# Bioaerosol Risk Assessment

# Horse Close AD Plant, Northamptonshire

**Client: Earthcare Technical Ltd**

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## Report Issue

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# 1.0 INTRODUCTION

## 1.1 Background

1.1.1 Redmore Environmental Ltd was commissioned by Earthcare Technical Ltd to undertake a Site Specific Bioaerosol Risk Assessment (SSBRA) in support of an Environmental Permit Application for Horse Close Anaerobic Digestion (AD) Plant, Northamptonshire, NN7 2QF.

1.1.2 During the operation of the facility there is the potential for bioaerosol emissions and associated impacts at sensitive receptor locations in the vicinity of the site. A Risk Assessment has therefore been undertaken to identify potential emission sources and evaluate effects in the local area.

1.1.3 The purpose of this Bioaerosol Risk Assessment is to:

- Establish the likely sources of bioaerosols arising from proposed operations at the site;
- Assess the potential for significant risk of impact at sensitive locations due to emissions from the identified sources; and,
- Identify any additional mitigation required to control potential effects.

## 1.2 Site Location and Context

1.2.1 This SSBRA report has been produced in support of a Bespoke Environmental Permit Application for a proposed AD plant on land at Courteenhall, Northamptonshire, NN7 2QF, at approximate National Grid Reference (NGR): SP 77438 52588. The plant will be operated by Acorn Bioenergy Operations Limited (ABL), herein termed 'the Operator'. Reference should be made to Figure 1 for a map of the site and surrounding area.

1.2.2 The facility will treat approximately 94,900 tonnes per annum (tpa) of liquid and solid feedstocks comprising livestock waste (poultry litter, farmyard manures and slurry), energy crops and crop residues, as well as dirty water and several non-hazardous liquid wastes to supplement process water use. The site area was previously arable land and is situated adjacent to a poultry unit, the manures from which will be treated within the AD Plant.

1.2.3 The biogas produced by the AD process will be upgraded into biomethane on site which will be injected to the National Gas Grid via virtual pipeline. Carbon dioxide ($CO_2$) which is stripped during the upgrade process will be captured for use or sequestration off-site. A proportion of the biogas will also be combusted within a Combined Heat and Power (CHP) unit to generate electricity and heat required to run and maintain the AD process.

1.2.4 The facility will also produce around 26,182tpa of solid fibre digestate and 67,454tpa of liquid digestate which will be used as a biofertiliser on local farms.

1.2.5 The operation of the plant may result in bioaerosol emissions from a number of activities. These have the potential to cause impacts at sensitive locations within the vicinity of the site and have therefore been assessed within this report.

# 2.0 PROCESS DESCRIPTION

## 2.1 Introduction

2.1.1 A brief summary of the proposed AD process is provided in the following Sections. Reference should be made to Figure 2 for a site layout plan.

## 2.2 Management

2.2.1 The site will be operated by ABL who are in the process of developing several AD plants nationwide. The AD plant will be managed by ABL, supported by the management team. There will be a Site Manager, who will be responsible for the day-to-day operation of the AD plant and who will act as the Technically Competent Manager (TCM). The Site Manager will manage Site Operatives to assist in day-to-day operations.

## 2.3 Feedstock Delivery and Storage

2.3.1 The plant will operate using a range of feedstocks. A summary of the types and quantities of materials that will be processed is provided in Table 1.

**Table 1 Feedstock Types and Quantities**

| Feedstock Type | Quantity (t/yr) |
|---|---|
| Dirty water | 35,000 |
| Whole crop silage | 23,600 |
| Maize silage | 24,000 |
| Straw bales | 20,000 |
| Pig slurry | 4,500 |
| Farmyard manure | 13,800 |
| Chicken manure | 3,000 |
| Cattle Slurry | 6,000 |
| Total approximate annual tonnage (excluding water) | 94,900 |

2.3.2 A summary of the proposed delivery and storage procedures for the feedstocks is provided in the following Sections.

**Energy Crops**

2.3.3 Energy crops including whole crop silage and maize silage grown under contract with local farms will be transferred to the facility and deposited within three clamps located on the eastern section of the site.

2.3.4 The clamps will be compacted and covered using protective polythene impermeable sheeting. This will form an airtight layer to minimise emissions and maintain anaerobic conditions to ensile and preserve the silage throughout the year. It should be noted that any decomposition of the material would affect its effectiveness as a feedstock. As such, the protective sheeting will be specified to prevent water and air reaching the material and hence avoid any unwanted breakdown with associated emissions.

2.3.5 Any leachate generated by the feedstocks during storage will be transferred to an underground tank for storage prior to treatment into the AD process.

**Solid Animal Wastes**

2.3.6 The facility will accept and process solid chicken manure and farmyard manure. All deliveries to the site will be subject to pre-acceptance checks including waste sampling and verification where appropriate in accordance with the Waste Pre-Acceptance Procedure. Quarantined and rejected waste will be stored in a designated area, returned or removed to a suitably regulated facility.

2.3.7 Farmyard and chicken manure will be transferred to the facility using tractor and trailer and Heavy Goods Vehicles (HGVs). These will drive directly into a dedicated Manure Reception Building where they will deposit their loads into the corresponding manure pile. The reception building will feature fast-action roller shutter doors which will be utilised to maintain a sealed environment as far as practicable during deliveries. In addition, air will be extracted from the building. The system design will ensure that negative pressure is maintained within the building and that the extract rate is appropriate for treatment of air within the emissions abatement system. The extract air will be transferred to a Centriair ammonia ($NH_3$) scrubber and ColdOx Ultraviolet (UV) and activated carbon abatement system for treatment prior to discharge to atmosphere via a dedicated dispersion stack.

2.3.8 Manure will be stored in the reception building for a maximum of 21-days and the total will not exceed 400t at any one time.

**Liquid Wastes**

2.3.9 Slurry and non-hazardous liquid wastes will be delivered to the site in tankers. Following arrival, the tankers will reverse up to the liquid loading point and discharge the contents via sealed pipework into Liquid Feedstock Tank. This closed system pumping arrangement prevents the materials being exposed to atmosphere during offloading. The waste discharged from the delivery tanker is macerated within the tanker dispatch pump during transfer to the Liquid Feedstock Tank, where it will be stored prior to feeding into the PowerRing Digesters.

2.3.10 Air displaced from Feedstock Reception Tank during filling will be treated by an impregnated carbon filter prior to discharge to atmosphere.

2.3.11 Slurry and non-hazardous liquid wastes will be stored in the Liquid Feedstock Tank for a maximum period of 14-days. The total volume of slurry and non-hazardous liquid waste will not exceed 100t and 402t respectively, at any one time.

**Straw**

2.3.12 Cereal straw will be provided by local farmers and delivered to the facility in HGVs and then deposited in a dedicated Straw Processing Building on the southern section of the site for storage prior to extrusion and incorporation into the AD process. The building will be enclosed on all sides except for the northern elevation, offering partial containment during storage.

2.3.13 Prior to the maize harvest, approximately 4,000t of straw will be delivered to the site. The straw will either be delivered and stored in the dedicated processing building or be stockpiled within the clamps for up to 10-weeks prior to extrusion within the building and incorporation into the AD process.

## 2.4 Processing of Feedstocks

2.4.1 A summary of the feedstock processing operations is provided in the following Sections.

**Energy Crops**

2.4.2 Crops will be transferred from the storage clamps to the Feed Hoppers using a front loader twice a day. The silage clamp cover is removed just enough to cut away the required feedstock minimise the disturbance of material as practicable.

2.4.3 The feed hoppers will be loaded twice a day. The Feed Hoppers will macerate and blend the material prior to being fed to a pre-treatment hammermill which reduces the feedstock particle size further to improve digestion and reduce the potential for floating layers, as well as energy consumption associated with stirring during digestion. The feedstock is then transferred through a Screw Loader into the PowerRing Digesters.

**Solid Animal Wastes**

2.4.4 A front loader will be used to transfer manure into the conveyor hopper which is located within the reception building. The manure will then be macerated and blended with separated liquor in a dedicated pre-mix system ready for pumping into the PowerRing Digesters.

**Liquid Wastes**

2.4.5 Liquid wastes will be transferred from the reception tank and mixed with macerated solid feedstocks to make a pumpable feedstock which can be fed into the PowerRing Digesters. Pumping Station 2 within the Central Pumping Station (CPS) is used to distribute the liquid feedstock from the Liquid Feedstock Tank to the PowerRing Digesters via two progressive cavity pumps.

2.4.6 The pumping arrangement is a closed system and therefore the feedstocks will not be exposed to atmosphere.

**Straw**

2.4.7 The straw bales will be broken up using a bale breaker and fed into a Straw Mill with water injection. The crushed wet straw will then either be stored in a bay within the building or fed directly into the Feed Hoppers of the extruders. Extrusion is a thermo-mechanical process which due to pressurisation, produces a fine stackable broken-down straw material that improves digestion and increases gas yield.

2.4.8 Extruded straw will be temporarily set down in an external Set Down Bay prior to being loaded into the dedicated external straw Solid Feed Hopper throughout the day as its produced. The straw is mixed with digestate within an enclosed Pre-mix Liquid Feeding System and macerated before entering the PowerRing Digesters.

## 2.5 AD Plant Operation

2.5.1 The feedstocks will be digested within two PowerRing Digesters. The PowerRing system operates using two digesters; a Secondary Digestor positioned inside of a Primary Digestor. The two Primary Digesters operate in parallel and feed into the two Secondary Digesters via an overflow. Both Secondary Digesters feed into a single Tertiary Digester. Pumping Station 1 within the CPS is used to interconnect the two PowerRings to allow the digestate to be pumped between the digestors via two progressive cavity pumps based on operational needs.

2.5.2 The five sealed AD tanks all include all necessary non-return valves and pumps to ensure there are no losses from any part of the process. The facility will be fully automated to maintain maximum efficiency at all times.

2.5.3 The biogas produced by the process (a mixture of methane ($CH_4$) and $CO_2$ will be collected in available void space above the digesters prior to upgrade which involves stripping out impurities, mainly $CO_2$, specific volatile organic compounds (VOCs) and hydrogen sulphide ($H_2S$) before transfer off-site for gid injection.

2.5.4 A proportion of the biogas will be transferred to a CHP unit where it be combusted to generate both electricity and heat. The site will also include a second CHP unit which will be fuelled using natural gas. Exhaust gases from the plant will be dispersed to atmosphere via dedicated stacks.

2.5.5 $CO_2$ will also be recovered from the biogas, upgraded to 99.9% purity and then liquified to allow offsite transportation for use in commercial and industrial applications in the UK or sequestration. $CO_2$ may be released via a vent on the $CO_2$ capture equipment, when carbon capture equipment in not operational.

2.5.6 The site will feature an automatic back-up flare that burns gas in a controlled manner if the upgrade systems or CHP unit stops temporarily, or if plant maintenance is required. Should the flare fail for any reason, the digesters, biogas upgrading unit and $CO_2$ recovery plant are fitted with emergency release valves to avoid over pressure. These are a necessary safety feature. A record of their use will be kept and the reason for utilisation fully documented.

2.5.7 Frequent or extended use of the pressure release valves would indicate the plant is not being managed correctly and would have financial consequences for the operator due to loss of biogas and potential impacts to the digester conditions. It is therefore in their best interest to ensure they are utilised as infrequently as possible.

## 2.6 Digestate

2.6.1 The process will create digestate in liquid and solid form which can be used as a biofertiliser. This will be heat treated in three pasteurisation units before being pumped to the Hygienized Digestate Tank. Air displaced from the pasteurisers during filling and operation will be either redirected into the gas line or passed through the $NH_3$ scrubbing section of the emissions abatement plant serving the Manure Reception Building before release to atmosphere.

2.6.2 Whole digestate from the Hygienized Digestate Tank will be pumped to the 2 No. Borger type mechanical separators which are capable of separating 75m$^3$/hr and up to 1,800m$^3$/day of whole digestate each. The expected daily process requirement is to separate approximately 448 m$^3$/day. The resultant liquor enters the Digestate Buffer Tank for recirculation or is transferred to the Digestate Storage Lagoon.

2.6.3 The separators are within an enclosed bunker that has front roller shutters which remain open for no longer than 20 minutes during loading for off-site transfer and closed thereafter. Separated fibre collects in the concrete storage bay below and is removed periodically throughout the day to designated field heaps for use as a soil improver.

2.6.4 The Digestate Storage Lagoon will feature a floating gas collection cover which will prevent rain ingress and provide containment of the material. Any gases collected from the headspace between the liquid surfaces of the digestate and the cover will be channelled via an impregnated carbon filter prior to discharge to atmosphere. The lagoon provides two months storage capacity for digestate liquor and benefits from leak detection and mixing.

## 2.7 Digestate Transfer Off-site

2.7.1 Solid fibre digestate is removed from the storage bay and loaded into trailers or HDVs for transport off site to on-farm storage locations or to be spread directly to land for agricultural benefit to meet crop need as a biofertiliser.

2.7.2 Liquid digestate will be transported off site in tankers. These will couple to the outlet at the Digestate Dispatch Point using a hose before the material is transferred from the lagoon using a mechanical pumping system. The pumping arrangement is a closed system and therefore the digestate will not be exposed to atmosphere. Air displaced from the tankers during filling will be treated by a carbon filter prior to discharge to atmosphere.

# 3.0 BIOAEROSOL BACKGROUND

## 3.1 Bioaerosol Definition

3.1.1 Bioaerosol is a general term for microorganisms suspended in the air. These microorganisms include fungi and bacteria, as well as their components such as mycotoxins, endotoxins and glucans. Bioaerosols are generally less than 100µm in size and are not filtered out by hairs and specialised cells that line the nose. Due to their airborne nature and small size, many bioaerosols can penetrate the human respiratory system, resulting in inflammatory and allergic responses.

3.1.2 Although bioaerosols are ubiquitous, operations involving organic materials provide environments that are conducive to their growth. Bioaerosols are therefore likely to be associated with AD feedstocks and products, and in particular, handling activities, which release the microorganisms into the air.

## 3.2 Health Risks from Bioaerosols

3.2.1 Exposure to bioaerosols has been associated with human health effects, symptoms can include inflammation of the respiratory system, coughs and fever. Inhalation of bioaerosols may also cause or exacerbate respiratory diseases[1]. They have been known to cause gastrointestinal illness, eye irritation and dermatitis.

3.2.2 Possible links have also been made between exposure to bioaerosols and organic dust toxic syndrome. This is an acute disease that causes symptoms resembling those of influenza, such as shivering, an increase in body temperature, dry cough and muscle and joint pains. Of particular relevance to waste management facilities are infections caused by Aspergillus fumigatus. Invasive aspergillosis is a particularly severe infection, which may be fatal and is primarily a concern with at risk and immuno-suppressed patients.

3.2.3 Although some data is available, one of the major knowledge gaps for bioaerosols is their associated dose-response relationships. It is not currently possible to state with any certainty that a given concentration will result in a particular health impact. This is due to

1 Guidance on the evaluation of bioaerosol risk assessments for composting facilities, Environment Agency, undated.

the number of bioaerosols that are naturally present within the environment as well as the complexities associated with human responses to different microorganisms.

## 3.3 Bioaerosol Emissions from Waste Management Operations

3.3.1 Most scientific research on bioaerosol emissions from waste management operations focusses on open windrow and In-Vessel Composting (IVC) systems. Although it is recognised that there are fundamental differences between composting and AD processes, there are similarities between the types of feedstocks, handling activities and infrastructure utilised. As such, a review of relevant research has been undertaken in order to inform the assessment. The findings are detailed in the following Section.

3.3.2 The Environment Agency (EA) document 'Health Effects of Composting - A Study of Three Compost Sites and Review of Past Data'[2] summarises the findings of emissions measurement work undertaken at three composting facilities, including two open air turned windrow sites and one IVC plant. The results from the work indicated a well-defined decline in concentrations of bioaerosols with increased distance from source. In most cases, measured concentrations were at or below background levels within 250m of the sources assessed.

3.3.3 The ADAS report 'Bioaerosol Monitoring and Dispersal from Composting Sites'[3] provides a summary of the findings from measurement work undertaken at three composting sites. Sampling for bioaerosols was undertaken downwind of a wide range of composting activities including shredding, turning, loading, unloading and screening. The results indicated that 91% of all micro-organisms sampled across all three sites were below 1,000cfu/m$^3$ at a downwind distance of 125m.

3.3.4 The Scotland and Northern Ireland Forum for Environmental Research (SNIFFER) report 'Measurement and Modelling of Emissions from Three Composting Sites'[4] provides a summary of the findings from monitoring work undertaken at three composting sites, which included two IVC facilities and one open windrow system. The findings indicated that there is the potential for seasonal variation in ambient concentrations of the mould

2 Health Effects of Composting - A Study of Three Compost Sites and Review of Past Data, EA, 2001.

3 Bioaerosol Monitoring and Dispersal from Composting Sites, ADAS, 2005.

4 Measurement and Modelling of Emissions from Three Composting Sites, SNIFFER, 2007.

of Aspergillus fumigatus, with concentrations being the highest in the autumn. In most cases, levels of all bioaerosols assessed were at or below background equivalent concentrations within 250m of the sources assessed.

3.3.5 The Department for Environment Food and Rural Affairs (DEFRA) research report 'Bioaerosols and odour emissions from composting facilities'[5] focusses on the comparability of different sampling methodologies and the influence of spatial and temporal variation on ambient bioaerosol concentrations. Measurements were undertaken at four different composting facilities in England, which represent a range of system types. The results of the study corroborate existing research and suggest that concentrations of bioaerosols generally return to background levels within 250m of the source.

3.3.6 The findings of the review have been considered as appropriate throughout the assessment.

## 3.4 Legislative Control

3.4.1 Atmospheric emissions from industry are controlled in the UK through the Environmental Permitting (England and Wales) Regulations (2016) and subsequent amendments. The operation of the proposed AD plant is included within the Regulations. As such, the facility is required to obtain an Environmental Permit issued by the EA.

## 3.5 Environment Agency Policy

3.5.1 The EA Regulatory Position Statement (RPS) 'Bioaerosol monitoring at regulated facilities - use of M9: RPS 209'[6] outlines the conditions that apply to facilities in relation to bioaerosol emissions.

3.5.2 The RPS states that if a regulated facility is located within 250m of a sensitive receptor (a place where people live or work for more than 6-hours at a time), the operator must:

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5 Bioaerosols and odour emissions from composting facilities, DEFRA, 2013.

6 Bioaerosol monitoring at regulated facilities - use of M9: RPS 209, EA, 2023.

- Monitor bioaerosols in accordance with EA guidance 'M9: environmental monitoring of bioaerosols at regulated facilities'[7];
- Undertake a site specific Bioaerosol Risk Assessment; and,
- Comply with all other conditions set out in your permit.

3.5.3 The conditions outlined within the RPS have been considered as appropriate throughout the assessment.

## 3.6 Benchmark Levels

3.6.1 In the absence of dose-response data, the EA have adopted a precautionary risk-based approach in determining guidance levels for bioaerosols. The EA position statement 'Composting and potential health effects from bioaerosols: our interim guidance for permit applicants'[8] specifies the following criteria for acceptable concentrations of Aspergillus fumigatus and total bacteria at sensitive receptor locations:

- Aspergillus fumigatus - 500cfu/$m^3$; and,
- Total bacteria - 1,000cfu/$m^3$.

3.6.2 The relevant benchmark levels have been considered as appropriate throughout the assessment.

## 3.7 Technical Guidance

3.7.1 The EA guidance 'How to comply with your environmental permit. Additional technical guidance for: Anaerobic Digestion'[9] sets out indicative Best Available Technique (BAT) or appropriate measures for the AD of organic materials. The document provides practical guidance on how and why bioaerosol emissions occur, as well as measures that can be employed to prevent or minimise release.

[7] M9: environmental monitoring of bioaerosols at regulated facilities, EA, 2023.

[8] Composting and potential health effects from bioaerosols: our interim guidance for permit applicants, EA, 2022.

[9] How to comply with your environmental permit. Additional technical guidance for: Anaerobic Digestion, EA, 2013.

3.7.2 The EA guidance for 'Biological waste treatment: appropriate measures for permitted facilities'[10] sets out the factors that should be considered when assessing appropriate measures for biowaste installations. The requirements of the guidance have been considered throughout the assessment.

10 Biological waste treatment: appropriate measures for permitted facilities, EA, 2022.

# 4.0 PROBLEM DEFINITION

## 4.1 Introduction

4.1.1 The first stage of any risk assessment is to clearly set out the problem, including what will be addressed and what will not. This determines the scope, level of detail and focus. In particular, the temporal and spatial scales, contaminants to be assessed, persons at risk and the endpoint are identified. These factors are considered in the following Sections.

## 4.2 Conceptual Model

4.2.1 Potential hazards from bioaerosols are summarised in the conceptual model in Table 2.

**Table 2 Conceptual Model**

| Criteria | Description |
|---|---|
| Source | Feedstocks and output materials on the site as outlined in Section 4.3 |
| Hazard | Potential adverse health impacts as outlined in Section 3.2 |
| Transport Mechanism | Airborne |
| Medium of Exposure | Inhalation, ingestion, absorption, injection |
| Receptor | Human receptors as outlined in Section 4.4 |

## 4.3 Sources

4.3.1 The operation of the AD plant may result in bioaerosol emissions from a number of activities. A review of the proposed operations was undertaken in order to identify relevant emissions sources for inclusion in the assessment. These are summarised in Table 3.

**Table 3 Bioaerosol Sources**

| Source | | Emission Characteristics |
|---|---|---|
| 1 | Exposed crop feedstocks and straw within the clamp area during delivery and storage | Diffuse emissions from exposed materials |
| 2 | Straw Treatment Building | Fugitive emissions from the building |

| Source | | Emission Characteristics |
|---|---|---|
| 3 | Exposed extruded straw temporarily set down in the Straw Set Down Bay | Diffuse emissions from exposed materials |
| 4 | Exposed crop feedstocks and extruded straw during transfer to the Feed Hoppers | Diffuse emissions from exposed materials |
| 5 | Exposed materials within the Feed Hoppers | Diffuse emissions from exposed materials |
| 6 | Air expelled from the Liquid Feedstock Tanker carbon filter | Residual bioaerosols in treated air released to atmosphere from the carbon filter |
| 7 | Emissions from the abatement system which will be used to treat air extracted from the Manure Reception Building | Residual bioaerosols in treated air released to atmosphere from the abatement system stack |
| 8 | Air expelled from Liquid Digestate Storage Lagoon carbon filter | Residual bioaerosols in treated air released to atmosphere from the carbon filter |
| 9 | Air expelled from the digestate tanker offtake Carbon Filter | Residual bioaerosols in treated air released to atmosphere from the carbon filter |
| 10 | Solid digestate within the separator bunker and during loading of trailers for transportation off site | Fugitive emissions from the covered digestate storage bunker |
| 11 | $CO_2$ recovery plant vent | Emissions released to atmosphere via a dedicated vent |

4.3.2 It should be noted that the actual AD process itself is sealed and therefore does not form a source of bioaerosols under normal operation. As stated previously the digesters, biogas upgrading unit and $CO_2$ recovery plant feature release valves to avoid over pressure and any gases emitted from these may contain bioaerosols as a result of the processes. However, gas released from these sources will be directed to the manure reception building where it will be treated by the emission abatement system. As such, there will be no emissions to atmosphere during over pressure scenarios. Therefore, the pressure release vales have not been considered further in the assessment.

4.3.3 The CHP units, flare and emergency standby boiler only emit products of combustion when in use which do not contain bioaerosols. As such, they have not been considered further in this report.

4.3.4 The potential for bioaerosol emissions from each remaining source is considered further in the following Sections.

**Exposed Crop Feedstocks and Straw within the Clamp During Delivery and Storage**

4.3.5 Crop feedstocks will be delivered to the facility and deposited within storage clamps located on the south-eastern section of the site. Disturbance of the material during delivery may cause bioaerosol release. However, the seasonal nature of deliveries and short amount of time required to deposit loads is likely to minimise potential exposure durations.

4.3.6 During delivery, the drop height of material will be minimised as far as practicable in order to limit agitation and the associated potential for emissions. In addition, where practicable, crops will be tipped as bulk loads to reduce material separation and the overall emitting surface area that is exposed to atmosphere.

4.3.7 Following delivery, the feedstocks will be compacted and covered with protective polythene impermeable sheeting. This will help to minimise bioaerosol release during storage.

4.3.8 The cover on the clamps will be slightly open at one end during cutting phases in order to allow access to the feedstock for removal and transportation to the AD plant Feed Hoppers. It is anticipated that there will typically be 2 cutting phases per working day. The area of uncovered material during transfer to the Feed Hoppers will be kept to a minimum at all times in order to limit the potential for surface wind stripping of microorganisms.

4.3.9 The clamps will be inspected on a daily basis to ensure the sheeting is intact and providing effective coverage of the feedstock material.

4.3.10 Approximately 4,000t of straw will also be delivered to the site prior to the maize harvest and stockpiled within the clamp for up to 10-weeks prior to extrusion within the building and incorporation into the AD process. The bales will be stacked in order to minimise the area of straw that is exposed to atmosphere and moisture ingress. In addition, the stacked bales will remain static except for when transfer to the building for pre-processing is required in order to limit disturbance and the potential for bioaerosol release.

**Straw Processing Building**

4.3.11 Baled straw will be delivered to the facility in HGVs and deposited in a dedicated building on the southern section of the site for storage prior to crushing and extrusion to allow incorporation into the AD process. The building will be enclosed on all sides except for the northern elevation in order to provide partial containment of processes and any associated bioaerosol emissions.

4.3.12 During initial crushing, the straw will be injected with water and extruded prior to removal for temporarily storage. The wet nature of the crushing and extrusion process will help minimise bioaerosol release.

**Exposed Extruded Straw**

4.3.13 Processed extruded straw will be temporarily stored outside in the Straw Set Down Bay prior to being transferred to the external Straw Solid Feed Hoppers. The material will remain static with minimal mechanical agitation except for during removal to the Feed Hoppers in order to limit disturbance and the potential for bioaerosol release.

4.3.14 The wet nature of the extruded straw will also help to minimise the potential for bioaerosol emissions during storage within the Straw Set Down Bay.

**Exposed Crop Feedstocks and Extruded Straw During Transfer**

4.3.15 Crop feedstocks and extruded straw will be transferred from the storage clamps and Straw Set Down Bay, respectively, to the Feed Hoppers using a front loader.

4.3.16 There is the potential for bioaerosol release during removal of crops and straw from the relevant storage areas and loading into the Feed Hoppers. As such, all reasonable measures will be undertaken to minimise disturbance of the material during this operation. In addition, the shortest transfer routes and a large front loader bucket will be utilised to limit the number of movements and potential exposure durations.

4.3.17 Full training will be provided to the front loader operative to avoid material spillage during transfer. Any spilled material will be cleared within the working day.

### Feed Hoppers

4.3.18 The Feed Hoppers will macerate and blend crop feedstocks and straw prior to processing within the AD plant. Bioaerosol emissions may occur from exposed materials during operation of the Feed Hoppers. As such, potential releases have been considered further as part of the assessment.

### Liquid Feedstock Tank Carbon Filter

4.3.19 Slurry and non-hazardous liquid wastes will be pumped from tankers into Liquid Feedstock Tank. The pumping arrangement is a closed system and therefore waste will not be exposed to atmosphere during transfer.

4.3.20 Air displaced from the Liquid Feedstock Tank during filling will be passed through a carbon filter prior to discharge to atmosphere. This system is likely to provide beneficial reductions in bioaerosol concentrations between inlet and outlet air due to the impaction of microorganisms onto the carbon during operation. However, there may be the potential for the release of residual components which pass straight through the media. As such, emissions have been evaluated further as part of the assessment.

### Centriair Abatement System Stack

4.3.21 Air extracted from the Manure Reception Building will be transferred to a Centriair $NH_3$ scrubber and ColdOx UV and activated carbon abatement system for treatment prior to discharge to atmosphere via a dedicated dispersion stack.

4.3.22 The proposed abatement system is likely to provide beneficial reductions in bioaerosol concentrations between inlet and outlet air due to the following:

- The $NH_3$ scrubbing system is a wet process which is likely to result in capture and blowdown of bioaerosols contained within the inlet airstream;
- UV radiation is mutagenic to bacteria and is therefore likely to lead to death or inactivation of components within the feedstock reception building extract air; and,
- Secondary treatment using activated carbon housed within the ColdOx unit is likely result in the impaction of fungi and residual viable bacterial components not removed by the UV stage.

4.3.23 Although it is considered that the stated control mechanisms will provide effective reductions in bioaerosol concentrations, it is recognised that there is the potential for the release of residual microorganisms from the dispersion stack. As such, emissions have been evaluated further as part of the assessment.

**Digestate Storage Lagoon**

4.3.24 The liquid digestate fraction will be stored within the Digestate Storage Lagoon prior to transfer off-site for use as a fertiliser. Any gases displaced from the headspace between the liquid surface of the digestate and the cover will be channelled via an impregnated carbon filter prior to discharge to atmosphere. This system is likely to provide beneficial reductions in bioaerosol concentrations between inlet and outlet air due to the impaction of microorganisms onto the carbon during operation. However, there may be the potential for the release of residual components which pass straight through the media. As such, emissions have been evaluated further as part of the assessment.

**Digestate Tanker Offtake Carbon Filter**

4.3.25 Digestate will be pumped from the Digestate Storage Lagoon into a tanker for transfer off-site. The pumping arrangement is a closed system and therefore digestate will not be exposed to atmosphere during transfer.

4.3.26 Air displaced from the tanker during filling will be passed through a carbon filter prior to discharge to atmosphere. This system is likely to provide beneficial reductions in bioaerosol concentrations between inlet and outlet air due to the impaction of microorganisms onto the carbon during operation. However, there may be the potential for the release of residual components which pass straight through the media. As such, emissions have been evaluated further as part of the assessment.

**Solid Digestate**

4.3.27 Solid digestate will be stored within a covered bunker prior to removal from site. Although the AD process will reduce the quantities of some bioaerosols, particularly pathogens[11],

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11 Anaerobic digestion, storage, oligolysis, lime, heat and aerobic treatment of livestock manures, FEC Services Ltd, 2003.

there is the potential for emissions from this part of the process. Enclosure of the solid digestate within the covered bunker will reduce the potential for surface wind stripping of microorganisms. In addition, the material will be removed from site frequently to avoid storage of significant amounts and the associated potential for bioaerosol release.

4.3.28 Solid fibre digestate will be removed from the storage bay within the bunker and loaded into trailers prior to transportation off-site. This process has the potential to result in bioaerosol emissions. As such, releases have been considered further as part of the assessment.

**$CO_2$ Recovery Plant Vent**

4.3.29 $CO_2$ will also be recovered from the biogas, upgraded to 99.9% purity and then liquified to allow off site transportation for use in commercial and industrial applications in the UK or sequestration. Exhaust gases generated by the $CO_2$ purification process will be discharged to atmosphere via dedicated vent.

4.3.30 The $CO_2$ recovery process will utilise multiple purification stages which are likely to result in the capture and/or destruction of bioaerosols. However, there may be the potential for the release of residual components from the vent. As such, impacts associated with emissions from this source have been considered further as part of the assessment.

## 4.4 Receptors

EA guidance 'M9: environmental monitoring of bioaerosols at regulated facilities'[12] defines a sensitive receptor as follows:

> "Nearest sensitive receptor means the nearest place to the permitted activities where people are likely to be for prolonged periods. This term would therefore apply to dwellings (including any associated gardens) and to 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, their staff when they are at work or to visitors to the facility, as their health is covered by Health and Safety

12 M9: environmental monitoring of bioaerosols at regulated facilities, EA, 2018.

at Work legislation, but would apply to dwellings occupied by the family of those controlling the facility."

4.4.1 A desk-top study was undertaken in order to identify any sensitive receptor locations in the vicinity of the site that required specific consideration during the assessment. In accordance the requirements of the EA RPS[13], this focussed on locations within 250m of the facility boundary where people may be present for more than 6-hours at one time.

4.4.2 The identified receptors are summarised in Table 4.

**Table 4 Sensitive Receptors**

| Receptor | | NGR (m) | | Distance from Closest Source (m) | Direction from Facility |
|---|---|---|---|---|---|
| | | X | Y | | |
| R1 | Courteenhall East Lodge | 477260 | 252901 | 211 | North |

4.4.3 As shown in Table 4, sensitive locations have been identified at distances of 211m from the nearest identified sources. Additional receptors were identified in the surrounding of the site, however, these were located in excess of 600m from the closest potential source and therefore considerably beyond the 250m threshold specified in the EA RPS[14] and the distance outlined in Section 3.3, where bioaerosol emissions from management operations have been shown to reduce to background levels.

4.4.4 Reference should be made to Figure 3 for a visual representation of the identified receptors included in the assessment.

## 4.5 Prevailing Meteorological Conditions

4.5.1 The potential for bioaerosol emissions to impact at sensitive locations depends significantly on the meteorology, particularly wind direction, during release. In order to consider prevailing conditions at the site review of historical weather data was undertaken. Bedford meteorological station is located at NGR: 504893, 259667, which is approximately 28.2 km east of the facility. It is anticipated that conditions would be

13 Bioaerosol monitoring at regulated facilities - use of M9: RPS 209, EA, 2018.

14 Bioaerosol monitoring at regulated facilities - use of M9: RPS 209, EA, 2018.

reasonably similar over a distance of this magnitude. The data was therefore considered suitable for an assessment of this nature.

4.5.2 Meteorological data was obtained from Bedford meteorological station over the period 1st January 2018 to 31st December 2023 (inclusive). The frequency of wind from the eight sectors which best describe the directions which may cause impacts in the vicinity of the site is shown in Table 5. Reference should be made to Figure 4 for a wind rose of the meteorological data.

**Table 5 Wind Frequency Data**

| Wind Direction (°) | Frequency of Wind (%) |
|---|---|
| 337.5 - 22.5 | 10.29 |
| 22.5 - 67.5 | 10.65 |
| 67.5 - 112.5 | 6.08 |
| 112.5 - 157.5 | 5.87 |
| 157.5 - 202.5 | 13.84 |
| 202.5 - 247.5 | 24.13 |
| 247.5 - 292.5 | 17.74 |
| 292.5 - 337.5 | 8.26 |
| Sub-Total | 96.84 |
| Calms | 2.45 |
| Missing/Incomplete | 0.71 |

4.5.3 All meteorological data used in the assessment was provided by Atmospheric Dispersion Modelling Ltd, which is an established distributor of meteorological data within the UK.

4.5.4 As shown in Table 5, the prevailing wind direction at the AD facility is from the south-west with significant frequencies from the west and south. Winds from the north and east are relatively infrequent, which is indicative of conditions throughout the majority of the UK.

## 4.6 Other Sources of Bioaerosols and Cumulative Effects

4.6.1 There is agricultural land use in the immediate vicinity of the site. Arable fields may form further sources of bioaerosols if fertilised with animal manures or slurries, as well as during crop harvest periods. However, likely impacts associated with these releases are not considered to be significant and would be expected for any rural location within the UK.

4.6.2 The Courteenhall Poultry Farm facility is located 10m to the north-east of the site. This facility also has the potential to contribute to cumulative atmospheric bioaerosol concentrations.

4.6.3 The Courteenhall Poultry Farm is regulated under an Environmental Permit issued by the EA (ref: EPR/TP3109BY). In addition, under the Health and Safety at Work Legislation Act[15], the operator is required to protect employees working at the facility. As such, it is considered likely that effective containment measures are in place to minimise bioaerosol emissions at the site in order to maintain safe working conditions.

4.6.4 It should also be noted that it is considered unlikely that cumulative impacts will occur at the identified receptor as the geographical orientation of Courteenhall Poultry Farm and the Horse Close AD Plant prevent the receptor from being downwind of both sources simultaneously.

[15] UK Government, Health and Safety at Work etc. Act 1974

# 5.0 RISK ASSESSMENT METHODOLOGY

## 5.1 Overview

5.1.1 The Bioaerosol Risk Assessment has been undertaken in accordance with the general principles of EA document 'Guidance on the evaluation of bioaerosol risk assessments for composting facilities'[16]. This included consideration of the following:

- Receptor - what is at risk? What do I wish to protect?
- Source - what is the agent or process with potential to cause harm?
- Harm - what are the harmful consequences if things go wrong?
- Pathway - how might the receptor come into contact with the source?
- Probability of exposure - how likely is this contact?
- Consequence - how severe will the consequences be if this occurs?
- Magnitude of risk - what is the overall magnitude of the risk? and,
- Justification for magnitude - on what did I base my judgement?

5.1.2 Based on the Bioaerosol Risk Assessment outcomes potential mitigation and control options were identified.

5.1.3 Further explanation for the key assessment areas is provided below.

## 5.2 Receptor

5.2.1 The first step was to consider how the activity could harm the environment. This involved identifying 'receptors' that may be affected and included people, property, and the natural and physical environment.

## 5.3 Probability of Exposure

5.3.1 The probability of exposure was defined based on the likelihood of exposure of the specific receptor to the identified sources. This depended on several factors, such as:

- Distance between source and receptor;

[16] Guidance on the evaluation of bioaerosol risk assessments for composting facilities, EA, undated.

- Dispersion potential of emission;
- Duration of emission; and,
- Frequency of emission.

5.3.2 Probability was categorised in accordance with the following criteria:

- High - exposure is probable, direct exposure likely with no/few barriers between source and receptor;
- Medium - exposure is fairly probable, barriers less controllable;
- Low - exposure unlikely, barriers exist to mitigate; or,
- Very low - exposure very unlikely, effective and multiple barriers.

## 5.4 Harm

5.4.1 The severity of harm from a risk depends on:

- How much a person or part of the environment is exposed; and,
- How sensitive a person or part of the environment is.

5.4.2 Some parts of the environment can be very sensitive. For example, serious health effects can occur if humans are exposed to certain chemicals for only short periods of time.

5.4.3 Harm can be described as follows:

- High - severe consequences, evidence that exposure may result in serious damage;
- Medium - significant consequences, evidence that exposure may result in damage that is not severe and is reversible;
- Low - minor consequences, damage not apparent, reversible adverse changes possible; and,
- Very low - negligible consequences, no evidence for adverse changes.

## 5.5 Magnitude of Risk

5.5.1 The level of risk is a combination of:

- How likely a problem is to occur; and,

- How serious the harm might be.

5.5.2 Risk is highest where both the likelihood of a problem is high and the potential harm is severe. Risk is lowest where a problem is unlikely to occur and the harm that might result is not serious.

5.5.3 Risk was defined based on the interaction between the probability of exposure and potential harm, as outlined in Table 6.

**Table 6 Magnitude of Risk**

| Probability of Exposure | Potential Harm | | | |
|---|---|---|---|---|
| | Very Low | Low | Medium | High |
| High | Low | Medium | High | High |
| Medium | Low | Medium | Medium | High |
| Low | Low | Low | Medium | Medium |
| Very Low | Very Low | Low | Low | Medium |

## 5.6 Further Requirements

5.6.1 Based on the outcomes of the risk assessment the EA document provides guidance on further requirements for different risks. These can be summarised as follows:

- High risks - additional assessment and active management;
- Medium risks - likely to require further assessment and may require either active management or monitoring; and,
- Low and very low risk - will only require periodic review.

5.6.2 Mitigation to reduce risk can also be applied to avoid the requirement for further assessment and/or monitoring.

# 6.0 RISK ASSESSMENT

6.1.1 The Bioaerosol Risk Assessment is shown in Table 7.

**Table 7 Risk Assessment**

| Source | Probability of exposure | Harm | Magnitude of Risk | Control Measures | Residual Risk | Justification for Residual Risk |
|---|---|---|---|---|---|---|
| Exposed crop feedstocks and straw within the clamp area | **Medium** at R1 due to the distance between the source and receptor, the frequency of winds blowing towards the location and the containment of crop feedstocks during storage<br><br>**Low** at R2 due to the distance between the source and receptors, the frequency of winds blowing towards the locations and the containment of crop feedstocks during storage | **Medium** | **Medium** | All reasonable measures will be undertaken to reduce the drop height of materials during unloading of the delivery vehicles. Where practicable, feedstocks will be tipped as bulk loads to reduce material separation and the overall emitting surface area<br><br>Crop feedstocks will be stored protective polythene impermeable sheeting following delivery. The clamps will be inspected on a daily basis to ensure the cover is intact and providing effective containment. The area of uncovered material will be kept to a minimum during storage. This will help to limit the potential for surface wind stripping of microorganisms<br><br>Straw bales will be stacked in order to minimise the area that is exposed to atmosphere and moisture ingress. In addition, the stacked bales will remain static except for when transfer to the building for pre-processing is required in order to limit disturbance and the potential for bioaerosol release | **Low** | Full implementation of the stated control measures, is considered to result in a **low** residual risk of impact occurring |

| Source | Probability of exposure | Harm | Magnitude of Risk | Control Measures | Residual Risk | Justification for Residual Risk |
|---|---|---|---|---|---|---|
| Straw processing building | **Low** at R1 due to the distance between the source and receptors, the frequency of winds blowing towards the locations, the nature of the material being processed and the partial containment of processes and materials within the building<br>**Very low** at R2 due to the distance between the source and receptors, the frequency of winds blowing towards the locations, the nature of the material being processed and the partial containment of processes and materials within the building | **Medium** | **Low** to **Medium** | The building will be enclosed on all sides except for the northern elevation in order to provide partial containment of processes and any associated bioaerosol emissions<br>During initial crushing, the straw will be injected with water and extruded to produce crushed wet straw prior to removal for temporary storage. The wet nature of the crushing and extrusion process will help minimise bioaerosol release | **Low** | Full implementation of the stated control measures, is considered to result in a **low** residual risk of impact occurring |
| Exposed extruded straw temporarily set down in the Straw Set Down Bay | **Low** at R1 due to the distance between the source and receptors, the frequency of winds blowing towards the location and the wet nature of the material<br>**Very Low** at R2 due to the distance between the source and receptors, the | **Medium** | **Low** to **Medium** | The wet nature of the extruded straw will help to minimise the potential for bioaerosol emissions during storage within the bunker<br>The material which is stored at the site will remain static with minimal mechanical agitation except for during removal to the hoppers in order to limit disturbance and the potential for bioaerosol release | **Low** | Full implementation of the stated control measures, is considered to result in a **low** residual risk of impact occurring |

| Source | Probability of exposure | Harm | Magnitude of Risk | Control Measures | Residual Risk | Justification for Residual Risk |
|---|---|---|---|---|---|---|
| | frequency of winds blowing towards the location and the wet nature of the material | | | | | |
| Exposed crop feedstocks and extruded straw during transfer to the Feed Hoppers | **Low** at R1 due to the distance between the sources and receptor, the frequency of winds blowing towards the location and the limited duration of transfer operations<br>**Very Low** at R2 due to the distance between the sources and receptors, the frequency of winds blowing towards the location and the limited duration of transfer operations | **Medium** | **Low** to **Medium** | All reasonable measures will be undertaken to minimise disturbance of the material during loading and movement between the process areas<br>The shortest transfer routes will be utilised in order to limit potential exposure durations<br>Full training will be provided to the bucket loader operative to avoid material spillage during transfer<br>Any spilled material will be cleared by a site operative within the working day | **Low** | The short duration of transfer activities and use the stated control measures is considered to result in a **low** residual risk of impact occurring |
| Exposed materials within the Feed Hoppers | **Medium** at R1 due to the distance between the source and receptor and the frequency of winds blowing towards the location<br>**Low** at R2 due to the distance between the source and receptors and the frequency of winds | **Medium** | **Medium** | The drop height of material will be minimised as far as practicable during loading of the Feed Hoppers in order to limit agitation and the associated potential for emissions<br>Any spilled material will be cleared by a site operative within the working day<br>Visual inspection of the Feed Hoppers will be undertaken daily in order to identify any mechanical issues which need to be resolved or operating conditions which | **Low** | Full implementation of the stated control measures, is considered to result in a **low** residual risk of impact occurring |

| Source | Probability of exposure | Harm | Magnitude of Risk | Control Measures | Residual Risk | Justification for Residual Risk |
|---|---|---|---|---|---|---|
| | blowing towards the location | | | have the potential to result in an increased potential for bioaerosol emissions | | |
| Liquid Feedstock Tank Carbon Filter | **Very low** at R1 and R2 due the distance between source and receptors and the low release potential due to carbon filtration of air | **Medium** | **Low** | Air displaced by the Liquid Feedstock tank will be treated by a carbon filter prior to release to atmosphere. This system is likely to provide beneficial reductions in bioaerosol concentrations between inlet and outlet air due to the impaction of microorganisms onto the media | **Very low** | Full application of the proposed control measures is considered to result in a **very low** residual risk of impact occurring |
| Air expelled from the Manure Reception Building abatement system stack | **Very Low** at R1 and R2 due the distance between source and receptors, the frequency of winds blowing towards the location and the limited release potential due to treatment using the Centriair abatement system | **Medium** | **Low** | The proposed abatement system is likely to provide beneficial reductions in bioaerosol concentrations between inlet and outlet air due to the use of $NH_3$ scrubbing and ColdOx UV treatment. In addition, impaction of microorganisms onto the carbon media is likely to contribute to reductions<br><br>Discharge of treated air to atmosphere via a dedicated stack will help to promote effective dilution and dispersion of any residual components | **Very Low** | Full application of the proposed control measures is considered to result in a **very low** residual risk of impact occurring |
| Digestate Storage Lagoon Carbon Filter | **Very low** at R1 and R2 due the distance between source and receptors and the low release potential due to carbon filtration of air | **Medium** | **Low** | The wet nature of digestate within the lagoon is likely to limit the bioaerosol release potential<br><br>The Digestate Storage Lagoon will provide containment of digestate and associated emissions<br><br>The Digestate Storage Lagoon will be inspected regularly by site operatives in | **Very Low** | Full application of the proposed control measures is considered to result in a **very low** residual risk of impact occurring |

| Source | Probability of exposure | Harm | Magnitude of Risk | Control Measures | Residual Risk | Justification for Residual Risk |
|---|---|---|---|---|---|---|
| | | | | order to ensure that it is providing effective containment of emissions | | |
| Digestate Tanker Offtake Carbon Filter | **Very low** at R1 and R2 due the distance between source and receptors and the low release potential due to carbon filtration of air | **Medium** | **Low** | Air displaced by the tankers will be treated by a carbon filter prior to release to atmosphere. This system is likely to provide beneficial reductions in bioaerosol concentrations between inlet and outlet air due to the impaction of microorganisms onto the media | **Very low** | Full application of the proposed control measures is considered to result in a **very low** residual risk of impact occurring |
| Solid digestate within the separator bunker and during loading | **Low** at R1 due to the distance between the source and receptor, the frequency of winds blowing towards the locations and the level of containment of the source<br>**Very Low** at R2 due to the distance between the source and receptors, the frequency of winds blowing towards the locations and the level of containment of the source | **Medium** | **Low** to **Medium** | Solid digestate will be removed from site daily to avoid storage of significant amounts and associated emissions<br>Enclosure of the solid digestate within the covered bunker will reduce the potential for surface wind stripping of microorganisms<br>The drop height of material will be minimised as far as practicable during loading into trailers in order to limit agitation and the associated potential for emissions | **Low** | Full application of the proposed control measures is considered to result in a **low** residual risk of impact occurring |
| $CO_2$ recovery plant vent | **Very low** at R1 and R2 due the distance between source and receptors, the frequency of winds blowing towards the locations and the limited release potential | **Medium** | **Low** | The $CO_2$ recovery process includes multiple treatment stages which are likely to provide beneficial reductions in bioaerosol concentrations. It is anticipated that the residual release potential via the vent serving the process will be limited | **Very low** | Full application of the proposed control measures is considered to result in a **very low** residual risk of impact occurring |

6.1.2 As shown in Table 7, the results of the assessment indicated residual risk from all sources was determined as **very low** or **low**. As such, it is concluded that no further control measures, other than those specified, are required in order reduce the potential for impacts at sensitive locations in the vicinity of the site.

# 7.0 CONCLUSION

7.1.1 Redmore Environmental Ltd was commissioned by Earthcare Technical Ltd to undertake a SSBRA in support of an Environmental Permit Application for Horse Close AD Plant, Northamptonshire.

7.1.2 During the operation of the facility there is the potential for bioaerosol emissions and associated impacts at sensitive receptor locations in the vicinity of the site. A Risk Assessment was therefore undertaken to identify potential emission sources and evaluate effects in the local area.

7.1.3 The following potential bioaerosol emission sources were identified:

- Exposed crop feedstocks and straw within the clamp area during delivery and storage;
- Straw Processing Building;
- Exposed extruded Straw;
- Exposed crop feedstocks and extruded straw during transfer;
- Exposed materials within the Feed Hoppers;
- Liquid Feedstock Tank carbon filter;
- Emissions from the abatement system which will be used to treat air extracted from the Manure Reception Building;
- Air expelled from vents serving the Digestate Storage Lagoon;
- Air expelled from the Digestate Tanker offtake carbon filter;
- Solid digestate within the separator bunker and during loading; and,
- $CO_2$ recovery plant vent.

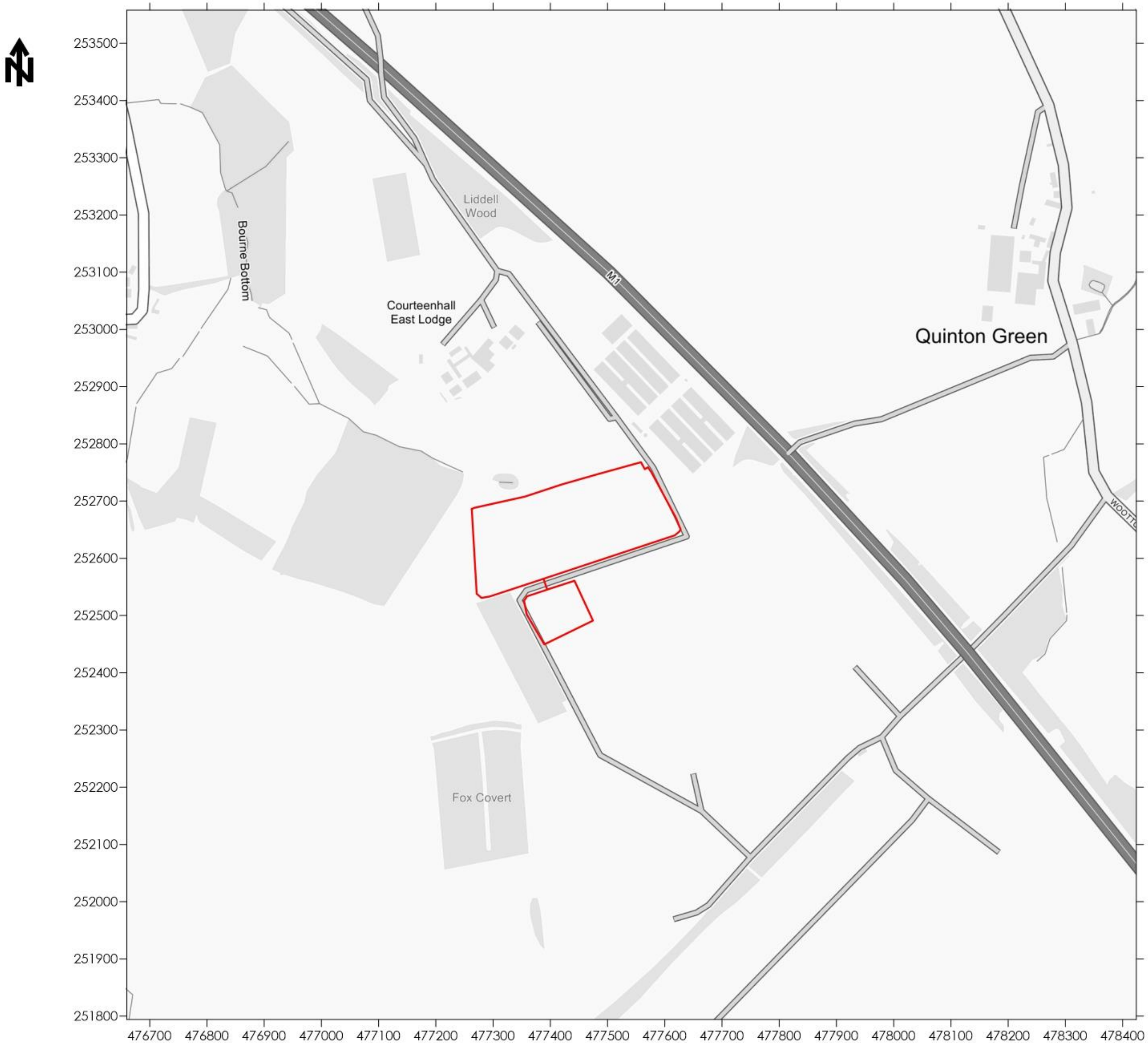
7.1.4 The risk of significant bioaerosol impact at sensitive locations in the vicinity of the site for each of the identified sources was assessed using a source - pathway - receptor approach. This considered the nature of the potential emission, any barriers to dispersion and the severity of harm.

7.1.5 The results of the assessment indicated residual risk from all sources was determined as **low** or **very low**. As such, it is concluded that no further control measures, other than those detailed in the assessment, are required in order to reduce the potential for impacts at sensitive locations in the vicinity of the site.

## 8.0 ABBREVIATIONS

| | |
|---|---|
| AD | Anaerobic Digestion |
| ABL | Acorn Bioenergy Operations Ltd |
| BAT | Best Available Technique |
| CFU | Colony Forming Units |
| $CH_4$ | Methane |
| CHP | Combined Heat and Power |
| $CO_2$ | Carbon dioxide |
| CPS | Central Pumping Station |
| DEFRA | Department for Environment, Food and Rural Affairs |
| EA | Environment Agency |
| EV | Electric Vehicle |
| HGV | Heavy Goods Vehicle |
| $H_2S$ | Hydrogen sulphide |
| IVC | In-Vessel Composting |
| NGR | National Grid Reference |
| RPS | Regulatory Position Statement |
| SNIFFER | Scotland and Northern Ireland Forum for Environmental Research |
| SSBRA | Site Specific Bioaerosol Risk Assessment |
| TPA | Tonnes per Annum |
| TCM | Technically Competent Manager |
| UV | Ultra Violet |
| VOC | Volatile Organic Compound |

# Figures




**Legend**

Site Boundary

**Title**
Figure 1 - Site Location Plan

**Project**
Bioaersol Risk Assessment
Horse Close AD Plant,
Northamptonshire

**Project Reference**
8876

**Client**
Earthcare Technical Ltd

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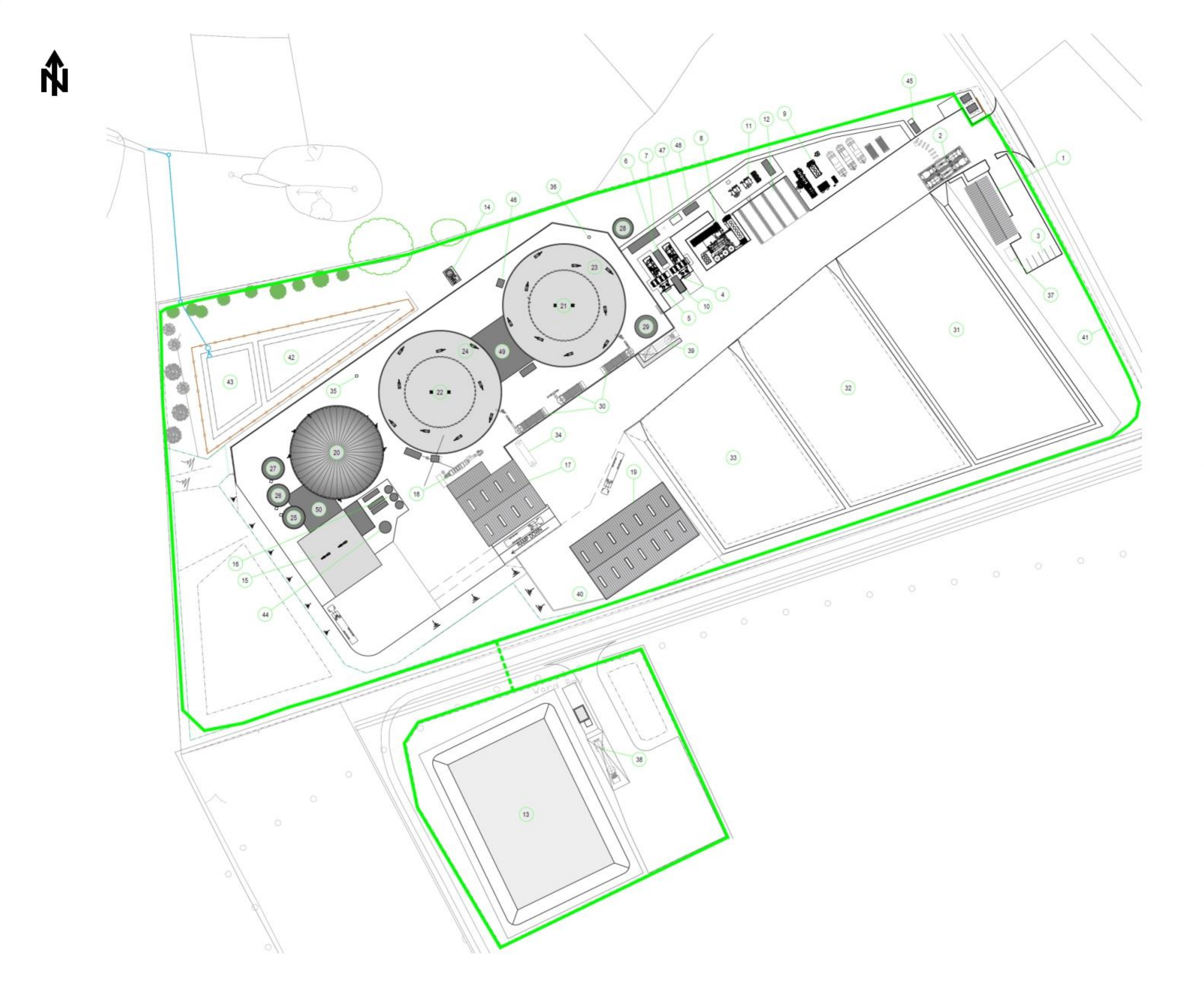

**Legend**

**Title**
Figure 2 - Site Layout Plan

**Project**
Bioaersol Risk Assessment
Horse Close AD Plant,
Northamptonshire

**Project Reference**
8876

**Client**
Earthcare Technical Ltd

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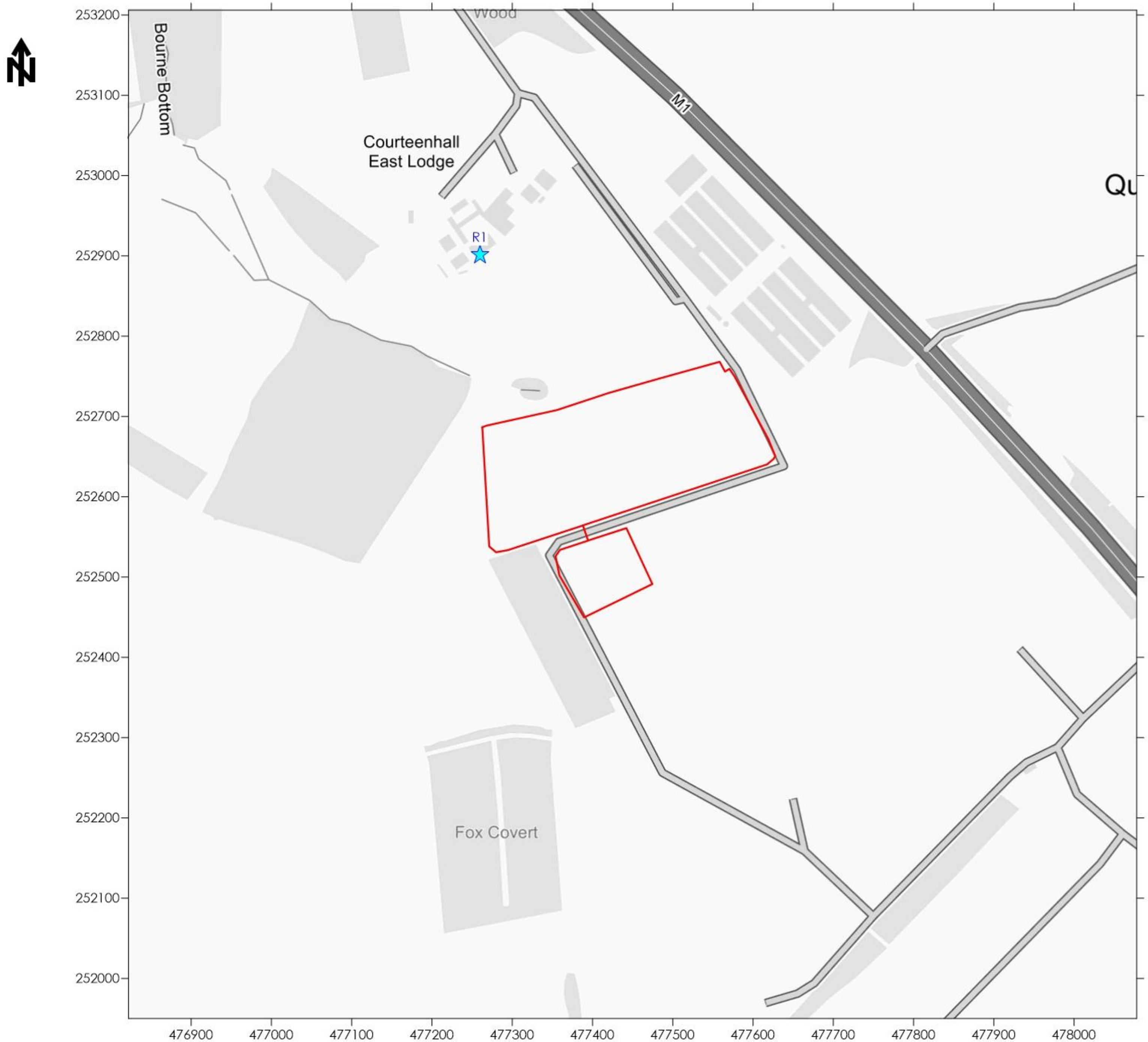


**Legend**

Site Boundary

Sensitive Receptor

**Title**

Figure 3 - Sensitve Receptor Locations

**Project**

Bioaersol Risk Assessment
Horse Close AD Plant,
Northamptonshire

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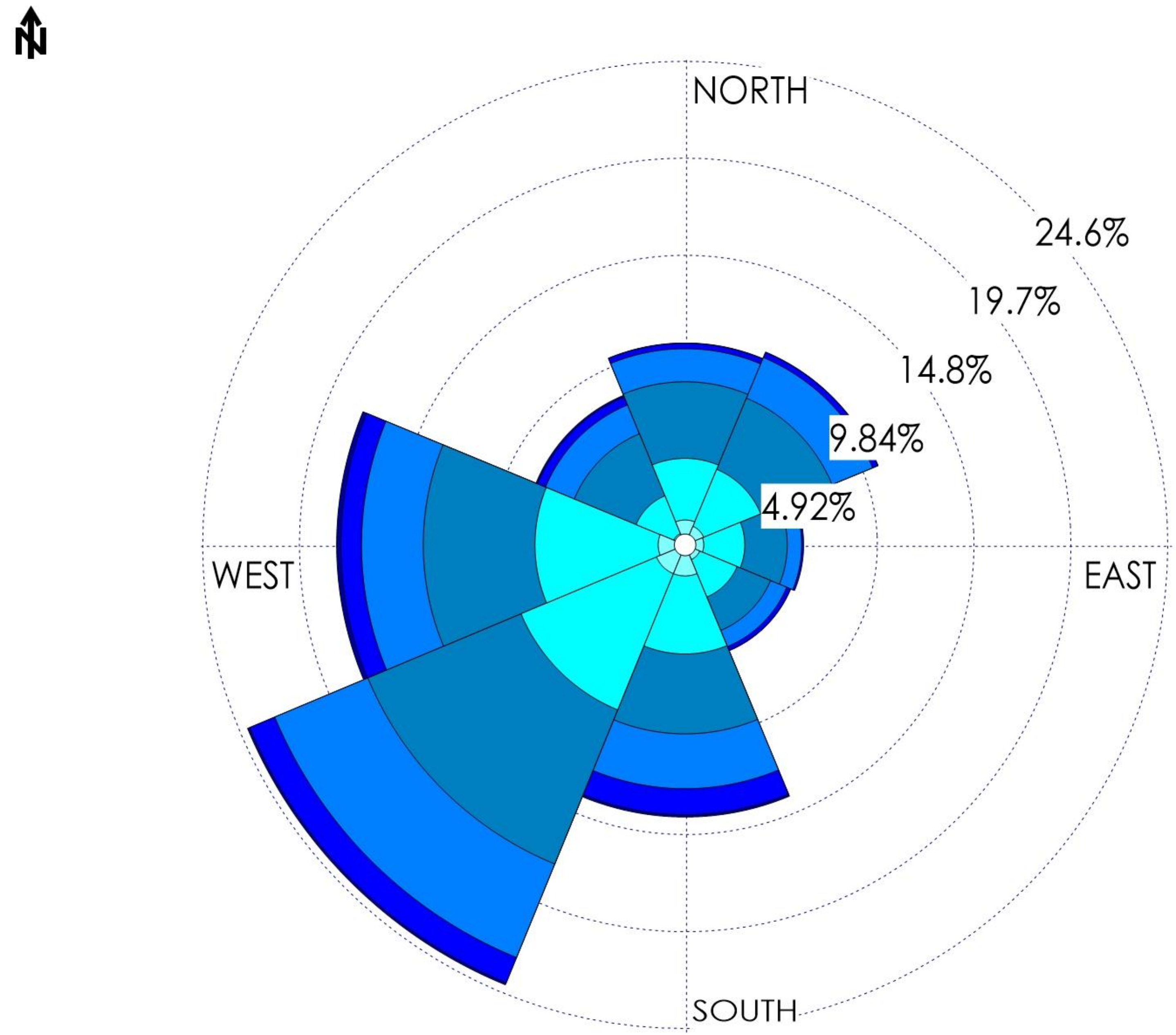


**Legend**

WIND SPEED (m/s)

- >= 11.10
- 8.00 - 11.10
- 5.70 - 8.00
- 3.60 - 5.70
- 2.10 - 3.60
- 0.50 - 2.10

Calms: 2.45%

**Title**
Figure 4 - Wind Rose of 2019 to 2023 Bedford Meteorological Data

**Project**
Bioaersol Risk Assessment
Horse Close AD Plant,
Northamptonshire

**Project Reference**
8876

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