Cwm Environmental (Nantycaws) Composting Facility

Bioaerosols Monitoring

28th November 2019

4th Quarter Report
'Open Windrow Composting'
(IVC Compost Processing has ceased)

Prepared on behalf of:
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Cwm Environmental
c/o Compost Site Office
Nantycaws Landfill Site
Llanddarog Rd.
Nant y Caws
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Site Detail:
Composting Facility (IVC & Pad)
Nantycaws Landfill Site
Llanddarog Rd.
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Sampling date **28th November 2019**
Report date **12th January 2020**

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 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 in England updated their guidance for using the M9 Methodology for the monitoring of bioaerosols in 2019.

This report utilises both the M9 Method[Apx 2] with regard to upwind/downwind sampling and the AfOR Protocol[Box 1] to take account of Nearby Sensitive Receptors (NSR's).

Box 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 3): http://www.organics-recycling.org.uk/

This Report

This report provides the **4th Quarter 2019** bioaerosols monitoring results. With the IVC **NOT** undertaking composting; the focus was on sampling for the **External Windrow Composting Facilities**. The day selected was **Thursday 28th November 2019** so that both of the procedures of **Green Waste Compost Windrow TURNING and SCREENING** on the pad were taken into account. The wind direction was from the West-North-West i.e. was across the site generally **TOWARDS** the nearby Farm - 'sensitive receptor' in the SE (but not the Garage on the A48) The following may be concluded from the air quality results sampled **28/11/2019**:

Overall Conclusion

The results of sampling on this occasion reveal that the open windrow composting activities at the site made minimal contribution to the **Total Bacteria** and **Aspergillus Fumigatus** Type Bioaerosols. **The median downwind Total Bacteria bioaerosols was 57 cfu/m^3 (Maximum 61 cfu/m^3). The median downwind Aspergillus Fumigatus bioaerosols was 7 cfu/m^3 (Maximum 11 cfu/m^3). These levels are well within the recognised NRW / EA acceptable thresholds.**

CONTENTS

This Report provides the results of a specific one-day session of sampling of bioaerosols at the Composting Facility. The report follows guidelines provided within the "AfOR Protocol" for monitoring bioaerosols and also the Environment Agency guidelines for "Risk Assessment".

Reference to The M9 Guidance and the AfOR Protocol

The M9 Guidance and AfOR Protocol (refer APPENDICES 2 and 3) are referred to throughout; and were 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 36 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 Association for Organic Recycling (AfOR) now 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 (PAS100:2005 and 2011), 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 <u>are attributable</u> 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}

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1.0 SITE LOCATION (IVC and External Composting Facility)

The Composting Facility
Cwm Environmental
Nantycaws Landfill Site
Llanddarog Rd.
Nant y Caws
Carmarthen
SA 32 8BG

Figure 1: Nantycaws Composting Site Location Map

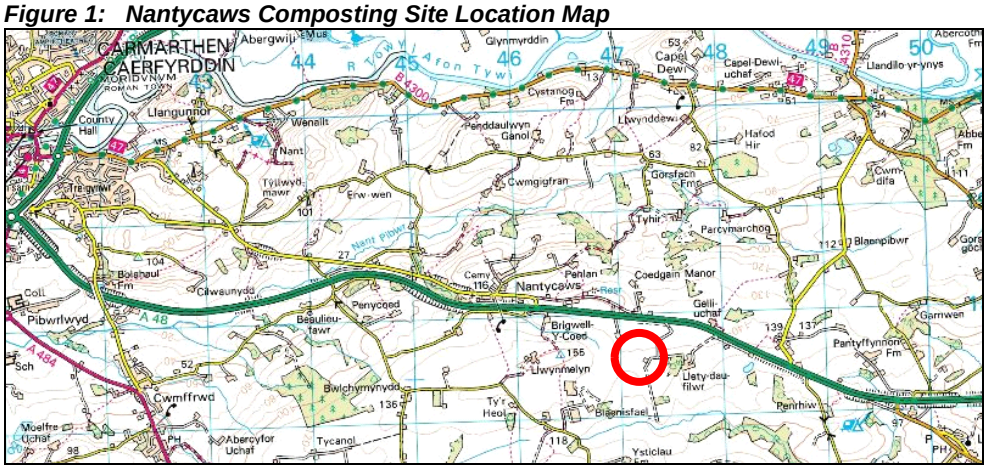
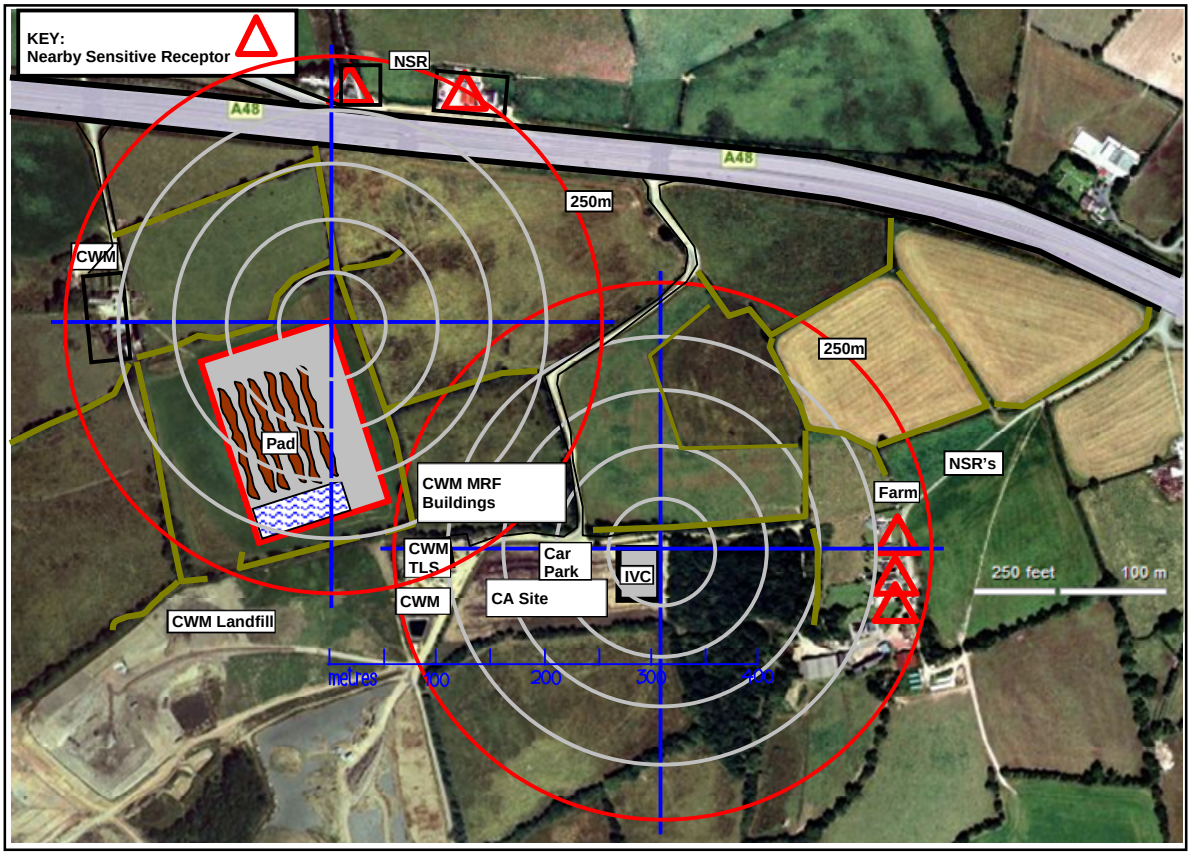


Figure 2: Nantycaws Composting Site Plan View



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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 2009 policy provided 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
300 cfu m^{-3} gram-negative bacteria (for In Vessel facilities; no longer required)

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/m^3 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.

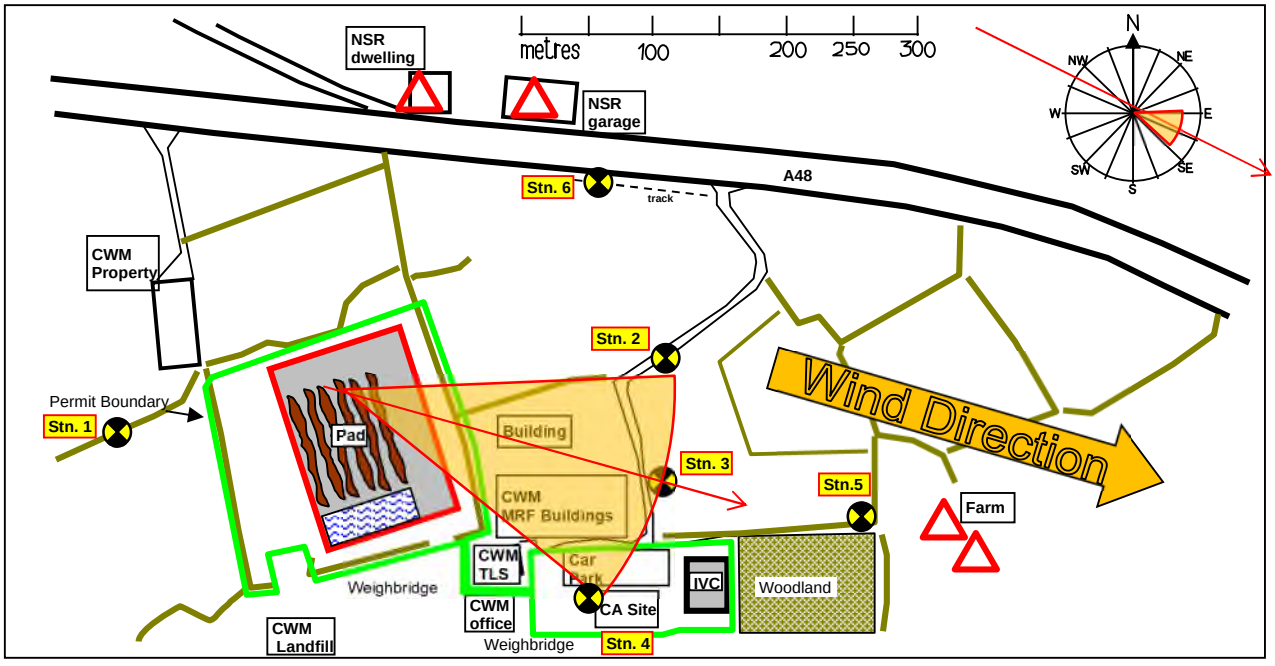
3.2 External Windrow Site Situation in Regard to Sensitive Receptors

The external windrow composting area is located within a rural area and is separated from sensitive receptors by distances of >200 m. There is a garage on northern side of the A48 carriageway and a dwelling just westward at the Nantycaws junction. These are 250m and 225m distant from the pad composting facility.

4.0 BIOAEROSOL SAMPLING STATIONS

The following plan for sampling stations was utilised. The wind was from generally from the **West-North-West direction**. Sampling stations were selected to provide data in accordance with 'upwind' and 'downwind' locations as shown in Figure 3.

Figure 3: Sampling Station Locations – Open Windrow Composting Facility



Station 1. was established to provide **data UPNWIND of the open windrow compost site**
Station 2. was established to provide the **DOWNWIND** sample left of the centreline
Station 3. provided data for the **DOWNWIND of the External Composting Pad.**
Station 4. was established to provide the **DOWNWIND** sample right of the centreline
Station 5. **provided data DOWNWIND equivalent to the NSR i.e. Farmhouse dwelling'**
Station 6. **provided data DOWNWIND** relating to the **NSR at the Garage on the A48**
NSR = Nearest Sensitive Receptor;

The Materials Recovery Facility (MRF) treats municipal waste under a separate permit. Any emissions from this were not measured specifically.

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	*Not required*

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 activity has now been discontinued.

6.0 BIOAEROSOL SAMPLING PROCEDURE

6.1 Standardised sampling Procedure

The procedure was based on the **M9 Methodology**; but with additional samples that relate to the Association for Organic Recycling (AfOR) Protocol regarding NSR's. (See Appendices 2 and 3).

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 between 1.5 and 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 were selected to provide the data for environmental purposes. 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 compost site office. The station comprises a wind vane, anemometer, temperature and humidity sensors and programmable data-logger set at logging intervals of 2 minutes. The data is shown at Table 1.The raw data is shown at Appendix 4.

Table 1: Meteorological Conditions Cwm Environmental, NantyCaws – 28th November 2019

Meteorological Conditions												
Site:		***NantyCaws Landfill, Carmarthen***			Site Operator:			**Cwm Environmental**				
Sampling Date:		***28th November 2019***			Monitoring Contractor:			**Recogen Ltd.**				
Sample Ref Nos.		Location	Bearing of Samplers from centre of Active Area ° to N	Mean Wind Direction wind blows TO during sampling period degrees ° to N	Difference in bearing of samplers and mean direction wind blows TO degrees ° to N	Wind Speed as sampling ms^{-1} @ 2m | @10m		Mean Air Temp as sampling °C	Mean Air RH Mean RH%	Prevailing Weather Pressure mbar	Cloud Cover 1/8 ths (okta)
C	1A TVC Upwind	Upwind Stn. 1	290	**111**	**179**	5.8	8.0	8.6	97.5	1000	7/8
C	1B TVC Left	Downwind Stn. 2	90		-20.9						
C	1C TVC Centre	Downwind Stn. 3	115		4						
C	1D TVC Right	Downwind Stn. 4	140		29						
C	1A AF Upwind	Upwind Stn. 1	290	**119**	**171**	6.5	9.0	9.5	95.7	1000	7/8
C	1B AF Left	Downwind Stn. 2	90		-28.9						
C	1C AF Centre	Downwind Stn. 3	115		-4						
C	1D AF Right	Downwind Stn. 4	140		21						
C	2A TVC U2wind	Upwind Stn. 1	290	**118**	**172**	7.4	10.2	10.2	95.2	1000	7/8
C	2 TVC Left	Downwind Stn. 2	90		-28.5						
C	2 TVC Centre	Downwind Stn. 3	115		-3						
C	2 TVC Right	Downwind Stn. 4	140		22						
C	2A AF Upwind	Upwind Stn. 1	290	**122**	**168**	7.3	10.1	10.6	91.6	1000	7/8
C	2B AF Left	Downwind Stn. 2	90		-32.1						
C	2C AF Centre	Downwind Stn. 3	115		-7						
C	2D AF Right	Downwind Stn. 4	140		18						
C	3A TVC Upwind	Upwind Stn. 1	290	**122**	**168**	7.5	10.4	11.0	83.4	1000	7/8
C	3B TVC Left	Downwind Stn. 2	90		-32.5						
C	3C TVC Centre	Downwind Stn. 3	115		-7						
C	3D TVC Right	Downwind Stn. 4	140		18						
C	3A AF Upwind	Upwind Stn. 1	290	**121**	**169**	8.2	11.4	11.3	82.6	1000	7/8
C	3B AF Left	Downwind Stn. 2	90		-30.8						
C	3C AF Centre	Downwind Stn. 3	115		-6						
C	3D AF Right	Downwind Stn. 4	140		19						
C	4A TVC Upwind	Upwind Stn. 1	290	**122**	**168**	3.9	5.4	11.6	84.9	1000	7/8
C	4B TVC Left	NSR Farm Stn 5	105		-12						
C	4C TVC Centre	NSR Farm Stn 5	105		-12						
C	4D TVC Right	NSR Garg Stn 6	50		-66						
C	4B AF Upwind	Upwind Stn. 1	290	**121**	**169**	4.4	6.1	11.5	77.3	1000	7/8
C	4C AF Left	NSR Farm Stn 5	105		-11						
C	4A AF Centre	NSR Farm Stn 5	105		-11						
C	4D AF Right	NSR Garg Stn 6	50		-67						

During the monitoring, the morning was cool, overcast but dry but with a cool wind. The data recording was started at 10:00 AM and the temperature rose from 8 – 11.5° C. The sky remained overcast with high cloud at 7/8. The wind from the **West-North-West;** was strong and gusting at 5.8 to 8.2 m/sec at times. The humidity decreased in relation to the temperature rise.

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 - 28th November 2019

Site:	***NantyCaws Landfill, Carmarthen***			Type of materials on site			**Composted Green Waste**		
Sampling Date:		***28th November 2019***		Estimated material on site			2500 tonnes		
Site Operator:		**Cwm Environmental**		Type of Activity			Open Windrow Composting		
Monitoring Contractor:		**Recogen Ltd** of Shrewsbury.		Activities affecting bioaerosols release			Compost Turning and screening. Other vehicle movements around the site.		
				Bioaerosol Type:			**TOTAL BACTERIA**		
Sample Ref Nos. Station Location ref. **All Sample Refs: 'T' (Total Viable Bacteria)**		**Station Location** bearing from centre of site ° from N	**Distance** from centre of activity metres	**Difference in bearing** between sampler location and mean direction that wind blows TO	**Sampling Period** Start Time	End Time	**Concentration of bioaerosols** **Total Viable Bacteria cfu/m³**	**Mean** of **UPWIND** Samples **Total Bacteria cfu/m³**	**Median** of **DOWNWIND** Samples **Total Bacteria cfu/m³**
C1 AT	UW Stn. 1	290	100	179	10:44	11:04	**39**	39	
C1 BT	DW Stn. 2	90	220	-21	10:48	10:58	**354**		
C1 CT	DW Stn. 3	115	250	4	10:48	10:58	**57**		57
C1 DT	DW Stn. 4	140	280	29	10:48	10:58	**39**		
C2 AT	UW Stn. 1	290	100	172	11:50	12:10	**11**	11	
C2 BT	DW Stn. 2	90	220	-28	11:54	12:04	**264**		
C2 CT	DW Stn. 3	115	250	-3	11:54	12:04	**21**		21
C2 DT	DW Stn. 4	140	280	22	11:54	12:04	**14**		
C3 AT	UW Stn. 1	290	100	168	13:06	13:26	**9**	9	
C3 BT	DW Stn. 2	90	220	-32	13:10	13:20	**143**		
C3 CT	DW Stn. 3	115	250	-7	13:10	13:20	**61**		61
C3 DT	DW Stn. 4	140	280	-32	13:10	13:20	**25**		
C4 AT	UW Stn. 1	290	100	171	14:19	14:29	**7**	7	
C4 BT	DW Stn. 5	105	350	-11	14:19	14:29	**64**		NSR's
C4 CT	DW Stn. 5	105	350	-11	14:19	14:29	**43**		
C4 DT	DW Stn. 6	50	260	-67	14:19	14:29	**7**		
				OVERALL MEAN VALUE				**17**	109
				OVERALL MEDIAN DOWNWIND VALUE					**57**
				MAXIMUM MEDIAN DOWNWIND VALUE					**61**

Commentary to assist interpretation

1. The wind during the sampling session was from the **West-North-West** arriving from farmland and the A48 highway and exiting the MRF site towards **East-South-East**.

2. The **UPWIND** values for Total Bacteria were **VERY LOW i.e. mean of 17 cfu/m³.**

3. The **DOWNWIND** values for Total Bacteria showed a small increase compared to the samples in the Upwind. The **DOWNWIND** MEDIAN value was **57 cfu/m³.** The **MAXIMUM MEDIAN VALUE** (derived from all values) was **61 cfu/m³.**

4. The values at the Nearest Sensitive Receptors were for **The Farm NSR** to the SE ~**53 cfu/m³** (approximately downwind) and for the **A48 Garage NSR; 7 cfu/m³** off-set away from the downwind.

Table 3: Sampling Results – ASPERGILLUS FUMIGATUS - Cwm Environmental - 28th November 2019

Site:	***NantyCaws Landfill, Carmarthen***			Type of materials on site			**Composted Green Waste**		
Sampling Date:		***28th November 2019***		Estimated material on site			2500 tonnes		
Site Operator:		**Cwm Environmental**		Type of Activity			Open Windrow Composting		
Monitoring Contractor:		**Recogen Ltd** of Shrewsbury.		Activities affecting bioaerosols release			Compost Turning and 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	Sampling Period End Time	Concentration of bioaerosols Aspergillus Fumigatus cfu/m^3	Mean of UPWIND Samples Aspergillus Fumigatus cfu/m^3	Median of DOWNWIND Samples Aspergillus Fumigatus cfu/m^3
C1 AF	UW Stn. 1	290	100	171	11:13	11:33	**16**	16	
C1 BF	DW Stn. 2	90	220	-29	11:17	11:27	**4**		
C1 CF	DW Stn. 3	115	250	-4	11:17	11:27	**118**		4
C1 DT	DW Stn. 4	140	280	21	11:17	11:27	**4**		
C2 AF	UW Stn. 1	290	100	168	12:22	12:42	**9**	9	
C2 BF	DW Stn. 2	90	220	-32	12:26	12:36	**11**		
C2 CF	DW Stn. 3	115	250	-7	12:26	12:36	**171**		11
C2 DF	DW Stn. 4	140	280	18	12:26	12:36	**0**		
C3 AF	UW Stn. 1	290	100	169	13:35	13:55	**20**	20	
C3 BF	DW Stn. 2	90	220	-31	13:39	13:49	**7**		
C3 CF	DW Stn. 3	115	250	-6	13:39	13:49	**25**		7
C3 DF	DW Stn. 4	140	280	19	13:39	13:49	**7**		
C4 AF	UW Stn. 1	290	100	171	14:38	14:48	**46**	46	
C4 BF	DW Stn. 5	105	350	-11	14:38	14:48	**29**		
C4 CF	DW Stn. 5	105	350	-67	14:38	14:48	**39**		NSR's
C4 DF	DW Stn. 6	50	260	-67	14:38	14:48	**4**		
				OVERALL MEAN UPWIND 'AF' VALUE				23	38
				OVERALL MEDIAN DOWNWIND 'AF' VALUE					7
				MAXIMUM MEDIAN DOWNWIND 'AF' VALUE					11

Commentary to assist interpretation

1. The wind during the sampling session was from the **West-North-West** arriving from farmland and the A48 highway and exiting the MRF site towards **East-South-East**.

2. The **UPWIND** values for Aspergillus Fumigatus were **VERY LOW i.e. mean of 23 cfu/m^3.**

3. The **DOWNWIND** values for Aspergillus Fumigatus showed minimal difference for those samples in the Upwind. The **DOWNWIND** MEDIAN value was **7 cfu/m^3.** The **MAXIMUM MEDIAN VALUE** (derived from all values) was **11 cfu/m^3.**

4. The values at the Nearest Sensitive Receptors were for **The Farm NSR to SE ~34 cfu/m^3** (approximately downwind' and for the **A48 Garage NSR 4 cfu/m^3** off-set away from the downwind.

9.0 DISCUSSION OF RESULTS

9.1 Summary – Site Conditions and Activity During Sampling

This sampling occasion was undertaken in late Autumn. On site, there were movements of vehicles (loading shovels/equipment) moving materials on the main composting pad and around the buildings. The composting is undertaken to the north and east of the pad. The Downwind sampling stations were located at ~280m distant from the centre of activity approximately 230m from the perimeter of the pad area.

Table 4 provides a summary of results and includes the additional session of sample data for the Nearest Sensitive Receptors (NSR's) i.e. The Farm to the SE and the A48 Garage to the NE.

9.2 Summary - Bioaerosol levels

Table 4 – Summary of results Cwm Environmental Composting Facility 28th November 2019

		Total Bacteria			Asp. Fumigatus	
	Activities	**Mean UW**	**Median DW**		**Mean UW**	**Median DW**
		cfu/m^3	cfu/m^3		cfu/m^3	cfu/m^3
Session 1	**Compost processing on the Pad**	**39**	**57**		**16**	**4**
Session 2	**Compost processing on the Pad**	**11**	**21**		**9**	**11**
Session 3	**Compost processing on the Pad**	**9**	**61**		**20**	**7**
Session 4	**Compost processing on the Pad**	**7**	**See NSR**		**46**	**See NSR**
Overall	**Mean UW and Median Downwind**	**17**	**57**		**23**	**7**
Maximum Median Downwind			**61**			**11**
Nearest Sensitive Receptor 'The Farm'		**53**			**34**	
Nearest Sensitive Receptor 'The A48 Garage'		**7**			**4**	

* Mean value downwind is not required. Refer to Median Values. Mean value shown for interest. NSR relates to Elm Farm (Appendix 4)

The downwind levels of Total Bacteria bioaerosols were found to be **VERY LOW** and the Aspergillus Fumigatus bioaerosols were similarly **VERY LOW**. The results show that on average there was a small gain in the 'Total Bacteria' bioaerosol levels due to the contribution from activities on or around the composting pad. The contribution of the 'Aspergillus Fumigatus' was nil.

Reasons for the levels being **VERY LOW** may be attributable to the seasonally wet weather, the damp condition of the compost and the wet field surfaces.

10.0 CONCLUSIONS-BIOAEROSOL SAMPLING

10.1 General Conclusions

The following may be concluded from the air quality results sampled **28/11/2019**:

The MAXIMUM of the median downwind Total Bacteria bioaerosols was 61 cfu/m^3.
The MAXIMUM of the median downwind Aspergillus Fumigatus bioaerosols was 11 cfu/m^3.

1. In general, the results show **VERY LOW** levels of Total Bacteria and **VERY LOW** Aspergillus Fumigatus (AF) in the samples taken **Upwind** of the site.

2. The Median **Downwind** Bacteria type bioaerosol levels were **VERY LOW** and Aspergillus Fumigatus similarly **VERY LOW**.

3. The results showed that on this occasion there was very little contribution of bioaerosols to the air passing over the facility.

10.2 Overall Conclusion

The results of sampling on this occasion reveal that the open windrow composting activities at the site made minimal contribution to the **Total Bacteria** and **Aspergillus Fumigatus** Type Bioaerosols. **The median downwind Total Bacteria bioaerosols was 57 cfu/m^3 (Maximum 61 cfu/m^3). The median downwind Aspergillus Fumigatus bioaerosols was 7 cfu/m^3 (Maximum 11 cfu/m^3).**

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

APPENDIX 1. Bioaerosols Sampling Record and Results

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	10:44	11:04	20.00	**22**	39	
C1 B	TVC	DOWNWIND B	2	YB	P2	28	10:48	10:58	10.00	**99**	354	
C1 C	TVC	DOWNWIND C	3	RA	P3	28	10:48	10:58	10.00	**16**	57	
C1 D	TVC	DOWNWIND D	4	RB	P4	28	10:48	10:58	10.00	**11**	39	
C1 A	AF	UPWIND A	1	YA	P1	28	11:13	11:33	20.00	**9**		16
C1 B	AF	DOWNWIND B	2	YB	P2	28	11:17	11:27	10.00	**1**		4
C1 C	AF	DOWNWIND C	3	RA	P3	28	11:17	11:27	10.00	**33**		118
C1 D	AF	DOWNWIND D	4	RB	P4	28	11:17	11:27	10.00	**1**		4

*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	11:50	12:10	20.00	**6**	11	
C2 B	TVC	DOWNWIND B	2	YB	P2	28	11:54	12:04	10.00	**74**	264	
C2 C	TVC	DOWNWIND C	3	RA	P3	28	11:54	12:04	10.00	**6**	21	
C2 D	TVC	DOWNWIND D	4	RB	P4	28	11:54	12:04	10.00	**4**	14	
C2 A	AF	UPWIND A	1	YA	P1	28	12:22	12:42	20.00	**5**		9
C2 B	AF	DOWNWIND B	2	YB	P2	28	12:26	12:36	10.00	**3**		11
C2 C	AF	DOWNWIND C	3	RA	P3	28	12:26	12:36	10.00	**48**		171
C2 D	AF	DOWNWIND D	4	RB	P4	28	12:26	12:36	10.00	**0**		0

*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	13:06	13:26	20.00	**5**	9	
C3 B	TVC	DOWNWIND B	2	YB	P2	28	13:10	13:20	10.00	**40**	143	
C3 C	TVC	DOWNWIND C	3	RA	P3	28	13:10	13:20	10.00	**17**	61	
C3 D	TVC	DOWNWIND D	4	RB	P4	28	13:10	13:20	10.00	**7**	25	
C3 A	AF	UPWIND A	1	YA	P1	28	13:35	13:55	20.00	**11**		20
C3 B	AF	DOWNWIND B	2	YB	P2	28	13:39	13:49	10.00	**2**		7
C3 C	AF	DOWNWIND C	3	RA	P3	28	13:39	13:49	10.00	**7**		25
C3 D	AF	DOWNWIND D	4	RB	P4	28	13:39	13:49	10.00	**2**		7

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

Results Table A1.4: Session 4: Bioaerosol levels at Nearest Sensitive Receptors for 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}
C4 A	TVC	UPWIND A	1	YA	P1	28	14:19	14:29	10.00	**2**	7	
C4 B	TVC	NSR Farm (track)	5	YB	P2	28	14:19	14:29	10.00	**18**	64	
C4 C	TVC	NSR Farm (track)	5	RA	P3	28	14:19	14:29	10.00	**12**	43	
C4 D	TVC	NSR Garage	6	RB	P4	28	14:19	14:29	10.00	**2**	7	
C4 A	AF	UPWIND A	1	YA	P1	28	14:38	14:48	10.00	**13**		46
C4 B	AF	NSR Farm (track)	5	YB	P2	28	14:38	14:48	10.00	**8**		29
C4 C	AF	NSR Farm (track)	5	RA	P3	28	14:38	14:48	10.00	**11**		39
C4 D	AF	NSR Garage	6	RB	P4	28	14:38	14:48	10.00	**1**		4

*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	WT1 =0, WT2 =0		WF1 =0, WF2 =0

APPENDIX 2. The M9 Technical Guidance Note (Monitoring)

Technical Guidance Note (Monitoring) M9
Environmental monitoring of bioaerosols at regulated facilities

Environment Agency January 2017 Version 1

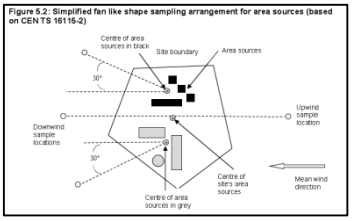
Sampling bioaerosols
Bioaerosols can be measured using a number of different techniques. This technical note describes the following techniques for sampling bioaerosols:

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

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

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

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



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

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

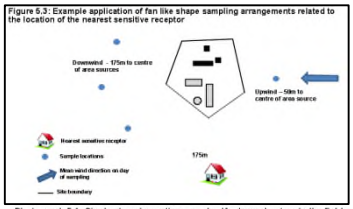


Figure 5.1 shows this approach applied to a facility with a single point source. Topography or vegetation may restrict the line of sight required to locate sample traverses. This may make it difficult to determine the angle for locating the sample points. The restriction should be noted in the sample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

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

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

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

APPENDIX 3. The Association for Organic Recycling Protocol

A Standardised Protocol for the Monitoring of Bioaerosols at Open Composting Facilities

CONTENTS

The AfOR Protocol is available by order from the AfOR website [publications]: http://www.organics-recycling.org.uk/

APPENDIX 4: METEOROLOGICAL DATA Recorded by the Met Station.

Table A4.1: Weather Data Thursday 28th November 2019

Time	Wind Direction	Wind Bearing	Wind Speed ms^{-1}	Air Temp °C	RH %	BP mb
10:42:00	283	WNW	3.7	8.7	96	1000
10:43:00	316	NW	4.1	8.6	98	1000
10:44:00	306	NW	4.3	8.5	99	1000
10:45:00	285	WNW	4.4	8.5	98	1000
10:46:00	303	WNW	4.2	8.5	98	1000
10:47:00	311	NW	4	8.6	99	1000
10:48:00	273	W	3.3	8.6	98	1000
10:49:00	261	W	2.9	8.6	99	1000
10:50:00	293	WNW	3.2	8.4	99	1000
10:51:00	285	WNW	4	8.5	98	1000
10:52:00	234	SW	3	8.6	98	1000
10:53:00	300	WNW	4.1	8.6	98	1000
10:54:00	291	WNW	3.4	8.7	97	1000
10:55:00	268	W	5	8.4	98	1000
10:56:00	304	NW	3.3	8.6	97	1000
10:57:00	285	WNW	2.8	8.7	98	1000
10:58:00	300	WNW	3.1	8.7	97	1000
10:59:00	302	WNW	3.6	8.7	97	1000
11:00:00	302	WNW	3	8.7	97	1000
11:01:00	295	WNW	3.8	8.7	96	1000
11:02:00	295	WNW	3.8	8.7	95	1000
11:03:00	306	NW	3.3	8.7	95	1000
11:04:00	306	NW	4	8.8	95	1000
11:05:00	311	NW	3.3	8.8	95	1000
11:06:00	311	NW	4.6	8.8	95	1000
11:07:00	295	WNW	3.4	8.9	95	1000
11:08:00	295	WNW	3.3	8.8	95	1000
11:09:00	303	WNW	3.9	9	95	1000
11:10:00	303	WNW	3.2	9	95	1000
11:11:00	301	WNW	3.4	9	96	1000
11:12:00	301	WNW	4.8	9.1	95	1000
11:13:00	304	NW	2.9	9.4	95	1000
11:14:00	304	NW	3.3	9.4	95	1000
11:15:00	307	NW	3.4	9.4	95	1000
11:16:00	307	NW	3.9	9.1	95	1000
11:17:00	296	WNW	5.2	9	95	1000
11:18:00	296	WNW	3.4	9.1	95	1000
11:19:00	294	WNW	3.3	9.3	95	1000
11:20:00	294	WNW	4.5	9.3	96	1000
11:21:00	296	WNW	3.8	9.3	95	1000
11:22:00	296	WNW	5.4	9.3	95	1000
11:23:00	303	WNW	2.3	10.2	95	1000
11:24:00	304	NW	3.5	9.8	95	1000
11:25:00	292	WNW	4	9.6	95	1000
11:26:00	292	WNW	3.2	9.8	94	1000
11:27:00	298	WNW	4.5	9.6	96	1000
11:28:00	298	WNW	4.5	9.7	96	1000
11:29:00	312	NW	3.7	9.7	99	1000
11:30:00	312	NW	4.1	10	99	1000
11:31:00	291	WNW	4.1	9.7	98	1000
11:32:00	291	WNW	5.8	9.7	98	1000
11:33:00	302	WNW	6.1	9.7	98	1000
11:34:00	302	WNW	3.9	9.9	97	1000
11:35:00	304	NW	5.5	9.7	98	1000
11:36:00	304	NW	5.2	10	97	1000
11:37:00	304	NW	5.2	9.9	98	1000
11:38:00	304	NW	3.8	10	97	1000
11:39:00	301	WNW	4.9	9.9	97	1000
11:40:00	301	WNW	6.4	9.9	97	1000
11:41:00	302	WNW	6.4	9.8	96	1000
11:42:00	302	WNW	5.3	10.3	95	1000
11:43:00	291	WNW	4	10.1	95	1000
11:44:00	291	WNW	4.9	10.2	95	1000
11:45:00	298	WNW	5.2	10.3	95	1000
11:46:00	298	WNW	5.6	10	95	1000
11:47:00	303	WNW	5.9	10	95	1000
11:48:00	303	WNW	5.2	10.2	96	1000
11:49:00	300	WNW	5	10.1	95	1000
11:50:00	300	WNW	3.9	10.1	95	1000
11:51:00	292	WNW	5.2	10.1	95	1000
11:52:00	293	WNW	3.8	10.5	95	1000
11:53:00	303	WNW	3.9	10.1	95	1000
11:54:00	304	NW	3.6	10.5	94	1000
11:55:00	299	WNW	5.1	10	96	1000
11:56:00	299	WNW	3.7	10.6	94	1000
11:57:00	291	WNW	4	10.3	95	1000
11:58:00	292	WNW	4	10.4	95	1000
11:59:00	304	NW	3.5	10.4	95	1000
12:00:00	303	WNW	4.6	10.3	96	1000
12:01:00	296	WNW	5.5	9.9	97	1000
12:02:00	298	WNW	3.6	10.2	95	1000
12:03:00	293	WNW	6	10.1	96	1000

Time	Wind Direction	Wind Bearing	Wind Speed ms^{-1}	Air Temp °C	RH %	BP mb
12:51:00	299	WNW	5.4	10.8	88	1000
12:52:00	298	WNW	4.2	10.6	86	1000
12:53:00	308	NW	4.8	10.9	85	1000
12:54:00	309	NW	3.1	10.8	86	1000
12:55:00	304	NW	5.2	10.6	86	1000
12:56:00	303	WNW	5.5	10.8	86	1000
12:57:00	299	WNW	5.6	10.8	85	1000
12:58:00	301	WNW	4.8	10.7	86	1000
12:59:00	301	WNW	4.6	10.6	86	1000
13:00:00	300	WNW	4.8	10.6	86	1000
13:01:00	313	NW	4.3	10.8	85	1000
13:02:00	313	NW	3.5	10.7	86	1000
13:03:00	303	WNW	5.6	10.9	86	1000
13:04:00	302	WNW	4.2	10.9	86	1000
13:05:00	312	NW	4.9	10.9	84	1000
13:06:00	311	NW	4.3	10.8	85	1000
13:07:00	295	WNW	4.5	11.2	85	1000
13:08:00	294	WNW	5.6	10.8	86	1000
13:09:00	302	WNW	3.2	11	84	1000
13:10:00	302	WNW	6.1	10.8	85	1000
13:11:00	322	NW	3	11.2	80	1000
13:12:00	325	NW	6.2	10.6	85	1000
13:13:00	305	NW	5.5	11.3	83	1000
13:14:00	304	NW	5.5	11	83	1000
13:15:00	297	WNW	3.7	11.1	83	1000
13:16:00	296	WNW	4.3	11.1	83	1000
13:17:00	288	WNW	2.8	11.4	83	1000
13:18:00	289	WNW	4.7	10.9	84	1000
13:19:00	297	WNW	4	11	84	1000
13:20:00	296	WNW	5.6	10.9	85	1000
13:21:00	295	WNW	4.5	10.9	82	1000
13:22:00	295	WNW	3.3	11.1	82	1000
13:23:00	315	NW	4.5	10.8	82	1000
13:24:00	316	NW	3.6	10.7	82	1000
13:25:00	301	WNW	6.3	10.4	84	1000
13:26:00	301	WNW	4.1	10.5	84	1000
13:27:00	295	WNW	5.8	10.3	86	1000
13:28:00	294	WNW	6	10.2	87	1000
13:29:00	300	WNW	4.4	10	88	1000
13:30:00	300	WNW	5	10.4	87	1000
13:31:00	299	WNW	5.7	10.4	87	1000
13:32:00	299	WNW	5.8	10.8	87	1000
13:33:00	289	WNW	4	11.5	86	1000
13:34:00	290	WNW	8.1	10.9	86	1000
13:35:00	308	NW	6.1	11	85	1000
13:36:00	308	NW	6.6	11.1	86	1000
13:37:00	299	WNW	4.7	11.3	84	1000
13:38:00	300	WNW	3.7	11.9	82	1000
13:39:00	290	WNW	4.5	11.4	84	1000
13:40:00	288	WNW	5.6	11.2	85	1000
13:41:00	307	NW	5.6	11	84	1000
13:42:00	307	NW	6.1	11.3	84	1000
13:43:00	307	NW	4.4	11.6	81	1000
13:44:00	307	NW	4.4	11.7	82	1000
13:45:00	300	WNW	4.1	11.8	81	1000
13:46:00	300	WNW	4.1	11.4	82	1000
13:47:00	297	WNW	4	12	81	1000
13:48:00	297	WNW	5.4	11.4	81	1000
13:49:00	298	WNW	6.2	11.3	82	1000
13:50:00	298	WNW	3.9	11.2	81	1000
13:51:00	304	NW	5.6	11.1	82	1000
13:52:00	303	WNW	4.5	10.9	82	1000
13:53:00	295	WNW	4.9	10.8	83	1000
13:54:00	296	WNW	4.8	11	82	1000
13:55:00	305	NW	4.6	11.3	81	1000
13:56:00	305	NW	5	11.4	82	1000
13:57:00	297	WNW	6.1	11.2	83	1000
13:58:00	297	WNW	7.7	10.9	83	1000
13:59:00	289	WNW	3	11.3	81	1000
14:00:00	290	WNW	5.1	10.8	83	1000
14:01:00	294	WNW	5.9	10.9	82	1000
14:02:00	294	WNW	6.6	11	82	1000
14:03:00	294	WNW	6.6	10.8	82	1000
14:04:00	294	WNW	5.3	11	81	1000
14:05:00	303	WNW	3.9	11.4	81	1000
14:06:00	303	WNW	6.5	11.1	81	1000
14:07:00	294	WNW	3.5	11.7	79	1000
14:08:00	295	WNW	7.2	10.9	82	1000
14:09:00	297	WNW	6.5	11.2	81	1000
14:10:00	299	WNW	4.8	10.9	81	1000
14:11:00	298	WNW	3.6	11	80	1000
14:12:00	297	WNW	5.5	11	81	1000

12:04:00	290	WNW	4	10	95	1000
12:05:00	302	WNW	4.7	10.1	95	1000
12:06:00	303	WNW	5.3	10	96	1000
12:07:00	304	NW	5.6	10.1	95	1000
12:08:00	304	NW	4.6	10.2	95	1000
12:09:00	299	WNW	4.4	10.3	96	1000
12:10:00	298	WNW	3.9	10.4	96	1000
12:11:00	304	NW	3.6	10.5	95	1000
12:12:00	304	NW	5.7	10.5	94	1000
12:13:00	306	NW	5.3	10.4	94	1000
12:14:00	306	NW	4.9	10.4	94	1000
12:15:00	298	WNW	4.7	10.5	94	1000
12:16:00	298	WNW	5.7	10.2	93	1000
12:17:00	296	WNW	4.9	10.3	93	1000
12:18:00	297	WNW	4.8	10.3	93	1000
12:19:00	307	NW	3.3	10.9	92	1000
12:20:00	308	NW	4.4	10.7	91	1000
12:21:00	294	WNW	4.9	10.7	90	1000
12:22:00	291	WNW	5.3	10.3	91	1000
12:23:00	296	WNW	4.6	10.2	93	1000
12:24:00	297	WNW	3.6	10.3	93	1000
12:25:00	303	WNW	4	10.2	95	1000
12:26:00	303	WNW	5	10	94	1000
12:27:00	293	WNW	3.7	10.2	94	1000
12:28:00	294	WNW	5.4	10.4	94	1000
12:29:00	318	NW	3.6	10.5	94	1000
12:30:00	317	NW	3.9	11	93	1000
12:31:00	299	WNW	4.2	10.5	92	1000
12:32:00	299	WNW	4.2	10.7	92	1000
12:33:00	306	NW	5.9	10.5	92	1000
12:34:00	306	NW	4.4	10.9	89	1000
12:35:00	302	WNW	3	11.1	90	1000
12:36:00	302	WNW	4.5	11.1	89	1000
12:37:00	308	NW	4.7	10.7	90	1000
12:38:00	309	NW	4	11.2	89	1000
12:39:00	301	WNW	4	11	90	1000
12:40:00	301	WNW	5.2	10.9	88	1000
12:41:00	302	WNW	5.1	10.6	89	1000
12:42:00	301	WNW	5	10.6	89	1000
12:43:00	308	NW	4.2	10.7	88	1000
12:44:00	308	NW	3.8	10.7	89	1000
12:45:00	307	NW	3.7	10.6	90	1000
12:46:00	307	NW	4.7	10.8	90	1000
12:47:00	312	NW	3.9	11.1	89	1000
12:48:00	311	NW	5.5	10.9	87	1000
12:49:00	301	WNW	4.2	11.1	86	1000
12:50:00	303	WNW	3	11.6	86	1000

14:13:00	302	WNW	5.3	10.9	83	1000
14:14:00	302	WNW	2.9	11.5	84	1000
14:15:00	295	WNW	3.5	11.9	84	1000
14:16:00	296	WNW	5.5	11	87	1000
14:17:00	299	WNW	5.1	11	89	1000
14:18:00	298	WNW	5.7	11.1	88	1000
14:19:00	291	WNW	4.5	11	89	1000
14:20:00	293	WNW	4.6	11.5	88	1000
14:21:00	287	WNW	4.9	11.8	87	1000
14:22:00	284	WNW	4.2	12	86	1000
14:23:00	299	WNW	6.1	11.6	87	1000
14:24:00	300	WNW	3.8	11.5	86	1000
14:25:00	300	WNW	5.3	11.6	85	1000
14:26:00	301	WNW	4.2	11.6	80	1000
14:27:00	302	WNW	4.9	11.7	80	1000
14:28:00	303	WNW	4.2	11.7	81	1000
14:29:00	293	WNW	3.3	11.5	80	1000
14:30:00	293	WNW	7.1	11.5	80	1000
14:31:00	295	WNW	5.8	11.6	80	1000
14:32:00	295	WNW	2.8	12.5	77	1000
14:33:00	300	WNW	4.9	11.8	79	1000
14:34:00	300	WNW	4.5	12.4	77	1000
14:35:00	299	WNW	5.2	11.7	79	1000
14:36:00	299	WNW	4.2	11.6	78	1000
14:37:00	297	WNW	3.8	11.9	77	1000
14:38:00	298	WNW	5.6	11.6	77	1000
14:39:00	294	WNW	4.7	11.9	75	1000
14:40:00	292	WNW	3.3	11.6	77	1000
14:41:00	297	WNW	6.9	11.4	77	1000
14:42:00	296	WNW	8.7	11.3	77	1000
14:43:00	302	WNW	4.9	11.4	77	1000
14:44:00	304	NW	4.7	11.3	78	1000
14:45:00	298	WNW	5.9	11.2	78	1000
14:46:00	298	WNW	4.6	11.3	78	1000
14:47:00	293	WNW	3.5	12	79	1000
14:48:00	292	WNW	5.1	12.1	78	1000
14:49:00	311	NW	7.3	11.7	79	1000
14:50:00	311	NW	4.1	11.6	78	1000
14:51:00	291	WNW	4.9	11.6	79	1000
14:52:00	291	WNW	7.8	10.9	82	1000
14:53:00	292	WNW	5	11.4	81	1000
14:54:00	292	WNW	4	12	80	1000
14:55:00	285	WNW	3.8	12.9	77	1000
14:56:00	287	WNW	4.2	12.9	77	1000
14:57:00	291	WNW	5.4	12.4	78	1000
14:58:00	291	WNW	3.1	13.9	75	1000
14:59:00	312	NW	3.9	13	75	1000
15:00:00	312	NW	4.8	13.4	74	1000