

Llantrisant Recycling Centre Limited

**Pantybrad Lane
Castellau Fach
Llantrisant
CF72 8LP**

Background Bioaerosol Data to Support Site Specific Bioaerosol Risk Assessment

February 2017



Cardiff
Metropolitan
University

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Summary

In February 2017, Llantrisant Recycling Centre Limited commissioned the Centre for Health Safety and Environment (CHSE) at Cardiff Metropolitan University to prepare a Site Specific Bioaerosol Risk Assessment (SSBRA) to accompany their application for an Environmental Permit (EPR/AB3092FR). This report has been prepared to provide background bioaerosol data to accompany the SSBRA and application.

On-site monitoring and laboratory analysis was carried out in accordance with the Association for Organics Recycling (AfOR) protocol, '*A standard protocol for the monitoring of bioaerosols at open composting facilities*' (2009). The intention of the protocol is to provide guidance for monitoring bioaerosols at open composting facilities and requires that levels of total mesophilic bacteria and the fungi *Aspergillus fumigatus* be monitored.

In the absence of specific Natural Resources Wales (NRW) guidance on bioaerosols the analysis and report has been prepared with reference to Environment Agency appropriate levels and guidance. References to policy and guidance from the Environment Agency within the text therefore also refer to NRW.

Monitoring was undertaken on Tuesday 08th February 2017. The results from one round of bioaerosol monitoring provide a snap-shot of background bioaerosol levels on the day of monitoring.

Section 7.0, page 28, details the results obtained. At present, there are no statutory levels that exist in order to put the results in to a regulatory context only the guidance values set by the Environment Agency for total bacteria and *Aspergillus fumigatus*. The main tasks undertaken at the facility during the monitoring were construction of the concrete composting pad biomass boiler building and other associated buildings. However, hand sorting of green waste was undertaken at the site during the morning. Wood waste was also delivered throughout the monitoring period.

Concentrations of all micro-organisms measured, mesophilic bacteria, gram negative bacteria and the fungi *Aspergillus fumigatus*, at all locations were low and below the acceptable levels set by the Environment Agency of 1000 cfu/m³, 300 cfu/m³ and 500 cfu/m³ respectively. Concentrations of *Aspergillus fumigatus* on the south west boundary, south east boundary and upwind of the CA site, suggest that the current waste transfer activities make a contribution to background bioaerosol concentrations. Concentrations of mesophilic bacteria show a slight contribution from the existing activities. The background monitoring did not find a significant contribution to the background bioaerosol concentrations from the CA site. A full set of results and analysis can be found in sections 7.0 Results and 8.0 – Conclusions.

1.0 Introduction

In February 2017, Llantrisant Recycling Centre Limited commissioned the Centre for Health Safety and Environment (CHSE) at Cardiff Metropolitan University to prepare a Site Specific Bioaerosol Risk Assessment (SSBRA) to accompany their application for an Environmental Permit (EPR/AB3092FR). This report has been prepared to provide background bioaerosol data to accompany the SSBRA and application. This report presents bioaerosol data from a bioaerosol monitoring exercise carried out on Wednesday 08th February 2017.

In the absence of specific Natural Resources Wales (NRW) guidance on bioaerosols the analysis and report has been prepared with reference to Environment Agency appropriate levels and guidance. References to policy and guidance from the Environment Agency within the text therefore also refer to NRW.

2.0 Potential Health Effects

Bioaerosols are defined as a collection of aerosolised biological particles including actinomycetes, bacteria, fungi protozoa and their components (Millner et al 1994, Millner, 1995, Gilbert and Ward, 1998; Van der Werf, 1996, Epstein, 1994; Fischer et al 1999, Cox and Wathes, 1995). These organisms are fundamental to the composting process. The concern regarding bioaerosols from composting activities arises because of their potential to cause adverse health effects in employees and the public living in close proximity to such facilities. These adverse effects can potentially occur in susceptible individuals from exposure to the micro-organisms associated with the composting process and can elicit an adverse response by infection, allergy or an adverse response to toxins (Environment Agency, 2005). According to Swan *et al.* (2003) the effects of exposure to organic dust on respiratory health may lead to or exacerbate a number of distinct identifiable conditions including Aspergillosis in immuno-compromised individuals (Millner *et al*, 1994, Millner 1995), Allergic Rhinitis and Asthma (Zuskin *et al*, 1994), Extrinsic allergic alveolitis (Farmers Lung) (Flannigan *et al* 1991) where prolonged (usually occupational) exposure occurs, Chronic Obstructive Pulmonary Disease (COPD) (Lacey and Crook,

1988, Matheson, 2005); Toxic Pneumonitis (Lacey and Crook, 1988) and upper airway irritation/mucous membrane irritation (Dutkiewicz, 1997).

Risk to the public

Whilst many measurements of airborne concentrations of organisms have been made within and in the vicinity of composting plants, which give ample evidence for a hazard especially to composting workers, there have been very few studies of health effects from which any quantitative indication of risk can be derived for members of the public (IOM, 2008). Concern has been raised by residents in the vicinity of composting sites that composting activities could increase levels of bioaerosols, such as airborne *Aspergillus fumigatus* spores. Most reports show numbers to have declined to 'background' within 200 m from a compost bioaerosol source, although some report levels above background at a greater distance. Background or typical ambient bioaerosol levels may differ by orders of magnitude depending on location, weather and season, which hinder interpretation. Few published studies exist where the health of residents near composting sites has been investigated, but where such work has been done there is little evidence of ill health compared to controls (Millner, 1995). The responses to bioaerosols are host and dose dependent; that is some individuals may respond to a dose that does not affect others (Millner et al., 1994, Millner 1995). However based on the current knowledge, the risk is impossible to quantify due to the lack of accepted dose-response relationships for bioaerosol exposure (Wheeler et al, 2001; IOM, 2008; Drew et al, 2009; EA, 2009). Bioaerosols are endemic in the environment from decomposing leaves in gardens and woods, wheat fields etc. and the body has many natural defences against them. However individual susceptibilities vary considerably and even natural levels of bioaerosols can be harmful to certain individuals. The Environment Agency (EA), has established conservative '*acceptable levels*' for micro-organisms in air as shown in Table 1 (EA, 2010). The EA concede that other activities may lead to higher background bioaerosol levels than would normally be expected (EA, 2007).

Table 1:

Environment Agency Reference for Bioaerosol (EA, 2010)	
Reference Pollutant	CFU m ⁻³
Total Bacteria	1000
<i>Aspergillus fumigatus</i>	500
Gram negative Bacteria	300

3.0 Monitoring Protocol

The monitoring was undertaken in accordance with the AfOR guidance, “*A Standardised Protocol for the Monitoring of Bioaerosols at Open Composting Facilities*” (2009).

On Thursday 09th February 2017 confirmation was received from the Environment Agency and Organics Recycling Group (formerly AfOR) that the revised Technical Guidance Note M9: Environmental monitoring of bioaerosols at regulated facilities (EA, 2017) had been published. This new protocol for the measurement of bioaerosols uses a fan-like arrangement of samplers downwind of the facility being monitored. Where Anderson type, impaction, samplers are used, the new protocol proposes the use of single samplers placed in three locations downwind. The aim of the monitoring undertaken in the 08th February 2017 was to gather background concentrations at the facility. There is currently no composting activity undertaken at the site, only the sorting of green waste for further treatment at other locations. During the current monitoring, dual samplers were used at each location. Several locations around the facility were sampled during the monitoring exercise. While not fully following the protocol issued after the date of monitoring, the monitoring undertaken does provide useable background data for the facility.

Bioaerosols were sampled at a position 1.5m above ground level using a single stage Anderson sampler during normal site operations. Monitoring was conducted in parallel at each of the monitoring locations. Additional passive samples, i.e. no air drawn through the sampler, were taken at the locations downwind of the working area.

4.0 Sample Collection

There are currently no composting operations, at the Pantybrad Lane site. However, green waste is received and sorted for further treatment at other locations.

The purpose of the bioaerosol sampling undertaken on 8th February was to:

- provide background concentrations of bioaerosols at the site, and
- investigate the contribution of the current adjacent civic amenity site to background bioaerosol concentrations.

In order to measure the background bioaerosol concentrations, and provide useful data for future monitoring at the facility, it was proposed that upwind and downwind measurements should be taken, concurrently. It was proposed that the downwind monitoring location should be at the same distance from the proposed working area as the closest receptor.

Table 2 details the distances and bearing of the closest receptors to the working area.

Table 2: – Sensitive Receptors within 250m of the facility

Receptor	From working area		Description
	Distance	Bearing	
Llantrisant Community Recycling Centre	27m	SW	Workplace
Public footpath	50m	S - E	Public Right of Way. Linear feature.
Former Universal Engineering factory	60m	SE	Workplace
Glanmychudd-fach	87m	SW	Residential
Country Timber (Timber Yard)	100m	S	Workplace
Pantybrad Lane	140m	S - NNW	Minor Highway. Linear feature.
Public footpath	140m	SW - NW	Public Right of Way. Linear feature.
Royal Mint	160m	SW	Workplace
GeesinkNorba Ltd	160m	S	Workplace
The Potting Shed	205m	ESE	Retail/Catering (Workplace/Public)
Tom Pritchard Contractors Ltd	230m +	E	Workplace

NB: Distances refer to the distance from the proposed composting area to the closest point of the receptor property or in the case of footpaths and minor roads, the closest point along its length.

On the day of monitoring, normal waste operations and construction work took place at the site. Monitoring locations were selected that did not interfere with the work on site. The selection of monitoring location was further complicated on the day by the presence of geographical features (inclines, stream), trees, structures and parked vehicles. The monitoring locations used on the day were selected to represent background concentrations at four point surrounding the proposed composting area and two locations to determine the contribution of the activities to background concentrations.

Concentrations of total mesophilic bacteria and the fungus *Aspergillus fumigatus* were measured at each location, in accordance with EA protocols for bioaerosol measurement at green waste composting facilities. Concentrations of mesophilic bacteria and *Aspergillus fumigatus* can be found in Section 7.0 Results and Appendix 1. In addition, concentrations of gram negative bacteria were also measured at each location. Concentrations of gram negative bacteria can be found in Appendix 5.

4.1. Selection of Monitoring Locations

On arrival at the site on the day of monitoring the weather station was erected on top of an earth bund to the north of the working area, away from buildings and trees that may affect meteorological data. From gathered data, a working plan was proposed and monitoring locations selected. The meteorological data was consulted between each monitoring location and monitoring locations positioned accordingly.

On the day of monitoring, the prevailing wind was predominantly from a northerly direction.

Monitoring was carried out at six locations:

- North west boundary mid-point
- North east boundary mid-point
- South east boundary mid-point (Edge of the composting area)
- South west boundary
- Upwind of the CA site

- Downwind of the CA site.

Monitoring locations are marked on the site location plan, Appendix 2.

North west boundary mid-point.

A location was chosen approximately mid-way along the north west boundary of the facility. Along the north west boundary, the surface level of the site is below the level of the surrounding land. The samplers were placed between the boundary fence and the retaining wall of the proposed stone and soil storage bays.

At the time of sampling on the north west boundary, the wind blew from a general north easterly direction.

Photograph 1: Midpoint north west – looking away from site.



Photograph 2: Mid-point north west – looking towards site.



North east boundary mid-point.

The working area is bordered by an earth bund, approximately 4m high, along the north east boundary. The samplers were located on top of the earth bund, at approximately the mid-point.

During sampling at this location, the prevailing wind was from a north easterly direction, meaning that the sampling location was upwind of the proposed working area.

Photograph 3: Mid-point north east boundary – looking away from site.



Photograph 4: Mid-point north east boundary – looking towards site.



South east boundary mid-point.

The south east boundary of the proposed working area is formed by a steep embankment down to the Nant Muchudd stream. The samplers were located on the edge of the concrete pad laid to house the composting activities at its mid-point.

At the time of sampling, the wind was generally blowing from a north easterly direction.

Photograph 5 – South east boundary mid-point – looking away from site.



Photograph 6 - South east boundary mid-point – looking towards site.



South west boundary.

A small drainage channel runs along the width of the south west boundary of the Llantrisant Recycling site, separating it from the neighbouring CA site. The nappy store building is also located close to the south west boundary. As a result, a suitable monitoring location was required that was not screened by the nappy store building and was accessible. A location was selected close to the perimeter fence of the CA site. This placed the monitoring location adjacent to the closest receptor, CA site.

A monitoring location on top of the shallow earth bund currently running from the nappy store building to the south east corner of the site was used as the upwind monitoring location when sampling upwind and downwind of the CA site.

Photograph 7: South west boundary – looking away from site.



Photograph 8: South west boundary – looking towards site.



Upwind of Community Recycling site.

The wind direction on the day of monitoring was from the north/north east. This meant that the Llantrisant Recycling site was upwind of the CA site. In order to comply with the AfOR protocol, an upwind location should be between 25m and 50m upwind of a facility. This is in order to minimise the possibility that there are other sources of bioaerosol between the monitoring location and the site boundary that would contribute to the bioaerosol concentration measured at the downwind location but it is also to ensure that emissions from the site are not recorded at the upwind location. The selection of an upwind location for the CA site was hampered by the proximity of the Llantrisant Recycling site. A location 25m from the CA site boundary would have placed the monitoring location within an active working area and meant that there were potentially other sources of bioaerosol (wood waste and nappy waste) between the monitoring location and the boundary of the CA site. The choice of location was further complicated by the presence of the nappy store building, which could act to shadow the sampling location. As a result, a location was selected on top of the temporary earth bund on top of the embankment between the CA site and Llantrisant Recycling, approximately 7m from the nappy store building, i.e. greater than $1 \frac{1}{2}$ times the height of the building. This was approximately 10m from the CA boundary fence at its closest point, approximately 15m from the closest waste container in the CA site, but was approximately 6m (sampling height 7.5m) above the level of the CA site.

Photograph 9: Upwind of Community Recycling site – looking away from CA site.



Photograph 10: Upwind of Community Recycling site – looking towards CA site.



Downwind of Community Recycling site.

In order to assess the potential contribution of the CA site to the bioaerosol concentrations, it was proposed to locate the monitoring location downwind of the CA site at a similar distance as between the CA site and the Llantrisant Recycling site, i.e. 10m.

On the day of monitoring, the prevailing wind was blowing from a north/north east direction. This would have placed the downwind location for the CA site, 10m from the site boundary, on Pantybrad Lane. This would have meant that the monitoring location was behind a row of trees and low hedge. The monitoring protocols require that where an obstacle intervenes between the boundary of a site and the monitoring location, the monitoring location should be moved in front, i.e. upwind, of the obstacle. As a result, a location was selected on the site side of the hedge/trees, adjacent to the settling pond. This location was upwind of the trees by a distance of approximately 1 ½ times the height of the trees.

Photograph 11: Downwind of Community Recycling site – looking away from CA site.



Photograph 12: Downwind of Community Recycling site – looking towards CA site.



4.2. Site Activity

- Waste wood was delivered to the site in high sided open skip vehicles.
- Bags of green waste were broken open and the contents sorted by hand during the morning.
- One delivery of nappy waste was made during the monitoring period.

In addition to waste transfer activities, construction of the proposed biomass building and biomass storage area were undertaken during the monitoring period.

5.0 Meteorological Data

Meteorological data was logged with a Davis Instruments wireless Vantage Pro2 with associated 'Weatherlink' software throughout the monitoring period. The full meteorological data has been omitted from the report due to the large volume that is generated. However, supplementary meteorological data that provides a general overview is listed in Appendix 4.

The weather during monitoring was cloudy with a north/north easterly light breeze. The mean wind speed was 1.0 m/s (mean of data recorded through time on site 08.10 to 15.10). The ambient temperature rose gradually during the monitoring period from 3.0°C at 9am to 6.8°C at 13.55pm.

Calculation of average wind speed and average wind direction during sampling periods, have been calculated as vector components in accordance with AfOR protocol (2009), Appendix, Page 30.

Weather conditions for the 24 hours prior to the monitoring exercise were:
Broken cloud. Northerly breeze. No precipitation during the day.

6.0 Analysis

Analysis was carried out for total mesophilic bacteria, the fungi *Aspergillus fumigatus*, and gram negative bacteria using standard 'Cardiff Met Laboratory Protocol' and in line with BS EN ISO 7218:2007 + A1:2013 – “Microbiology of food and animal feeding stuffs. General requirements and guidance for microbiological examinations.”

This method is taken from the protocol, “A Standardised Protocol for the Monitoring of Bioaerosols at Open Composting Facilities” (AFOR, 2009).

6.1 Selective Media

All laboratory media preparation and sterilisation was carried out in accordance with the standard procedures as set out in the Cardiff School of Health Sciences Laboratory Manual (volume 2, section 5) in line with BS EN ISO 7218:2007 + A1:2013 – “Microbiology of food and animal feeding stuffs. General requirements and guidance for microbiological examinations.” and ISO 11133-1:2009 (ISO, 2009).

Half-strength nutrient agar medium is used to culture mesophilic bacteria; malt extract medium was used to culture *Aspergillus fumigatus* and MacConkey No.3 agar was used to culture Gram Negative bacteria.

The mesophilic bacterial count derives from the AfOR protocol (2009) and HPA standard methodology. The count for *Aspergillus fumigatus* follows the AfOR protocol (2009). The total gram negative count method is not covered by the AfOR protocol, but is based on reference by Drew et al (2009).

6.2 Sampling

The sampling at the composting site followed the procedures laid out in the guidance, “A Standardised Protocol for the Monitoring of Bioaerosols at Open Composting Facilities” (AFOR, 2009).

Petri dishes were stored in a cooled container (at approximately 4°C) following sampling, until all remaining samples had been collected. All dishes were then

inverted and placed in the appropriate microbiological incubator at the same time. Samples were placed in the incubator on arrival at the laboratory at 4.15pm on Tuesday 08th February 2017. The nutrient agar medium, selecting for mesophilic bacteria and the MacConkey No. 3 agar medium, culturing for total Gram Negative bacteria were incubated at 37°C. Colonies growing on these media were enumerated after two and three days respectively. The malt extract medium, culturing for *Aspergillus fumigatus*, were incubated at 42°C and enumerated after 2 days.

6.3 Enumeration

Mesophilic Bacteria:

The number of colonies on each nutrient agar medium plate was counted after incubation of the sample for two days at 37°C.

If 399 or more colonies are counted on any single plate, this is recorded as “Too Numerous To Count” (TNTC).

Gram Negative Bacteria:

The number of colonies of Gram Negative bacteria growing on each MacConkey No. 3 agar plate after incubation of the sample for three days at 37°C were counted and recorded.

If 399 or more colonies are counted on any single plate, this is recorded as “Too Numerous To Count” (TNTC).

Aspergillus fumigatus:

The number of colonies of *A. fumigatus* growing on each malt extract agar medium plate after incubation of the sample for two days at 40°C were counted and recorded. Identification is based upon gross colony colour and morphology plus spore bearing structures according to standard texts.

Identification was confirmed by low magnification bright field light microscopy where necessary.

If enumeration of *Aspergillus fumigatus* is not possible because of the large number of colonies, this is recorded as “Too Numerous To Count” (TNTC). Where spreading colonies of other fungi obscure less than half of a Petri dish,

then colonies of *A. fumigatus* were enumerated on the un-obscured half, as long as this appears to be representative of the entire sample. This is recorded and the number of colonies adjusted as if the whole dish were enumerated.

Only colonies that fall at the impaction sites of the sampler were counted and recorded. Satellite colonies growing adjacent to larger colonies at the impaction site and colonies growing around the perimeter of the medium are ignored.

If spreading colonies obscured more than half of one Petri dish, this was recorded as “No results, spreaders”. If 399 or more colonies are counted on any single plate, this is recorded as “Too Numerous To Count” (TNTC).

Where spreading colonies obscure less than half of a Petri dish, then colonies were enumerated on the un-obscured half, as long as this appears to be representative of the entire sample. This is recorded and the number of colonies adjusted as if the whole dish were enumerated.

6.4 Data Recording

Laboratory – prior to sampling:

- Date and time of media preparation (media preparation log file)
- Batch numbers of the media components (media preparation log file)
- Laboratory personnel (media preparation log file)
- Trace of the sterilisation temperature profiles (refer to Cardiff Met Laboratory Manual volume 2, section 5.6 “Media Autoclaving” and section 9.22 “Osprey Multicycle Autoclave”)
- Storage conditions of the prepared media (media preparation log file)

Laboratory - post sampling:

For each Petri dish the following was recorded,

- Unique sample number
- Sampling date
- Date and time Petri dishes were placed in incubators
- Date and time Petri dishes were removed from incubators
- Number of colonies on the plate

- Corrected number of colonies (using the Positive Hole Correction Table supplied by the Andersen sampler manufacturer)

7.0 Results

The data interpretation has been conducted and presented in accordance with the AFOR guidance, “*A Standardised Protocol for the Monitoring of Bioaerosols at Open Composting Facilities*” (2009).

In the tabulated results below;

- *‘NW’ refers to the sample location on the north west boundary of the site.*
- *‘NE’ refers to the sample location on the north east boundary of the site.*
- *‘SE’ refers to the sample location on the south east boundary of the site.*
- *‘SW’ refers to the sample location on the south west boundary of the site.*
- *‘UW’ refers to the sample location upwind of the adjacent CA site.*
- *‘DW’ refers to the sample location downwind of the CA site.*
- *‘½Str Nutrient’ refers to the ½ strength nutrient agar media*
- *‘MacConkey’ refers to the MacConkey No. 3 agar media*
- *‘Malt extract’ refers to the Malt extract media*
- *‘AF’ refers to Aspergillus fumigatus*
- *‘MB’ refers to Mesophilic Bacteria*
- *‘GN’ refers to Gram Negative Bacteria*
- *‘Passive’ refers to a sample left in the sampler but with no vacuum applied*
- *‘Control’ refers to a sample not exposed to the atmosphere before analysis*
- *TNTC is indicated when enumeration is not possible because of the large numbers of colonies. This is greater than 399 colonies or greater than 2427 cfu m⁻³*
- *‘No Count – Spreaders’ is indicated when spreading fungal growth, other than A. fumigatus, has obscured greater than 50% of the plate.*
- *cfu m⁻³ refers to Colony forming units per cubic meter of air*
- *‘Corrected Number of colonies’ refers to the number of colonies per plate adjusted using the Positive Hole Correction Table*

The results presented below are for each organism for the monitoring exercise undertaken on 08th February 2017. A graphical overview of the results can be found in Appendix 1, page 37.

Mesophilic Bacteria Counts – 08th February 2017

Sample Reference Number	Media	Incubation Period		Identification	Date Completed	Presumptive count (colonies per plate)	Sample Duration	Flow Rate	Corrected Number of colonies*	Colony forming units per cubic meter of air (cfu m-3)
		IN	OUT							
NW MB 1	½Str Nutrient	08/02/2017	10/02/2017	n/a	10/02/2017	7	20	0.0283	7	12
NW MB 2	½Str Nutrient	08/02/2017	10/02/2017	n/a	10/02/2017	4	20	0.0283	4	7
NE MB1	½Str Nutrient	08/02/2017	10/02/2017	n/a	10/02/2017	7	20	0.0283	7	12
NE MB2	½Str Nutrient	08/02/2017	10/02/2017	n/a	10/02/2017	2	20	0.0283	2	4
SE MB 1	½Str Nutrient	08/02/2017	10/02/2017	n/a	10/02/2017	12	20	0.0283	12	21
SE MB 2	½Str Nutrient	08/02/2017	10/02/2017	n/a	10/02/2017	8	20	0.0283	8	14
SW MB 1	½Str Nutrient	08/02/2017	10/02/2017	n/a	10/02/2017	22	20	0.0283	23	41
SW MB 2	½Str Nutrient	08/02/2017	10/02/2017	n/a	10/02/2017	20	20	0.0283	21	37
UW MB1	½Str Nutrient	08/02/2017	10/02/2017	n/a	10/02/2017	27	20	0.0283	28	49
UW MB2	½Str Nutrient	08/02/2017	10/02/2017	n/a	10/02/2017	18	20	0.0283	18	32
DW MB 1	½Str Nutrient	08/02/2017	10/02/2017	n/a	10/02/2017	26	20	0.0283	27	48
DW MB 2	½Str Nutrient	08/02/2017	10/02/2017	n/a	10/02/2017	20	20	0.0283	21	37

Sample Reference Number	Media	Incubation Period		Identification	Date Completed	Presumptive count (colonies per plate)	Sample Duration	Flow Rate	Corrected Number of colonies*	Colony forming units per cubic meter of air (cfu m-3)
		IN	OUT							
SE MB Passive	½Str Nutrient	08/02/2017	10/02/2017	n/a	10/02/2017	0	20	0	0	n/a
DW MB	½Str Nutrient	08/02/2017	10/02/2017	n/a	10/02/2017	0	20	0	0	n/a
SW MB Passive	½Str Nutrient	08/02/2017	10/02/2017	n/a	10/02/2017	0	20	0	0	n/a
Control 1	½Str Nutrient	08/02/2017	10/02/2017	n/a	10/02/2017	0	n/a	n/a	n/a	n/a
Control 2	½Str Nutrient	08/02/2017	10/02/2017	n/a	10/02/2017	0	n/a	n/a	n/a	n/a

Aspergillus fumigatus Counts – 08th February 2017

Sample Reference Number	Media	Incubation Period		Identification	Date Completed	Presumptive count (colonies per plate)	Sample Duration	Flow Rate	Corrected Number of colonies*	Colony forming units per cubic meter of air (cfu m-3)
		IN	OUT							
NW AF 1	Malt Extract	08/02/2017	10/02/2017	1 +ve <i>A. fumigatus</i>	10/02/2017	1	20	0.0283	1	2
NW AF 2	Malt Extract	08/02/2017	10/02/2017	n/a	10/02/2017	0	20	0.0283	0	0
NE AF1	Malt Extract	08/02/2017	10/02/2017	1 +ve <i>A. fumigatus</i>	10/02/2017	1	20	0.0283	1	2
NE AF2	Malt Extract	08/02/2017	10/02/2017	n/a	10/02/2017	0	20	0.0283	0	0
SE AF 1	Malt Extract	08/02/2017	10/02/2017	21 +ve <i>A. fumigatus</i>	10/02/2017	21	20	0.0283	22	39
SE AF 2	Malt Extract	08/02/2017	10/02/2017	18 +ve <i>A. fumigatus</i>	10/02/2017	18	20	0.0283	18	32
SW AF 1	Malt Extract	08/02/2017	10/02/2017	37 +ve <i>A. fumigatus</i>	10/02/2017	37	20	0.0283	39	69
SW AF 2	Malt Extract	08/02/2017	10/02/2017	52 +ve <i>A. fumigatus</i>	10/02/2017	52	20	0.0283	56	99
UW AF1	Malt Extract	08/02/2017	10/02/2017	39 +ve <i>A. fumigatus</i>	10/02/2017	39	20	0.0283	41	72
UW AF2	Malt Extract	08/02/2017	10/02/2017	39 +ve <i>A. fumigatus</i>	10/02/2017	39	20	0.0283	41	72
DW AF 1	Malt Extract	08/02/2017	10/02/2017	13 +ve <i>A. fumigatus</i>	10/02/2017	13	20	0.0283	13	23
DW AF2	Malt Extract	08/02/2017	10/02/2017	7 +ve <i>A. fumigatus</i>	10/02/2017	7	20	0.0283	7	12

Sample Reference Number	Media	Incubation Period		Identification	Date Completed	Presumptive count (colonies per plate)	Sample Duration	Flow Rate	Corrected Number of colonies*	Colony forming units per cubic meter of air (cfu m-3)
		IN	OUT							
SE AF Passive	Malt Extract	08/02/2017	10/02/2017	n/a	10/02/2017	0	20	0	n/a	n/a
DW AF Passive	Malt Extract	08/02/2017	10/02/2017	n/a	10/02/2017	0	20	0	n/a	n/a
SW AF Passive	Malt Extract	08/02/2017	10/02/2017	n/a	10/02/2017	0	20	0	n/a	n/a
Control 1	Malt Extract	08/02/2017	10/02/2017	n/a	10/02/2017	0	n/a	n/a	n/a	n/a
Control 2	Malt Extract	08/02/2017	10/02/2017	n/a	10/02/2017	0	n/a	n/a	n/a	n/a

The results from the round of bioaerosol monitoring carried out at the Pantybrad Lane site on 08th February 2017 provide a snap-shot of background bioaerosol levels on the day of monitoring. All concentrations of bioaerosols measured on 08th February 2017 were well below guidance levels suggested by the Environment Agency of 1000 cfu/m³ for mesophilic bacteria, 500 cfu/m³ for *Aspergillus fumigatus* and 300 cfu/m³ for gram negative bacteria.

During the monitoring, waste transfer activities were undertaken at Llantrisant Recycling. This included, deliveries of wood waste throughout the monitoring period, a delivery of nappy waste and the delivery of green waste and hand sorting of green waste at various times during the monitoring period.

The selection of suitable sampling locations on the day of monitoring was problematic, due to topographical features and bunds. The best available locations on the day of monitoring were used.

Concentrations of mesophilic bacteria were very low at all locations. The highest mean concentrations were observed at the south west boundary (mean 39 cfu/m³), the upwind sample at the CA site (mean 41 cfu/m³) and the downwind sample at the CA site (mean 43 cfu/m³). These account for less than 5% of the appropriate concentrations proposed by the Environment Agency.

Concentrations of the fungi *Aspergillus fumigatus* were low at all locations. The highest mean concentrations were observed downwind of the CA site (mean 36 cfu/m³), upwind of the CA site (mean 72 cfu/m³) and on south west boundary (mean 84 cfu/m³). These account for 8%, 15 % and 17% of the appropriate concentrations proposed by the Environment Agency, respectively.

The wind direction during sampling was relatively stable, predominantly blowing from a north or north easterly direction during the monitoring period. As a result, the sampling locations on the south west boundary and the upwind sample for the CA site were downwind of the existing Llantrisant Recycling site and the proposed composting area.

Samples on the north east and south west boundaries were carried out concurrently. The prevailing wind at the time of these samples mean that they represent upwind (NE) and downwind (SW) samples for the existing site and the proposed composting area. The south west boundary sample was located close to the boundary of the CA site, and therefore is representative of concentrations at the sensitive receptor (CA site) under the current operating conditions.

The south west boundary and upwind of CA site locations are taken from a similar location, being 10m apart. During monitoring, these locations were downwind of the current waste transfer activities taking place at Llantrisant Recycling. The concentrations of mesophilic bacteria and *Aspergillus fumigatus* recorded at these locations, when compared to the concentrations recorded on the north east boundary, indicate that the current operations contribute to the ambient bioaerosol concentrations. As the north east and south west sample were taken concurrently, the difference in concentrations can be regarded as the contribution from the existing activities (mesophilic bacteria: 31 cfu/m³, *Aspergillus fumigatus*: 83 cfu/m³).

Concentrations of *Aspergillus fumigatus* dropped between the monitoring locations upwind (mean 72 cfu/m³) and downwind (mean 36 cfu/m³) of the CA site. A similar reduction was seen for mesophilic bacteria (mean 41 cfu/m³ to mean 18 cfu/m³). This suggests that on the day of monitoring, the CA site did not make a significant contribution to the ambient bioaerosol concentrations in the area.

8.0 Conclusions

In conclusion, the CHSE / Cardiff Met have completed ambient air monitoring of bioaerosols in accordance with Association for Organics Recycling approved methodology. Selective media has been used to enumerate mesophilic bacteria, the fungus *Aspergillus fumigatus* and gram negative bacteria.

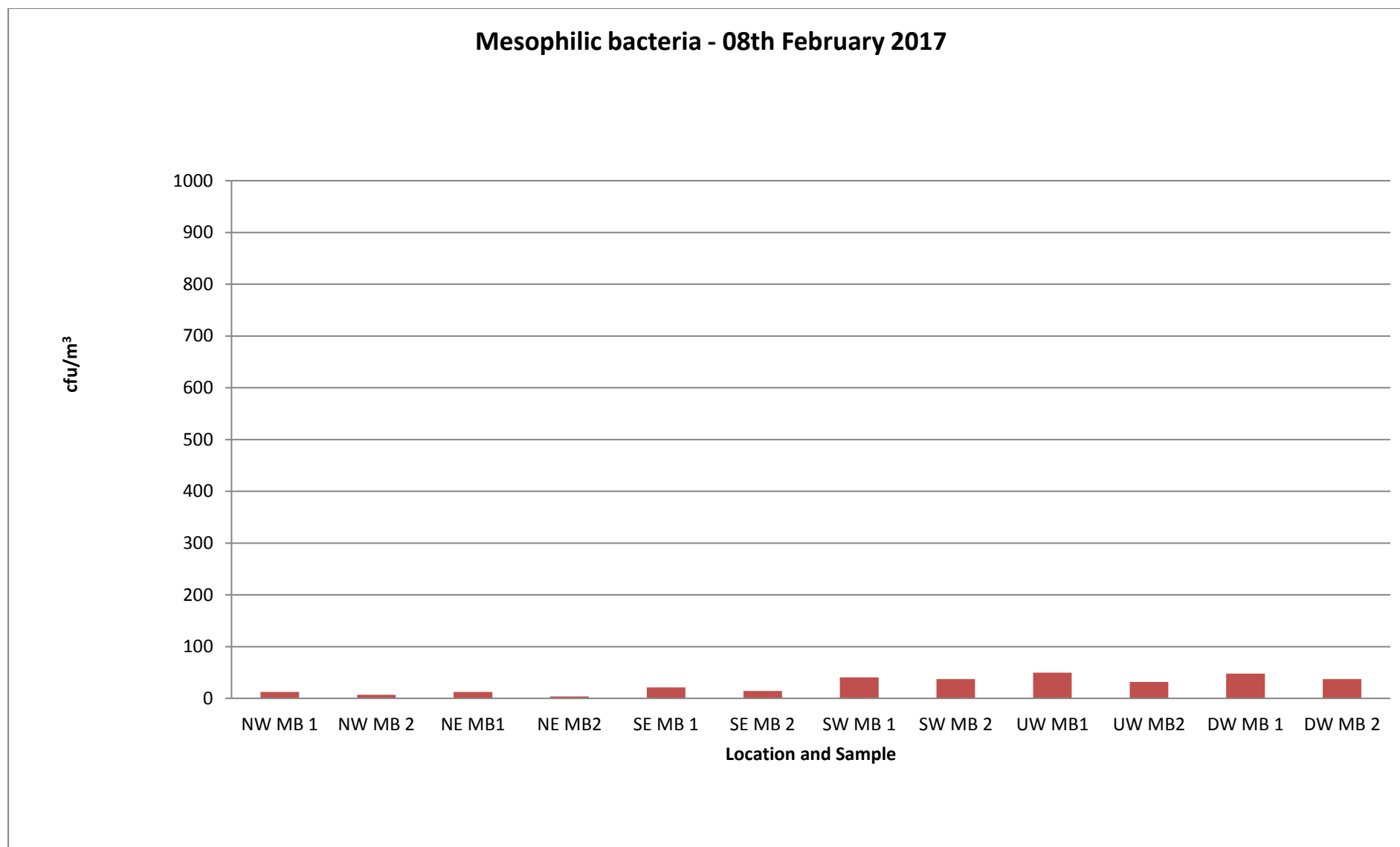
During the monitoring, waste transfer activities were undertaken at Llantrisant Recycling. This included, deliveries of wood waste throughout the monitoring period, nappy waste deliveries, delivery of green waste and hand sorting of green waste at various times during the monitoring period.

During the monitoring exercises on 08th February 2017, levels of mesophilic bacteria, gram negative bacteria and the fungi *Aspergillus fumigatus* were all below the appropriate levels set by the Environment Agency of 1000 cfu/m³, 300 cfu/m³ and 500 cfu/m³ respectively, at all locations monitored.

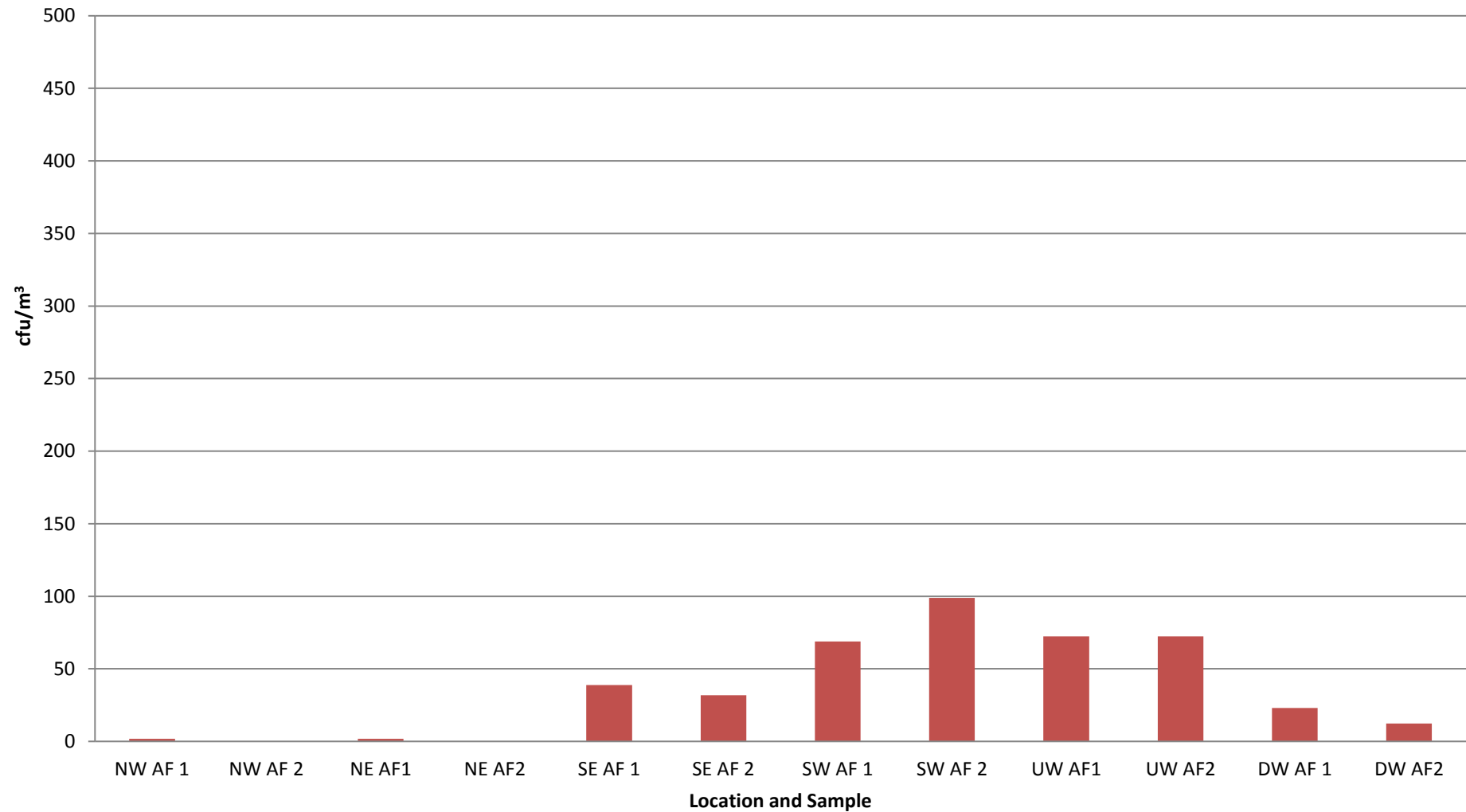
Concentrations of all micro-organisms measured, mesophilic bacteria, gram negative bacteria and the fungi *Aspergillus fumigatus*, at all locations were low and below the acceptable levels set by the Environment Agency of 1000 cfu/m³, 300 cfu/m³ and 500 cfu/m³ respectively. Concentrations of *Aspergillus fumigatus* on the south west boundary, south east boundary and upwind of the CA site, suggest that the current waste transfer activities make a contribution to background *Aspergillus fumigatus* concentrations. Concentrations of mesophilic bacteria show a slight contribution from the existing activities. The background monitoring did not find a significant contribution to the background bioaerosol concentrations from the CA site.

Appendices

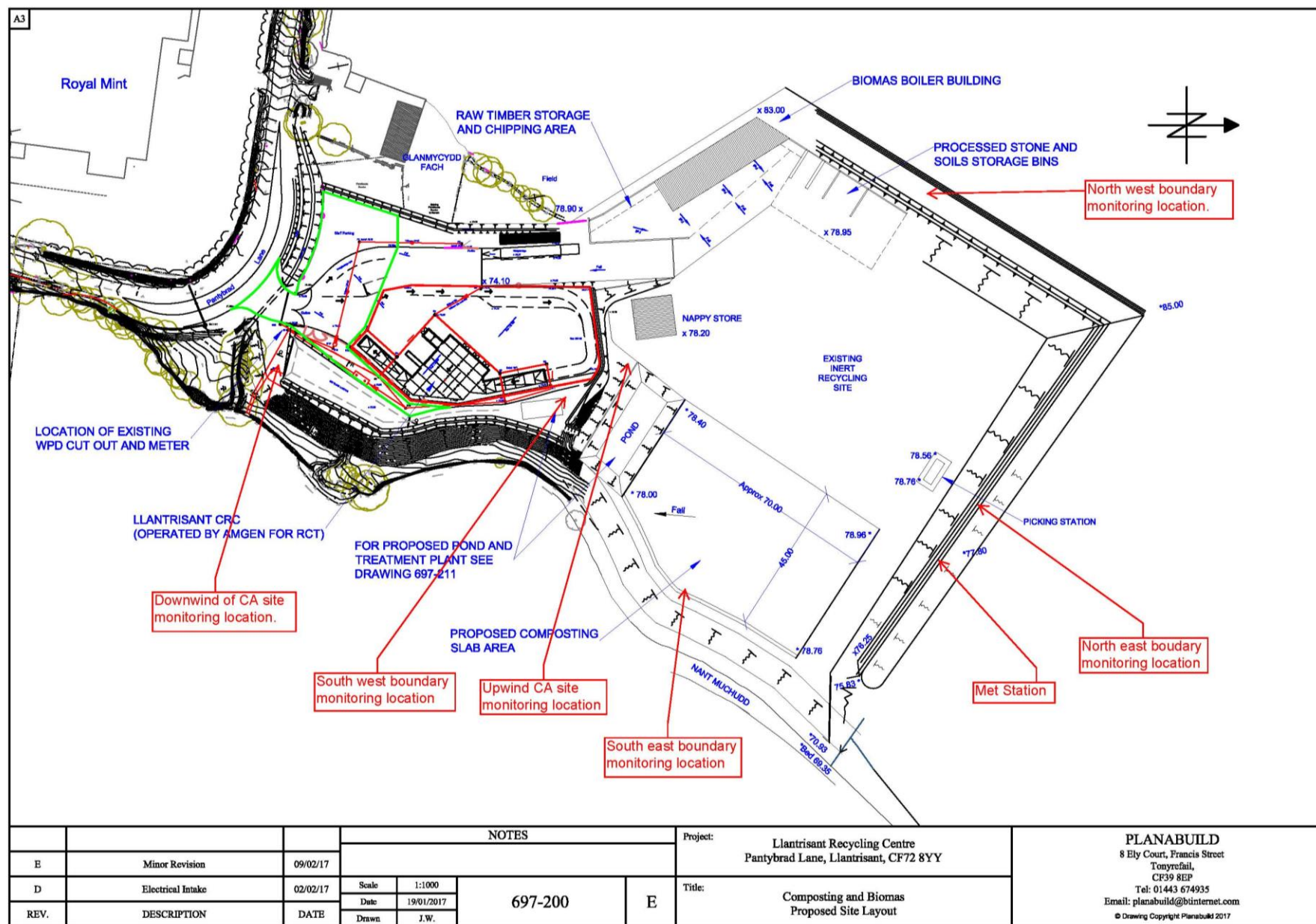
Appendix 1 – Variation in monitored levels of specific micro-organisms
08th February 2017.



Aspergillus fumigatus - 08th February 2017



Appendix 2 Monitoring Location Plan – 08th February 2017



Appendix 3 – Location Specific Site Data

North West boundary location – 08th February 2017

North west boundary Site: Llantrisant Recycling Centre, Pantybrad Lane Sampling Date: 08/02/2017 Estimated Mass of Material: Background assessment.												Site Operator: Llantrisant Recycling Ltd Commissioning Laboratory: Cardiff Met, Western Avenue, Llandaff, Cardiff Type of Material Processed on site: Wood, green, glass, nappy waste.	
Location:	Sampling Reference Number:	Difference from boundary of operational area or tuning / screening operation (m)	Difference in bearing location of samplers from boundary / source and mean direction wind blows to (o)	Sampling time: (hh:mm)	Sampling duration (min)	Microbial type	Site activity	Material processed	Calculated concentration of airborne micro-organisms (cfu m-3)	Arithmetic mean of parallel samples (cfu m-3)	Comments relating to any activities occurring during the sampling period that might affect the concentration of airborne micro-organisms		
Upwind	AF SR 1	80.0	72	11.26	20	AF	Hand sorting green waste, wood deliveries and 1 nappy delivery.	Wood, green, glass, nappy waste.	2	1			
Upwind	AF SR 2	80.0	72	11.26	20	AF			0				
Upwind	MB SR 1	80.0	102	11.50	20	MB			12	10			
Upwind	MB SR 2	80.0	102	11.50	20	MB			7				
Upwind	GN SR 1	80.0	105	12.14	20	GN			0	0			
Upwind	GN SR 2	80.0	105	12.14	20	GN			0				

North east boundary location – 08th February 2017

North east boundary

Site: Llantrisant Recycling Centre, Pantybrad Lane

Sampling Date: 08/02/2017

Estimated Mass of Material: Background assessment.

Site Operator: Llantrisant Recycling Ltd

Commissioning Laboratory: Cardiff Met, Western Avenue, Llandaff, Cardiff

Type of Material Processed on site: Wood, green, glass, nappy waste.

Location:	Sampling Reference Number:	Difference from boundary of operational area or tuning / screening operation (m)	Difference in bearing location of samplers from boundary / source and mean direction wind blows to (o)	Sampling time: (hh:mm)	Sampling duration (min)	Microbial type	Site activity	Material processed	Calculated concentration of airborne micro-organisms (cfu m-3)	Arithmetic mean of parallel samples (cfu m-3)	Comments relating to any activities occurring during the sampling period that might affect the concentration of airborne micro-organisms
Upwind	AF SR 1	20.0	200	13.40	20	AF	Hand sorting green waste, wood deliveries.	Wood, green, glass, nappy waste.	2	1	
Upwind	AF SR 2	20.0	200	13.40	20	AF			0		
Upwind	MB SR 1	20.0	196	14.02	20	MB			12	8	
Upwind	MB SR 2	20.0	196	14.02	20	MB			4		
Upwind	GN SR 1	20.0	201	14.22	20	GN			0	0	
Upwind	GN SR 2	20.0	201	14.22	20	GN			0		

South east boundary location – 08th February 2017

South east boundary

Site: Llantrisant Recycling Centre, Pantybrad Lane

Sampling Date: 08/02/2017

Estimated Mass of Material: Background assessment.

Site Operator: Llantrisant Recycling Ltd

Commissioning Laboratory: Cardiff Met, Western Avenue, Llandaff, Cardiff

Type of Material Processed on site: Wood, green, glass, nappy waste.

Location:	Sampling Reference Number:	Difference from boundary of operational area or turning / screening operation (m)	Difference in bearing location of samplers from boundary / source and mean direction wind blows to (o)	Sampling time: (hh:mm)	Sampling duration (min)	Microbial type	Site activity	Material processed	Calculated concentration of airborne micro-organisms (cfu m-3)	Arithmetic mean of parallel samples (cfu m-3)	Comments relating to any activities occurring during the sampling period that might affect the concentration of airborne micro-organisms
Downwind	AF DW 1	0.0	n/a	11.35	20	AF	Hand sorting green waste, wood deliveries and 1 nappy delivery.	Wood, green, glass, nappy waste.	39	36	
Downwind	AF DW 2	0.0	n/a	11.35	20	AF			32		
Downwind	MB DW 1	0.0	n/a	11.59	20	MB			21	18	
Downwind	MB DW 2	0.0	n/a	11.59	20	MB			14		
Downwind	GN DW 1	0.0	n/a	12.22	20	GN			0	0	
Downwind	GN DW 2	0.0	n/a	12.22	20	GN			0		
Downwind	AF DW Passive	0.0	n/a	11.35	20	AF			0*	n/a	*Presumptive count per plate
Downwind	MB DW Passive	0.0	n/a	11.59	20	MB			0*	n/a	
Downwind	GN DW Passive	0.0	n/a	12.22	20	GN			0*	n/a	

South west boundary location – 08th February 2017

South west boundary

Site: Llantrisant Recycling Centre, Pantybrad Lane

Sampling Date: 08/02/2017

Estimated Mass of Material: Background assessment.

Site Operator: Llantrisant Recycling Ltd

Commissioning Laboratory: Cardiff Met, Western Avenue, Llandaff, Cardiff

Type of Material Processed on site: Wood, green, glass, nappy waste.

Location:	Sampling Reference Number:	Difference from boundary of operational area or turning / screening operation (m)	Difference in bearing location of samplers from boundary / source and mean direction wind blows to (o)	Sampling time: (hh:mm)	Sampling duration (min)	Microbial type	Site activity	Material processed	Calculated concentration of airborne micro-organisms (cfu m-3)	Arithmetic mean of parallel samples (cfu m-3)	Comments relating to any activities occurring during the sampling period that might affect the concentration of airborne micro-organisms
Downwind	AF DW 1	50.0	22	13.50	20	AF	Hand sorting green waste, wood deliveries.	Wood, green, glass, nappy waste.	69	84	
Downwind	AF DW 2	50.0	22	13.50	20	AF			99		
Downwind	MB DW 1	50.0	26	14.12	20	MB			41	39	
Downwind	MB DW 2	50.0	26	14.12	20	MB			37		
Downwind	GN DW 1	50.0	15	14.35	20	GN			4	7	
Downwind	GN DW 2	50.0	15	14.35	20	GN			9		
Downwind	AF DW Passive	50.0	22	13.50	20	AF			0*	n/a	*Presumptive count per plate
Downwind	MB DW Passive	50.0	26	14.12	20	MB			0*	n/a	
Downwind	GN DW Passive	50.0	15	14.35	20	GN			0*	n/a	

Upwind CA site – 08th February 2017

Upwind (CA Site)							Site Operator: Llantrisant Recycling Centre Ltd				
Site: Llantrisant Recycling Centre, Pantybrad Lane							Commissioning Laboratory: Cardiff Met, Western Avenue, Llandaff, Cardiff				
Sampling Date: 08/02/2017							Type of Material Processed on site: Various household/garden waste/recycling.				
Estimated Mass of Material: unknown											
Location:	Sampling Reference Number:	Difference from boundary of operational area or tuning / screening operation (m)	Difference in bearing location of samplers from boundary / source and mean direction wind blows to (o)	Sampling time: (hh:mm)	Sampling duration (min)	Microbial type	Site activity	Material processed	Calculated concentration of airborne micro-organisms (cfu m-3)	Arithmetic mean of parallel samples (cfu m-3)	Comments relating to any activities occurring during the sampling period that might affect the concentration of airborne micro-organisms
Upwind	AF UW 1	10.0	No wind	9.30	20	AF	Civic Amenity site - waste recycling drop off.	Household and garden waste.	72	72	
Upwind	AF UW 2	10.0	No wind	9.30	20	AF			72		
Upwind	MB UW 1	10.0	166	9.52	20	MB			49	41	
Upwind	MB UW 2	10.0	166	9.52	20	MB			32		
Upwind	GN UW 1	10.0	123	10.14	20	GN			0	1	
Upwind	GN UW 2	10.0	123	10.14	20	GN			2		

Downwind CA Site – 08th February 2017

Downwind (CA Site) Site: Llantrisant Recycling Centre, Pantybrad Lane Sampling Date: 08/02/2017 Estimated Mass of Material: unknown Site Operator: Llantrisant Recycling Centre Ltd Commissioning Laboratory: Cardiff Met, Western Avenue, Llandaff, Cardiff Type of Material Processed on site: Various household/garden waste/recycling.											
Location:	Sampling Reference Number:	Difference from boundary of operational area or turning / screening operation (m)	Difference in bearing location of samplers from boundary / source and mean direction wind blows to (o)	Sampling time: (hh:mm)	Sampling duration (min)	Microbial type	Site activity	Material processed	Calculated concentration of airborne micro-organisms (cfu m-3)	Arithmetic mean of parallel samples (cfu m-3)	Comments relating to any activities occurring during the sampling period that might affect the concentration of airborne micro-organisms
Downwind	AF DW 1	12.0	No wind	11.26	20	AF	Civic Amenity site - waste recycling drop off.	Household and garden waste.	21	18	
Downwind	AF DW 2	12.0	No wind	11.26	20	AF			14		
Downwind	MB DW 1	12.0	0	11.50	20	MB			39	36	
Downwind	MB DW 2	12.0	0	11.50	20	MB			32		
Downwind	GN DW 1	12.0	44	12.14	20	GN			0	0	
Downwind	GN DW 2	12.0	44	12.14	20	GN			0		
Downwind	AF DW Passive	12.0	No wind	11.26	20	AF	Civic Amenity site - waste recycling drop off.	Household and garden waste.	0*	n/a	*Presumptive count per plate
Downwind	MB DW Passive	12.0	0	11.50	20	MB			0*	n/a	
Downwind	GN DW Passive	12.0	44	12.14	20	GN			0*	n/a	

Appendix 4 – Location Specific Meteorological Data – 08th February 2017

Site: Llantrisant Recycling Centre, Pantybrad Lane. Sampling Date: 08/02/2017 Estimated Mass of Material: Background assessment.					Site Operator: Llantrisant Recycling Ltd Commissioning Laboratory: Cardiff Met, Western Avenue, Llandaff, Cardiff Type of Material Processed on site: Background monitoring.				
Location:	Sampling Reference Number:	Bearing of samplers from boundary of operational area or turning / screening operation (o from true north)	Mean direction the wind blows from during the sampling period (each individual sample) (o from true north)	Mean direction the wind blows to during the sampling period (each individual sample) (o from true north)	Difference in bearing between location of samplers from boundary / source and mean direction wind blows to (o)	Mean wind speed during sampling (m s ⁻¹)	Arithmetic mean of air temperature (°C)	Arithmetic mean of relative humidity (%)	Prevailing weather conditions (cloud cover in eighths)
NE Boundary	AF NE 1	6	26	206	200	2.0	6.8	61	8/8
NE Boundary	AF NE 2	6	26	206	200	2.0	6.8	61	8/8
NE Boundary	MB NE 1	6	22	202	196	1.7	6.7	61	8/8
NE Boundary	MB NE 2	6	22	202	196	1.7	6.7	61	8/8
NE Boundary	GN NE 1	6	27	207	201	1.7	6.7	61	8/8
NE Boundary	GN NE 2	6	27	207	201	1.7	6.7	61	8/8
SW Boundary	AF SP 1	226	24	204	22	2.0	6.7	60	8/8
SW Boundary	AF SP 2	226	24	204	22	2.0	6.7	60	8/8
SW Boundary	AF SP Passive	226	24	204	22	2.0	6.7	60	8/8
SW Boundary	MB SP 1	226	20	200	26	1.7	6.7	61	8/8
SW Boundary	MB SP 2	226	20	200	26	1.7	6.7	61	8/8
SW Boundary	MB SP Passive	226	20	200	26	1.7	6.7	61	8/8
SW Boundary	GN SP 1	226	31	211	15	1.5	6.7	61	8/8
SW Boundary	GN SP 2	226	31	211	15	1.5	6.7	61	8/8
SW Boundary	GN SP Passive	226	31	211	15	1.5	6.7	61	8/8

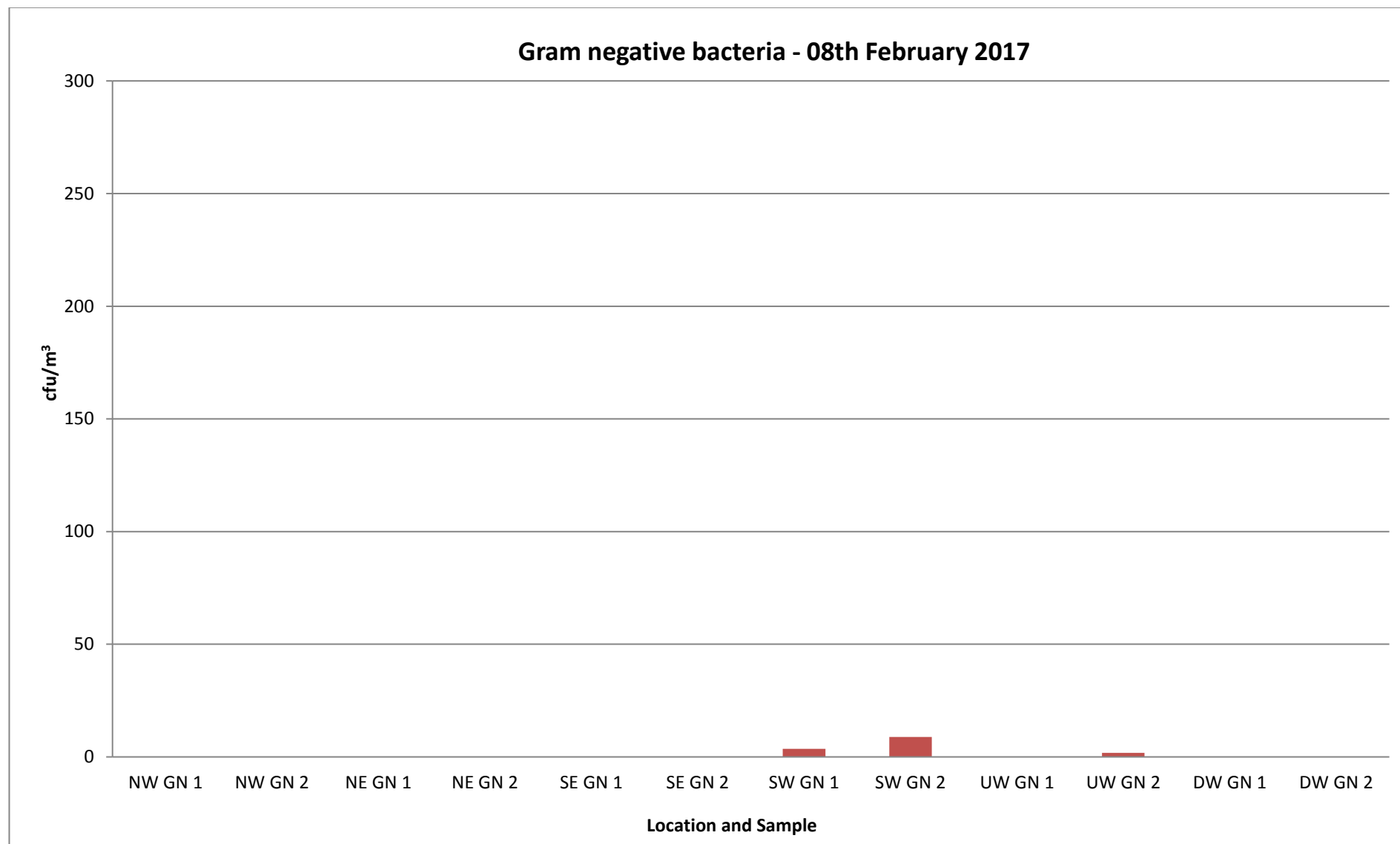
Site: Llantrisant Recycling Centre, Pantybrad Lane.					Site Operator: Llantrisant Recycling Centre Ltd				
Sampling Date: 08/02/2017					Commissioning Laboratory: Cardiff Met, Western Avenue, Llandaff, Cardiff				
Estimated Mass of Material: Background assessment.					Type of Material Processed on site: Background monitoring.				
Location:	Sampling Reference Number:	Bearing of samplers from boundary of operational area or turning / screening operation (o from true north)	Mean direction the wind blows from during the sampling period (each individual sample) (o from true north)	Mean direction the wind blows to during the sampling period (each individual sample) (o from true north)	Difference in bearing between location of samplers from boundary / source and mean direction wind blows to (o)	Mean wind speed during sampling (m s-1)	Arithmetic mean of air temperature (°C)	Arithmetic mean of relative humidity (%)	Prevailing weather conditions (cloud cover in eighths)
NW Boundary	AF NW 1	300	48	228	72	1.0	6.2	71	7/8
NW Boundary	AF NW 2	300	48	228	72	1.0	6.2	71	7/8
NW Boundary	MB NW 1	300	18	198	102	2.0	6.5	68	7/8
NW Boundary	MB NW 2	300	18	198	102	2.0	6.5	68	7/8
NW Boundary	GN NW 1	300	15	195	105	1.8	6.6	66	7/8
NW Boundary	GN NW 2	300	15	195	105	1.8	6.6	66	7/8
SE Boundary	AF SE 1	n/a	32	212	n/a	1.5	6.3	71	7/8
SE Boundary	AF SE 2	n/a	32	212	n/a	1.5	6.3	71	7/8
SE Boundary	AF SE Passive	n/a	32	212	n/a	1.5	6.3	71	7/8
SE Boundary	MB SE 1	n/a	16	196	n/a	1.8	6.5	67	6/8
SE Boundary	MB SE 2	n/a	16	196	n/a	1.8	6.5	67	6/8
SE Boundary	MB SE Passive	n/a	16	196	n/a	1.8	6.5	67	6/8
SE Boundary	GN SE 1	n/a	25	205	n/a	1.8	6.7	66	7/8
SE Boundary	GN SE 2	n/a	25	205	n/a	1.8	6.7	66	7/8
SE Boundary	GN SE Passive	n/a	25	205	n/a	1.8	6.7	66	7/8

Site: Llantrisant Recycling Centre, Pantybrad Lane.					Site Operator: Llantrisant Recycling Centre Ltd				
Sampling Date: 08/02/2017					Commissioning Laboratory: Cardiff Met, Western Avenue, Llandaff, Cardiff				
Estimated Mass of Material: Background assessment.					Type of Material Processed on site: Background monitoring.				
Location:	Sampling Reference Number:	Bearing of samplers from boundary of operational area or turning / screening operation (o from true north)	Mean direction the wind blows from during the sampling period (each individual sample) (o from true north)	Mean direction the wind blows to during the sampling period (each individual sample) (o from true north)	Difference in bearing between location of samplers from boundary / source and mean direction wind blows to (o)	Mean wind speed during sampling (m s ⁻¹)	Arithmetic mean of air temperature (°C)	Arithmetic mean of relative humidity (%)	Prevailing weather conditions (cloud cover in eighths)
UW CA Site	AF UW 1	14	No wind	No wind	No wind	0.0	3.0	86	6/8
UW CA Site	AF UW 2	14	No wind	No wind	No wind	0.0	3.0	86	6/8
UW CA Site	MB UW 1	14	0	180	166	0.1	3.5	86	5/8
UW CA Site	MB UW 2	14	0	180	166	0.1	3.5	86	5/8
UW CA Site	GN UW 1	14	317	137	123	0.5	4.4	83	6/8
UW CA Site	GN UW 2	14	317	137	123	0.5	4.4	83	6/8
DW CA Site	AF DW 1	180	No wind	No wind	No wind	0.0	3.0	86	6/8
DW CA Site	AF DW 2	180	No wind	No wind	No wind	0.0	3.0	86	6/8
DW CA Site	AF DW Passive	180	No wind	No wind	No wind	0.0	3.0	86	6/8
DW CA Site	MB DW 1	180	0	180	0	0.1	3.8	86	6/8
DW CA Site	MB DW 2	180	0	180	0	0.1	3.8	86	6/8
DW CA Site	MB DW Passive	180	0	180	0	0.1	3.8	86	6/8
DW CA Site	GN DW 1	180	316	136	44	0.7	4.7	82	6/8
DW CA Site	GN DW 2	180	316	136	44	0.7	4.7	82	6/8
DW CA Site	GN DW Passive	180	316	136	44	0.7	4.7	82	6/8

Appendix 5 Gram negative bacteria.

Sample Reference Number	Media	Incubation Period		Identification	Date Completed	Presumptive count (colonies per plate)	Sample Duration	Flow Rate	Corrected Number of colonies*	Colony forming units per cubic meter of air (cfu m-3)
		IN	OUT							
NW GN 1	MacConkey	08/02/2017	11/02/2017	n/a	11/02/2017	0	20	0.0283	0	0
NW GN 2	MacConkey	08/02/2017	11/02/2017	n/a	11/02/2017	0	20	0.0283	0	0
NE GN 1	MacConkey	08/02/2017	11/02/2017	n/a	11/02/2017	0	20	0.0283	0	0
NE GN 2	MacConkey	08/02/2017	11/02/2017	n/a	11/02/2017	0	20	0.0283	0	0
SE GN 1	MacConkey	08/02/2017	11/02/2017	n/a	11/02/2017	0	20	0.0283	0	0
SE GN 2	MacConkey	08/02/2017	11/02/2017	n/a	11/02/2017	0	20	0.0283	0	0
SW GN 1	MacConkey	08/02/2017	11/02/2017	2 G-ve	11/02/2017	2	20	0.0283	2	4
SW GN 2	MacConkey	08/02/2017	11/02/2017	5 G-ve	11/02/2017	5	20	0.0283	5	9
UW GN 1	MacConkey	08/02/2017	11/02/2017	n/a	11/02/2017	0	20	0.0283	0	0
UW GN 2	MacConkey	08/02/2017	11/02/2017	1 G-ve	11/02/2017	1	20	0.0283	1	2
DW GN 1	MacConkey	08/02/2017	11/02/2017	n/a	11/02/2017	0	20	0.0283	0	0
DW GN 2	MacConkey	08/02/2017	11/02/2017	n/a	11/02/2017	0	20	0.0283	0	0

Sample Reference Number	Media	Incubation Period		Identification	Date Completed	Presumptive count (colonies per plate)	Sample Duration	Flow Rate	Corrected Number of colonies*	Colony forming units per cubic meter of air (cfu m-3)
		IN	OUT							
SE GN Passive	MacConkey	08/02/2017	11/02/2017	n/a	11/02/2017	0	20	0	0	n/a
DW GN Passive	MacConkey	08/02/2017	11/02/2017	n/a	11/02/2017	0	20	0	0	n/a
SW GN Passive	MacConkey	08/02/2017	11/02/2017	n/a	11/02/2017	0	20	0	0	n/a
Control 1	MacConkey	08/02/2017	11/02/2017	n/a	11/02/2017	0	n/a	n/a	n/a	n/a
Control 2	MacConkey	08/02/2017	11/02/2017	n/a	11/02/2017	0	n/a	n/a	n/a	n/a



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