



**AGRIORGANICS Ltd.**

**ENCLOSED  
Composting Facility**

**Bioaerosols Monitoring**

**Spring 2020**

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**Relates to Permit/Site:  
  
AGRIORGANICS Ltd  
IVC Facility  
The Hangar  
East Causeway head  
Silloth  
Cumbria CA7 4PJ**

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**Sampling date 16<sup>th</sup> March 2020  
Report date 25<sup>th</sup> April 2020**

## SUMMARY - BIOAEROSOLS MONITORING

### The In-Vessel Composting Operations

The site is located at

**The Hangar,  
Causeway Head  
Silloth, Cumbria CA7 4PJ**

The composting facilities are located within old aircraft hangars at the Silloth Airfield, East Causeway head, Silloth, Cumbria. There are two hangars within the site and the 'In-Vessel Composting' Facility is within the northern-most Hangar (No. 25). The site is located in a rural agricultural setting at the edge of the village with farmed animals and grassland surrounding it.

The IVC facility is within 250m of a number of dwellings that are to the north-east and the west of the facility. However, the IVC is an entirely **enclosed** process. To the west is an open field some dwellings and a caravan site. To the north-west there is a cemetery, the B5302 highway and a church. To the north-east is a redundant poultry farm building and dwellings. To the east and to the south at a further distance there are livestock farms.

The northern-most hangar (No. 25) provides a complete enclosure of the processes, has shutter doors that provide a sealed environment and utilises an extraction ventilation system that vents air to a biofilter on the south-east corner.

On the date of the bioaerosols sampling, the site was very busy with several vehicle movements of new material being received for treatment arriving at the southern doorway; and many vehicles removing processed material from the northern-most doorway in covered trailers. These movements as inputs and outputs required the doors to be opened and closed multiple times during the sampling.

The Composting facility is at a distance closer than 250m away from the nearest third party dwelling – 'New Bungalow' – which is the nearest sensitive receptor (NSR).

Figure 1. Extract from Map (1km grid) Showing location of Composting Facility.



## 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. Health effects may be attributable to prolonged and high concentrations of *Aspergillus Fumigatus*, however these can be minimised by good management.

## Environment Agency Requirements to Monitor Bioaerosols Emissions – M9v2 2018

### Environment Agency Revised and Updated Policy in regard to Bioaerosols

Bioaerosols comes under the statutory control of the Environment Agency (The EA). The EA have produced a Position Statement and in 2017/18 have revised their guidance in regard to Bioaerosols Monitoring. The 'Guidance' is provided within two documents: one for established/unchanged sites [Ref 1.] and the other providing guidance to methods for the on-site sampling (monitoring) of bioaerosols at new sites [Appendix 1].

**Ref 1: A Standardised Protocol for the Monitoring of Bioaerosols at Open Composting Facilities**, EA and The Association for Organic Recycling (AfOR), edited by Toni Gladding (Open University) available by order at the AfOR website [publications] (See Appendix 1): <http://www.organics-recycling.org.uk/>

In **2018 the M9v2 Technical Guidance** note [Ref 2, Appendix 1] was published 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 2009 standardised protocol referred to earlier [Ref 1.].

It 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 and downwind using a 'fan-shaped' array of samplers in the downwind direction from the site. [Ref 2 - see Appendix 1].

### This Report

This report is in regard to a bioaerosols sampling session undertaken **16/03/2020**. This provides an indication of the levels of bioaerosols around the facility during active operation of the facility. This session was undertaken in cool, dry weather during normal composting activities and during a period when there was a worst-case-scenario of vehicle movements and need for doors being opened for both new material being delivered into the southern end of Hangar 25; and also processed material being moved out of the northern doorway. Material was being moved, screened and loaded using a loading shovel operating within the enclosed building.

The wind was arriving at the site from the **South-West** and blowing over the site towards the **North-East**; i.e. over the main part of the site and towards the fields directly towards the NSR.

### Overall Conclusion

The results showed some variability and revealed that there was a **MODERATE** increase in the Bacteria Type Bioaerosol concentrations in the air sampled downwind of the site when the **MAXIMUM** median concentration for Total Bacteria bioaerosols was **450 cfu.m<sup>-3</sup>**; and the **MAXIMUM** median concentration for *Aspergillus Fumigatus* bioaerosols was **4 cfu.m<sup>-3</sup>**.

These **MODERATE OR MINIMAL** levels were attributed to the containment afforded by the enclosed activity.

In conclusion, the levels did not exceed the EA Thresholds for Total Bacteria or *Aspergillus Fumigatus* and are unlikely to cause any adverse impact to the health of residents nearby.

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**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 the standard threshold values.

### Reference to The M9 Monitoring Guidance

The **M9 Monitoring Guidance** (Summary shown at Appendix 2.) is referred to throughout; and was used as the basis for the methodology employed during these sampling sessions.

### 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., is registered with WAMITAB (Environmental Permit Operators Certificate) and whom has over 38 years' experience.

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 Ltd. (Organics Group).

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 (PAS100:2018), The Compost Quality Protocol, ISO9001, ISO14001, COSHH and H&S Risk Assessments.

D and F Associates Laboratory (Widnes, Cheshire) were used for provision and enumeration of the Collection Plates. This laboratory utilises the UKAS procedures.

#### Notes:

1. Culture media supplied by D and F Associates Laboratory (Widnes, Cheshire) is based on that specified in the AfOR Protocol. The mediums used are particularly useful for the identification of bacteria and the type used for the mould species and allows the Laboratory to accurately identify and quantify *Aspergillus Fumigatus* on plates that may contain many other mould species.
2. D and F Associates Laboratory (Widnes, Cheshire) work to UKAS accredited procedures for many analyses and also runs its own internal Quality Management System. All media preparation and storage, is carried-out in accordance with UKAS approved Standard Operating Procedures and fully recorded to appropriate standards.
3. D and F Associates Laboratory undertakes sub-contract work for the Environment Agency providing services for the sampling and laboratory work in relation to bioaerosols.

## **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 may 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.

### **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.

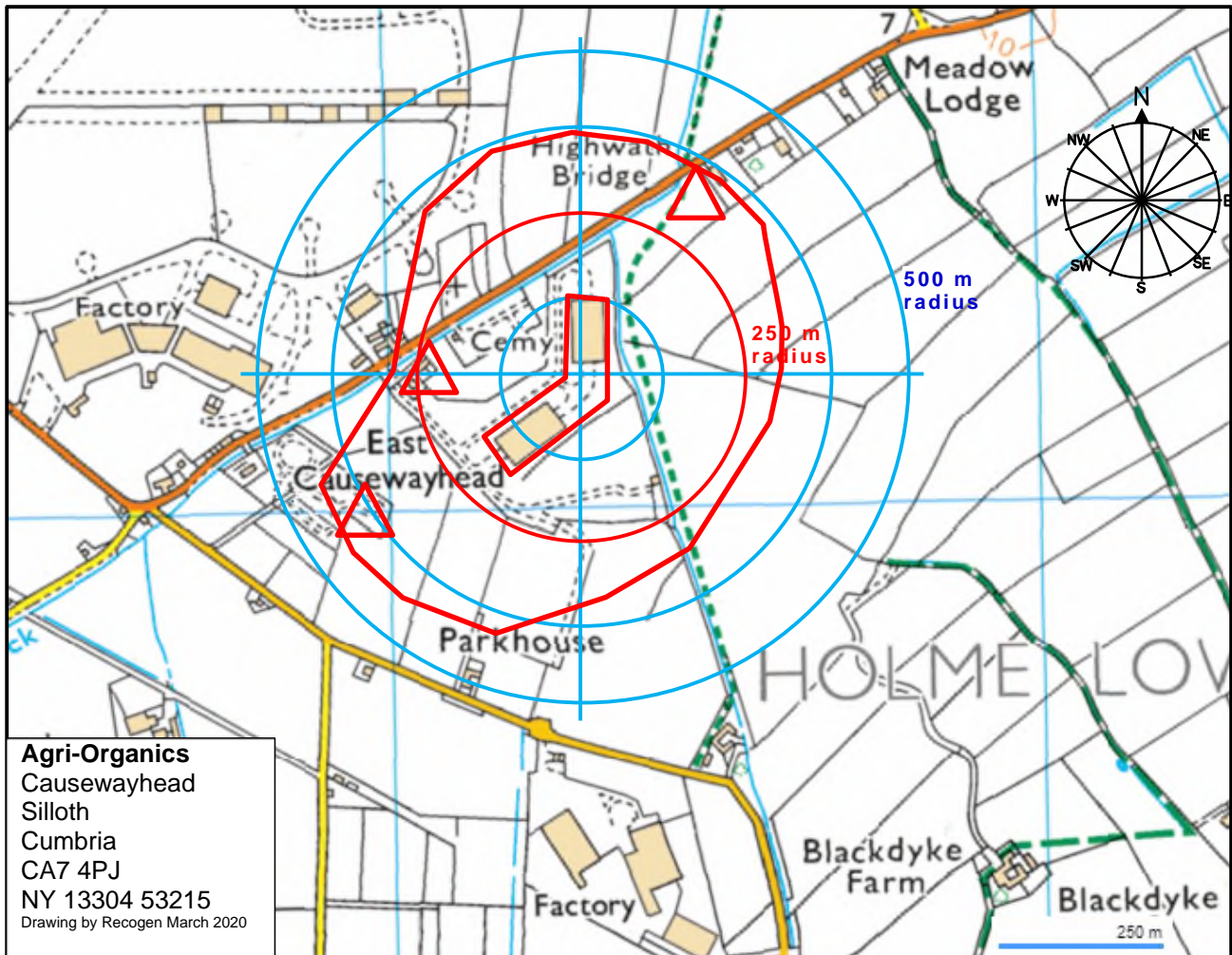
The acceptable (appropriate) levels (given as colony forming units per cubic metre of air) are:

| Bioaerosol type       | Threshold value | units               |
|-----------------------|-----------------|---------------------|
| Total Bacteria        | 1000            | cfu m <sup>-3</sup> |
| Aspergillus Fumigatus | 500             | cfu m <sup>-3</sup> |

## 1.0 SITE LOCATION (In-Vessel-Composting Facility)

The 'In-Vessel' Composting Facility  
 Hangar 25  
 Silloth Airfield  
 East Causewayhead  
 Cumbria CA7 4PJ

Figure 1: Location map for Silloth Airfield composting Facility also showing nearby receptors



## 2.0 SENSITIVE RECEPTORS

### Site Situation with Site Situation with Regard to Nearest Receptors

The Composting Facility Location at The Hangar was developed as a completely enclosed composting plant. Based on company policy and due to the proximity of nearby sensitive receptors, it was agreed that the activities should be given due consideration in regard to bioaerosols generation, release and dispersion. A Biofilter is used to filter air exhaust from the main building.

Staff that work on the site, including the office staff are managed by the company operating the Permitted composting site. The well-being of these people is covered by Health and Safety Policies and management. The EA definitions therefore do not include these staff as being 'sensitive receptors'.

The cemetery is not defined as a sensitive receptor due to the time anyone being present is less than 6 hours per day. This is the same for the road and pathway users and farm workers nearby.

For each of the main compass points, The Nearby Sensitive Receptors include the following:

|                   |   |
|-------------------|---|
| <b>North</b>      | Open land leading to the B5302 main road and beyond which is St Paul's Church to the NW. Further north is Silloth Airfield. To the NE are open fields and farmland.   |
| <b>North East</b> | Open land leading to a livestock farm, farmland and to houses 440m to the NE and Meadow Lodge. There is a new bungalow to the north-east, near the poultry farm building.   |
| <b>East</b>       | Open farmland leading to a livestock farm.  |
| <b>South</b>      | Open land of the old airfield including the second hangar at the site and leading over open ground to a distant industrial estate.  |
| <b>West</b>       | To the north west, is the cemetery, and various properties on the outskirts of the village. To the west are 4 dwellings near the entrance from the B5302, the nearest being 227m distant from the proposed facility. Beyond this are an open area caravan parks (at 316m - 438 m) and further |

### Nearest Sensitive Receptors

The nearest sensitive receptors are identified as the new bungalow to the north-east and the 4 dwellings to the west-north-west near to the entrance from the B5302.

## **3.0 INTERPRETATION OF THE EA'S BIOAEROSOL POLICY**

### **3.1 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) has recently reviewed, updated and re-published ([Ref 3] 2010) its 'Policy' in regard to bioaerosols. This built 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. In summary, **the 2009 policy highlighted *the need to maintain bioaerosols at appropriate levels at any dwelling or workplace.***

In regard to this (see definitions in the Introduction on page 1) the 2009 policy provided the following and these have remained the same in the 2010 PS031: '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<sup>-3</sup> total bacteria,
  - 500 cfu m<sup>-3</sup> *Aspergillus Fumigatus* and

[Note: within the Permit Variation and use of M9 sampling, the Gram negative bacteria or not monitored)

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

The EA Policy and the more recent updates continue to use the 250metre distance as the standard measure so that for sites that provide a greater separation distance than this, should not require ongoing monitoring as they present minimal risk to third parties.

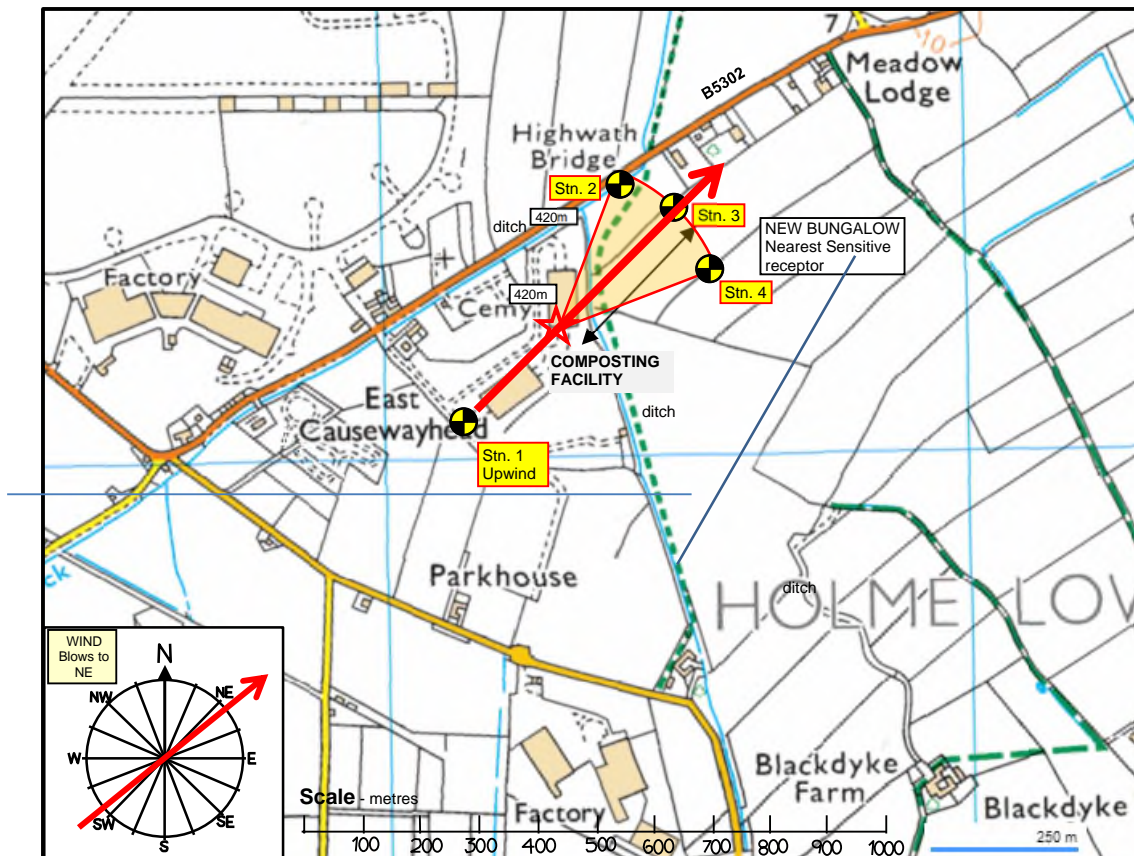
In this instance, the ambient monitoring of bioaerosols was deemed appropriate as part of company policy in order to verify the management of minimal risk to nearby sensitive receptors.

## 4.0 COMPOSTING SITE - BIOAEROSOL SAMPLING STATIONS

### 4.1 Location of sampling Stations

The plan shown at figure 4 is used to identify the sampling stations. The stations were selected, to provide data in accordance with 'upwind' and multiple 'downwind' locations taking account of the distance to the Nearest Receptor (NR). The station locations were selected so that there was no intrusion onto 'private' property and so that the effect of bioaerosols from other operations or natural features was minimised.

**Figure 4: Sampling Station Locations in the Downwind Fan Array for the Composting Facility**





The first sampling session was started when the prevailing wind was from the south-west and the the average wind direction (to north-east) held steady through the whole session.

| Station   | Purpose    | Locations  | Distance from Activity (site) |
|-----------|------------|--|-------------------------------|
|           |            | Note: Centre of activity (southern door to Hangar) marked with a red star. ..★ |                               |
| Station 1 | Upwind A   | SW of the entry track near entry to Southern Hangar Building                   | 200m (50m)                    |
| Station 2 | Downwind B | Open grassed field area NNE of site  | 200m (100m)                   |
| Station 3 | Downwind C | Open grassed field area NE of site   | 200m (100m)                   |
| Station 4 | Downwind D | Open grassed field area ENE of site (NSR)                                      | 200m (100m)                   |

#### 4.2 Activities Ongoing at the Site during Sampling

There were activities ongoing at the site during sampling; these included waste feedstock arrivals into the reception buildings, compost screening and Out-loading of IVC compost from the main IVC Building. There were several biowaste deliveries during the sampling sessions and these were received into the south door of the large hangar building. The unloading of the building entailed multiple traffic/loading shovel movements. The movement and screening of material was all undertaken within the Hangar building.

The centre of activity was determined as being the southern door of the main Hangar building.

The downwind sampling sessions were planned with distances based on this point of reference.

During the sessions the upwind sessions were undertaken so that they started several minutes before the downwind sessions and ended several minutes after the downwind sessions for both the bacteria and for the Fungi. (i.e. a 16 minute time period for the upwind while the downwind sessions operated for 10 minutes). Within the overall time period at the site, four replicate sampling sessions were successfully completed.

#### 4.3 Condition of the Site and of Ambient Air Quality during Sampling

The site was approximately 75% filled with compost in process in the buildings. The air temperature was cool and humid with damp ground. Further details are provided later in this report.

### 5.0 BIOAEROSOL TYPES

The following types of bioaerosol were sampled and enumerated

| Description | Total Bacteria     | Aspergillus Fumigatus |
|-------------|--------------------|-----------------------|
|             | cfu/m <sup>3</sup> | cfu/m <sup>3</sup>    |

These types relate to the EA guidance given earlier (Section 2.3 on page 3 )

### 6.0 BIOAEROSOL SAMPLING PROCEDURE

#### 6.1 Standardised sampling Procedure

The procedure was based on the M9 Methodology. (Ref 2: and refer to Appendix 2).

#### 6.2 Sampling Equipment

##### 6.2.1 Samplers

Samplers comprised the industry standard 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 1.8m during each session of sampling. Samplers were timer controlled.

### 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% i.e. 0.57 l/min).

Measured flow-rates are shown in the results for each sampler. These were adjusted to 28 l/min. The sampling duration was selected on the basis of avoided saturation of the plates. Thus, the upwind were set to run for up to 16 mins while the downwind samplers were set to 10mins.

### 6.3 Sample Collection media and Enumeration

The D and F Associates Laboratory (Widnes, Cheshire) was used for provision and enumeration of the Collection Plates. This is a UKAS accredited laboratory.

*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 are particularly useful for the identification of bacteria and the type used for the mould species and allows the Laboratory to accurately identify and quantify *Aspergillus Fumigatus* on plates that may contain many other mould species.

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.

### 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. (Section 7).

### 6.5 Sampler Locations

The sampling station locations were selected in accordance with the M9 Methods. Refer to 4.1.

### 6.6 Other Activity at the Site during Sampling

The sampling was undertaken during activity at the site that included bio-waste deliveries, tunnel out-loading, and active windrow composting, compost screening and the movement of material to form the windrows externally – see 4.2. The main activity was compost movement and screening.

### 6.7 Special Circumstances for Sampling

The sampling was undertaken during the unusual circumstances when due to the Covid19 virus, everyone was taking steps to limit time spent on third party sites; for which reason four sampling sessions were undertaken employing minimal persons at work around the site.

## 7.0 MET DATA DURING SAMPLING

The meteorological data was recorded during the sessions of sampling. The Station was a Kestrel 4500, mounted on a tripod and mast at approx. 2.0m height above ground level. It was located near to Station 1 on a clear open area of the field to the west of the composting site.

The Kestrel 4500 comprises a wind vane, vane type anemometer, temperature and humidity sensors and facility to store its own data within its programmable data-logger.

The data logging interval was set at 1 minute. The full data is provided within the Appendix 3.

**Table 1: Meteorological Conditions – Agri-Organics Composting - Silloth – 16<sup>th</sup> March 2020**

| Meteorological Conditions |               |                             |   |   |   |  |      |                              |                         |   |   |
|---------------------------|---------------|-----------------------------|---|---|---|--|------|------------------------------|-------------------------|---|---|
| Site:                     |               | The Hangar, Silloth         |   |   | Site Operator:  |  |      | Agri-Organics Ltd.           |                         |   |   |
| Sampling Date:            |               | 16 <sup>th</sup> March 2020 |   |   | Monitoring Contractor:  |  |      | Recogen Ltd.                 |                         |   |   |
| Sample Ref Nos.           |               | Location                    | Bearing of Samplers from centre of Active Area ° to N | Mean Wind Direction<br>wind blows TO during sampling degrees ° to N | Difference in bearing of samplers and mean direction wind blows TO degrees ° to N | Wind Speed as sampling ms <sup>-1</sup><br>@ 2m   @10m |      | Mean Air Temp as sampling °C | Mean Air RH<br>Mean RH% | Prevailing Weather<br>Pressure Cloud<br>Cover 1/8 ths mbar (okta) |   |
| S                         | 1A TVC Upwind | Upwind Stn. 1               | 225   | 53  | 172   | 5.5  | 7.7  | 7.9                          | 87                      | 1021  | 7 |
| S                         | 1B TVC Left   | Downwind Stn. 2             | 20  |   | -33.2   |  |      |                              |                         |   |   |
| S                         | 1C TVC Centre | Downwind Stn. 3             | 45  |   | -8  |  |      |                              |                         |   |   |
| S                         | 1D TVC Right  | Downwind Stn. 4             | 70  |   | 17  |  |      |                              |                         |   |   |
| S                         | 1A AF Upwind  | Upwind Stn. 1               | 225   | 41  | 184   | 6.1  | 8.4  | 8.1                          | 87                      | 1021  | 6 |
| S                         | 1B AF Left    | Downwind Stn. 2             | 20  |   | -21.0   |  |      |                              |                         |   |   |
| S                         | 1C AF Centre  | Downwind Stn. 3             | 45  |   | 4   |  |      |                              |                         |   |   |
| S                         | 1D AF Right   | Downwind Stn. 4             | 70  |   | 29  |  |      |                              |                         |   |   |
| S                         | 2A TVC Upwind | Upwind Stn. 1               | 225   | 45  | 180   | 6.5  | 9.0  | 8.1                          | 81                      | 1021  | 6 |
| S                         | 2B TVC Left   | Downwind Stn. 2             | 20  |   | -25.4   |  |      |                              |                         |   |   |
| S                         | 2C TVC Centre | Downwind Stn. 3             | 45  |   | 0   |  |      |                              |                         |   |   |
| S                         | 2D TVC Right  | Downwind Stn. 4             | 70  |   | 25  |  |      |                              |                         |   |   |
| S                         | 2A AF Upwind  | Upwind Stn. 1               | 225   | 40  | 185   | 8.0  | 11.0 | 8.1                          | 81                      | 1021  | 6 |
| S                         | 2B AF Centre  | Downwind Stn. 2             | 20  |   | -19.7   |  |      |                              |                         |   |   |
| S                         | 2C AF Left    | Downwind Stn. 3             | 45  |   | 5   |  |      |                              |                         |   |   |
| S                         | 2D AF Right   | Downwind Stn. 4             | 70  |   | 30  |  |      |                              |                         |   |   |
| S                         | 3A TVC Upwind | Upwind Stn. 1               | 225   | 42  | 183   | 6.3  | 8.7  | 8.5                          | 77                      | 1021  | 6 |
| S                         | 3B TVC Left   | Downwind Stn. 2             | 20  |   | -22.2   |  |      |                              |                         |   |   |
| S                         | 3C TVC Centre | Downwind Stn. 3             | 45  |   | 3   |  |      |                              |                         |   |   |
| S                         | 3D TVC Right  | Downwind Stn. 4             | 70  |   | 28  |  |      |                              |                         |   |   |
| S                         | 3A AF Upwind  | Upwind Stn. 1               | 225   | 49  | 176   | 5.8  | 8.0  | 8.0                          | 77                      | 1020  | 6 |
| S                         | 3B AF Centre  | Downwind Stn. 2             | 20  |   | -29.5   |  |      |                              |                         |   |   |
| S                         | 3C AF Left    | Downwind Stn. 3             | 45  |   | -4  |  |      |                              |                         |   |   |
| S                         | 3D AF Right   | Downwind Stn. 4             | 70  |   | 21  |  |      |                              |                         |   |   |
| S                         | 4A TVC Upwind | Upwind Stn. 1               | 225   | 47  | 178   | 7.0  | 9.7  | 7.9                          | 78                      | 1021  | 6 |
| S                         | 4B TVC Left   | Downwind Stn. 2             | 20  |   | -27.4   |  |      |                              |                         |   |   |
| S                         | 4C TVC Centre | Downwind Stn. 3             | 45  |   | -2  |  |      |                              |                         |   |   |
| S                         | 4D TVC Right  | Downwind Stn. 4             | 70  |   | 23  |  |      |                              |                         |   |   |
| S                         | 4A AF Upwind  | Upwind Stn. 1               | 225   | 46  | 179   | 5.9  | 8.1  | 7.9                          | 72                      | 1020  | 6 |
| S                         | 4B AF Centre  | Downwind Stn. 2             | 20  |   | -25.5   |  |      |                              |                         |   |   |
| S                         | 4C AF Left    | Downwind Stn. 3             | 45  |   | -1  |  |      |                              |                         |   |   |
| S                         | 4D AF Right   | Downwind Stn. 4             | 70  |   | 24  |  |      |                              |                         |   |   |

During the sessions the wind was gusting and generally from the South-West for the duration. Wind-speeds ranged 5.5 to 7.0 m.s<sup>-1</sup> with some stronger gusts of up to 8.5m.s<sup>-1</sup>. It was cool with temperatures rising between 7.9° C to 8.5° C .

During the period the RH remained high at 87% falling to 72% later in the period.

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

## 8.0 SUMMARY OF THE BIOAEROSOL SAMPLING RESULTS

The full raw results are shown in Appendix 1. 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 2 and 3 in accordance with the M9 Guidance. Table 2 shows the Results for **Total Viable Bacteria** and Table 3 shows the results for the **Aspergillus Fumigatus** Samples.

The tables reveal the **MEDIAN** of the **UPWIND** and the **DOWNWIND** sampling results. The overall Median value is derived from the individual Median results. The mean values are not required.

**Table 2: Sampling Results – TOTAL BACTERIA - Agri-Organics Ltd – The Hangar - 16<sup>th</sup> March 2020**

| Site:   | <b>The Hangar, Silloth</b>                                     |  | Type of materials on site   | Composted organics, wood etc.                    |                |   |   |   |
|---|--|--|---|--|----------------|---|---|---|
| Sampling Date:  | <b>16<sup>th</sup> March 2020</b>                              |  | Estimated material on site  | Internal <5,000 tonnes                           |                |   |   |   |
| Site Operator:  | <b>Agri-Organics Ltd.</b>                                      |  | Type of Activity  | IVC Composting                                   |                |   |   |   |
| Monitoring Contractor:  | <b>Recogen Ltd of Shrewsbury.</b>                              |  | Activities affecting bioaerosols release  | <b>Compost Product Screening; IVC Unloading.</b> |                |   |   |   |
|   |  |  | Bioaerosol Type:  |  | TOTAL BACTERIA |   |   |   |
| Sample Ref Nos.<br>Station Location ref.<br><small>All Sample Refs: 'T'<br/>(Total Viable Bacteria)</small> | Station Location<br>bearing from<br>centre of site<br>° from N | Distance<br>from centre of<br>activity<br>metres | Difference<br>in bearing<br>between sampler<br>location & mean<br>direction that<br>wind blows to | Sampling<br>Period                               |                | Concentration<br>of bioaerosols<br><br>Total Viable<br>Bacteria<br>cfu/m <sup>3</sup> | Mean of<br>UPWIND<br>Samples<br>Total<br>Bacteria<br>cfu/m <sup>3</sup> | Median of<br>DOWNWIND<br>Samples<br>Total<br>Bacteria<br>cfu/m <sup>3</sup> |
|   |  |  |   | Start<br>Time                                    | End<br>Time    |   |   |   |
| S1 AT   | UW Stn. 1  | 225  | 200   | 172  | 11:09          | 11:25   | 18  | 250   |
| S1 BT   | DW Stn. 2  | 20   | 200   | -33  | 11:13          | 11:23   | 232   |   |
| S1 CT   | DW Stn. 3  | 45   | 200   | -8   | 11:13          | 11:23   | 425   |   |
| S1 DT   | DW Stn. 4  | 70   | 200   | 17   | 11:13          | 11:23   | 250   |   |
| S2 AT   | UW Stn. 1  | 225  | 200   | 180  | 12:12          | 12:28   | 29  | 450   |
| S2 BT   | DW Stn. 2  | 20   | 200   | -25  | 12:16          | 12:26   | 364   |   |
| S2 CT   | DW Stn. 3  | 45   | 200   | 0  | 12:16          | 12:26   | 450   |   |
| S2 DT   | DW Stn. 4  | 70   | 200   | 25   | 12:16          | 12:26   | 454   |   |
| S3 AT   | UW Stn. 1  | 225  | 200   | 183  | 13:14          | 13:30   | 2   | 43  |
| S3 BT   | DW Stn. 2  | 20   | 200   | -22  | 13:18          | 13:28   | 4   |   |
| S3 CT   | DW Stn. 3  | 45   | 200   | 3  | 13:18          | 13:28   | 43  |   |
| S3 DT   | DW Stn. 4  | 70   | 200   | 28   | 13:18          | 13:28   | 264   |   |
| S4 AT   | UW Stn. 1  | 225  | 200   | 178  | 14:19          | 14:35   | 7   | 168   |
| S4 BT   | DW Stn. 2  | 20   | 200   | -27  | 14:23          | 14:33   | 168   |   |
| S4 CT   | DW Stn. 3  | 45   | 200   | -2   | 14:23          | 14:33   | 118   |   |
| S4 DT   | DW Stn. 4  | 70   | 200   | 23   | 14:23          | 14:33   | 525   |   |
| <b>OVERALL MEDIAN UPWIND VALUE</b>  |  |  |   |  |                |   | <b>28</b>   |   |
| <b>OVERALL MEDIAN DOWNWIND VALUE</b>  |  |  |   |  |                |   |   | <b>209</b>  |
| <b>MAXIMUM MEDIAN DOWNWIND VALUE</b>  |  |  |   |  |                |   |   | <b>450</b>  |

### Commentary to assist interpretation

1. The wind during the sampling sessions was from the South-West arriving from grassland and over the site centre of activity towards the North-East fields towards the Poultry Farm and NSR.
2. The **Upwind station** was located to the South-West of the site, by the entry track of the southern Hangar. The Total Bacteria bioaerosol levels were quite low (**Median 28 cfu/m<sup>3</sup>**) for all sessions. This is likely attributable to the cold air, time of year, damp ground and weather conditions.
3. The downwind bacteria type bioaerosol levels were **moderately elevated**; with all sessions revealing high peak levels; causing the median level to be **MODERATE** and easily within the target limits. (**Median 209 and Maximum Median 450 cfu/m<sup>3</sup>**).

**Table 3: Sampling Results – ASPERGILLUS FUMIGATUS - Agri-Organics Ltd – The Hangar - 16<sup>th</sup> March 2020**

| Site:                                    | The Hangar, Silloth   |   |   | Type of materials on site                 | Composted organics, wood etc.                    |   |  |  |
|--|---|---|---|---|--|---|--|--|
| Sampling Date:                           | 16 <sup>th</sup> March 2020                                 |   |   | Estimated material on site                | External <5,000 tonnes                           |   |  |  |
| Site Operator:                           | Agri-Organics Ltd.  |   |   | Type of Activity                          | IVC Composting                                   |   |  |  |
| Monitoring Contractor:                   | Recogen Ltd of Shrewsbury.                                  |   |   | Activities affecting bioaerosols release  | <b>Compost Product Screening; IVC Unloading.</b> |   |  |  |
|  |   |   |   | Bioaerosol Type:                          | <b>ASPERGILLUS FUMIGATUS</b>                     |   |  |  |
| Sample Ref Nos.<br>Station Location ref. | Station Location<br>bearing from centre of site<br>° from N | Distance<br>from centre of activity<br>metres | Difference<br>in bearing<br>between sampler<br>location & mean<br>direction that<br>wind blows to | Sampling Period<br>Start Time    End Time |  | Concentration<br>of bioaerosols<br><br>Aspergillus<br>Fumigatus<br>cfu/m <sup>3</sup> | Mean of<br>UPWIND<br>Samples<br>Aspergillus<br>Fumigatus<br>cfu/m <sup>3</sup> | Median of<br>DOWNWIND<br>Samples<br>Aspergillus<br>Fumigatus<br>cfu/m <sup>3</sup> |
| S1 AF                                    | UW Stn. 1   | 225   | 200   | 184                                       | 11:37  | 11:53   | 0  | 0  |
| S1 BF                                    | DW Stn. 2   | 20  | 200   | -21                                       | 11:41  | 11:51   | 0  |  |
| S1 CF                                    | DW Stn. 3   | 45  | 200   | 4   | 11:41  | 11:51   | 0  |  |
| S1 DF                                    | DW Stn. 4   | 70  | 200   | 29  | 11:41  | 11:51   | 4  |  |
| S2 AF                                    | UW Stn. 1   | 225   | 200   | 185                                       | 12:39  | 12:55   | 0  | 0  |
| S2 BF                                    | DW Stn. 2   | 20  | 200   | -20                                       | 12:43  | 12:53   | 0  |  |
| S2 CF                                    | DW Stn. 3   | 45  | 200   | 5   | 12:43  | 12:53   | 0  |  |
| S2 DF                                    | DW Stn. 4   | 70  | 200   | 30  | 12:43  | 12:53   | 4  |  |
| S3 AF                                    | UW Stn. 1   | 225   | 200   | 176                                       | 13:43  | 13:59   | 0  | 0  |
| S3 BF                                    | DW Stn. 2   | 20  | 200   | -29                                       | 13:47  | 13:57   | 0  |  |
| S3 CF                                    | DW Stn. 3   | 45  | 200   | -4  | 13:47  | 13:57   | 4  |  |
| S3 DF                                    | DW Stn. 4   | 70  | 200   | 21  | 13:47  | 13:57   | 7  |  |
| S4 AF                                    | UW Stn. 1   | 225   | 200   | 179                                       | 14:46  | 15:02   | 0  | 0  |
| S4 BF                                    | DW Stn. 2   | 20  | 200   | -26                                       | 14:50  | 15:00   | 0  |  |
| S4 CF                                    | DW Stn. 3   | 45  | 200   | -1  | 14:50  | 15:00   | 0  |  |
| S4 DF                                    | DW Stn. 4   | 70  | 200   | 24  | 14:50  | 15:00   | 0  |  |
|  |   |   |   | <b>OVERALL MEDIAN UPWIND VALUE</b>        |  | <b>0</b>  |  |  |
|  |   |   |   | <b>OVERALL MEDIAN DOWNWIND VALUE</b>      |  |   |  | <b>0</b>   |
|  |   |   |   | <b>MAXIMUM MEDIAN DOWNWIND VALUE</b>      |  |   |  | <b>4</b>   |

**Commentary to assist interpretation**

- 1) The wind during the sampling sessions was from the South-West arriving from grassland and over the site centre of activity towards the North-East fields towards the Poultry Farm and NSR.
- 2) The **Upwind station** was located to the South-West of the site, by the entry track of the southern Hangar. The Aspergillus Fumigatus bioaerosol levels were **NIL (Median 0 cfu/m<sup>3</sup>)** for all sessions. This is likely attributable to the cold air, time of year, damp ground and weather conditions.
- 3) The Downwind sample values of Aspergillus Fumigatus were similarly **ABSENT** revealing only **NIL OR NEGLIGIBLE** concentrations (**Median 0 and Maximum Median 4 cfu/m<sup>3</sup>**).
- 4) Again, this was most likely attributable to the cold and damp weather preceding the monitoring, and low levels of ambient Aspergillus Fumigatus bioaerosols at this time of year.

## 9.0 INTERPRETATION OF RESULTS

### 9.1 The Bioaerosol Sampling

The sampling of bioaerosols was undertaken in accordance with the M9 Method.

During each sampling session, three sampling stations circa 200 metres from the centre of the activity were used to assess the downwind emissions from the overall site being located within the 'fan-tail' of the wind. The central station location was in line with the centre of activity (the opening of the main doors for the receipt of feedstock material). During sampling the prevailing wind was predominantly from the south-west blowing out to the north-east.

During sampling there were Large Vehicles delivering bio-waste to the facility and the Reception building doors were necessarily open; there were materials handling and screening ongoing within the building. The northern doors were opened from time to time as loads of compost material were taken away.

The site was working at a high capacity on account of the time of year. On this occasion the sampling was through the **middle part of the day**.

The weather conditions were cool and with a gusting wind. The sessions followed a cold damp night after a period of cool wet weather and so field surfaces were wet or damp.

### 9.2 The Bioaerosol Sample Results

Table 5: SUMMARY TABLE - Sampling Results – Bioaerosols - Agri-Organics Ltd – The Hangar – 16<sup>th</sup> March 2020

|                                | Activities                          | Total Bacteria                |                                 | Asp. Fumigatus                |                                 |
|--------------------------------|-------------------------------------|-------------------------------|---------------------------------|-------------------------------|---------------------------------|
|                                |                                     | Mean UW<br>cfu/m <sup>3</sup> | Median DW<br>cfu/m <sup>3</sup> | Mean UW<br>cfu/m <sup>3</sup> | Median DW<br>cfu/m <sup>3</sup> |
| <b>Session 1</b>               | General Enclosed site ops.          | 18                            | 250                             | 0                             | 0                               |
| <b>Session 2</b>               | General Enclosed site ops.          | 29                            | 450                             | 0                             | 0                               |
| <b>Session 3</b>               | General Enclosed site ops.          | 2                             | 43                              | 0                             | 4                               |
| <b>Session 4</b>               | General Enclosed site ops.          | 7                             | 168                             | 0                             | 0                               |
| <b>Overall</b>                 | <b>Median Upwind &amp; Downwind</b> | 28                            | 209                             | 0                             | 4                               |
| <b>Maximum Median Downwind</b> |                                     |                               | 450                             |                               | 4                               |

\* The Maximum Median Value is used as an indicator.

In the background, i.e. **The Upwind Samples - Station 1**... the Bioaerosols concentrations were variable with the Total Bacteria concentrations being generally low; average ~28 cfu.m<sup>-3</sup> overall. This was likely attributable to the upwind fields entailing lush grass with minimal dust emission.

#### **Downwind Sample Results - Stations 2, 3 and 4**

In the **DOWNWIND** locations to the north-east within a ~50° arc, 200m from the centre of activities the Total Bacteria samples were found to be **MODERATE (MEDIAN 209 cfu.m<sup>-3</sup>)**; when the internal activities and screening were being operated.

The presence of Aspergillus Fumigatus was **NEGLIGIBLE** in the upwind and similarly MINIMAL in the downwind samples.

The array of sampling points and the results show that there are slight variations in the peak values of bioaerosols released and carried downwind, but also show that the harmful Aspergillus Fumigatus bioaerosols remain at background 200metres downwind.

The variations may have been attributable to door opening/closing or vehicles movements.

## **10.0 CONCLUSIONS-BIOAEROSOL SAMPLING**

### **10.1 General Conclusions**

The following may be concluded from the air quality results sampled **16<sup>th</sup> March 2020** :

1. The Composting Site does generate and release 'Total Viable Bacteria' type bioaerosols into the downwind environment. There appeared to be only a minimal release and contribution of *Aspergillus Fumigatus* type bioaerosols.
2. The Total Viable Bacteria results found at the sampling stations Downwind (that included a station reasonably near to the Nearest Sensitive Receptor (NSR = Poultry Farm Dwelling) on this occasion; revealed levels that were generally only MODERATE and were most likely attributable to the occasional opening of doors and or the disturbance of residual dust on the paved roads and surfaces.
3. It was concluded that the full enclosure and air handling facilities provide an excellent level of containment and help ensure minimal adverse impact of bioaerosols

### **10.2 Overall Conclusion**

The results showed some variability and revealed that there was a **MODERATE** increase in the Bacteria Type Bioaerosol concentrations in the air sampled downwind of the site when the **MAXIMUM** median concentration for Total Bacteria bioaerosols was **450 cfu.m<sup>-3</sup>**; and the **MAXIMUM** median concentration for *Aspergillus Fumigatus* bioaerosols was **4 cfu.m<sup>-3</sup>**.

These **MODERATE** and **MINIMAL** levels were attributed to the containment afforded by the enclosed activity.

In conclusion, the levels did not exceed the EA Thresholds for Total Bacteria or *Aspergillus Fumigatus* and are unlikely to cause any adverse impact to the health of residents nearby.

## APPENDIX 1. Bioaerosols Sampling Record and Results

**Results Table A1.1: Run 1 Bioaerosol levels UP 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 <sup>-3</sup> | Aspergillus Fumigatus cfu m <sup>-3</sup> |
|---------|-------------|------------------|------------------------|--------------|-----------|--------------------------|------------|----------|-------------------|-------------------|------------------------------------|---|
| S1 A    | TVC         | UPWIND A         | 1                      | YA           | P1        | 28                       | 11:09      | 11:25    | 16.00             | 8                 | 18                                 |   |
| S1 B    | TVC         | DOWNWIND B       | 2                      | YB           | P2        | 28                       | 11:13      | 11:23    | 10.00             | 65                | 232                                |   |
| S1 C    | TVC         | DOWNWIND C       | 3                      | RA           | P3        | 28                       | 11:13      | 11:23    | 10.00             | 119               | 425                                |   |
| S1 D    | TVC         | DOWNWIND D       | 4                      | RB           | P4        | 28                       | 11:13      | 11:23    | 10.00             | 70                | 250                                |   |
| S1 A    | AF          | UPWIND A         | 1                      | YA           | P1        | 28                       | 11:37      | 11:53    | 16.00             | 0                 |                                    | 0   |
| S1 B    | AF          | DOWNWIND B       | 2                      | YB           | P2        | 28                       | 11:41      | 11:51    | 10.00             | 0                 |                                    | 0   |
| S1 C    | AF          | DOWNWIND C       | 3                      | RA           | P3        | 28                       | 11:41      | 11:51    | 10.00             | 0                 |                                    | 0   |
| S1 D    | AF          | DOWNWIND D       | 4                      | RB           | P4        | 28                       | 11:41      | 11:51    | 10.00             | 1                 |                                    | 4   |

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

**Results Table A1.2: Run 2 Bioaerosol levels UP 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 <sup>-3</sup> | Aspergillus Fumigatus cfu m <sup>-3</sup> |
|---------|-------------|------------------|------------------------|--------------|-----------|--------------------------|------------|----------|-------------------|-------------------|------------------------------------|---|
| S2 A    | TVC         | UPWIND A         | 1                      | YA           | P1        | 28                       | 12:12      | 12:28    | 16.00             | 13                | 29                                 |   |
| S2 B    | TVC         | DOWNWIND B       | 2                      | YB           | P2        | 28                       | 12:16      | 12:26    | 10.00             | 102               | 364                                |   |
| S2 C    | TVC         | DOWNWIND C       | 3                      | RA           | P3        | 28                       | 12:16      | 12:26    | 10.00             | 126               | 450                                |   |
| S2 D    | TVC         | DOWNWIND D       | 4                      | RB           | P4        | 28                       | 12:16      | 12:26    | 10.00             | 127               | 454                                |   |
| S2 A    | AF          | UPWIND A         | 1                      | YA           | P1        | 28                       | 12:39      | 12:55    | 16.00             | 0                 |                                    | 0   |
| S2 B    | AF          | DOWNWIND B       | 2                      | YB           | P2        | 28                       | 12:43      | 12:53    | 10.00             | 0                 |                                    | 0   |
| S2 C    | AF          | DOWNWIND C       | 3                      | RA           | P3        | 28                       | 12:43      | 12:53    | 10.00             | 0                 |                                    | 0   |
| S2 D    | AF          | DOWNWIND D       | 4                      | RB           | P4        | 28                       | 12:43      | 12:53    | 10.00             | 1                 |                                    | 4   |

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

**Results Table A1.3: Run 3 Bioaerosol levels UP 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 <sup>-3</sup> | Aspergillus Fumigatus cfu m <sup>-3</sup> |
|---------|-------------|------------------|------------------------|--------------|-----------|--------------------------|------------|----------|-------------------|-------------------|------------------------------------|---|
| S3 A    | TVC         | UPWIND A         | 1                      | YA           | P1        | 28                       | 13:14      | 13:30    | 16.00             | 1                 | 2                                  |   |
| S3 B    | TVC         | DOWNWIND B       | 2                      | YB           | P2        | 28                       | 13:18      | 13:28    | 10.00             | 1                 | 4                                  |   |
| S3 C    | TVC         | DOWNWIND C       | 3                      | RA           | P3        | 28                       | 13:18      | 13:28    | 10.00             | 12                | 43                                 |   |
| S3 D    | TVC         | DOWNWIND D       | 4                      | RB           | P4        | 28                       | 13:18      | 13:28    | 10.00             | 74                | 264                                |   |
| S3 A    | AF          | UPWIND A         | 1                      | YA           | P1        | 28                       | 13:43      | 13:59    | 16.00             | 0                 |                                    | 0   |
| S3 B    | AF          | DOWNWIND B       | 2                      | YB           | P2        | 28                       | 13:47      | 13:57    | 10.00             | 0                 |                                    | 0   |
| S3 C    | AF          | DOWNWIND C       | 3                      | RA           | P3        | 28                       | 13:47      | 13:57    | 10.00             | 1                 |                                    | 4   |
| S3 D    | AF          | DOWNWIND D       | 4                      | RB           | P4        | 28                       | 13:47      | 13:57    | 10.00             | 2                 |                                    | 7   |

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

**Results Table A1.4: Run 4 Bioaerosol levels UP 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 <sup>-3</sup> | Aspergillus Fumigatus cfu m <sup>-3</sup> |
|---------|-------------|------------------|------------------------|--------------|-----------|--------------------------|------------|----------|-------------------|-------------------|------------------------------------|---|
| S4 A    | TVC         | UPWIND A         | 1                      | YA           | P1        | 28                       | 14:19      | 14:35    | 16.00             | 3                 | 7                                  |   |
| S4 B    | TVC         | DOWNWIND B       | 2                      | YB           | P2        | 28                       | 14:23      | 14:33    | 10.00             | 47                | 168                                |   |
| S4 C    | TVC         | DOWNWIND C       | 3                      | RA           | P3        | 28                       | 14:23      | 14:33    | 10.00             | 33                | 118                                |   |
| S4 D    | TVC         | DOWNWIND D       | 4                      | RB           | P4        | 28                       | 14:23      | 14:33    | 10.00             | 147               | 525                                |   |
| S4 A    | AF          | UPWIND A         | 1                      | YA           | P1        | 28                       | 14:46      | 15:02    | 16.00             | 0                 |                                    | 0   |
| S4 B    | AF          | DOWNWIND B       | 2                      | YB           | P2        | 28                       | 14:50      | 15:00    | 10.00             | 0                 |                                    | 0   |
| S4 C    | AF          | DOWNWIND C       | 3                      | RA           | P3        | 28                       | 14:50      | 15:00    | 10.00             | 0                 |                                    | 0   |
| S4 D    | AF          | DOWNWIND D       | 4                      | RB           | P4        | 28                       | 14:50      | 15:00    | 10.00             | 0                 |                                    | 0   |

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

**Results Table A1.5: Bioaerosol Plate controls (Plates carried with the Sample Plates)**

| Bioaerosol Type | Plate Identity | Viable Bacteria Count cfu/plate | Aspergillus Fumigatus Count cfu/plate |
|-----------------|----------------|---------------------------------|---------------------------------------|
| TVC             | Control 1      | 0                               |                                       |
| TVC             | Control 2      | 0                               |                                       |
| AF              | Control 1      |                                 | 0                                     |
| AF              | Control 2      |                                 | 0                                     |

Control plates travelled with sample plates to and from labs and during sampling at site, but lids were not removed or medium exposed.



## APPENDIX 2. The M9 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.

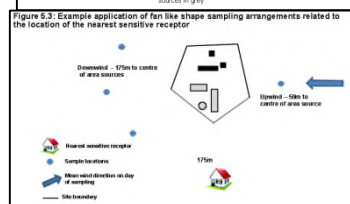
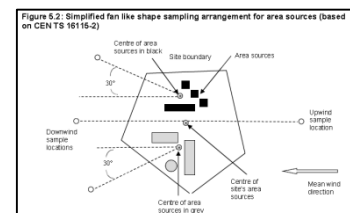
This approach is used to ensure that measurements are made in the emission plume, during the sampling campaign. If there are any buildings, installations or structures between the downwind location(s) and the centre of the active operational area, then sampling should be carried out upwind of that structure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

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.



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



## APPENDIX 3. The Meteorological data logged by the Weather Station

The meteorological data was recorded during the sessions of sampling. The Station was a Kestrel 4500, mounted on a tripod and mast at approx. 2.0m height above ground level. The Kestrel 4500 comprises a wind vane, vane type anemometer, temperature and humidity sensors and facility to store its own data within its programmable data-logger. The data logging interval was 1 minute.

The data-log shown here at Table A3.1 spans the sessions of sampling on **16<sup>th</sup> March 2020**.

**Table A3.1: Weather Data The Hangar Silloth, 16<sup>th</sup> March 2020**

| Time     | Wind Bearing | Wind Direction | Wind Speed | Air Temp | RH | BP   | Time     | Wind Bearing | Wind Direction | Wind Speed | Air Temp | RH | BP   |
|----------|--------------|----------------|------------|----------|----|------|----------|--------------|----------------|------------|----------|----|------|
|          | degrees      | from           | m/s        | °C       | %  | mb   |          | degrees      | from           | m/s        | °C       | %  | mb   |
| 11:08:00 | 210          | SSW            | 6.3        | 8.5      | 85 | 1022 | 13:19:00 | 218          | SW             | 3.8        | 8.4      | 77 | 1020 |
| 11:09:00 | 219          | SW             | 6.1        | 8.2      | 86 | 1021 | 13:20:00 | 228          | SW             | 4.7        | 8.4      | 77 | 1021 |
| 11:10:00 | 231          | SW             | 4.4        | 8.5      | 81 | 1021 | 13:21:00 | 225          | SW             | 5.2        | 8.3      | 76 | 1021 |
| 11:11:00 | 221          | SW             | 2.2        | 8.5      | 85 | 1021 | 13:22:00 | 211          | SSW            | 3.4        | 8.8      | 75 | 1021 |
| 11:12:00 | 250          | WSW            | 5          | 8.2      | 85 | 1021 | 13:23:00 | 207          | SSW            | 5.1        | 8.5      | 75 | 1021 |
| 11:13:00 | 225          | SW             | 5.9        | 7.9      | 86 | 1022 | 13:24:00 | 222          | SW             | 3.2        | 9.1      | 76 | 1021 |
| 11:14:00 | 210          | SSW            | 3.9        | 8.5      | 87 | 1022 | 13:25:00 | 225          | SW             | 3.7        | 8.9      | 77 | 1021 |
| 11:15:00 | 219          | SW             | 6.3        | 8        | 86 | 1022 | 13:26:00 | 231          | SW             | 7.9        | 8.3      | 78 | 1021 |
| 11:16:00 | 235          | SW             | 6.1        | 7.6      | 86 | 1022 | 13:27:00 | 233          | SW             | 3.9        | 9.1      | 78 | 1021 |
| 11:17:00 | 231          | SW             | 3.2        | 8.1      | 88 | 1022 | 13:28:00 | 225          | SW             | 4.6        | 9.2      | 78 | 1021 |
| 11:18:00 | 233          | SW             | 2.9        | 8.2      | 88 | 1022 | 13:29:00 | 223          | SW             | 4.6        | 8.9      | 77 | 1021 |
| 11:19:00 | 227          | SW             | 4.2        | 7.8      | 87 | 1022 | 13:30:00 | 227          | SW             | 5.5        | 8.8      | 77 | 1021 |
| 11:20:00 | 219          | SW             | 3.2        | 7.7      | 87 | 1022 | 13:31:00 | 229          | SW             | 3.3        | 9        | 77 | 1021 |
| 11:21:00 | 245          | WSW            | 4.2        | 7.4      | 88 | 1021 | 13:32:00 | 228          | SW             | 6.1        | 8.5      | 78 | 1021 |
| 11:22:00 | 260          | W              | 6.2        | 7.5      | 89 | 1022 | 13:33:00 | 229          | SW             | 5.2        | 8.5      | 78 | 1021 |
| 11:23:00 | 228          | SW             | 3.3        | 7.7      | 88 | 1021 | 13:34:00 | 226          | SW             | 3.9        | 8.7      | 76 | 1021 |
| 11:24:00 | 238          | WSW            | 3.2        | 7.5      | 88 | 1022 | 13:35:00 | 224          | SW             | 5          | 8.9      | 77 | 1021 |
| 11:25:00 | 242          | WSW            | 4          | 7.4      | 88 | 1021 | 13:36:00 | 232          | SW             | 5.7        | 8.4      | 79 | 1021 |
| 11:26:00 | 231          | SW             | 5.5        | 7.5      | 90 | 1022 | 13:37:00 | 230          | SW             | 5.9        | 8.5      | 79 | 1021 |
| 11:27:00 | 221          | SW             | 4.1        | 7.8      | 88 | 1022 | 13:38:00 | 228          | SW             | 7.9        | 8.2      | 78 | 1021 |
| 11:28:00 | 228          | SW             | 3.1        | 8.4      | 88 | 1022 | 13:39:00 | 229          | SW             | 4.3        | 8.1      | 77 | 1021 |
| 11:29:00 | 228          | SW             | 4.1        | 8.3      | 90 | 1022 | 13:40:00 | 210          | SSW            | 5          | 7.9      | 77 | 1020 |
| 11:30:00 | 228          | SW             | 5.9        | 8.1      | 90 | 1022 | 13:41:00 | 213          | SSW            | 6.4        | 7.7      | 78 | 1021 |
| 11:31:00 | 231          | SW             | 4.9        | 8        | 89 | 1022 | 13:42:00 | 196          | SSW            | 3.8        | 7.7      | 79 | 1020 |
| 11:32:00 | 226          | SW             | 7.9        | 7.5      | 90 | 1022 | 13:43:00 | 196          | SSW            | 1.3        | 8.3      | 78 | 1020 |
| 11:33:00 | 225          | SW             | 4.3        | 7.6      | 89 | 1021 | 13:44:00 | 218          | SW             | 3.2        | 8        | 79 | 1021 |
| 11:34:00 | 222          | SW             | 3.8        | 8.3      | 88 | 1022 | 13:45:00 | 216          | SW             | 4.1        | 8.4      | 78 | 1021 |
| 11:35:00 | 221          | SW             | 4          | 8.1      | 89 | 1021 | 13:46:00 | 230          | SW             | 4.6        | 8.1      | 78 | 1021 |
| 11:36:00 | 229          | SW             | 5          | 7.9      | 89 | 1022 | 13:47:00 | 231          | SW             | 5.9        | 7.7      | 78 | 1021 |
| 11:37:00 | 230          | SW             | 4          | 8.4      | 88 | 1022 | 13:48:00 | 223          | SW             | 3.3        | 8.4      | 76 | 1021 |
| 11:38:00 | 219          | SW             | 3.9        | 8        | 88 | 1022 | 13:49:00 | 225          | SW             | 5.2        | 8.2      | 77 | 1020 |
| 11:39:00 | 219          | SW             | 4.1        | 8        | 87 | 1022 | 13:50:00 | 232          | SW             | 2.9        | 8.2      | 76 | 1020 |
| 11:40:00 | 214          | SW             | 4.4        | 8.4      | 87 | 1022 | 13:51:00 | 232          | SW             | 4.8        | 8.1      | 76 | 1020 |
| 11:41:00 | 215          | SW             | 5.2        | 7.9      | 88 | 1022 | 13:52:00 | 224          | SW             | 4.5        | 8.1      | 77 | 1020 |
| 11:42:00 | 225          | SW             | 3.9        | 8        | 88 | 1021 | 13:53:00 | 223          | SW             | 5.1        | 7.9      | 77 | 1020 |
| 11:43:00 | 222          | SW             | 4.9        | 7.8      | 87 | 1021 | 13:54:00 | 226          | SW             | 5.4        | 8        | 77 | 1020 |
| 11:44:00 | 222          | SW             | 5.7        | 7.8      | 88 | 1021 | 13:55:00 | 223          | SW             | 3.1        | 8.1      | 77 | 1020 |
| 11:45:00 | 224          | SW             | 3.7        | 8.2      | 86 | 1021 | 13:56:00 | 242          | WSW            | 3.4        | 7.9      | 77 | 1020 |
| 11:46:00 | 223          | SW             | 2.8        | 8.8      | 85 | 1021 | 13:57:00 | 249          | WSW            | 3.5        | 7.8      | 76 | 1020 |
| 11:47:00 | 220          | SW             | 5.5        | 8.2      | 87 | 1022 | 13:58:00 | 240          | WSW            | 5.6        | 7.4      | 77 | 1021 |
| 11:48:00 | 216          | SW             | 5.3        | 8.2      | 86 | 1021 | 13:59:00 | 235          | SW             | 5.7        | 7.6      | 77 | 1020 |
| 11:49:00 | 219          | SW             | 3.9        | 8.5      | 86 | 1021 | 14:00:00 | 222          | SW             | 5.6        | 7.8      | 76 | 1020 |
| 11:50:00 | 226          | SW             | 5.6        | 8        | 87 | 1021 | 14:01:00 | 228          | SW             | 6.5        | 7.7      | 77 | 1020 |
| 11:51:00 | 223          | SW             | 4.4        | 8.1      | 87 | 1021 | 14:02:00 | 227          | SW             | 4.4        | 7.8      | 76 | 1020 |
| 11:52:00 | 223          | SW             | 5.8        | 7.9      | 88 | 1022 | 14:03:00 | 223          | SW             | 6          | 7.9      | 77 | 1020 |
| 11:53:00 | 227          | SW             | 3.7        | 8.3      | 85 | 1021 | 14:04:00 | 226          | SW             | 5.6        | 8.2      | 78 | 1020 |
| 11:54:00 | 215          | SW             | 3.5        | 8.2      | 84 | 1021 | 14:05:00 | 223          | SW             | 4.4        | 8.1      | 76 | 1021 |
| 11:55:00 | 213          | SSW            | 4.4        | 8.6      | 83 | 1021 | 14:06:00 | 222          | SW             | 7.1        | 8        | 79 | 1021 |
| 11:56:00 | 227          | SW             | 4.9        | 8.3      | 83 | 1021 | 14:07:00 | 211          | SSW            | 2.9        | 8.2      | 77 | 1020 |
| 11:57:00 | 228          | SW             | 6.2        | 7.9      | 83 | 1021 | 14:08:00 | 210          | SSW            | 3.3        | 8.2      | 78 | 1020 |
| 11:58:00 | 220          | SW             | 3.6        | 8.6      | 81 | 1021 | 14:09:00 | 213          | SSW            | 5.9        | 7.7      | 78 | 1020 |
| 11:59:00 | 222          | SW             | 5.5        | 8.4      | 82 | 1022 | 14:10:00 | 215          | SW             | 6.1        | 7.6      | 77 | 1020 |
| 12:00:00 | 229          | SW             | 3.2        | 8.4      | 81 | 1021 | 14:11:00 | 225          | SW             | 6.1        | 7.6      | 77 | 1020 |
| 12:01:00 | 229          | SW             | 5.1        | 8.3      | 81 | 1022 | 14:12:00 | 223          | SW             | 5.1        | 7.6      | 78 | 1020 |
| 12:02:00 | 221          | SW             | 4.8        | 8.3      | 82 | 1021 | 14:13:00 | 219          | SW             | 4.2        | 8.1      | 79 | 1021 |
| 12:03:00 | 220          | SW             | 5.4        | 8.1      | 82 | 1021 | 14:14:00 | 220          | SW             | 5.6        | 8.2      | 78 | 1020 |
| 12:04:00 | 215          | SW             | 3.7        | 8.4      | 81 | 1021 | 14:15:00 | 225          | SW             | 7.8        | 7.7      | 78 | 1020 |
| 12:05:00 | 214          | SW             | 5.8        | 8.2      | 83 | 1021 | 14:16:00 | 226          | SW             | 6.2        | 8.1      | 76 | 1020 |
| 12:06:00 | 224          | SW             | 6.7        | 8        | 83 | 1021 | 14:17:00 | 218          | SW             | 5.1        | 7.8      | 75 | 1021 |
| 12:07:00 | 223          | SW             | 5.5        | 8.1      | 83 | 1021 | 14:18:00 | 217          | SW             | 4.7        | 8        | 75 | 1021 |
| 12:08:00 | 222          | SW             | 4          | 8.6      | 82 | 1021 | 14:19:00 | 222          | SW             | 5.9        | 7.9      | 76 | 1021 |
| 12:09:00 | 224          | SW             | 5.2        | 8.4      | 82 | 1021 | 14:20:00 | 221          | SW             | 3.8        | 8        | 75 | 1021 |
| 12:10:00 | 231          | SW             | 8.4        | 8        | 83 | 1021 | 14:21:00 | 224          | SW             | 5.4        | 8.2      | 76 | 1021 |
| 12:11:00 | 232          | SW             | 4.1        | 8.4      | 81 | 1021 | 14:22:00 | 227          | SW             | 5.1        | 8        | 75 | 1021 |
| 12:12:00 | 226          | SW             | 3.4        | 8.7      | 81 | 1021 | 14:23:00 | 231          | SW             | 6.6        | 7.8      | 75 | 1021 |
| 12:13:00 | 225          | SW             | 4.5        | 8.6      | 81 | 1021 | 14:24:00 | 230          | SW             | 7.5        | 7.6      | 74 | 1021 |
| 12:14:00 | 223          | SW             | 5.7        | 8.2      | 82 | 1021 | 14:25:00 | 221          | SW             | 5.8        | 7.5      | 74 | 1021 |
| 12:15:00 | 220          | SW             | 3.4        | 8.3      | 82 | 1021 | 14:26:00 | 210          | SSW            | 3.3        | 8        | 75 | 1021 |
| 12:16:00 | 239          | WSW            | 3.7        | 8.1      | 82 | 1021 | 14:27:00 | 223          | SW             | 5.5        | 7.6      | 73 | 1021 |
| 12:17:00 | 246          | WSW            | 3.8        | 8        | 81 | 1021 | 14:28:00 | 226          | SW             | 4.8        | 7.5      | 73 | 1021 |
| 12:18:00 | 237          | WSW            | 5.9        | 7.6      | 82 | 1021 | 14:29:00 | 243          | WSW            | 5.3        | 7.5      | 75 | 1021 |
| 12:19:00 | 232          | SW             | 6          | 7.8      | 82 | 1021 | 14:30:00 | 241          | WSW            | 7.3        | 7.6      | 74 | 1021 |
| 12:20:00 | 219          | SW             | 5.9        | 8        | 81 | 1021 | 14:31:00 | 223          | SW             | 5          | 7.5      | 73 | 1021 |
| 12:21:00 | 225          | SW             | 6.8        | 7.9      | 82 | 1021 | 14:32:00 | 225          | SW             | 5.7        | 7.5      | 73 | 1020 |
| 12:22:00 | 224          | SW             | 4.7        | 8        | 81 | 1021 | 14:33:00 | 229          | SW             | 5.6        | 7.5      | 71 | 1019 |
| 12:23:00 | 220          | SW             | 6.3        | 8.1      | 82 | 1021 | 14:34:00 | 229          | SW             | 4.1        | 7.6      | 71 | 1018 |
| 12:24:00 | 219          | SW             | 5          | 8.3      | 82 | 1021 | 14:35:00 | 220          | SW             | 4.4        | 7.6      | 72 | 1020 |
| 12:25:00 | 222          | SW             | 3.6        | 8.3      | 80 | 1021 | 14:36:00 | 219          | SW             | 3.1        | 7.8      | 73 | 1020 |
| 12:26:00 | 222          | SW             | 4.7        | 8.2      | 82 | 1021 | 14:37:00 | 225          | SW             | 4.2        | 7.7      | 74 | 1020 |
| 12:27:00 | 216          | SW             | 5.9        | 8.1      | 82 | 1021 | 14:38:00 | 225          | SW             | 6.4        | 7.5      | 72 | 1020 |
| 12:28:00 | 224          | SW             | 2.6        | 8.5      | 81 | 1021 | 14:39:00 | 216          | SW             | 5.2        | 7.8      | 72 | 1020 |
| 12:29:00 | 221          | SW             | 4.1        | 8.1      | 82 | 1021 | 14:40:00 | 246          | WSW            | 5.7        | 7.8      | 73 | 1020 |

**Table A3.1: Weather Data The Hangar Silloth, 16<sup>th</sup> March 2020 contd.**

| Time     | Wind Bearing | Wind Direction | Wind Speed | Air Temp | RH | BP   | Time     | Wind Bearing | Wind Direction | Wind Speed | Air Temp | RH | BP   |
|----------|--------------|----------------|------------|----------|----|------|----------|--------------|----------------|------------|----------|----|------|
|          | degrees      | from           | m/s        | °C       | %  | mb   |          | degrees      | from           | m/s        | °C       | %  | mb   |
| 12:30:00 | 232          | SW             | 3.2        | 8.2      | 81 | 1021 | 14:41:00 | 243          | WSW            | 3.1        | 7.9      | 74 | 1020 |
| 12:31:00 | 235          | SW             | 5.6        | 7.9      | 83 | 1021 | 14:42:00 | 238          | WSW            | 5.7        | 7.8      | 73 | 1020 |
| 12:32:00 | 226          | SW             | 3.8        | 8.3      | 82 | 1021 | 14:43:00 | 242          | WSW            | 6.7        | 7.6      | 73 | 1021 |
| 12:33:00 | 226          | SW             | 7.2        | 8        | 83 | 1021 | 14:44:00 | 242          | WSW            | 5.1        | 7.8      | 73 | 1020 |
| 12:34:00 | 222          | SW             | 4.8        | 8.1      | 82 | 1021 | 14:45:00 | 210          | SSW            | 5.5        | 7.8      | 74 | 1020 |
| 12:35:00 | 223          | SW             | 5.9        | 8.4      | 83 | 1021 | 14:46:00 | 222          | SW             | 5.1        | 7.6      | 70 | 1020 |
| 12:36:00 | 220          | SW             | 4.7        | 8.3      | 81 | 1021 | 14:47:00 | 243          | WSW            | 3.6        | 7.9      | 73 | 1020 |
| 12:37:00 | 219          | SW             | 7.4        | 8.2      | 84 | 1021 | 14:48:00 | 221          | SW             | 3.5        | 8.2      | 72 | 1020 |
| 12:38:00 | 208          | SSW            | 3.2        | 8.4      | 82 | 1021 | 14:49:00 | 231          | SW             | 4.4        | 8.2      | 72 | 1020 |
| 12:39:00 | 207          | SSW            | 3.6        | 8.4      | 83 | 1021 | 14:50:00 | 228          | SW             | 4.9        | 8.1      | 71 | 1021 |
| 12:40:00 | 210          | SSW            | 6.2        | 7.9      | 83 | 1021 | 14:51:00 | 214          | SW             | 3.1        | 8.6      | 70 | 1021 |
| 12:41:00 | 212          | SSW            | 6.4        | 7.8      | 82 | 1021 | 14:52:00 | 228          | SW             | 4.9        | 8.1      | 71 | 1020 |
| 12:42:00 | 222          | SW             | 6.4        | 7.8      | 82 | 1021 | 14:53:00 | 221          | SW             | 3.5        | 8.2      | 72 | 1020 |
| 12:43:00 | 220          | SW             | 5.4        | 7.8      | 83 | 1021 | 14:54:00 | 231          | SW             | 4.4        | 8.2      | 72 | 1020 |
| 12:44:00 | 216          | SW             | 4.5        | 8.3      | 84 | 1021 | 14:55:00 | 219          | SW             | 3.1        | 7.8      | 73 | 1020 |
| 12:45:00 | 217          | SW             | 5.9        | 8.4      | 83 | 1021 | 14:56:00 | 225          | SW             | 4.2        | 7.7      | 74 | 1020 |
| 12:46:00 | 222          | SW             | 8.1        | 7.9      | 83 | 1021 | 14:57:00 | 229          | SW             | 4.1        | 7.6      | 71 | 1020 |
| 12:47:00 | 223          | SW             | 6.5        | 8.3      | 81 | 1021 | 14:58:00 | 220          | SW             | 4.4        | 7.6      | 72 | 1020 |
| 12:48:00 | 215          | SW             | 5.4        | 8        | 80 | 1021 | 14:59:00 | 225          | SW             | 5.7        | 7.5      | 73 | 1020 |
| 12:49:00 | 214          | SW             | 5          | 8.2      | 80 | 1021 | 15:00:00 | 229          | SW             | 5.6        | 7.5      | 71 | 1020 |
| 12:50:00 | 219          | SW             | 6.2        | 8.1      | 81 | 1021 | 15:01:00 | 225          | SW             | 6.4        | 7.5      | 72 | 1020 |
| 12:51:00 | 218          | SW             | 4.1        | 8.2      | 80 | 1021 | 15:02:00 | 216          | SW             | 5.2        | 7.8      | 72 | 1021 |
| 12:52:00 | 221          | SW             | 5.7        | 8.4      | 81 | 1021 | 15:03:00 | 242          | WSW            | 5.1        | 7.8      | 73 | 1020 |
| 12:53:00 | 224          | SW             | 5.4        | 8.2      | 80 | 1021 | 15:04:00 | 210          | SSW            | 5.5        | 7.8      | 74 | 1020 |
| 12:54:00 | 228          | SW             | 6.9        | 8        | 80 | 1021 | 15:05:00 | 238          | WSW            | 5.7        | 7.8      | 73 | 1020 |
| 12:55:00 | 227          | SW             | 7.8        | 7.8      | 79 | 1021 | 15:06:00 | 242          | WSW            | 6.7        | 7.6      | 73 | 1020 |
| 12:56:00 | 218          | SW             | 6.1        | 7.7      | 79 | 1021 | 15:07:00 | 246          | WSW            | 5.7        | 7.8      | 73 | 1020 |
| 12:57:00 | 219          | SW             | 5.4        | 7.8      | 75 | 1021 | 15:08:00 | 243          | WSW            | 3.1        | 7.9      | 74 | 1020 |
| 12:58:00 | 240          | WSW            | 3.9        | 8.1      | 78 | 1021 | 15:09:00 | 241          | WSW            | 7.3        | 7.6      | 74 | 1021 |
| 12:59:00 | 243          | WSW            | 6          | 8        | 78 | 1021 | 15:10:00 | 243          | WSW            | 3.6        | 7.9      | 73 | 1021 |
| 13:00:00 | 240          | WSW            | 3.4        | 8.1      | 79 | 1021 | 15:11:00 | 223          | SW             | 5          | 7.5      | 73 | 1020 |
| 13:01:00 | 235          | SW             | 6          | 8        | 78 | 1021 | 15:12:00 | 225          | SW             | 3.7        | 8.4      | 77 | 1020 |
| 13:02:00 | 239          | WSW            | 7          | 7.8      | 78 | 1021 | 15:13:00 | 235          | SW             | 5.7        | 7.6      | 75 | 1017 |
| 13:03:00 | 239          | WSW            | 5.4        | 8        | 78 | 1021 | 15:14:00 | 234          | SW             | 8.1        | 7.8      | 78 | 1021 |
| 13:04:00 | 207          | SSW            | 5.8        | 8        | 79 | 1021 | 15:15:00 | 228          | SW             | 6.5        | 7.7      | 77 | 1020 |
| 13:05:00 | 207          | SSW            | 3.6        | 8.2      | 80 | 1021 | 15:16:00 | 229          | SW             | 3.1        | 8.5      | 76 | 1021 |
| 13:06:00 | 220          | SW             | 5.8        | 7.8      | 78 | 1021 | 15:17:00 | 223          | SW             | 6          | 7.9      | 77 | 1020 |
| 13:07:00 | 223          | SW             | 5.1        | 7.7      | 78 | 1021 | 15:18:00 | 226          | SW             | 5.4        | 8        | 77 | 1018 |
| 13:08:00 | 240          | WSW            | 5.6        | 7.7      | 80 | 1021 | 15:19:00 | 225          | SW             | 3.3        | 8.1      | 75 | 1021 |
| 13:09:00 | 238          | WSW            | 7.6        | 7.8      | 79 | 1021 | 15:20:00 | 242          | WSW            | 3.4        | 7.9      | 77 | 1020 |
| 13:10:00 | 220          | SW             | 5.3        | 7.7      | 78 | 1021 | 15:21:00 | 219          | SW             | 5.6        | 7.9      | 77 | 1021 |
| 13:11:00 | 222          | SW             | 6          | 7.7      | 78 | 1021 | 15:22:00 | 240          | WSW            | 5.6        | 7.4      | 77 | 1020 |
| 13:12:00 | 226          | SW             | 5.9        | 7.7      | 76 | 1021 | 15:23:00 | 224          | SW             | 3.8        | 7.9      | 77 | 1021 |
| 13:13:00 | 226          | SW             | 4.4        | 7.8      | 76 | 1021 | 15:24:00 | 235          | SW             | 2.9        | 8        | 76 | 1020 |
| 13:14:00 | 217          | SW             | 4.7        | 7.8      | 77 | 1020 | 15:25:00 | 228          | SW             | 6.5        | 7.7      | 77 | 1019 |
| 13:15:00 | 216          | SW             | 3.4        | 8        | 78 | 1020 | 15:26:00 | 229          | SW             | 3.5        | 8.1      | 77 | 1021 |
| 13:16:00 | 222          | SW             | 4.5        | 7.9      | 79 | 1021 | 15:27:00 | 229          | SW             | 6.9        | 7.8      | 78 | 1020 |
| 13:17:00 | 222          | SW             | 6.7        | 7.7      | 77 | 1021 | 15:28:00 | 222          | SW             | 4.7        | 8.1      | 77 | 1021 |
| 13:18:00 | 213          | SSW            | 5.5        | 8        | 77 | 1020 | 15:29:00 | 226          | SW             | 5.6        | 8.2      | 78 | 1020 |
|          |              |                |            |          |    |      | 15:30:00 | 223          | SW             | 4.4        | 8.1      | 76 | 1021 |