

**Cwm Environmental
(Nantycaws)
Composting Facility**

Bioaerosols Monitoring

22nd June 2021

**2nd Quarter Report 2021
'Open Windrow Composting'
(IVC Compost Processing has ceased)**

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Nantycaws Landfill Site
Llanddarog Rd.
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Site Detail:
Composting Facility (IVC & Pad)
Nantycaws Landfill Site
Llanddarog Rd.
Nant y Caws
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Sampling date **22nd June 2021**
Report date **23rd July 2021**

SUMMARY NANTYCAWS BIOAEROSOLS MONITORING

The In Vessel Composting (IVC) and External Windrow (Pad) Composting Operations

The Cwm Environmental composting facilities are located at the Nantycaws Landfill Site Llanddarog Road, Nantycaws, Carmarthenshire. There are two linked sites: the 'In-Vessel Composting Facility and the External Composting Pad. The sites are located in a rural area near to the Nantycaws landfill. The two sites were amalgamated under one bespoke Environmental Permit, (EPR/EP3698FL, November 2012), and so this report deals with both areas as one site.

The **IVC facility** is just within 250m of a farmstead that is to the east of the facility. However, **at this time, the enclosed process IVC was not undertaking composting activities.** To the west is a Civic Amenity centre and the **Landfill**. To the NW there is a **Materials Reclamation Facility**.

The **Open Windrow facility** is located to the north west of the Offices and north-north east of the landfill. To the north west of the facility is a redundant farmstead 'Ty Hen' that belongs to Cwm Environmental. Further to the north is the A48 highway with a petrol station and houses beyond.

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 may be other fungal spores and bacteria that may present environmental effects at or near to composting facilities.

Environment Agency Requirements to Monitor Bioaerosols Emissions

Environment Agency Revised and Updated Policy in regard to Bioaerosols

Bioaerosols comes under the statutory control of the Natural Resources Wales, which has adopted the Environment Agency 'Policy' to provide the basis for monitoring bioaerosols. The Environment Agency (England) guidance is to use the M9 Methodology for the monitoring of bioaerosols.

This report utilises both the M9 Method ^{Apx 2} with regard to upwind/downwind sampling and the AfOR Protocol ^{Apx 3} to take account of Nearby Sensitive Receptors (NSR's).

This Report

This report provides the **2nd Quarter 2021** bioaerosols monitoring results. With the IVC **NOT** undertaking composting; the focus was on sampling for the **External Windrow Composting Facilities**. On the day selected the activities of **Green Waste Compost SCREENING** and **WINDROW TURNING** on the pad were being undertaken. The wind direction was from the **East-North-East** i.e. was offset **from** the nearby Garage on the A48 (i.e. the 'nearest sensitive receptor' – NSR) and was blowing across the site out **towards** the landfill. The following was concluded from the air quality results sampled **22/06/2021**:

Overall Conclusions

The **Maximum Median Upwind** Total Bacteria bioaerosols level was 170 cfu/m³; where-as the *Aspergillus Fumigatus* bioaerosols was 4 cfu/m³.

The **MAXIMUM MEDIAN DOWNWIND** bioaerosols levels were elevated: The **Total Bacteria was 550cfu/m³** (MEDIAN 314 cfu/m³); but the ***Aspergillus Fumigatus* was only 43 cfu/m³** (MEDIAN 36 cfu/m³). It was noted that there were intermittent elevations in the **Total Bacteria** bioaerosols levels, but these remained less than 55% of the guidance threshold.

These levels are well within recognised NRW thresholds and represent minimal risk to receptors.

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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 Guidance for monitoring bioaerosols.

Reference to The M9 Guidance and the AfOR Protocol

The M9 Guidance (refer 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 risk assessment/monitoring work, Recogen Ltd. is a recognised organisation with appropriately trained, qualified and experienced personnel; *independent* to the composting site operator. This assessment/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.

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 Organic Recycling Group being part of the Renewable Energy 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 (PAS100:2011 and 2018), The Compost Quality Protocol, ISO9001, ISO14001, COSHH and H&S Risk Assessments.

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

Notes:

1. Culture media supplied by D and F Associates Laboratory (Widnes, Cheshire) is in accordance with 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) operates to the UKAS accredited standards 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. D and F Associates Laboratory is an approved supplier of services to 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 more 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

'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 ⁻³
Aspergillus Fumigatus	500	cfu m ⁻³

1.0 SITE LOCATION (IVC and External Composting Facility)

The Composting Facility
Cwm Environmental
Nantycaws Landfill Site
Llanddarog Rd.
Nant y Caws
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Figure 1: Nantycaws Composting Site Location Map

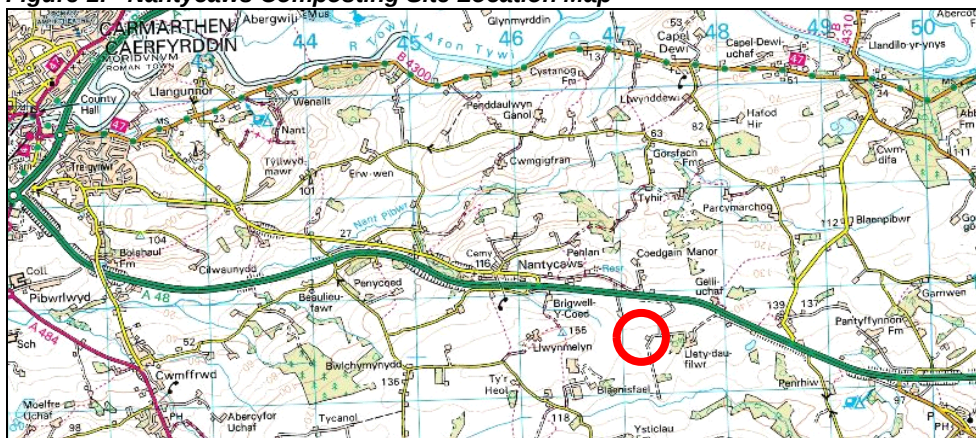
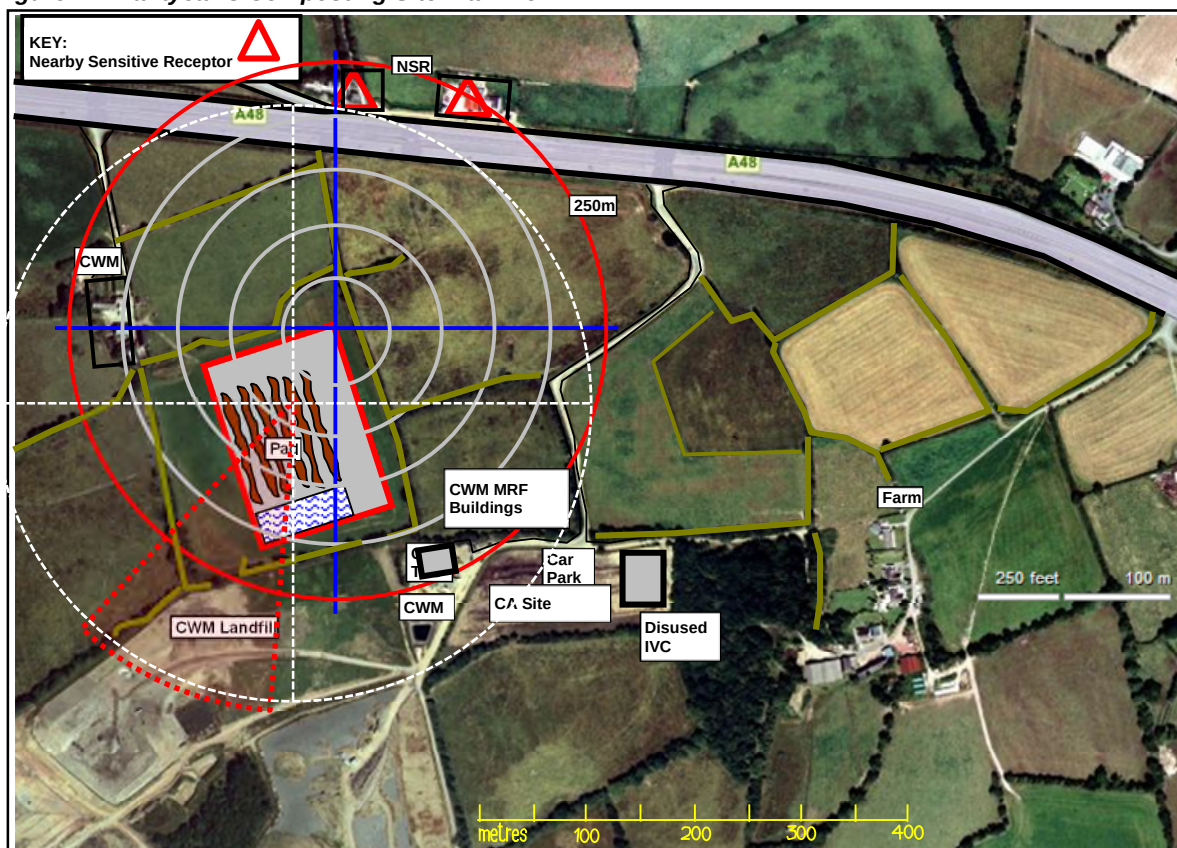


Figure 2: Nantycaws Composting Site Plan View



2.0 INTERPRETATION OF THE NRW / EA'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) 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 M9 follows the 2009 policy and provides the following: '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 range from 1- 1,000 cfu/m³ or more.

2.4 Applying the Bioaerosols Policy to the Composting Site.

The open windrow Composting Facility at Nantycaws is situated within 250m of third-party workplaces and/or dwellings (see fig 2). These have been taken account of during monitoring.

3.0 COMPOSTING SITE - SENSITIVE RECEPTORS

3.1 IVC Site Situation with Regard to Sensitive Receptors

The IVC composting facility is located in the east of the site, in a rural setting and is separated from sensitive receptors by distances of >200 m. However, there is a farmstead and dwellings to the east that are 210m distant. At this time the IVC facility was not in operation for composting.

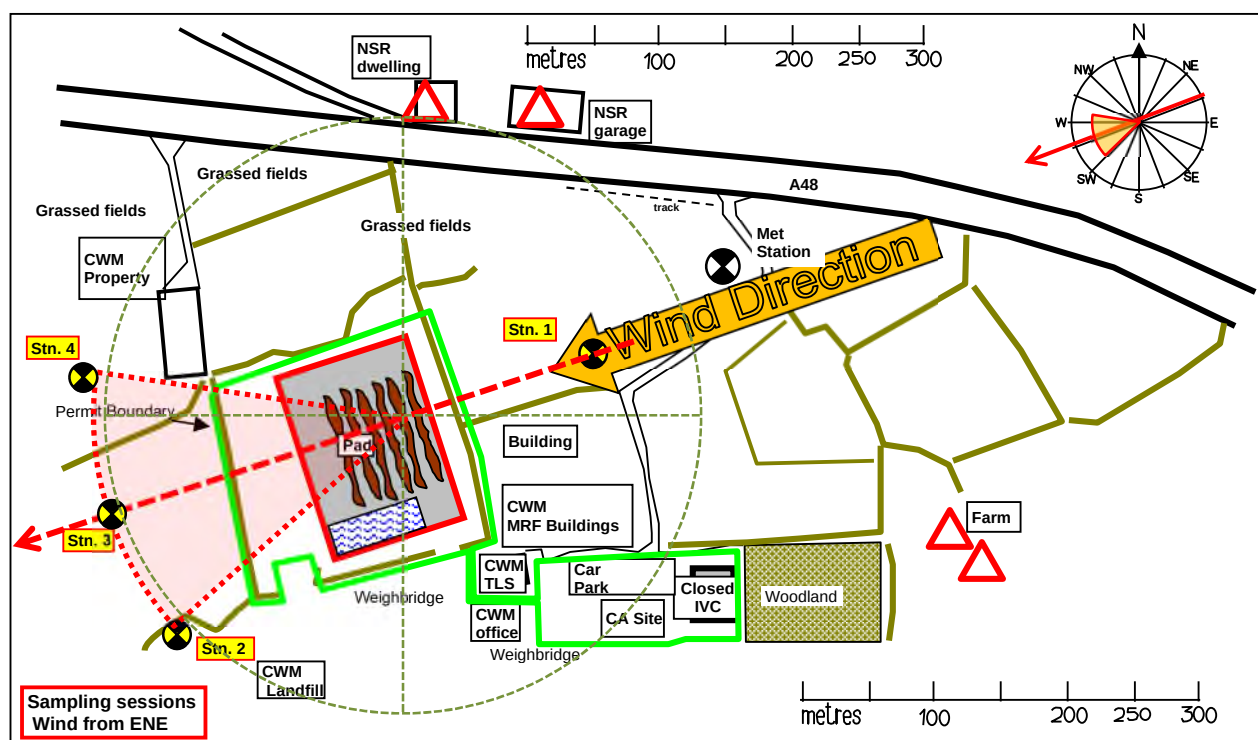
3.2 External Windrow Site Situation in Regard to Sensitive Receptors

The external windrow composting area is located within a rural area and is separated from sensitive receptors by distances of ~225 m. The Nearest Sensitive Receptors (NSR's) are the garage and dwellings on the northern side of the A48 carriageway north-west of the facility.

4.0 BIOAEROSOL SAMPLING STATIONS

The following plan for sampling stations was utilised. The wind was generally towards the **West-South-West direction** but varied through the session and the sampling stations were located to provide data in accordance with the 'upwind' and 'downwind'; at locations as shown in Figure 3.

Figure 3: Sampling Station Locations – Open Windrow Composting Facility



Station 1.	SN 47370,17788	Located to the south east of the grassed field to provide data UPWIND of the activity.
Station 2.	SN 47028,17553	Located at the side of the landfill track to the south-west of the site to provide the DOWNWIND sample to the left of the centreline...
Station 3.	SN 46954,17651	Located at the side of the landfill track to the west-south-west of the site to provide the DOWNWIND sample directly DOWNWIND of the Composting Pad.
Station 4.	SN 46931,17801	Located at the north of the aggregates centre to the west of the site to provide the DOWNWIND sample to the right of the centreline.

The Materials Recovery Facility (MRF) treats municipal waste under a separate permit. Any emissions from this were not measured specifically but may have affected the downwind results.

5.0 BIOAEROSOL TYPES

The following types of bioaerosol were enumerated

Description	Total Bacteria	Aspergillus Fumigatus	Gram Negative bacteria
	cfu/m ³	cfu/m ³	<i>Not required</i>

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

The gram-negative bacteria are NOT included because the IVC composting was deactivated.

6.0 BIOAEROSOL SAMPLING PROCEDURE

6.1 Standardised sampling Procedure

The procedure was based on the **M9 Methodology**. The Garage 'Sensitive Receptor' was offset to the UPWIND of the site and so **Station 1** provides useful information for this. Each of the stations for the UPWIND and DOWNWIND samples were retained in their respective locations during all sessions as the variations in the wind directions were not so great as to entail significant variation within the downwind 'fan'.

6.2 Sampling Equipment

6.2.1 Samplers

Samplers comprised the 3 part 'Andersen' type sampler design, with base, sampling hole manifold and collection funnel. Hemi-cylindrical air stagnation baffles extending 150mm above the inlet to the cone were fitted during sampling. The samplers were mounted as a pair on a platform at the top of an adjustable tripod that enabled the inlet cone to be held at 1.5 - 1.8m above ground level.

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.

6.3 Sample Collection media and Enumeration

The collection media and laboratory-based incubation and enumeration was undertaken by 'D&F Associates Labs' a laboratory working to UKAS accredited procedures.

6.4 Weather Monitoring Equipment

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

6.5 Sampler Locations

The sampling station locations are shown at figure 3.

6.6 Sample Management

The sample 'plates' were kept in a portable 12-volt refrigerator during the session and transport. The samples were delivered into the laboratory within 12 hours of the session completion.

7.0 MET DATA DURING SAMPLING

Weather 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 on a clear open area of grass, approx. 25m west of the cattle grid near the main-road access. The station comprises a wind vane, anemometer, temperature and humidity sensors and programmable data-logger set at a logging interval of 1 minute. The data is shown at Table 1. The raw data is shown at Appendix 3.

Table 1: Meteorological Conditions Cwm Environmental, NantyCaws – 22nd June 2021

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During the monitoring, the weather was warm, overcast but dry but with a fresh breeze. The data recording was started at 08:18 AM and the temperature varied at between 14.6-15.8° C. The sky remained overcast with high cloud at 7/8. The wind from the **East-North-East** blowing out towards the **West-South-West**; was fresh at 1.3 to 2.2 m/sec at times. The air was dry with the relative humidity remaining low at 57-52% RH.

8.0 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**.

The tables reveal the **MEAN** of the **UPWIND** results; and the **MEDIAN** of the **DOWNWIND** sampling results. The overall Median value is derived from all of the individual results.

Table 2: Sampling Results – TOTAL BACTERIA – Cwm Environmental – 22nd June 2021

Site:		NantyCaws Landfill, Carmarthen		Type of materials on site		Composted Green Waste			
Sampling Date:		22nd June 2021		Estimated material on site		3500 tonnes			
Site Operator:		Cwm Environmental		Type of Activity		Open Windrow Composting			
Monitoring Contractor:		Recogen Ltd of Shrewsbury.		Activities affecting bioaerosols release		Compost Turning & screening. Other vehicle movements around the site.			
				Bioaerosol Type:		TOTAL BACTERIA			
Sample Ref Nos.		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	Median of UPWIND Samples Total Bacteria cfu/m³	Median of DOWNWIND Samples Total Bacteria cfu/m³
Station Location ref. All Sample Refs: 'T' (Total Viable Bacteria)									
C1 AT	UW Stn. 1	75	140	-185	08:20	08:40	84	84	421
C1 BT	DW Stn. 2	230	250	-30	08:26	08:31	343		
C1 CT	DW Stn. 3	255	250	-5	08:27	08:32	721		
C1 DT	DW Stn. 4	280	250	20	08:28	08:33	421		
C2 AT	UW Stn. 1	75	140	-179	09:25	09:45	95	95	550
C2 BT	DW Stn. 2	230	250	-24	09:31	09:36	550		
C2 CT	DW Stn. 3	255	250	1	09:32	09:37	664		
C2 DT	DW Stn. 4	280	250	26	09:33	09:38	350		
C3 AT	UW Stn. 1	75	140	-179	10:29	10:49	170	170	207
C3 BT	DW Stn. 2	230	250	-24	10:35	10:40	550		
C3 CT	DW Stn. 3	255	250	1	10:36	10:41	107		
C3 DT	DW Stn. 4	280	250	-24	10:37	10:42	207		
C4 AT	UW Stn. 1	75	140	-168	11:30	11:50	91	91	207
C4 BT	DW Stn. 2	230	250	-13	11:36	11:41	364		
C4 CT	DW Stn. 3	255	250	12	11:37	11:42	129		
C4 DT	DW Stn. 4	280	250	37	11:38	11:43	207		
				MEDIAN UP and DOWNWIND VALUE				93	314
				MAXIMUM MEDIAN UP & DOWNWIND VALUE				170	550

Commentary to assist interpretation

1. The wind during the sampling session was from the **East-north-east**; arriving from the grassed fields and exiting the Composting site towards the landfill in the **West-South-West**.
2. The **UPWIND** values for Total Bacteria were **LOW** i.e. **median of 93 cfu/m³**.
3. The **DOWNWIND MEDIAN** values for **Total Bacteria** showed a **MODERATE** change compared to the samples in the Upwind. The **DOWNWIND MEDIAN** value was **314 cfu/m³**. There were some variations and the peak values were higher than this (**550 cfu/m³**).
4. (The **MAXIMUM MEDIAN VALUE** (derived from all values) was **550 cfu/m³**).

Table 3: Sampling Results – ASPERGILLUS FUMIGATUS - Cwm Environmental - 22nd June 2021

Site:		NantyCaws Landfill, Carmarthen		Type of materials on site			Composted Green Waste		
Sampling Date:		22 nd June 2021		Estimated material on site			3500 tonnes		
Site Operator:		Cwm Environmental		Type of Activity			Open Windrow Composting		
Monitoring Contractor:		Recogen Ltd of Shrewsbury.		Activities affecting bioaerosols release			Compost Turning & screening. Other vehicle movements around the site. .		
				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/m ³	Median of UPWIND Samples Aspergillus Fumigatus cfu/m ³	Median of DOWNWIND Samples Aspergillus Fumigatus cfu/m ³
C1 AF	UW Stn. 1	75	140	-177	08:50	09:10	0	0	29
C1 BF	DW Stn. 2	230	250	-22	08:56	09:01	50		
C1 CF	DW Stn. 3	255	250	3	08:57	09:02	29		
C1 DT	DW Stn. 4	280	250	28	08:58	09:03	7		
C2 AF	UW Stn. 1	75	140	-169	09:54	10:14	0	0	43
C2 BF	DW Stn. 2	230	250	-14	10:00	10:05	43		
C2 CF	DW Stn. 3	255	250	11	10:01	10:06	43		
C2 DF	DW Stn. 4	280	250	36	10:02	10:07	21		
C3 AF	UW Stn. 1	75	140	-182	10:57	11:17	4	4	14
C3 BF	DW Stn. 2	230	250	-27	11:03	11:08	14		
C3 CF	DW Stn. 3	255	250	-2	11:04	11:09	36		
C3 DF	DW Stn. 4	280	250	23	11:05	11:10	0		
C4 AF	UW Stn. 1	75	140	-183	11:59	12:19	2	2	43
C4 BF	DW Stn. 2	230	250	-28	12:05	12:10	43		
C4 CF	DW Stn. 3	255	250	-3	12:06	12:11	43		
C4 DF	DW Stn. 4	280	250	22	12:07	12:12	0		
				MEDIAN UP and DOWNWIND VALUE				1	36
				MAXIMUM MEDIAN UP & DOWNWIND VALUE				4	43

Commentary to assist interpretation

1. The wind during the sampling session was from the **East-North-East**; arriving from the grassed fields and exiting the Composting site towards the landfill in the **West-South-West**.
2. The **UPWIND** values for Aspergillus Fumigatus were **NEGLECTABLE** i.e. median of 1 cfu/m³.
3. The **DOWNWIND** values for **Aspergillus Fumigatus** showed a small elevation compared to the samples in the Upwind. The **DOWNWIND MEDIAN** value was **36 cfu/m³**. The **MAXIMUM MEDIAN VALUE** (derived from all values) was **43 cfu/m³**.

9.0 DISCUSSION OF RESULTS

9.1 Summary – Site Conditions and Activity During Sampling

This sampling occasion was undertaken in Summertime. On site, there were movements of vehicles (loading shovels/equipment) moving materials on the main composting pad; and specifically undertaking the 'turning' of the compost and screening the finished product. The Downwind sampling stations were located at approximately 250m from the centre of screening and windrow turning activity on the compost pad. The rise in the **bioaerosols values** showed that it was likely that the compost was having some impact on emissions.

Table 4 provides a summary of results. Sample data relating to the UPWIND may be taken as a proxy for the concentrations around the Nearest Sensitive Receptor (NSR) i.e. The A48 Garage to the NE.

9.2 Summary - Bioaerosol levels

Table 4 – Summary of results Cwm Environmental Composting Facility 22nd June 2021

	Activities	Total Bacteria		Asp. Fumigatus	
		Median UW	Median DW	Median UW	Median DW
		cfu/m ³	cfu/m ³	cfu/m ³	cfu/m ³
Session 1	Compost processing on the Pad	84	550	0	29
Session 2	Compost processing on the Pad	95	550	0	43
Session 3	Compost processing on the Pad	170	207	4	14
Session 4	Compost processing on the Pad	91	207	2	43
Overall	Median UW and Median Downwind	93	314	1	36
Maximum Median Downwind		170	550	4	43

* Mean value downwind is not required. Refer to Median Values.

The **DOWNWIND** levels of **Total Bacteria** bioaerosols were found to be **MODERATE** and the **Aspergillus Fumigatus** bioaerosols concentrations were **LOW**.

It was noted that there were occasional increases; but none of the **Bacteria** levels were elevated excessively and all remained at or below the 'Moderate' level. The results show that on average there was a small gain in the **Aspergillus Fumigatus** bioaerosol levels due to the contribution from the activities on the composting pad.

Reasons for the levels being **LOW** to **MODERATE** may be attributable to the seasonally warm and dry summer weather; and some dust being generated where the traffic were operating.

10.0 CONCLUSIONS-BIOAEROSOL SAMPLING

10.1 General Conclusions

The following may be concluded from the air quality results sampled **22nd June 2021**.

The MAXIMUM of the median downwind Total Bacteria bioaerosols was 550 cfu/m³.

The MAXIMUM of the median downwind Aspergillus Fumigatus bioaerosols was 43 cfu/m³.

1. In general, the results in the samples taken **UPWIND** of the site show **LOW** levels of Total Bacteria and **VERY LOW / NEGLIGIBLE** levels of Aspergillus Fumigatus (AF).
2. In the **DOWNWIND**, the **MEDIAN Bacteria** type bioaerosol levels were **MODERATE**. The **DOWNWIND MEDIAN of the Aspergillus Fumigatus** bioaerosols was **LOW**.
3. On this occasion the results showed that there was some elevation in the contribution of **Total Bacteria Bioaerosols resulting in the 550 cfu/m³ MAXIMUM MEDIAN** concentration in the air passing from the facility; however, these levels remained **below 55%** of the guideline threshold level of 1000 cfu/m³.

10.2 Overall Conclusion

The **Maximum Median Upwind** Total Bacteria bioaerosols level was 170 cfu/m³; where-as the Aspergillus Fumigatus bioaerosols was 4 cfu/m³. The **MAXIMUM MEDIAN DOWNWIND** bioaerosols levels were elevated: The **Total Bacteria was 550cfu/m³** (MEDIAN 314 cfu/m³); but the **Aspergillus Fumigatus was only 43 cfu/m³** (MEDIAN 36 cfu/m³). It was noted that there were intermittent elevations in the **Total Bacteria** bioaerosols levels, but these remained less than 55% of the guidance threshold.

These levels are well within recognised NRW thresholds and represent minimal risk to receptors.

APPENDIX 1. Bioaerosols Sampling Record and Results

NOTE: On this occasion, The UPWIND provides a proxy assessment of the Bioaerosols levels adjacent to the NSR

Results Table A1.1: Session 1: Bioaerosol levels UPWIND and DOWNWIND of the Compost Facility.

Run No.	Sample Type	Sampler position	Sampler station location	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
C1 A	TVC	UPWIND A	1	YA	P1	28	8:20	8:40	20.00	47	84	
C1 B	TVC	DOWNWIND B	2	YB	P2	28	8:26	8:31	5.00	48	343	
C1 C	TVC	DOWNWIND C	3	RA	P3	28	8:27	8:32	5.00	101	721	
C1 D	TVC	DOWNWIND D	4	RB	P4	28	8:28	8:33	5.00	59	421	
C1 A	AF	UPWIND A	1	YA	P1	28	8:50	9:10	20.00	0		0
C1 B	AF	DOWNWIND B	2	YB	P2	28	8:56	9:01	5.00	7		50
C1 C	AF	DOWNWIND C	3	RA	P3	28	8:57	9:02	5.00	4		29
C1 D	AF	DOWNWIND D	4	RB	P4	28	8:58	9:03	5.00	1		7

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

Results Table A1.2: Session 2: Bioaerosol levels UPWIND and DOWNWIND of the Compost Facility.

Run No.	Sample Type	Sampler position	Sampler station location	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
C2 A	TVC	UPWIND A	1	YA	P1	28	9:25	9:45	20.00	53	95	
C2 B	TVC	DOWNWIND B	2	YB	P2	28	9:31	9:36	5.00	77	550	
C2 C	TVC	DOWNWIND C	3	RA	P3	28	9:32	9:37	5.00	93	664	
C2 D	TVC	DOWNWIND D	4	RB	P4	28	9:33	9:38	5.00	49	350	
C2 A	AF	UPWIND A	1	YA	P1	28	9:54	10:14	20.00	0		0
C2 B	AF	DOWNWIND B	2	YB	P2	28	10:00	10:05	5.00	6		43
C2 C	AF	DOWNWIND C	3	RA	P3	28	10:01	10:06	5.00	6		43
C2 D	AF	DOWNWIND D	4	RB	P4	28	10:02	10:07	5.00	3		21

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

Results Table A1.3: Session 3: Bioaerosol levels UPWIND and DOWNWIND of the Compost Facility.

Run No.	Sample Type	Sampler position	Sampler station location	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
C3 A	TVC	UPWIND A	1	YA	P1	28	10:29	10:49	20.00	95	170	
C3 B	TVC	DOWNWIND B	2	YB	P2	28	10:35	10:40	5.00	77	550	
C3 C	TVC	DOWNWIND C	3	RA	P3	28	10:36	10:41	5.00	15	107	
C3 D	TVC	DOWNWIND D	4	RB	P4	28	10:37	10:42	5.00	29	207	
C3 A	AF	UPWIND A	1	YA	P1	28	10:57	11:17	20.00	2		4
C3 B	AF	DOWNWIND B	2	YB	P2	28	11:03	11:08	5.00	2		14
C3 C	AF	DOWNWIND C	3	RA	P3	28	11:04	11:09	5.00	5		36
C3 D	AF	DOWNWIND D	4	RB	P4	28	11:05	11:10	5.00	0		0

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

Results Table A1.4: Session 4: Bioaerosol levels UPWIND and DOWNWIND of the Compost Facility.

Run No.	Sample Type	Sampler Position. Proxy for the	Sampler station location	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
C4 A	TVC	UPWIND A	1	YA	P1	28	11:30	11:50	20.00	51	91	
C4 B	TVC	DOWNWIND B	2	YB	P2	28	11:36	11:41	5.00	51	364	
C4 C	TVC	DOWNWIND C	3	RA	P3	28	11:37	11:42	5.00	18	129	
C4 D	TVC	DOWNWIND D	4	RB	P4	28	11:38	11:43	5.00	29	207	
C4 A	AF	UPWIND A	1	YA	P1	28	11:59	12:19	20.00	1		2
C4 B	AF	DOWNWIND B	2	YB	P2	28	12:05	12:10	5.00	6		43
C4 C	AF	DOWNWIND C	3	RA	P3	28	12:06	12:11	5.00	6		43
C4 D	AF	DOWNWIND D	4	RB	P4	28	12:07	12:12	5.00	0		0

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

Results Table A1.5: CONTROL PLATES

Control Type	Total Bacteria CfU/Plate (T)	Aspergillus Fumigatus CfU/Plate (F)
Passive Un-exposed Control	CT1 =0, CT2 =0	CF1 =0, CF2 =0

APPENDIX 2. The M9v2 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.

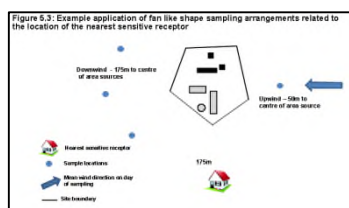
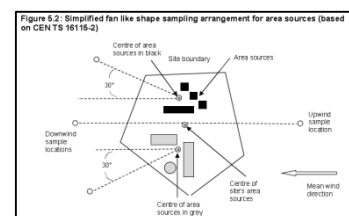
This approach is used to ensure that measurements are made in the emission plume, during the sampling campaign. If there are any buildings, installations or structures between the downwind location(s) and the centre of the active operational area, then sampling should be carried out upwind of that structure 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 3a: METEOROLOGICAL DATA Recorded by the Met Station.

Table A3.1: Meteorological Data 22nd June 2021

Time	Wind	Wind	Wind	Air	RH	BP		Time	Wind	Wind	Wind	Air	RH	BP
	Bearing	Direction	Speed	Temp	%	mb			Bearing	Direction	Speed	Temp	%	mb
			ms ⁻¹	°C	%	mb					ms ⁻¹	°C	%	mb
08:18:00	54	NE	0.4	16.1	57	1010		09:33:00	53	NE	2.4	15.8	56	1010
08:19:00	64	ENE	0.9	14.8	64	1010		09:34:00	74	ENE	1.5	15	57	1010
08:20:00	78	ENE	1.3	14.1	66	1010		09:35:00	72	ENE	1.1	14	57	1010
08:21:00	50	NE	0.8	15.5	69	1010		09:36:00	70	ENE	3.1	14	57	1010
08:22:00	80	E	1.2	14.6	66	1010		09:37:00	72	ENE	1.7	14.5	55	1010
08:23:00	67	ENE	2.6	14.9	67	1010		09:38:00	72	ENE	2.1	15.3	53	1010
08:24:00	91	E	0.9	14	64	1010		09:39:00	72	ENE	2.1	15.5	52	1010
08:25:00	100	E	2.2	14.5	66	1010		09:40:00	21	NNE	0.9	16.6	52	1010
08:26:00	89	E	0.8	15.4	66	1010		09:41:00	91	E	0.9	17.3	50	1010
08:27:00	53	NE	1.4	14.3	65	1010		09:42:00	97	E	1.5	15.4	53	1010
08:28:00	100	E	2.1	14	63	1010		09:43:00	97	E	0.9	15.7	54	1010
08:29:00	58	ENE	1.3	14.5	64	1010		09:44:00	112	ESE	1.6	14.9	55	1010
08:30:00	81	E	1.6	14.5	65	1010		09:45:00	109	ESE	1.5	13.9	56	1010
08:31:00	48	NE	1.4	14.5	66	1010		09:46:00	103	ESE	1.5	15.1	55	1010
08:32:00	98	E	1.6	15.1	68	1010		09:47:00	100	E	0.5	17.4	52	1010
08:33:00	114	ESE	1.2	14.9	64	1010		09:48:00	21	NNE	0.5	17.2	53	1010
08:34:00	88	E	2.2	14.2	64	1010		09:49:00	21	NNE	1.4	15.4	56	1010
08:35:00	92	E	0.5	14.5	60	1010		09:50:00	23	NNE	2.7	15.7	56	1010
08:36:00	72	ENE	1.1	14.5	60	1010		09:51:00	100	E	0.5	15.5	54	1010
08:37:00	68	ENE	0.7	14.9	59	1010		09:52:00	121	ESE	1.5	16.8	55	1010
08:38:00	91	E	0.7	15.5	59	1010		09:53:00	121	ESE	2.5	16.3	57	1010
08:39:00	89	E	2.4	14.1	64	1010		09:54:00	74	ENE	2.3	15.8	53	1010
08:40:00	58	ENE	1.4	14.4	63	1010		09:55:00	70	ENE	0.5	15.2	53	1010
08:41:00	35	NE	2.3	14.1	66	1010		09:56:00	72	ENE	4.1	15.5	55	1010
08:42:00	101	E	1.5	14.9	65	1010		09:57:00	16	NNE	1.7	15.9	53	1010
08:43:00	98	E	1.2	14.6	61	1010		09:58:00	61	ENE	0.9	15.8	52	1010
08:44:00	109	ESE	0.7	15	60	1010		09:59:00	61	ENE	0.8	16.2	51	1010
08:45:00	111	ESE	1.6	13.9	64	1010		10:00:00	89	E	0.9	17	52	1010
08:46:00	66	ENE	1.8	15.2	61	1010		10:01:00	91	E	1.2	15.4	55	1010
08:47:00	72	ENE	1.2	15.2	59	1010		10:02:00	43	NE	1.9	15.6	56	1010
08:48:00	61	ENE	0.6	16.1	58	1010		10:03:00	43	NE	2	15.7	56	1010
08:49:00	48	NE	1.1	15.7	56	1010		10:04:00	50	NE	1.2	16.1	55	1010
08:50:00	89	E	2	14.5	58	1010		10:05:00	38	NE	0.9	15.7	54	1010
08:51:00	88	E	1.9	14.1	59	1010		10:06:00	112	ESE	3	15.1	55	1010
08:52:00	98	E	0.9	15.8	57	1010		10:07:00	29	NNE	2.1	14.9	55	1010
08:53:00	114	ESE	1.2	14.9	61	1010		10:08:00	23	NNE	1.3	15.6	54	1010
08:54:00	69	ENE	0.9	16	56	1010		10:09:00	91	E	1	15	55	1010
08:55:00	70	ENE	1.7	15.3	57	1010		10:10:00	35	NE	1	15.6	55	1010
08:56:00	50	NE	2	14.8	60	1010		10:11:00	38	NE	0	17.2	51	1010
08:57:00	100	E	1.7	15.1	58	1010		10:12:00	111	ESE	1.4	16	54	1010
08:58:00	89	E	1.8	15	58	1010		10:13:00	105	ESE	0.8	15.3	55	1010
08:59:00	31	NNE	1.6	14.1	59	1010		10:14:00	74	ENE	0.9	16.8	54	1010
09:00:00	40	NE	2.1	14	59	1010		10:15:00	70	ENE	1.9	15.8	54	1010
09:01:00	98	E	1.6	15	58	1010		10:16:00	76	ENE	3.8	14.8	53	1010
09:02:00	53	NE	1.9	14.6	58	1010		10:17:00	82	E	2.5	14.9	53	1010
09:03:00	53	NE	1.8	14.9	58	1010		10:18:00	69	ENE	2.7	14.8	54	1010
09:04:00	66	ENE	2	14.9	57	1010		10:19:00	80	E	1.4	15.6	55	1010
09:05:00	51	NE	1.5	15.3	57	1010		10:20:00	61	ENE	1.7	15	55	1010
09:06:00	48	NE	1.1	16.4	55	1010		10:21:00	53	NE	3.5	14.6	55	1010
09:07:00	58	ENE	0.9	15.7	55	1010		10:22:00	16	NNE	1.8	14.5	55	1010
09:08:00	82	E	1.6	14.5	57	1010		10:23:00	97	E	3	14.7	55	1010
09:09:00	80	E	1.4	15.9	58	1010		10:24:00	103	ESE	1.6	16.5	53	1010
09:10:00	98	E	3.3	14	58	1010		10:25:00	109	ESE	2.2	15.3	53	1010
09:11:00	100	E	3.1	13.9	58	1010		10:26:00	49	NE	2.8	17	52	1010
09:12:00	38	NE	2.1	14.8	56	1010		10:27:00	50	NE	3.4	15.6	54	1010
09:13:00	30	NNE	1.1	14.6	57	1010		10:28:00	109	ESE	1.3	18.1	51	1010
09:14:00	72	ENE	2.5	15.2	58	1010		10:29:00	33	NNE	3.4	15.6	52	1010
09:15:00	70	ENE	1.1	14.6	56	1010		10:30:00	62	ENE	2.7	16.1	52	1010
09:16:00	118	ESE	1.1	15.5	55	1010		10:31:00	61	ENE	3.1	16	52	1010
09:17:00	119	ESE	1.8	14.8	57	1010		10:32:00	97	E	2.1	15.5	52	1010
09:18:00	121	ESE	1.1	15.7	55	1010		10:33:00	97	E	3.5	16.1	52	1010
09:19:00	109	ESE	1.6	14.6	56	1010		10:34:00	49	NE	2.5	15.6	52	1010
09:20:00	76	ENE	1.4	14.6	56	1010		10:35:00	43	NE	1.5	15.3	52	1010
09:21:00	82	E	3.8	14	58	1010		10:36:00	74	ENE	3	15.2	53	1010
09:22:00	16	NNE	2.2	14.8	56	1010		10:37:00	76	ENE	3.2	14.8	53	1010
09:23:00	16	NNE	1.2	14.2	56	1010		10:38:00	92	E	2	15.3	52	1010
09:24:00	124	SE	2.4	15.2	55	1010		10:39:00	54	NE	1.7	15.2	53	1010
09:25:00	125	SE	5.1	14.7	58	1010		10:40:00	78	ENE	1.4	15.2	53	1010
09:26:00	48	NE	1.8	14.4	56	1010		10:41:00	80	E	2	15.1	53	1010
09:27:00	35	NE	2	15.2	56	1010		10:42:00	53	NE	2.8	15.2	54	1010
09:28:00	81	E	2.5	14.4	56	1010		10:43:00	81	E	2.8	15.2	54	1010
09:29:00	68	ENE	2	13.9	57	1010		10:44:00	91	E	1.2	15	53	1010
09:30:00	100	E	1.2	14.8	56	1010		10:45:00	97	E	3.3	14.9	53	1010
09:31:00	98	E	1.1	14.6	56	1010		10:46:00	78	ENE	2	15.2	53	1010
09:32:00	54	NE	0.8	16.1	56	1010		10:47:00	80	E	2.1	15.2	53	1010

APPENDIX 3b: METEOROLOGICAL DATA Recorded by the Met Station.

Table A4.1 (continued): Meteorological Data 22nd June 2021

Time	Wind	Wind	Wind	Air	RH	BP		Time	Wind	Wind	Wind	Air	RH	BP
	Bearing	Direction	ms ⁻¹	°C	%	mb			Bearing	Direction	ms ⁻¹	°C	%	mb
10:48:00	111	ESE	0.7	15.9	53	1010		11:38:00	69	ENE	2	15.4	51	1010
10:49:00	30	NNE	2.2	15	53	1010		11:39:00	66	ENE	2	15.8	51	1010
10:50:00	80	E	1.3	15.2	52	1010		11:40:00	38	NE	1.2	15.6	51	1010
10:51:00	81	E	1	15.4	54	1010		11:41:00	35	NE	3.2	15.7	51	1010
10:52:00	100	E	1.6	15.3	54	1010		11:42:00	75	ENE	1.9	15	55	1010
10:53:00	98	E	2.2	15	54	1010		11:43:00	50	NE	0.7	15.4	54	1010
10:54:00	92	E	0.6	15.2	53	1010		11:44:00	68	ENE	2.4	15	55	1010
10:55:00	54	NE	1.4	15.4	53	1010		11:45:00	38	NE	2.5	14.9	54	1010
10:56:00	98	E	0.7	16.1	53	1010		11:46:00	33	NNE	1.9	15.1	54	1010
10:57:00	31	NNE	0.9	15.8	53	1010		11:47:00	70	ENE	4	15	55	1010
10:58:00	78	ENE	1.1	15.3	55	1010		11:48:00	68	ENE	1	15.5	54	1010
10:59:00	50	NE	2	14.7	55	1010		11:49:00	80	E	1.3	15.6	55	1010
11:00:00	76	ENE	3.5	14.9	56	1010		11:50:00	80	E	1.5	15.4	54	1010
11:01:00	75	ENE	1.9	15	55	1010		11:51:00	123	ESE	3.1	14.9	53	1010
11:02:00	50	NE	0.7	15.4	54	1010		11:52:00	119	ESE	2.4	15.2	53	1010
11:03:00	68	ENE	2.4	15	55	1010		11:53:00	72	ENE	1.2	15.4	53	1010
11:04:00	38	NE	2.5	14.9	54	1010		11:54:00	105	ESE	1	16.3	51	1010
11:05:00	33	NNE	1.9	15.1	54	1010		11:55:00	43	NE	1.8	15.6	51	1010
11:06:00	98	E	2.3	14.9	55	1010		11:56:00	40	NE	2.5	15.8	50	1010
11:07:00	114	ESE	3	15	55	1010		11:57:00	35	NE	0.4	18.1	48	1010
11:08:00	58	ENE	1.3	15.4	54	1010		11:58:00	51	NE	2.9	17.2	50	1010
11:09:00	61	ENE	2.2	15.1	55	1010		11:59:00	38	NE	1.3	16.3	51	1010
11:10:00	70	ENE	4	15	55	1010		12:00:00	40	NE	1.3	16.7	51	1010
11:11:00	68	ENE	1	15.5	54	1010		12:01:00	101	E	3.8	15.8	52	1010
11:12:00	80	E	1.3	15.6	55	1010		12:02:00	118	ESE	2	15.9	51	1010
11:13:00	80	E	1.5	15.4	54	1010		12:03:00	114	ESE	3	15	55	1010
11:14:00	123	ESE	3.1	14.9	53	1010		12:04:00	58	ENE	1.3	15.4	54	1010
11:15:00	119	ESE	2.4	15.2	53	1010		12:05:00	61	ENE	2.2	15.1	55	1010
11:16:00	72	ENE	1.2	15.4	53	1010		12:06:00	54	NE	1.4	15.4	53	1010
11:17:00	72	ENE	3.2	15.1	53	1010		12:07:00	98	E	0.7	16.1	53	1010
11:18:00	67	ENE	1.8	15.6	53	1010		12:08:00	31	NNE	0.9	15.8	53	1010
11:19:00	58	ENE	1.2	15.8	52	1010		12:09:00	78	ENE	1.1	15.3	55	1010
11:20:00	61	ENE	1.9	15.3	52	1010		12:10:00	58	ENE	1.2	15.8	52	1010
11:21:00	105	ESE	1	16.3	51	1010		12:11:00	61	ENE	1.9	15.3	52	1010
11:22:00	43	NE	1.8	15.6	51	1010		12:12:00	98	E	2.3	14.9	55	1010
11:23:00	40	NE	2.5	15.8	50	1010		12:13:00	50	NE	2	14.7	55	1010
11:24:00	35	NE	0.4	18.1	48	1010		12:14:00	76	ENE	3.5	14.9	56	1010
11:25:00	51	NE	2.9	17.2	50	1010		12:15:00	72	ENE	3.2	15.1	53	1010
11:26:00	38	NE	1.3	16.3	51	1010		12:16:00	67	ENE	1.8	15.6	53	1010
11:27:00	40	NE	1.3	16.7	51	1010		12:17:00	49	NE	1	16.9	51	1010
11:28:00	101	E	3.8	15.8	52	1010		12:18:00	58	ENE	2	15.9	51	1010
11:29:00	118	ESE	2	15.9	51	1010		12:19:00	119	ESE	1.9	16.2	51	1010
11:30:00	31	NNE	2.2	15.8	51	1010		12:20:00	29	NNE	2.6	16.2	51	1010
11:31:00	103	ESE	2.3	16.1	51	1010		12:21:00	69	ENE	2	15.4	51	1010
11:32:00	75	ENE	1.7	16.6	52	1010		12:22:00	66	ENE	2	15.8	51	1010
11:33:00	74	ENE	1.6	16.4	52	1010		12:23:00	31	NNE	2.2	15.8	51	1010
11:34:00	49	NE	1	16.9	51	1010		12:24:00	103	ESE	2.3	16.1	51	1010
11:35:00	58	ENE	2	15.9	51	1010		12:25:00	75	ENE	1.7	16.6	52	1010
11:36:00	119	ESE	1.9	16.2	51	1010		12:26:00	38	NE	1.2	15.6	51	1010
11:37:00	29	NNE	2.6	16.2	51	1010		12:27:00	35	NE	3.2	15.7	51	1010