

Caulmert Limited

Engineering, Environmental & Planning
Consultancy Services

Bryn Posteg Landfill Site

Potters Waste Management

Bioaerosol Monitoring Plan

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Document Reference: 3033-CAU-XX-XX-RP-V-0304.A0-C2

November 2017

APPROVAL RECORD

Site: Bryn Posteg Landfill Site, MRF & Composting Facility

Client: Potters Waste Management

Project Title: Bryn Posteg Environmental Management 2017

Document Title: Bioaerosol Monitoring Plan

Document Ref: 3033-CAU-XX-XX-RP-V-0304

Report Status: Final

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1.0 INTRODUCTION

1.0 Background

1.0.1 Sundorne Products (Llanidloes) operates Bryn Posteg waste management facility under Environmental Permit (EP) BU7766. The site is managed by Potters Waste Management. The facility comprises a landfill site, a Material Recycling Facility (MRF) (WML 47120) and a green waste composting facility (EPR CB3834RQ).

1.1.1 This Bioaerosols Monitoring Plan specifies the monitoring, analysis and reporting techniques, in accordance with the Environment Agency Technical Guidance Note M9 for the monitoring of emissions from the composting activities associated with Permit BU7766.

1.1 Site Location and Surrounding Land Use

1.1.1 Bryn Posteg Landfill Site is located approximately 3 km south east of Llanidloes in Powys and is centred at National Grid Reference SN 971 822. The site is accessed via the B4518, Llanidloes to Tylwch road. The B4518 runs parallel with the western site boundary.

1.1.2 Figure 1 below shows the location of the Site in relation to Llanidloes.

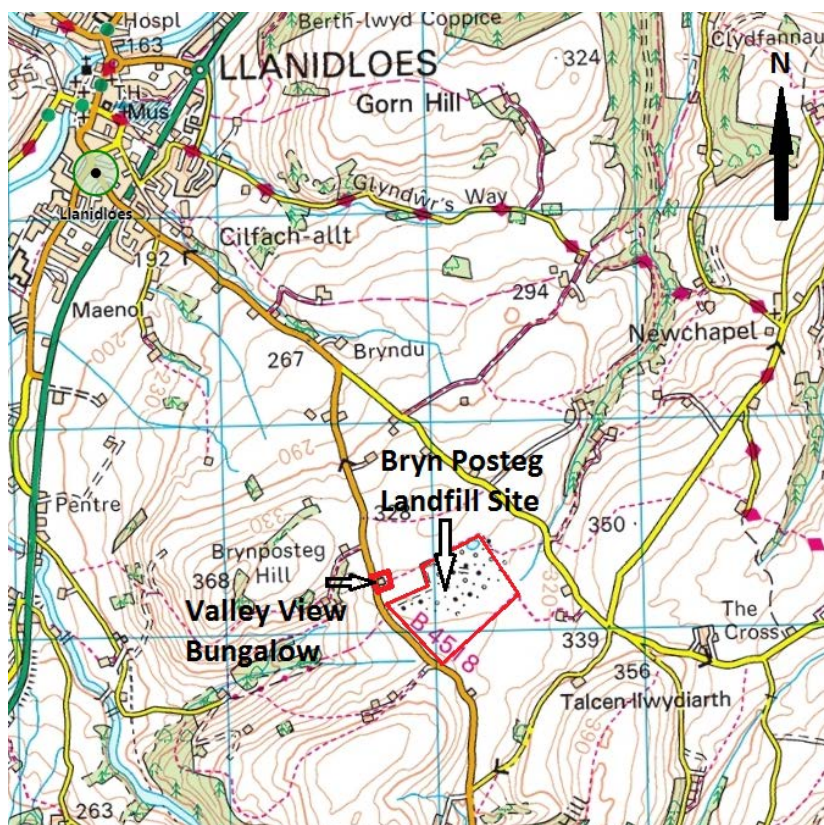


Figure 1: Site Location Plan

1.1.3 Bryn Posteg Landfill Site is situated in a rural area, with no close dense population and few residential properties. The site is surrounded by grassland, which is managed for silage

production and grazing. The sensitive receptors will be described in the context of the EA Guidance Note M9 in Section 2 below.

1.2 Site Operations

- 1.2.1 The Site Plan shows the Site layout and general plant arrangements.
- 1.2.2 Vehicles enter the site from the B5418 (Tylwch Road) and proceed immediately to the weighbridge before moving on to the reception and offloading area. Municipal solid waste (MSW) is offloaded by the delivery vehicles to temporary stockpiles then transferred to the Municipals Recycling Facility (MRF) for screening and sorting.
- 1.2.3 Waste material is shredded and passed under a magnet (under the MRFs WML47120), the material then passes for treatment for disposal under the Landfill Permit. The first stage of this is the screening trommel at the MRF this sorts the material by size. Biodegradable fines are transferred to a stockpile prior to compost treatment, which is the main stage of the mechanical-biological treatment process (MBT). This compost waste forms part of the waste stream for the Bryn Posteg Landfill Permit. The oversize material from the trammel passes directly for landfill disposal.
- 1.2.4 The residual, unrecyclable and non-biodegradable waste remaining after separation at the MRF is stockpiled for transfer to the active landfill cell. Recyclable materials are stockpiled for transport off site.
- 1.2.5 The MBT fines stockpile is prepared for open windrow composting by initial turning to create a suitable feedstock for composting. Windrows are then formed in the Compost Maturation Pad. Compost treatment is typically complete after 2 weeks, following which the end product compost is loaded to delivery vehicles for landfilling on Site.

2.0 COMPOSTING AND BIOAEROSOLS

2.0 Bioaerosols Description

- 2.0.1 The EA Guidance Note M9 has been incorporated in this section to provide a summarised description of bio-aerosol composition, sources and health impacts.
- 2.0.2 Bioaerosols occur naturally in the environment and consist of airborne particles that contain living organisms, such as bacteria, fungi and viruses. These particles can also contain parts of living organisms such as plant pollen, spores and endotoxins. The components of a bioaerosol range in size from 0.02 µm to 100 µm in diameter. The size, density and shape of a bioaerosol will affect its behaviour, survivability and ultimately its dispersion in the atmosphere.

2.1 Sources of Bioaerosols

- 2.1.1 Composting relies on bacteria, including spore-forming filamentous actinomycetes and fungi to produce a sanitised, stabilised, organic substrate that can be used on land or in horticulture (feedstock dependant). In composting, as the material breaks down it goes through different temperature dependent stages that are dominated by certain groups of bacteria and fungi.
- 2.1.2 Bacteria are the most numerous group of microorganisms. *Aspergillus fumigatus* is a mesophilic fungus that is thermos-tolerant and is present throughout the different stages of the breakdown process.
- 2.1.3 The dependence on microorganisms to degrade the organic material, and the way in which the material is processed make biological treatment facilities a source of bioaerosols.

2.2 Bioaerosol Issues and Impacts

- 2.2.1 The risks from bioaerosols have been reviewed for a number of years, which has led to reports that exposure to bioaerosols has been associated with human health effects. Adverse health effects have been observed in occupational settings involving exposure of workers to high concentrations of bioaerosols. Bioaerosol exposure has been identified with associations between respiratory and gastrointestinal illness at waste management facilities. Aspergillosis caused by exposure to the spores from *Aspergillus fumigatus* has been reported to give rise to a severe infection of the respiratory system and long term chronic respiratory conditions. In particular, people who have a suppressed immune system are at higher risk of developing infection.

2.3 Sensitive Receptors

- 2.3.1 The Technical Guidance Note M9 defines the nearest sensitive receptor as “*the nearest place to the permitted activities where people are likely to be for prolonged periods. This term would therefore apply to dwellings (including associated gardens) and many types of workplaces. We would not normally regard a place where people are likely to be present for less than 6 hours at one time as being a sensitive receptor. The term does not apply to those controlling the permitted facility. The health of staff and visitors to the facility is covered by Health and Safety*”

at Work Legislation. This term does however apply to dwellings occupied by the family of those controlling the permitted facility”.

- 2.3.2 The nearest sensitive receptor to the MBT composting activities at Bryn Posteg Landfill Site is the residential property; Valley View Bungalow. This property is approximately 210 m to the North West and is shown on Figure 1 in Section 1.

3.0 MONITORING METHODOLOGY

- 3.0.1 The Technical Guidance Note M9 outlines two different techniques for sampling bioaerosols in ambient air. These are summarised below, as presented in the Guidance.

3.0 Impaction Method

- 3.0.1 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. When using this method, the procedures defined in Section 5.6 of the Technical Guidance Note M9 will be followed.

3.1 Filtration

- 3.1.1 The filtration method uses an Institute of Occupational Medicine (IOM) sampling head. The method collects microorganisms by drawing a defined volume of air through a 25 millimetres (mm) porous polycarbonate or quartz filter with a typical pore size of 0.8µm. The collection efficiency of this process depends on the physical properties of the particle and the filter, and the flow rate of the air. When a sufficient volume of air has been sampled, the filter is removed and placed into a buffer for further processing. When using this method, the procedures defined in Section 5.7 of the Technical Guidance Note M9 will be followed.

3.2 Measurements of Bioaerosols and the Number of Samples

- 3.2.1 Bioaerosols analysis is reported in colony forming units (CFUs). A CFU is the unit that results in the growth of one colony on the selective medium used to culture microorganisms before analysis. A CFU may represent a single microbial cell or spore, or cluster of cells or spores that behave as a single aerodynamic particle. The CFU result is divided by the volume of gas sampled to give a final result in colony forming units per cubic metre of air (CFU/m³).

Number of Samples

- 3.2.2 The number of samples depends on the sampling technique used because bioaerosols collected on a filter can be suspended in a solution, which can then be used for generating results in the analytical laboratory for different bioaerosol components. It is not possible to do this with the impaction method because this sample technique relies on sampling directly onto the Petri dish that will be used for the laboratory analysis (a Petri dish is used to culture microorganisms). A Petri dish will provide a single result for either *Aspergillus fumigatus* or mesophilic bacteria, depending on the culture medium used. Table 3.0 below is an excerpt from the M9 Guidance which specifies the amount of samples required for each monitoring method.

Table 3.0: Excerpt from EA Technical Guidance Note M9; Number of samples required for *Aspergillus fumigatus* and mesophilic bacteria with Andersen and IOM Samplers

	Number of filter heads / impactors	Number of on-site samples	Number of plates in laboratory ^{Note 3}
Fan-like shape (4 locations)			
Andersen	4 ^{Note 1 & 2}	24	24
IOM	12	12	72 ^{Note 4}

^{Note 1} This is a minimum number of samples.

^{Note 2} This is based on using 1 impactor at each location. The time spent on site would be reduced if more impactors were used.

^{Note 3} This does not include blanks. Additional plates are used if serial dilution is required for IOM samples.

^{Note 4} The filter from each sample is plated in triplicate.

Sampling duration

- 3.2.3 The sample time depends on the sampling technique and the sampling strategy. Impactors can only be used for a short period of time (between 1 and 20 minutes) because the plates can become overloaded. This is more likely to occur closer to the source of bioaerosols.
- 3.2.4 Overloading does not affect filters, so longer sample times are possible, however, it is possible that the bioaerosols captured on the filters will become stressed and begin to die off. A sample time of 60 minutes is recommended in the Guidance for the filter technique and will be adopted in any monitoring conducted by this method. Shorter sample times may be necessary if sampled closer to the source due to potential build-up of dust on the filter and high concentrations of bioaerosols, making analysis more onerous.

3.3 Sample Location Strategy

- 3.3.1 A number of different sample locations are required to assess the levels of bioaerosols emitted from an open windrow composting facility. It is necessary to locate these at specific distance, which are dependent on the distance from the centre of the active operational area (waste shredding, screening and windrow turning) to the nearest sensitive receptor.
- 3.3.2 The fan shaped sampling arrangement is designed to assess bioaerosol levels at the nearest sensitive receptor to the site. Sampling will be carried out at a minimum of 1 upwind and 3 downwind locations in a fan like arrangement simultaneously. The downwind sampling locations will be selected based on the mean direction of the wind at the time of sampling to ensure measurements are made in the emission plume. The distance of the downwind locations from the centre of the active operational area will be 210 m; the same as the distance of the nearest sensitive receptor from the source. This approach measures the potential bioaerosol exposure at the nearest sensitive receptor, assuming the wind was blowing in the direction of the receptor and the terrain is similar.
- 3.3.3 Figure 2 below shows the sampling point layout for a single point source. A central traverse is determined based on the wind direction and a sampling traverse line is drawn through the central point at an angle of 30° (±3) to the traverse point (the source of bioaerosols).

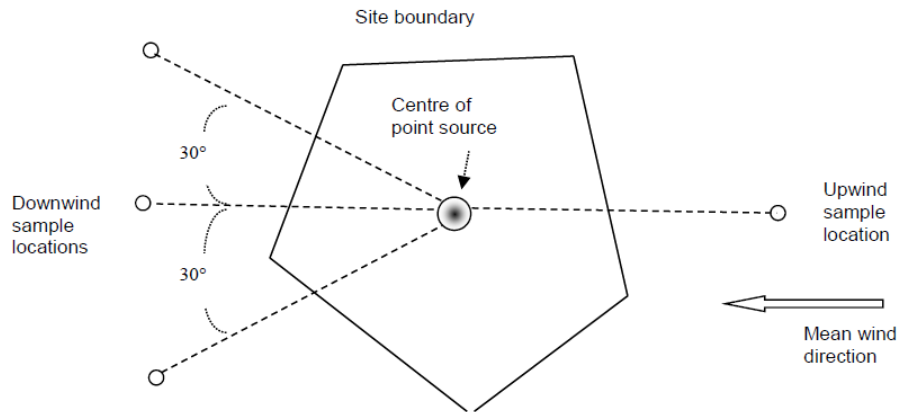


Figure 2: Excerpt from the EA Technical Guidance Note M9; Simplified fan like shape sampling arrangement for point sources

- 3.3.4 When area sources or multiple point sources are present on site, the orientation of the fan like shape sampling arrangement will be selected by determining the centre point of the different sources on the site. The centre points are determined from an estimate of the mass emissions for each source, and then determining the weighted geometric centroids (a calculation is provided in CEN TS 16115-2). If it is not possible to determine the mass emissions of each source, then they will be estimated or it will be assumed that each source contributes equally. The sampling locations will then be determined on each traverse line, in the same way as for a point source emissions. This arrangement is shown in Figure 3.

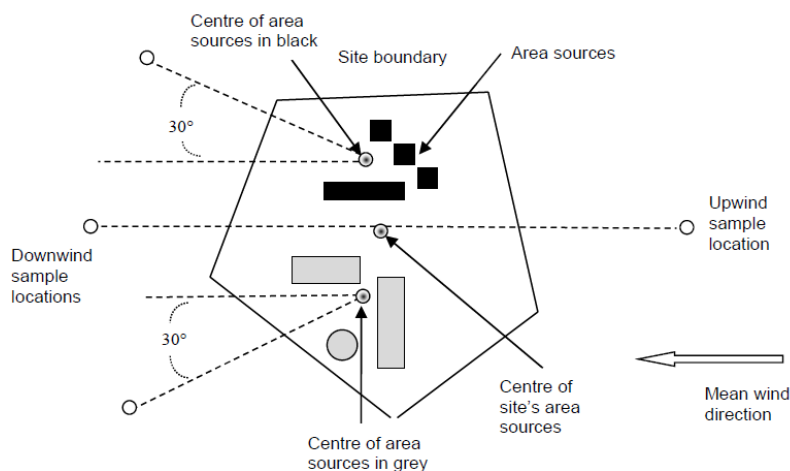


Figure 3: Excerpt from the EA Technical Guidance Note M9; Simplified fan like shape sampling arrangement for area sources

Upwind Location

- 3.3.5 Sampling will be carried out upwind of the site to provide information on the concentrations of specified bioaerosols that are present locally in the air blowing onto the operational area of the site. This could reflect background concentrations, or the effects of neighbouring operations such as agricultural activities.

- 3.3.6 The upwind sample location will be measured at a distance of 50 m from the centre of the active operational area. If a neighbouring operation, structure or installation prevents sampling at this location, then sampling will be carried out at a location which is at a distance as far upwind as is possible between the active operational area and the neighbouring operation, structure or installation. However, if a neighbouring operation has the potential to generate bioaerosols (such as the active landfill cell or Green Waste Compost Facility), then the upwind sample location will be located between the active operational area of the compost facility being assessed and the neighbouring operation, which may mean the sample location is closer to the active operational area than the preferred distance of 50 m.
- 3.3.7 Justification for the placement of the upwind sample location will be provided in the monitoring report.

Downwind Locations

- 3.3.8 Sampling will 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 at the time of sampling. This approach is used to ensure that measurements are made in the emission plume, during the sampling exercise. If there are any buildings, installations or structures between the downwind location(s) and the centre of the active operational area, then sampling will be carried out upwind of that structure or installation, at a distance greater than twice its height.
- 3.3.9 The bioaerosol sampling points may be affected by unique site conditions, such as; difficulties in establishing a definite point source for the facility where other sources of bioaerosols are near by or on site; composting operations split into multiple areas; access limitations due to terrain, private land, vegetation, watercourses, roadways and other off site industrial or agricultural activities. Limited visibility of the Site and the point source will also make locating downwind sample points more difficult, as will variable weather and wind direction due to site location and surrounding topography. The site specific conditions and suggested strategies to improve the accuracy of the monitoring results are outlined below in Section 3.6.
- 3.3.10 Any alterations to the layout defined in the M9 Guidance will be clearly defined in the Monitoring Report. If the fan like layout cannot be achieved, the Operator will inform Natural Resources Wales (NRW) and establish a modified sampling strategy.

3.4 Assessment of Meteorological Conditions

- 3.4.1 An automated weather station located on Site will record the wind speed, wind direction, temperature and relative humidity as required by Section 5.3.1 of TGN M9. Wind speed and direction will be recorded by the automated weather station at an interval of 60 seconds or less, and temperature will be recorded at intervals of at least every 10 minutes as required by TGN M9, Annex 2.
- 3.4.2 The average wind speed and average wind direction will be calculated for the duration of the sampling period for each sample according to the mathematical formulae in Annex 2 of the TGN M9. The difference in bearing of the samplers and the average bearing to which the wind

blows during the sampling period will be calculated and included in the monitoring report in the table format included in Appendix 2 (Annex 5B Meteorological report form for ambient emissions monitoring; Technical Guidance Note M9).

3.5 Laboratory Analysis

- 3.5.1 Samples collected by either method described in Section 3.0 will be kept at $5^{\circ}\text{C} \pm 3^{\circ}\text{C}$ after sampling during storage and transport. Samples will be delivered to the laboratory to allow analysis to begin within 24 hours of sample collection. Field blank samples will be included in the analysis to identify any bioaerosols that have entered the sampling media during handling.
- 3.5.2 Sample preparation, processing and enumeration will be carried out by a UKAS accredited laboratory, in accordance with the methodologies specified in the EA Technical Guidance Note M9, Section 6.

3.6 Site Specific Considerations

Previous Monitoring & Methodology

- 3.6.1 Previous bioaerosol monitoring at the MBT Recycling process at Bryn Posteg has been conducted utilising the impaction method in accordance with the previous industry standard guidance¹. In the interest of continuity, the impaction method will continue to be used for assessment of the bioaerosol emissions from the MBT Compost at Bryn Posteg, in the specification described in this management plan and TGN M9.
- 3.6.2 Sample duration was previously 10 minutes per location, however this has resulted in an overloading of the sample media during the June 2011 and December 2012 sampling rounds. To reduce the chance of this in any further monitoring the sample duration will be reduced to a 5 minute interval utilising the impaction method.
- 3.6.3 In cases where sample media are over loaded despite the short sample time on consecutive monitoring rounds, the filtration method may be employed during future monitoring.

Site Operations

- 3.6.4 Sampling will be conducted while the MBT Composting processes that have the potential to release bioaerosols (turning of the MBT fines and windrow formation) are operational. This will therefore represent a worst case scenario for bioaerosol emissions.
- 3.6.5 Other on site activities that have the potential to generate bioaerosols are present within the vicinity of the MBT area. These include offloading of MSW by the delivery vehicles to temporary stockpiles at the MRF, loading of MSW to the screening trommel, offloading of oversized waste from the MRF to the active landfill, offloading of MBT fines compost to the active landfill area and the treatment of green waste windrows at the Green Waste Composting Facility (EPR CB3834RQ). Where possible, activities at the separate Green Waste

¹ Association for Organics Recycling (2009) 'A standardised protocol for the monitoring of bioaerosols at open composting facilities'

Compost Facility and transport and deposition to the active landfill will cease while the bioaerosol monitoring is conducted at the MBT Compost Facility. Any of these additional sources of bioaerosol emissions that are carried out during the bioaerosol monitoring will be noted and clearly stated in the report.

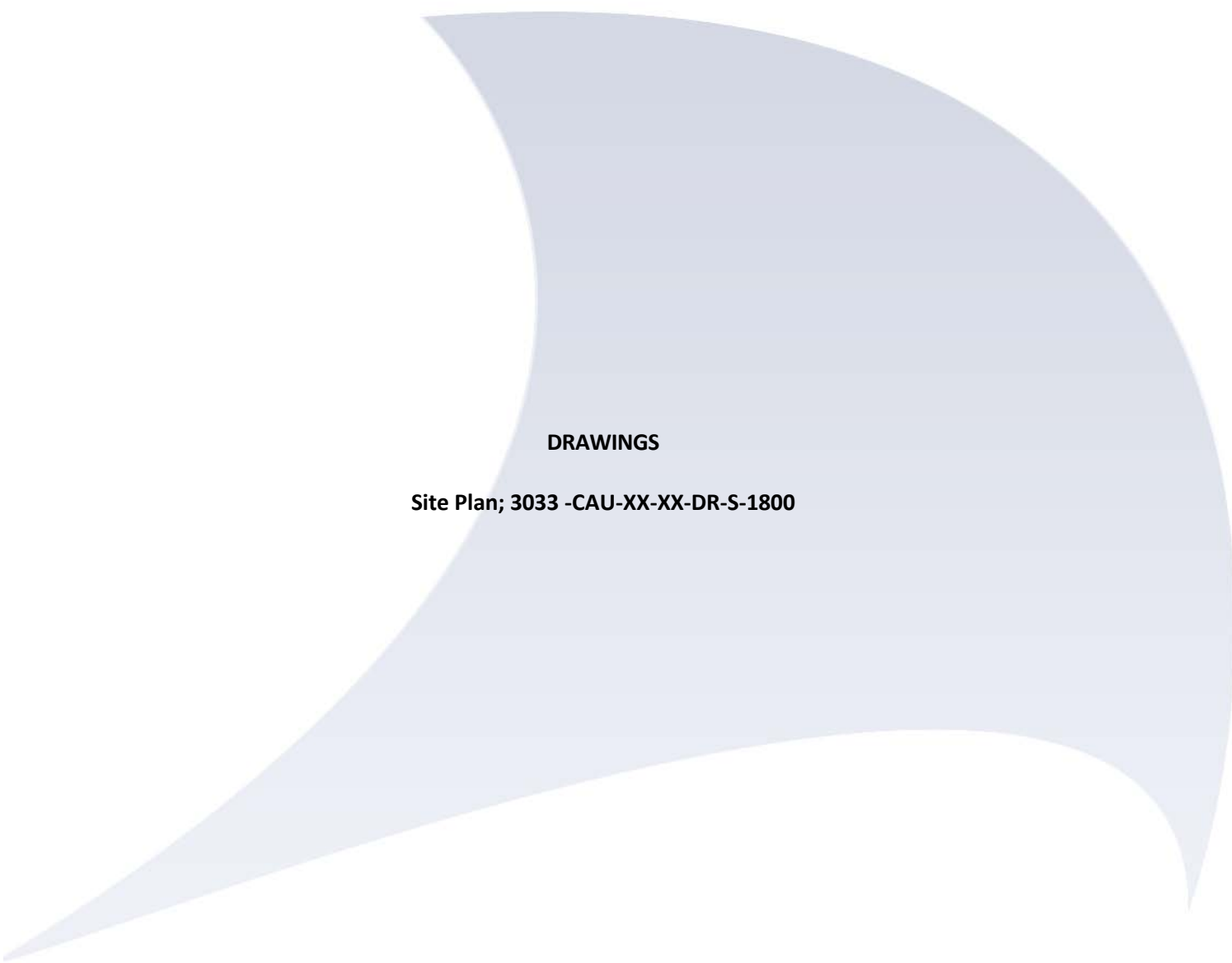
- 3.6.6 During a prevailing northerly wind, the Green Waste Composting Facility would be located in between the MBT Compost and the downwind sampling locations. Bioaerosol Monitoring during a prevailing northerly wind will be avoided when possible. This will reduce the impact of the Green Waste Compost activities on the bioaerosol concentrations.
- 3.6.7 It may be unfeasible to delay MSW stockpiling and screening during bioaerosol monitoring. Due to the location of the MBT Compost area within the MRF waste reception area, it will not be possible to avoid interference from these MRF activities. In order to allow differentiation between the potential bioaerosol emissions from the other site activities at the MRF and the MBT Compost, background monitoring of the MRF will be carried out to establish baseline conditions when MBT Composting is not being carried out. A round of background monitoring will be carried out via the same methodology to be used during MBT Compost monitoring, in accordance with TGN M9 before routine monitoring commences at the source. This will be conducted when no MBT Compost is being processed at the site.
- 3.6.8 Establishment of baseline concentrations of bioaerosols will allow more accurate assessment of the impact of MBT Composting on bioaerosol concentrations at the Nearest Receptor.

Accessibility

- 3.6.9 It will not be feasible to monitor downwind of the MBT compost during a westerly or north westerly prevailing wind due to the presence of the active landfill mass to the south east of the MBT Compost area, and the raised form of the capped landfill to the east of the MBT Compost area. Suitable wind conditions will be identified in the forecast prior to monitoring in order to avoid unsuitable conditions.
- 3.6.10 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 will be noted in the final monitoring report.
- 3.6.11 The topography to the west of the site drops significantly, approximately 40 meters from the Tylwch Road (B4518). As such, sampling downwind to the west of the MBT Compost at a distance greater than approximately 140 m would potentially locate the sample points below the elevation of the source of bioaerosols. This would not be an accurate representation of the conditions at the nearest sensitive receptor, which is located up gradient of the site. It will therefore be necessary to locate the downwind sampling locations closer to the MBT Compost than the sensitive receptor distance when sampling during a prevailing south easterly, easterly or north easterly wind direction.

4.0 REPORTING

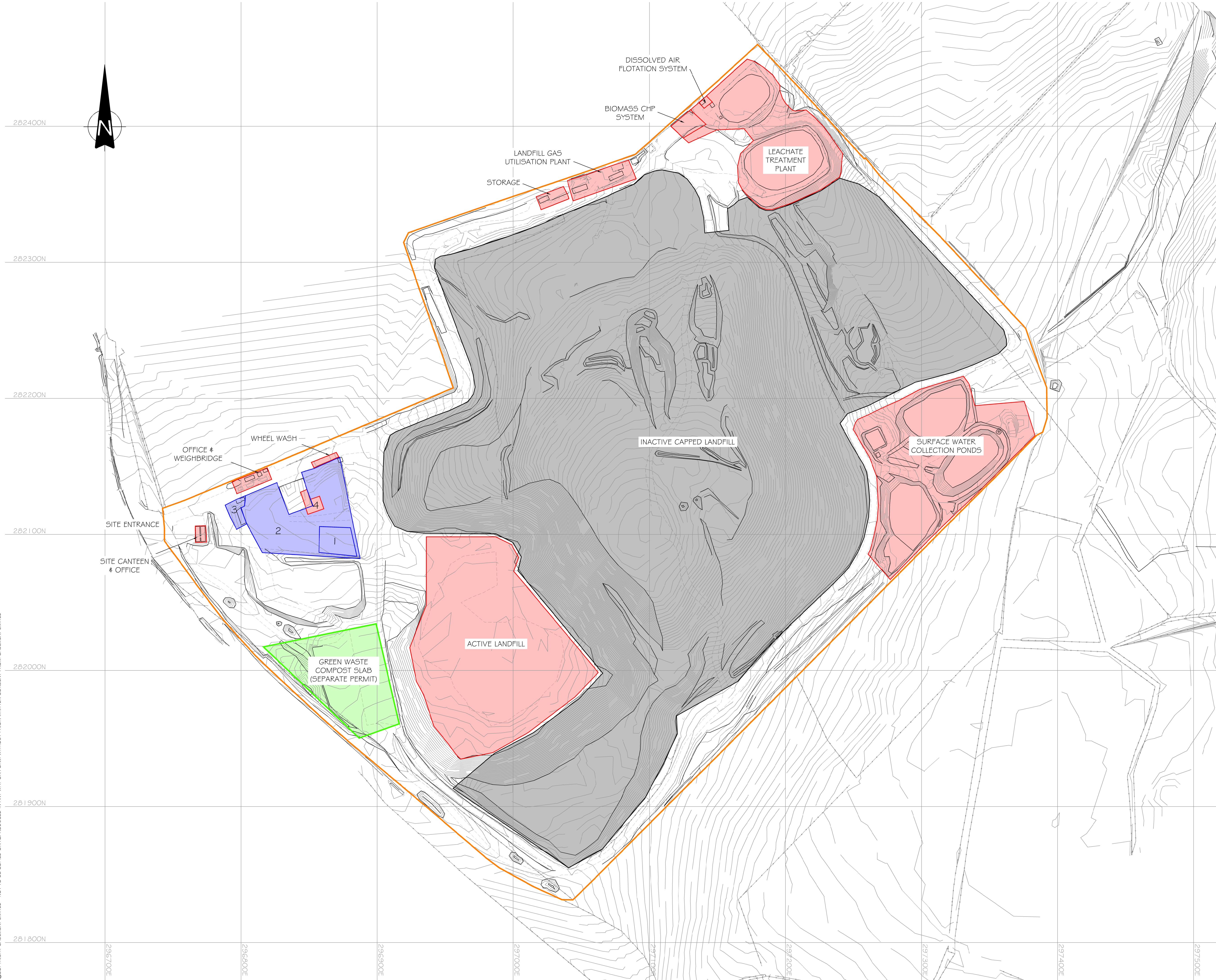
- 4.0.1 Bioaerosol monitoring will be conducted annually at Bryn Posteg during conditions most likely to represent a worst case scenario for bioaerosol emissions. This will take into account site activity, seasonal variations, meteorological conditions and compost material volume.
- 4.0.2 An interpretive report will be compiled in compliance with Section 7.2 of TGN M9 and submitted to NRW within one month of the sampling date.
- 4.0.3 In accordance with the Technical Guidance Note M9, Section 7.0, the report will include the following;
- Monitoring organisation name and personnel involved
 - Laboratory details
 - site details
 - date and time of monitoring
 - sampling methodology
 - any deviations from the sampling approach and justification
 - any potential influential factors
 - bioaerosol concentrations for Total Mesophilic Bacteria and *Aspergillus fumigatus* presented in the format of Annex 5A (included in Appendix 1)
 - meteorological data in the format of Annex 5B (included in Appendix 2),
- 4.0.4 Detailed, accurate records of the conditions on Site will be kept by the monitoring technician. Any off site activities or on site operations that could potentially affect bioaerosol concentrations will be reported.
- 4.0.5 The concentrations of culturable microorganisms will be calculated and reported as colony forming units per cubic meter of air (CFU/m³) as specified in Section 6.3.1 of the Technical Guidance Note M9.
- 4.0.6 Meteorological data statistics for the sampling period will include calculations according to Annex 2A and 2B of the Technical Guidance Note M9.
- 4.0.7 Laboratory certificates of analysis will be included as an appendix to all analytical reports.



DRAWINGS

Site Plan; 3033 -CAU-XX-XX-DR-S-1800

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3. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS, ENGINEERS AND SPECIALIST DRAWINGS AND SPECIFICATIONS.

- SITE BOUNDARY
- MRF PERMIT ACTIVITY
- LANDFILL PERMIT / GENERAL SITE ACTIVITY
- GREEN WASTE COMPOSTING PERMIT ACTIVITY
- CAPPED LANDFILL

1. MBT COMPOST (MRF PERMIT)
2. WASTE RECEPTION (MRF PERMIT)
3. TYRE STORAGE & BAILING (MRF PERMIT)
4. TROMMEL (LANDFILL PERMIT)

C1	ISSUED FOR CONSTRUCTION	DA	SB	SB	08/06/18
P1	ISSUED FOR COMMENT	EJD	SB	SB	20/11/17
REV	MODIFICATIONS	BY	RE	AP	DATE

POTTERS WASTE MANAGEMENT

PROJECT:

BRYN POSTEG LANDFILL SITE

TITLE:

ENVIRONMENTAL MONITORING PLAN

DRAWN BY	EJD	DATE	20/11/2017
REVIEWED BY	SB	SCALE @ A1	1:1250
AUTHORISED BY	SB	JOB REF:	3033
		ISSUE	AO
		REVISION	C1

DRAWING NUMBER

3033-CAU-XX-XX-DR-S-1800



engineering environmental planning

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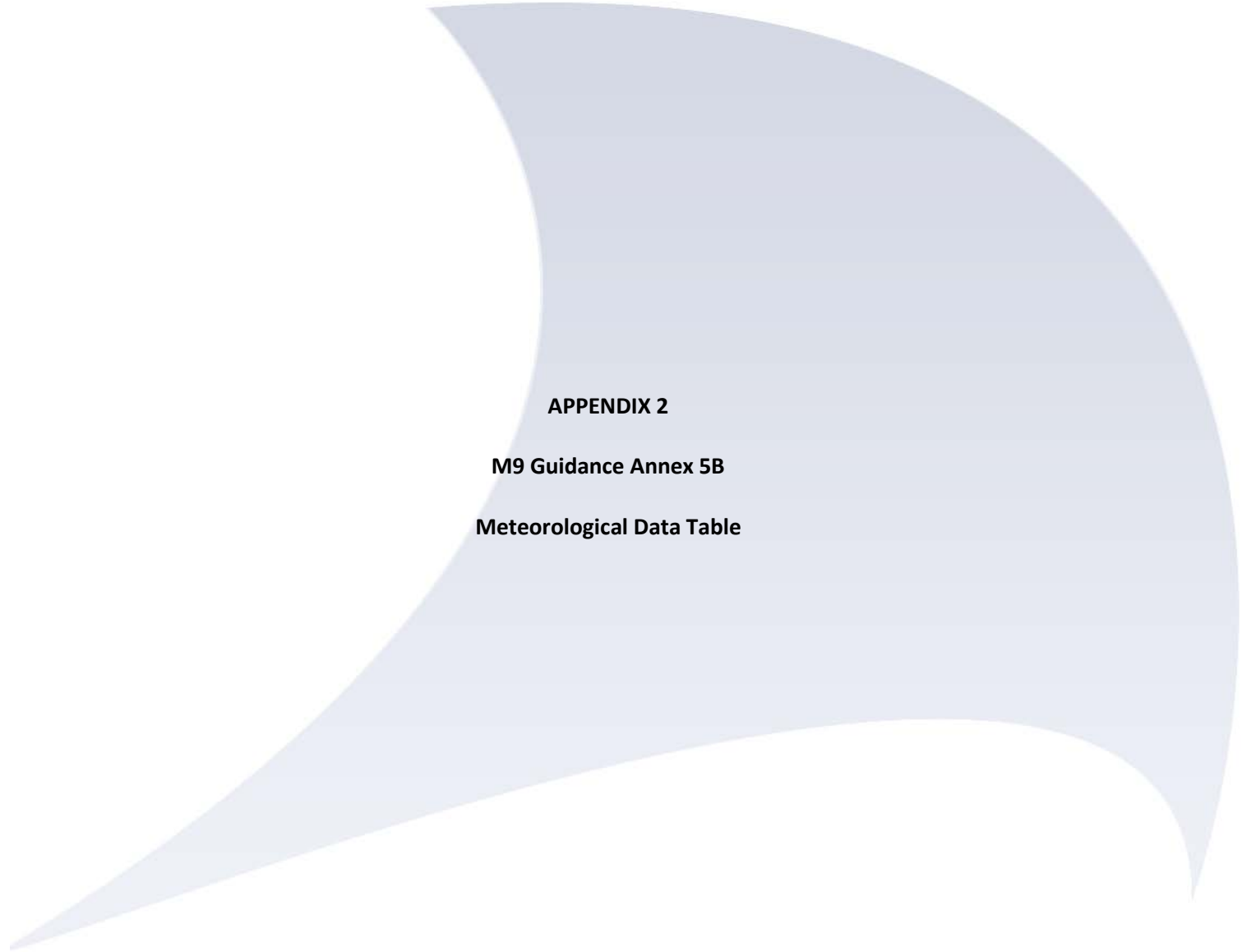
APPENDIX 1

M9 Guidance Annex 5A

Bioaerosol Concentrations Table

Annex 5A: Ambient emissions monitoring report form

Ambient sampling: estimated concentration of bioaerosols							
Site: Sampling date: Estimated mass of materials: Bioaerosol type: Activities affecting the concentration of bioaerosols:				Site operator: Monitoring contractor: Type of materials processed on site: Site activity:			
Location	Sample reference number	Distance from centre of active area (m)	Difference in bearing between location of samplers and mean direction wind blows to (°)	Sampling start/end times (hh:mm:ss)	Concentration of bioaerosols (CFU/m ³)	Arithmetic mean of upwind samples (CFU/m ³) (if required)	Median of downwind replicate field samples (CFU/m ³)



APPENDIX 2

M9 Guidance Annex 5B

Meteorological Data Table

Annex 5B: Meteorological report form for ambient emissions monitoring

Metrological conditions								
Site: Sampling date:					Site operator: Monitoring contractor:			
Location	Sample reference number	Bearing of samplers from centre of operational area or turning / screening operation (° from true north)	Mean direction the wind blows to during the sampling period (each individual sample) (° from true north)	Difference in bearing between location of samplers from centre of operational area and mean direction wind blows to (°)	Mean wind speed during sampling (m/s)	Arithmetic mean of air temperature (°C)	Arithmetic mean of relative humidity (%)	Prevailing weather conditions (cloud cover in eighths)



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