Crugmore Farm,
Penparc,
Cardigan, SA43 1RD. **OS Grid ref.** SM 93482 12647

Figure 1: M D Recycling - Composting Facility Location Map

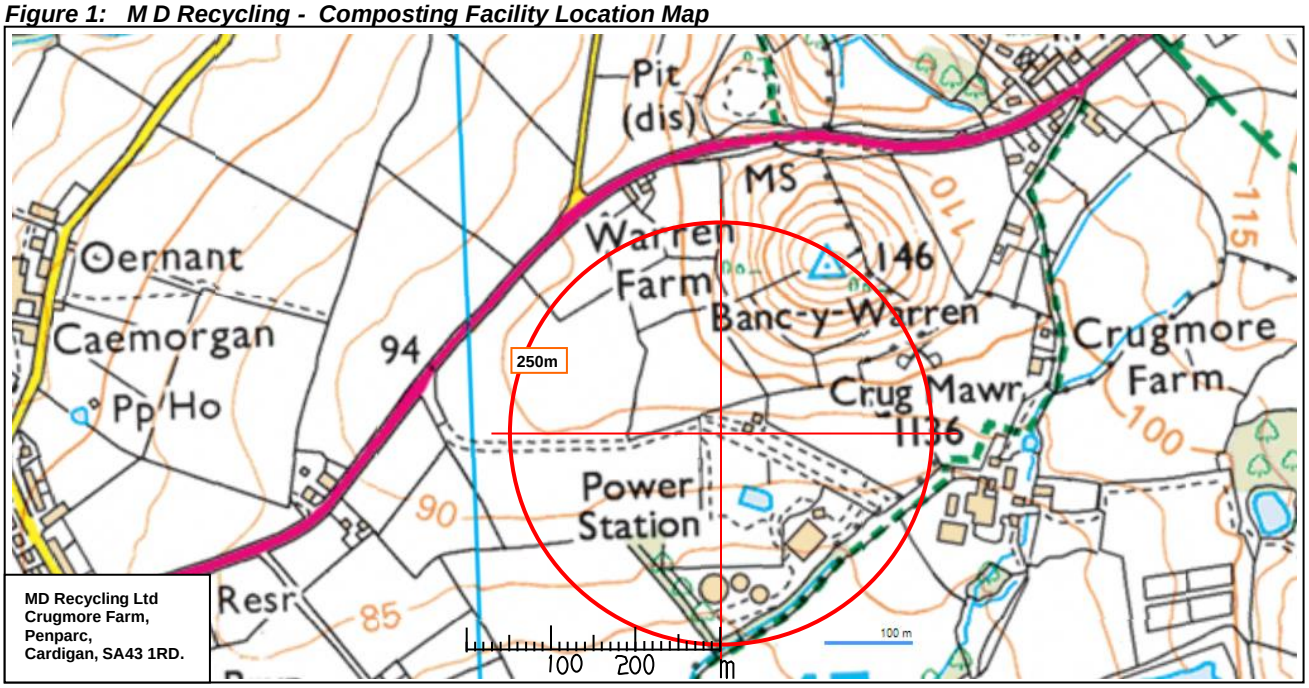


Figure 2: MD Recycling Composting Area (red outline)

2.0 INTERPRETATION OF THE EA (NRW)'s BIOAEROSOL POLICY

2.1 Composting and Bioaerosols

Composting processes rely on biological activity, notably the utilisation of bacteria and fungi in order to bio-degrade the volatile material and convert it to more stable forms of humic substance. The process relies on mechanical treatment in the preparation and handling of the material, as well as specialist facilities for controlling the processes involved.

It is recognised that when any agitation of organic material occurs, especially turning, screening or shredding, or when leachate is recirculated, elevated numbers of micro-organisms may be released into the air. Once released into the air they can remain airborne for long periods and form a 'bioaerosol' – an aerosol of biological particles.

2.2 Bioaerosols Risk

Bioaerosols are small particles of biologically active material that may be carried independently in the air or otherwise may become attached to other particles of dust or moisture. Consequently, the minute particles may be inhalable and also respirable (deposited in the air sacs of the lungs where gases are exchanged). Some of the small particles (<3-5microns) in bioaerosols have the potential to be harmful to human health and can cause pathogenic or allergenic reactions. Human physiology and therefore susceptibility is receptor-dependent and so the EA have advised arbitrary values as reference levels for risk.

2.3 Environment Agency Policy and Approach to Bioaerosols.

The Environment Agency (The EA) and **National Resources Wales (NRW)** has recently reviewed, updated and re-published (2018) its 'Policy' in regard to bioaerosols. This builds upon the 2009 policy in regard to the use of 250metres as a distance from a composting activity, within which there was deemed greater risk. T**he policy** highlighted ***the need to maintain bioaerosols at appropriate levels at any dwelling or workplace.***

'appropriate levels' may be….

i) those before the start of the composting process or
ii) bioaerosols levels no greater than
1,000 colony forming units (cfu) m^{-3} total bacteria,
500 cfu m^{-3} Aspergillus Fumigatus and

Reference to ***appropriate levels*** takes into account background levels specific to that locality. Background levels are highly variable and may range from 1- 1,000 cfu/m^3 or more.

In 2018 the **M9 Technical Guidance** note [see Appendix 1] was produced to provide a standardised approach for monitoring bioaerosols. It is applicable to facilities that have both ambient and point source emissions. It has been developed to replace the AfOR 2009 Standardised Protocol for use with Environmental Permits from 2018. It does not require the monitoring of gram-negative bacteria.

M9 describes how Bioaerosols can be sampled and measured using a number of different techniques. One of the techniques is the use of Andersen type samplers (impaction method) as used in this instance. It describes how sampling should be carried out upwind of the site and places more focus on gathering data that relates to the levels likely to be found at the 'Nearest Sensitive Receptor'. A summary of M9 is provided at Appendix 1. This was used to inform the methodology for the sampling of bioaerosols around this site.

2.4 Applying the Environment Agency Bioaerosols Policy to the Composting Site.

The Anaerobic Digester Facility is within 250m of the Composting Facility. This has been taken into account during monitoring and the Site Office for this may be regarded as the 'Nearest Sensitive Receptor' (NSR).

Other people present at the site are either the owner/managers, the employees, or delivery drivers, who are not present for more than 6 hrs per day.

3.0 COMPOSTING SITE - SENSITIVE RECEPTORS

Site Situation with Regard to Sensitive Receptors

The composting site is accommodated in a rural area and apart from the Anaerobic Facility there are no receptors within 250 metres of the operations. Operatives working within the AD Building are subject to H&S criteria just as the composting operatives are; and in effect are protected from the external environment.

However, the staff who work within the office at the AD Facility are not protected in the same way; and the composting site regards these as potentially sensitive and plans work activities with attention to environmental management with these people in mind. E.g. Various activities will not be undertaken if the wind is directly toward the AD Site offices, ***i.e. from the North-West blowing toward the South-East.***

For the Bioaerosol Assessment; the distance from the active operation to the AD Site office is used.

4.0 COMPOSTING SITE - BIOAEROSOL SAMPLING STATIONS

4.1 Location of sampling Stations

Sampling stations locations are shown at Figure 3. **Four** locations were used to provide data in accordance with 'Upwind'; and the 'Fan-Array' of 'Downwind' at distances equal to that to the AD Site Office.

Figure 3: Fan Array (blue sector) of Sampling Station Locations –MD Recycling Composting Facility. SA43 1RD

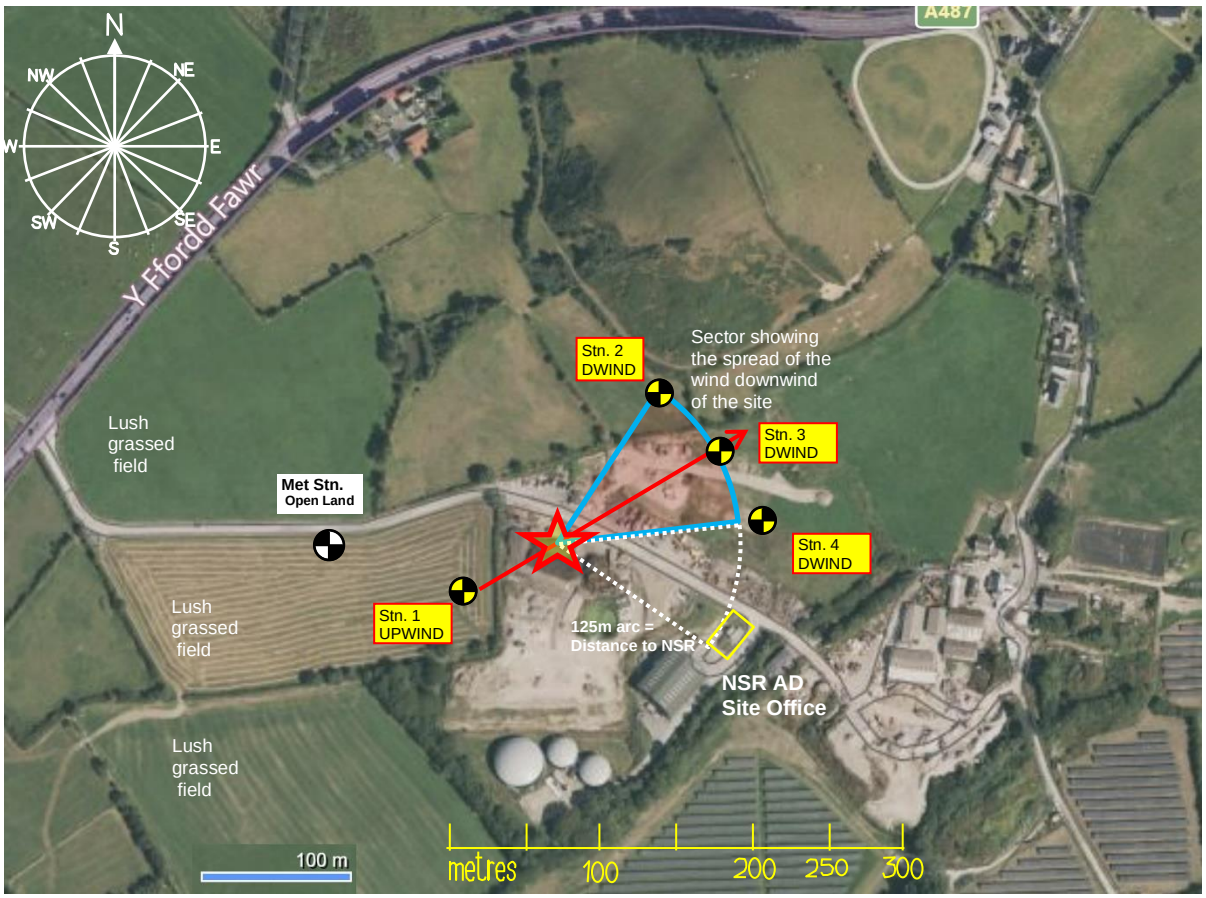


Table 1. Key to Sampling Stations SA43 1RD

Station 1	SN 20239 47262	Upwind for all sessions	50 m SW of Site	75m and SW from centre of activity (marked-)
Station 2	SN 20384 47407	Downwind left of centre	80m NNE of Site	125m NNE and -25° from downwind centre-line
Station 3	SN 20434 47373	Downwind as centre	80m NE of Site	125m NE and 0° Downwind activity centre-line
Station 4	SN 20446 47316	Downwind right of centre	80m ENE of Site	125m ENE and +25° from downwind centre-line

As can be seen, the station locations were arranged to relate to the South-Easterly wind i.e. blowing toward the North-West. The left station 2 and right station 4 were arranged either side of the centreline of the wind at the outset and as the wind direction was reasonably steady, it was deemed unnecessary to rearrange these as the sessions progressed. Stations 2 and 3 were higher up the bank i.e. at a higher elevation.

4.2 Activities Ongoing at the Site during Sampling

The sampling was undertaken during a period of **FEEDSTOCK** and **COMPOST Movement** and **SCREENING** activity, to purposefully determine the level of bioaerosols during a period when materials handling and processing (loading shovel operation) activities were being undertaken.

5.0 BIOAEROSOL TYPES

Types of bioaerosol were sampled and enumerated

Description	**Total Bacteria**	**Aspergillus Fumigatus**
Enumerated as	**cfu/plate**	**cfu/plate**
Interpreted as	**cfu/m^3**	**cfu/m^3**

These types relate to the EA guidance given earlier (Section 2.3 on page 3). Gram Negative Bacteria (mentioned in the Permit) were formerly only required with Animal By-Product material treatment facilities; but under M9 Guidance are NO LONGER required to be sampled.

6.0 BIOAEROSOL SAMPLING PROCEDURE

6.1 Standardised sampling Procedure

The methodology was based on the M9 Guidance 'Environmental Monitoring of Bioaerosols at Regulated Facilities' published 2018 V2 by The Environment Agency. (Refer to Appendix 1).

6.2 Sampling Equipment and Method

6.2.1 Samplers

Samplers comprised the 3 part 'Andersen' type sampler design, with base, sampling hole manifold and collection funnel. Air stagnation baffles were fitted during sampling. Using extendable tripods, the samplers were set at 2m during each session of sampling.

6.2.2 Positive Displacement Suction Pumps

The air suction diaphragm pumps, were Charles Austen Pumps, twin headed parallel pumps operating off 12v DC Motors. The Pumps were pre-calibrated to provide a uniform air-flow rate with the target flow of 28.3 litres/minute (+/- 2%) (0.57 l/min). Measured flow-rates are shown in the results for each sampler. These were recorded as 28 l/min.

6.3 Sample Collection media and Enumeration

The collection media and laboratory-based incubation and enumeration was undertaken by 'D & F Associates Ltd of Widnes' a UKAS accredited laboratory. (See Box1 at page ii)

6.4 Weather Monitoring Equipment

Weather during the sampling was monitored using a portable weather station mounted on a 2m pole at the site, with temperature, humidity, wind direction and wind-speed monitoring. See section 7.

6.5 Sampler Locations

The sampling station locations were selected to provide the data in accordance with the M9 Guidance. Station locations are described at 4.1 Table 1 and shown at figure 3. The fan array of the station locations was maintained through each session, because the wind direction did not vary by much. The stations were located in the nearby fields enabling useful time to set them up for each session. A small, time offset was used to provide time to work at each station.

6.6 Sample Chain of Custody

The sampling plates and exposed samples were kept in sealed polythene bags within a 12 volt powered refrigerator during the sampling sessions and during transport and short term storage. The samples were delivered refrigerated to the laboratory the same day as the sampling had been undertaken and placed into a refrigerator prior to processing.

Delivery to the lab	Same day as sampling.	The lab operates a secure reception protocol that enables the samples to be delivered directly into a refrigerator at any time of the day or evening
Sample analysis	Incubation of the samples was started immediately after receipt/ registration at the laboratory.	Samples are put into incubation within a few hours of reception.
How stored.	Samples are retained in a 12volt powered portable refrigerator during sampling progression and transport to the laboratory	Storage of the plates and after they have been exposed is undertaken using the mobile fridge where they are held at ~5°C temperature as defined in laboratory procedures.

6.7 Three Sampling Periods

Sampling was replicated in four Sessions. In each, the 20 minute Upwind sampling was started a few minutes before, and ended a few minutes after the 5 minute downwind sampling periods. A 2 minute stagger in downwind sampling was used to provide time for the Technician to move from station to station.

7.0 MET DATA DURING SAMPLING

The following data was recorded by the Kestrel 4500 portable Met Station, mounted on a tripod and mast at approx. 2.0m height above ground level. It was located on an open field to the South of the site. The Kestrel 4500 comprises a wind vane, vane type anemometer, temperature and humidity sensors and has a built-in data-logger. The data logging interval was set at 1 minute.

The data is presented at Table 3 in accordance with the M9 Guidance and is based on the raw data gathered during the overall period of sampling at the site. The raw data is shown at Appendix 2.

***Table 2: Meteorological Conditions M D Recycling* – 11th July 2023**

Meteorological Conditions											
Site:		**M D Recycling, Penparc**			**Site Operator:**			**M D Recycling Ltd.**			
Sampling Date:		**11th July 2023**			**Monitoring Contractor:**			**Recogen Ltd.**			
Sample Ref Nos.		**Location**	**Bearing of Samplers** from centre of Active Area ° to N	**Mean Wind Direction** wind blows TO during sampling period degrees ° to N	**Difference in bearing** of samplers and mean direction wind blows TO degrees ° to N	**Wind Speed** as sampling **ms-1** @ 2m | @10m		**Mean Air Temp** as sampling **°C**	**Mean Air RH** Mean **RH%**	**Prevailing Weather Pressure** Cloud Cover 1/8 ths mbar (okta)	
P	1A Upwind T & F	Upwind Stn. 1	240	**60**	**180**	4.8	6.7	17.4	74	1002	5/6
P	1B Left T & F	Downwind Stn. 2	35		-24.9						
P	1C Centre T & F	Downwind Stn. 3	60		0						
P	1D Right T & F	Downwind Stn. 4	85		25						
P	2A Upwind T & F	Upwind Stn. 1	240	**64**	**176**	4.9	6.8	17.9	71	1003	5/6
P	2B Left T & F	Downwind Stn. 2	35		-29.1						
P	2C Centre T & F	Downwind Stn. 3	60		-4						
P	2D Right T & F	Downwind Stn. 4	85		21						
P	3A Upwind T & F	Upwind Stn. 1	240	**58**	**182**	4.9	6.7	17.8	72	1002	5/6
P	3B Left T & F	Downwind Stn. 2	35		-23.1						
P	3C Centre T & F	Downwind Stn. 3	60		2						
P	3D Right T & F	Downwind Stn. 4	85		27						
P	4A Upwind T & F	Upwind Stn. 1	240	**60**	**180**	4.6	6.3	17.7	71	1003	5/6
P	4B Left T & F	Downwind Stn. 2	35		-24.8						
P	4C Centre T & F	Downwind Stn. 3	60		0						
P	4D Right T & F	Downwind Stn. 4	85		25						

The sampling sessions were started at around 2:00PM and the temperature was steady through the session at 17.4 to 17.7° C. There was a fresh breeze that was predominantly from the **South-West** between 4.6 and 4.8 m/sec. There was no rain during the sampling period; the air humidity was ~72%. Generally, the sky was overcast and entailed high cloud.

8.0 SUMMARY OF THE BIOAEROSOL SAMPLING RESULTS

The full raw results are shown in Appendix 3. These show the counts per plate and the calculation of the concentrations for each bioaerosol, based on the sampling time and airflow in the samplers.

The Data are presented in Tables 3 and 4 in accordance with the M9 Guidance. Table 3 shows the Results for **Total Viable Bacteria** and Table 4 shows the results for the **Aspergillus Fumigatus** Samples.

The tables reveal the **MEDIAN** of the **UPWIND** and the **DOWNWIND** sampling results. The **MAXIMUM MEDIAN** value is derived from the session medians. The sampling of TVC and AF was done concurrently.

***Table 3: Sampling Results – TOTAL BACTERIA – M D Recycling* – 11th July 2023**

Site:	**M D Recycling, Penparc**			Type of materials on site			Composted Green Waste		
Sampling Date:		**11th July 2023**		Estimated material on site			500 tonnes		
Site Operator:		**M D Recycling Ltd.**		Type of Activity			Open Windrow Composting		
Monitoring Contractor:		**Recogen Ltd** of Shrewsbury.		Activities affecting bioaerosols release			Compost Feedstock Stacking. Compost movement and screening.		
				Bioaerosol Type:			**TOTAL BACTERIA**		
Sample Ref Nos. Station Location ref. **All Sample Refs: 'T' (Total Viable Bacteria)**		**Station Location** bearing from centre of site ° from N	**Distance** from centre of activity metres	**Difference in bearing** between sampler location and mean direction that wind blows TO	**Sampling Period** Start Time.	End Time	**Concentration of bioaerosols** **Total Viable Bacteria cfu/m³**	**Mean** of **UPWIND** Samples **Total Bacteria cfu/m³**	**Median** of **DOWNWIND** Samples **Total Bacteria cfu/m³**
P1 AT	UW Stn. 1	120	75	-180	14:08	14:28	**18**	18	
P1 BT	DW Stn. 2	275	125	25	14:12	14:17	**57**		
P1 CT	DW Stn. 3	300	125	0	14:16	14:21	**171**		57
P1 DT	DW Stn. 4	325	125	25	14:18	14:23	**36**		
P2 AT	UW Stn. 1	120	75	-176	14:40	15:00	**25**	25	
P2 BT	DW Stn. 2	275	125	29	14:44	14:49	**14**		
P2 CT	DW Stn. 3	300	125	-4	14:48	14:53	**143**		21
P2 DT	DW Stn. 4	325	125	21	14:50	14:55	**21**		
P3 AT	UW Stn. 1	120	75	-182	15:13	15:33	**2**	2	
P3 BT	DW Stn. 2	275	125	23	15:17	15:22	**50**		
P3 CT	DW Stn. 3	300	125	2	15:21	15:26	**507**		57
P3 DT	DW Stn. 4	325	125	27	15:23	15:28	**57**		
P4 AT	UW Stn. 1	120	75	-180	15:46	16:06	**4**	4	
P4 BT	DW Stn. 2	275	125	25	15:50	15:55	**50**		
P4 CT	DW Stn. 3	300	125	0	15:54	15:59	**429**		50
P4 DT	DW Stn. 4	325	125	25	15:56	16:01	**7**		
				MEDIAN UPWIND AND DOWNWIND VALUE				**11**	**54**
				MAX MEDIAN UPWIND & DOWNWIND VALUE				**25**	**57**

Commentary to assist interpretation

1. The wind during the sampling sessions was generally from the South-West arriving from the main road, over grassed fields, over the site and off to the recycling centre north of the AD facility.

2. The upwind Total Bacteria bioaerosol levels were **VERY LOW**, (mean value **11 cfu/m³**) i.e. most likely attributable to the long lush wet grass in the fields to the SW; and preceding damp weather.

3. The Downwind sample values varied slightly depending on location within the 'fan-array'. However, these values could be described as **VERY LOW** (with the MEDIAN DOWNWIND of **54 cfu/m³). The MAXIMUM MEDIAN VALUE (derived from all values) was 57 cfu/m³**. There was evidence of some moderate levels, which suggests that there was a modest contribution to the bacteria bioaerosols in the downwind, likely attributable to the raw feedstock or the compost screening.

Table 4: Sampling Results – ASPERGILLUS FUMIGATUS - M D Recycling – 11th July 2023

Site:	**M D Recycling, Penparc**			Type of materials on site			Composted Green Waste		
Sampling Date:		**11th July 2023**		Estimated material on site			500 tonnes		
Site Operator:		**M D Recycling Ltd.**		Type of Activity			Open Windrow Composting		
Monitoring Contractor:		**Recogen Ltd** of Shrewsbury.		Activities affecting bioaerosols release			Compost Feedstock Shredding. Green Waste reception and stacking		
				Bioaerosol Type:			**ASPERGILLUS FUMIGATUS**		
Sample Ref Nos. Station Location ref. **All Sample Refs: 'F' (Asp. Fumigatus)**		**Station Location** bearing from centre of site ° from N	**Distance** from centre of activity metres	**Difference in bearing** between sampler location and mean direction that wind blows TO	**Sampling Period** Start Time.	End Time.	Concentration of bioaerosols **Aspergillus Fumigatus cfu/m³**	Mean of **UPWIND** Samples **Aspergillus Fumigatus cfu/m³**	Median of **DOWNWIND** Samples **Aspergillus Fumigatus cfu/m³**
P1 AF	UW Stn. 1	120	75	-180	14:08	14:28	0	0	
P1 BF	DW Stn. 2	275	125	25	14:12	14:17	0		
P1 CF	DW Stn. 3	300	125	0	14:16	14:21	100		43
P1 DF	DW Stn. 4	325	125	25	14:18	14:23	43		
P2 AF	UW Stn. 1	120	75	-176	14:40	15:00	0	0	
P2 BF	DW Stn. 2	275	125	29	14:44	14:49	7		
P2 CF	DW Stn. 3	300	125	-4	14:48	14:53	50		7
P2 DF	DW Stn. 4	325	125	21	14:50	14:55	7		
P3 AF	UW Stn. 1	120	75	-182	15:13	15:33	0	0	
P3 BF	DW Stn. 2	275	125	23	15:17	15:22	0		
P3 CF	DW Stn. 3	300	125	2	15:21	15:26	236		14
P3 DF	DW Stn. 4	325	125	27	15:23	15:28	14		
P4 AF	UW Stn. 1	120	75	-180	15:46	16:06	0	0	
P4 BF	DW Stn. 2	275	125	25	15:50	15:55	0		
P4 CF	DW Stn. 3	300	125	0	15:54	15:59	357		7
P4 DF	DW Stn. 4	325	125	25	15:56	16:01	7		
				MEDIAN UPWIND & DOWNWIND 'AF' VALUE				**0**	**11**
				MAX MEDIAN UP & DOWNWIND 'AF' VALUE				**0**	**43**

Commentary to assist interpretation

1. The wind during the sampling sessions was generally from the South-West arriving from the main road, over grassed fields, over the site and off to the recycling centre north of the AD facility.

2. The UPWIND values for Aspergillus Fumigatus in each instance were **NIL** (mean 0 cfu/m^3).

3. The Downwind Aspergillus Fumigatus sample values were **VERY LOW** (with the **MEDIAN DOWNWIND** of **11 cfu/m^3**). **The MAXIMUM MEDIAN VALUE (derived from all values) was similarly LOW; 43 cfu/m^3**. The **LOW** values in both the upwind and downwind locations, suggests both that there were minimal Aspergillus Fumigatus in the background, and also that neither the feedstock movement and screening (nor the material in process) were generating any significant Aspergillus Fumigatus emissions.

4. Aspergillus Fumigatus (fungi) are very often present where material is undergoing composting, however, background levels of these bioaerosols within rural areas may typically be ~ 50 cfu/m^3.

9.0 DISCUSSION OF RESULTS

9.1 Summary – Site Conditions and Activity During Sampling

During the sampling there was traffic moving around the overall site; with lorries delivering fresh green waste material and lorries hauling wood or aggregates to or from the site. Fresh green waste material was being stacked up and the composted material was being screened. Table 5 provides a results summary.

9.2 Summary - Bioaerosol levels

***Table 5 – Summary of results M D Recycling Composting Facility* - 11th July 2023**

		Total Bacteria			Asp. Fumigatus	
	Activities	**Median UW**	**Median DW**		**Mean UW**	**Median DW**
		cfu/m^3	cfu/m^3		cfu/m^3	cfu/m^3
Session 1	General External site ops.	**18**	**57**		**0**	**43**
Session 2	General External site ops.	**25**	**21**		**0**	**7**
Session 3	General External site ops.	**0**	**57**		**0**	**14**
Session 4	General External site ops.	**4**	**50**		**0**	**7**
Overall	Median Upwind & Downwind	**11**	**54**		**0**	**11**
Maximum Median Upwind and Downwind		**25**	**57**		**0**	**43**

* Maximum Median Values are used to compare to Permit Values.

10.0 CONCLUSIONS-BIOAEROSOL SAMPLING

10.1 General Conclusions

The following may be concluded from the air quality results sampled **11th July 2023**:

4. The results show **VERY LOW** levels of Total Bacteria and **NEGLIGIBLE** Aspergillus Fumigatus (AF) in the samples taken **UPWIND** of the site. These values reflect the absence of bioaerosol sources in the upwind and the damp over-night weather conditions.

5. The results show **VERY LOW** levels of both Total Bacteria and Aspergillus Fumigatus (AF) in the samples taken **DOWNWIND** of the site. These values suggest that at this time of the year, the activities (the feedstock materials movement, screening or compost in process) were contributing **some** modest levels of bioaerosols into the air leaving in the Downwind.

6. All of the Median bioaerosol levels determined downwind of the site, were much less than 10% of the guideline levels advised by the EA/NRW and therefore it may be concluded based on this instance that there is minimal risk of adverse effect to the third-party receptors nearby to the site.

10.2 Overall Conclusion

The results of sampling suggest that under these conditions, there were generally, **VERY LOW** levels of bioaerosols generated and released from the composting facility.

The **Maximum Median** Downwind Bioaerosol level of **Total Bacteria** was **57 cfu/m^3 and the Aspergillus Fumigatus** was **43 cfu/m^3** . The downwind Bioaerosols levels attributable to the compost site were therefore **VERY LOW** overall and **were less than 10%** of the EA/NRW Guideline thresholds.

It can be concluded that the composting activities pose minimal adverse risk to the health of persons nearby.

APPENDIX 1. The M9 2018 Technical Guidance Note (Monitoring)

Technical Guidance Note (Monitoring)

M9
Environmental monitoring of bioaerosols at regulated facilities

Environment Agency January 2018 Version 2

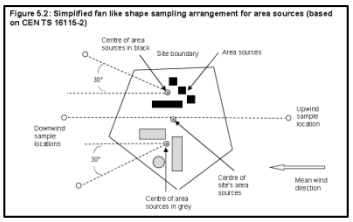
Sampling bioaerosols
Bioaerosols can be measured using a number of different techniques. This technical note describes the following techniques for sampling bioaerosols:

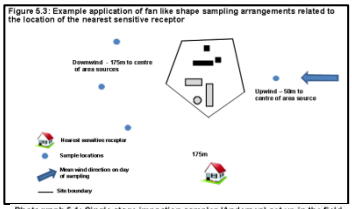
Impaction
The impaction method uses a single stage Andersen sampler, loaded with a Petri dish of appropriate media. This method uses inertial forces to collect microorganisms in the air. Air is drawn through the perforated holes in the sampling head at a constant rate, using a vacuum pump. The velocity of the air is determined by the diameter of the holes in the sampling head. When the air hits the collection surface it is forced to change direction. The inertia of the microorganisms prevents them from changing direction, which causes them to become impacted onto the Petri dish media. When a sufficient volume of air has been collected, the Petri dish is removed and incubated, without further treatment.

5.2 Sample location strategy
The principle of this specification is to compare the concentrations in air unaffected by the activities of the facility (that is the background air sampled upwind of the plant) with the concentration of bioaerosols in air downwind of the plant. This comparison enables an assessment of the plant related contribution over a specified area to be made. The difference between the upwind and downwind concentration caused by bioaerosol emissions from the site is known as the process contribution. It uses sampling locations that form a fan like shape, which helps to ensure that variable wind directions are taken account of during the sampling period.

5.2.2 Sample locations upwind of the site
Sampling should be carried out upwind of the site. Upwind data should provide information on the concentration of specified bioaerosols that are present in the air blowing onto the operational area of the site. This should reflect either the background concentration at that time, or the effects of neighbouring operations, such as agricultural activities.

Upwind data indicates the concentration of bioaerosols that would be present, irrespective of whether the facility was there or not. The sample location of the upwind concentration measurement should be measured at a distance of 50m from the centre of the active operational area.





5.2.3 Sample locations downwind of the site
Sampling should be carried out downwind of the site, using a fan like shape arrangement to detect the position of the plume. The orientation of the measurement area is determined by the prevailing mean wind direction.

This approach is used to ensure that measurements are made in the emission plume, during the sampling campaign. If there are any buildings, installations or structures between the downwind location(s) and the centre of the active operational area, then sampling should be carried out *upwind of that structure or installation, at a distance greater than twice its height*.

Figure 5.1 shows this approach applied to a facility with a single point source. Topography or vegetation may restrict the line of sight required to locate sample traverses. This may make it difficult to determine the angle for locating the sample points. The restriction should be noted in the sample strategy and final monitoring report. For area sources, the orientation of the fan like shape sampling arrangement is selected by determining the centre point of the sources in the site.

Photograph 5.1: Single stage impaction sampler (Andersen) set up in the field

Each impaction sampler should be mounted onto a tripod, or other suitable structure, so that the top of the inlet cone is held **between 1.5 and 1.8m above the ground**. Each single stage impaction sampler fitted with a cone should be fitted with a **hemi-cylindrical baffle** extending in height at least 15 centimetres (cm) above the top of the inlet of the cone, to ensure stagnation point sampling.

5.6.2 Sampling procedure
A single Petri dish (with the lid removed) should be loaded into each sampler immediately prior to use, in accordance with the manufacturer's instructions. Once loaded, the sampler should be kept upright, to prevent the Petri dish from dislodging. A single sample of *Aspergillus fumigatus* (1 Petri dish containing selective medium) should be collected at each of the specified locations using a single stage impaction sampler. The same procedure should be repeated for mesophilic bacteria using Petri dishes containing selective medium specific for the culturing of mesophilic bacteria.

APPENDIX 2. WEATHER DATA DURING SAMPLING

Meteorological data was recorded by the Kestrel 4500 mounted on a 2.0m mast. It comprises a wind vane, type anemometer, temperature and humidity sensors. The logging interval was 1 minute. See table A2.

***Table A2: Meteorological Data M D Recycling* - 11th July 2023**

Time	Wind	Wind	Wind	Temp	RH	BP		Time	Wind	Wind	Wind	Temp	RH	BP
	Bearing	Direction	Speed m/s	°C	%	mb			Bearing	Direction	Speed m/s	°C	%	mb
14:06:00	243	WSW	5.5	16.8	75	1003		15:20:00	239	WSW	4.8	18.8	69	1002
14:07:00	278	W	4.8	16.9	76	1002		15:21:00	234	SW	3.8	18.2	70	1003
14:08:00	238	WSW	2.6	16.7	74	1003		15:22:00	245	WSW	6.6	17.7	73	1002
14:09:00	240	WSW	3.2	17	76	1002		15:23:00	192	SSW	5.2	17.4	72	1002
14:10:00	242	WSW	5.9	18	75	1003		15:24:00	233	SW	5.6	17.6	73	1002
14:11:00	243	WSW	7.4	17.5	75	1003		15:25:00	241	WSW	3.6	17.6	73	1002
14:12:00	245	WSW	4.6	17.6	72	1002		15:26:00	244	WSW	4.5	16.9	73	1003
14:13:00	215	SW	6.7	16.8	76	1002		15:27:00	242	WSW	5.6	17.3	74	1003
14:14:00	225	SW	4.2	18	74	1002		15:28:00	241	WSW	7.8	17.8	72	1002
14:15:00	244	WSW	5.2	17.2	73	1002		15:29:00	245	WSW	5.1	17.3	73	1003
14:16:00	243	WSW	4.8	16.8	74	1002		15:30:00	234	SW	3.6	17.7	72	1002
14:17:00	239	WSW	2.8	16.2	75	1002		15:31:00	244	WSW	5.4	17.9	71	1002
14:18:00	245	WSW	3.9	16.8	74	1002		15:32:00	244	WSW	5.1	17.8	70	1003
14:19:00	242	WSW	5.4	17.6	72	1003		15:33:00	245	WSW	4.8	17.8	71	1003
14:20:00	238	WSW	5.2	17.6	73	1002		15:34:00	240	WSW	3.6	17.8	70	1002
14:21:00	238	WSW	3.5	17.8	74	1002		15:35:00	256	WSW	3.4	17.8	73	1002
14:22:00	241	WSW	4.6	16.5	73	1002		15:36:00	231	SW	6	19	71	1002
14:23:00	241	WSW	7.5	18.3	73	1003		15:37:00	243	WSW	6.2	17.9	72	1003
14:24:00	235	SW	4.1	18.3	72	1002		15:38:00	243	WSW	6.3	17.7	70	1003
14:25:00	245	WSW	2.3	17.8	72	1002		15:39:00	225	SW	0	18.2	71	1002
14:26:00	237	WSW	6.2	17.5	72	1002		15:40:00	244	WSW	6.5	17.3	69	1003
14:27:00	248	WSW	4.5	17.2	73	1003		15:41:00	241	WSW	5	17.7	70	1003
14:28:00	256	WSW	5.4	17.1	72	1003		15:42:00	244	WSW	3.4	18.1	70	1003
14:29:00	189	S	5.6	17.7	72	1003		15:43:00	246	WSW	3.8	18.3	72	1003
14:30:00	245	WSW	6.5	18	73	1002		15:44:00	242	WSW	3.9	18.5	70	1003
14:31:00	245	WSW	3.9	17.2	73	1003		15:45:00	235	SW	3.3	18	68	1003
14:32:00	242	WSW	3.9	18.1	73	1002		15:46:00	244	WSW	4.2	17.9	72	1002
14:33:00	240	WSW	5.7	17.5	73	1003		15:47:00	246	WSW	4.7	17.3	72	1003
14:34:00	242	WSW	4.6	16.8	73	1002		15:48:00	246	WSW	5.1	17.5	72	1002
14:35:00	238	WSW	6.2	16.6	73	1003		15:49:00	245	WSW	4.9	17.1	70	1003
14:36:00	244	WSW	3.5	16.9	73	1003		15:50:00	180	S	6.3	17.7	72	1003
14:37:00	245	WSW	5.6	16.7	72	1003		15:51:00	250	WSW	5.3	18	72	1003
14:38:00	248	WSW	5.1	17.3	71	1002		15:52:00	224	SW	4.5	18	70	1002
14:39:00	249	WSW	3.6	17.8	72	1003		15:53:00	242	WSW	3.4	18.7	71	1003
14:40:00	242	WSW	5.6	17.3	72	1002		15:54:00	222	SW	4.8	18.3	70	1002
14:41:00	244	WSW	3.8	17.7	71	1003		15:55:00	245	WSW	3.9	18.2	71	1002
14:42:00	245	WSW	6	17.9	72	1003		15:56:00	245	WSW	3.2	17.9	71	1003
14:43:00	239	WSW	6	17.8	70	1003		15:57:00	242	WSW	2.6	18.9	70	1003
14:44:00	228	SW	2.6	19	72	1003		15:58:00	243	WSW	6	17.9	70	1002
14:45:00	246	WSW	4.4	17.9	71	1003		15:59:00	239	WSW	6.1	17.5	72	1003
14:46:00	237	WSW	4.2	17.7	70	1003		16:00:00	238	WSW	3.6	17.3	70	1002
14:47:00	240	WSW	3.6	18.2	71	1003		16:01:00	245	WSW	6.3	17.5	70	1003
14:48:00	266	W	5	17.3	71	1003		16:02:00	244	WSW	5.3	17.3	73	1003
14:49:00	236	SW	3.8	17.7	70	1003		16:03:00	246	WSW	5.9	17.6	72	1003
14:50:00	235	SW	4.8	18.1	70	1003		16:04:00	245	WSW	4.6	17.2	72	1002
14:51:00	244	WSW	5.1	18.3	68	1003		16:05:00	240	WSW	5.3	17	71	1003
14:52:00	246	WSW	6.6	18.5	70	1003		16:06:00	275	W	4.6	17.5	70	1004
14:53:00	239	WSW	4.6	18	70	1003		16:07:00	235	SW	2.4	17.3	72	1004
14:54:00	244	WSW	6.4	17.9	72	1003		16:08:00	237	WSW	3	18.7	70	1004
14:55:00	244	WSW	6.7	17.3	71	1003		16:09:00	239	WSW	5.7	18.7	71	1004
14:56:00	240	WSW	4.7	17.5	73	1002		16:10:00	240	WSW	7.2	17.8	70	1004
14:57:00	241	WSW	2.5	17.1	71	1003		16:11:00	242	WSW	4.4	18.2	71	1004
14:58:00	251	WSW	5.6	17.7	70	1002		16:12:00	212	SSW	6.5	18.8	72	1004
14:59:00	267	W	5.6	18	70	1002		16:13:00	222	SW	4	18.2	71	1004
15:00:00	237	WSW	7.8	18	70	1003		16:14:00	241	WSW	5	17.7	72	1004
15:01:00	222	SW	4.3	18.7	69	1002		16:15:00	240	WSW	4.6	17.4	71	1004
15:02:00	245	WSW	5.1	18.3	72	1003		16:16:00	236	SW	2.6	17.6	71	1004
15:03:00	244	WSW	4.3	18.2	72	1003		16:17:00	242	WSW	3.7	17.6	72	1004
15:04:00	256	WSW	7	17.9	71	1003		16:18:00	239	WSW	5.2	16.9	71	1004
15:05:00	263	W	3.5	18.9	72	1003		16:19:00	235	SW	5	17.7	72	1004
15:06:00	257	WSW	7	17.9	72	1003		16:20:00	235	SW	3.3	17.3	71	1004
15:07:00	207	SSW	3	17.5	73	1003		16:21:00	238	WSW	4.4	17.8	70	1004
15:08:00	267	W	5.3	17.3	73	1003		16:22:00	238	WSW	7.3	17.2	71	1004
15:09:00	237	WSW	5.4	17.5	73	1003		16:23:00	232	SW	3.9	17.3	72	1004
15:10:00	235	SW	3.8	17.3	73	1003		16:24:00	242	WSW	2.1	17.5	71	1004
15:11:00	215	SW	6.7	17.6	73	1003		16:25:00	234	SW	6	17.5	70	1004
15:12:00	242	WSW	4.4	17.2	73	1002		16:26:00	245	WSW	4.3	17.2	70	1004
15:13:00	239	WSW	5.1	17	74	1003		16:27:00	253	WSW	5.2	17.1	70	1004
15:14:00	246	WSW	6.3	17.5	73	1003		16:28:00	186	S	5.4	17.7	70	1004
15:15:00	244	WSW	3.9	17.3	71	1003		16:29:00	242	WSW	6.3	18	73	1004
15:16:00	246	WSW	6.7	18.7	71	1002		16:30:00	242	WSW	3.7	17.2	70	1004
15:17:00	234	SW	3	18.7	71	1003		16:31:00	239	WSW	3.7	18.1	70	1004
15:18:00	224	SW	5.5	17.8	72	1002		16:32:00	237	WSW	5.5	17.5	70	1004
15:19:00	228	SW	2.8	18.2	71	1002		16:33:00	239	WSW	4.4	16.8	71	1004

APPENDIX 3. Bioaerosols Sampling Record and Results

Results Table A3.1: Session 1: Bioaerosol levels UPWIND and DOWNWIND of the Compost Facility.

Run No.	Sample Type	Sampler location	Sampler station number	Sampler code	Pump Code	Pump Flowrate litres/min	Start time	End Time	Sample time. min.	PLATE COUNT cfu**	Total Bacteria cfu m^{-3}	Aspergillus Fumigatus cfu m^{-3}
P1 A	TVC	UPWIND A	**1**	YA	P1	28	14:08	14:28	20.00	**10**	18	
P1 B	TVC	DOWNWIND B	**2**	YB	P2	28	14:12	14:17	5.00	**8**	57	
P1 C	TVC	DOWNWIND C	**3**	RA	P3	28	14:16	14:21	5.00	**24**	171	
P1 D	TVC	DOWNWIND D	**4**	RB	P4	28	14:18	14:23	5.00	**5**	36	
P1 A	AF	UPWIND A	**1**	BA	Q1	28	14:08	14:28	20.00	**0**		0
P1 B	AF	DOWNWIND B	**2**	BB	Q2	28	14:12	14:17	5.00	**0**		0
P1 C	AF	DOWNWIND C	**3**	GA	Q3	28	14:16	14:21	5.00	**14**		100
P1 D	AF	DOWNWIND D	**4**	GB	Q4	28	14:18	14:23	5.00	**6**		43

*TVC=Total Viable (Bacteria) Count. AF=Aspergillus Fumigatus. **cfu = colony forming units

Results Table A3.2: Session 2: Bioaerosol levels UPWIND and DOWNWIND of the Compost Facility.

Run No.	Sample Type	Sampler location	Sampler station number	Sampler code	Pump Code	Pump Flowrate litres/min	Start time	End Time	Sample time. min.	PLATE COUNT cfu**	Total Bacteria cfu m^{-3}	Aspergillus Fumigatus cfu m^{-3}
P2 A	TVC	UPWIND A	**1**	YA	P1	28	14:40	15:00	20.00	**14**	25	
P2 B	TVC	DOWNWIND B	**2**	YB	P2	28	14:44	14:49	5.00	**2**	14	
P2 C	TVC	DOWNWIND C	**3**	RA	P3	28	14:48	14:53	5.00	**20**	143	
P2 D	TVC	DOWNWIND D	**4**	RB	P4	28	14:50	14:55	5.00	**3**	21	
P2 A	AF	UPWIND A	**1**	BA	Q1	28	14:40	15:00	20.00	**0**		0
P2 B	AF	DOWNWIND B	**2**	BB	Q2	28	14:44	14:49	5.00	**1**		7
P2 C	AF	DOWNWIND C	**3**	GA	Q3	28	14:48	14:53	5.00	**7**		50
P2 D	AF	DOWNWIND D	**4**	GB	Q4	28	14:50	14:55	5.00	**1**		7

*TVC=Total Viable (Bacteria) Count. AF=Aspergillus Fumigatus. **cfu = colony forming units

Results Table A3.3: Session 3: Bioaerosol levels UPWIND and DOWNWIND of the Compost Facility.

Run No.	Sample Type	Sampler location	Sampler station number	Sampler code	Pump Code	Pump Flowrate litres/min	Start time	End Time	Sample time. min.	PLATE COUNT cfu**	Total Bacteria cfu m^{-3}	Aspergillus Fumigatus cfu m^{-3}
P3 A	TVC	UPWIND A	**1**	YA	P1	28	15:13	15:33	20.00	**1**	2	
P3 B	TVC	DOWNWIND B	**2**	YB	P2	28	15:17	15:22	5.00	**7**	50	
P3 C	TVC	DOWNWIND C	**3**	RA	P3	28	15:21	15:26	5.00	**71**	507	
P3 D	TVC	DOWNWIND D	**4**	RB	P4	28	15:23	15:28	5.00	**8**	57	
P3 A	AF	UPWIND A	**1**	BA	Q1	28	15:13	15:33	20.00	**0**		0
P3 B	AF	DOWNWIND B	**2**	BB	Q2	28	15:17	15:22	5.00	**0**		0
P3 C	AF	DOWNWIND C	**3**	GA	Q3	28	15:21	15:26	5.00	**33**		236
P3 D	AF	DOWNWIND D	**4**	GB	Q4	28	15:23	15:28	5.00	**2**		14

*TVC=Total Viable (Bacteria) Count. AF=Aspergillus Fumigatus. **cfu = colony forming units

Results Table A3.4: Session 4: Bioaerosol levels UPWIND and DOWNWIND of the Compost Facility.

Run No.	Sample Type	Sampler location	Sampler station number	Sampler code	Pump Code	Pump Flowrate litres/min	Start time	End Time	Sample time. min.	PLATE COUNT cfu**	Total Bacteria cfu m^{-3}	Aspergillus Fumigatus cfu m^{-3}
P4 A	TVC	UPWIND A	**1**	YA	P1	28	15:46	16:06	20.00	**2**	4	
P4 B	TVC	DOWNWIND B	**2**	YB	P2	28	15:50	15:55	5.00	**7**	50	
P4 C	TVC	DOWNWIND C	**3**	RA	P3	28	15:54	15:59	5.00	**60**	429	
P4 D	TVC	DOWNWIND D	**4**	RB	P4	28	15:56	16:01	5.00	**1**	7	
P4 A	AF	UPWIND A	**1**	BA	Q1	28	15:46	16:06	20.00	**0**		0
P4 B	AF	DOWNWIND B	**2**	BB	Q2	28	15:50	15:55	5.00	**0**		0
P4 C	AF	DOWNWIND C	**3**	GA	Q3	28	15:54	15:59	5.00	**50**		357
P4 D	AF	DOWNWIND D	**4**	GB	Q4	28	15:56	16:01	5.00	**1**		7

*TVC=Total Viable (Bacteria) Count. AF=Aspergillus Fumigatus. **cfu = colony forming units

Results Table A3.5: CONTROL PLATES

Control Type	Total Bacteria Cfu/Plate (T)		Aspergillus Fumigatus Cfu/Plate (F)
Passive Un-exposed Control	**PT1 =0, PT2 =0**		**PF1 =0, PF2 =0**