MOTT MACDONALD

Goddards Green Sludge Treatment Centre Environmental Permit Application

Bioaerosol risk assessment
790101_ERA_BioRA_GOD

March 2024

Mott MacDonald
4th Floor
Mountbatten House
Grosvenor Square
Southampton SO15 2JU
United Kingdom

T +44 (0)23 8062 8800
mottmac.com

Goddards Green Sludge Treatment Centre Environmental Permit Application

Bioaerosol risk assessment
790101_ERA_BioRA_GOD

March 2024

Issue and Revision Record

Revision	Date	Originator	Checker	Approver	Description
A	March 2022	H.Whalley	J.Burnell	C. Mills	First Draft
B	May 2022	H.Whalley	S. Stone	A. Manns	Second Draft
C	Aug 2022	H.Whalley	S. Stone	A. Manns	Final Draft
D	Jan 2024	H.Cheung	J.Dicks	A. Manns	Update to 500m assessment area
E	March 2024	I. Moss	S. Stone	A. Manns	Resubmission

Document reference: 790101_ERA_BioRA_GOD March 2024

Information class: Standard

Contents

1 Introduction

1.1 Overview

Southern Water is applying for a varied environmental permit to operate their sludge treatment facility at the Goddards Green Wastewater Treatment Works (WTW) and Sewage Treatment Centre (STC) ('the Site'). Sludge treatment activity is covered by the Environmental Permitting Regulations (EPR) 2016, which incorporates the application of the Industrial Emissions Directive (IED). The Site currently operates under a T21 exemption and has two environmental permits: one for waste activities (REF: EPR/WP3695HW) and one for combustion activities (REF: EPR/JP3137QB).

Regulatory Position Statement 209[1], issued 23 January 2018 by the Environment Agency, states that all sites that have a permit for the treatment of biological waste within 250 metres of a sensitive receptor (a place where people live or work for more than 6 hours at a time) must carry out a site-specific bioaerosol risk assessment. As a sensitive receptor is found within 250m of the Site boundary, a bioaerosol risk assessment has been undertaken to accompany the permit application for this Site.

This bioaerosol risk assessment has assessed the magnitude of risk from potential emissions of bioaerosols from the Site at nearby sensitive human health receptors. The assessment has been undertaken in accordance with the methods and principles outlined in Environment Agency's "*Guidance on the evaluation of bioaerosol risk assessments for composting facilities*"[2].

1.2 Site location

The Site is located to the north of the A2300, off Cuckfield Road, and lies in a semi-rural location approximately 3km north-west of Burgess Hill. The Site is surrounded by agricultural land to the north, east and west of the Site, and an industrial estate beyond the A2300 to the south of the Site.

The layout of the Site is shown in document reference 790101_MSD_SiteLayoutPlan_GOD March 2024. The Site includes four anaerobic digesters which are located in the southern half of the Site.

[1] Environment Agency (2018) Bioaerosol monitoring at regulated facilities - use of M9: RPS 209. Available online at: https://www.gov.uk/government/publications/bioaerosol-monitoring-at-regulated-facilities-use-of-m9-rps-209/bioaerosol-monitoring-at-regulated-facilities-use-of-m9-rps-209

[2] Drew, G.H., Deacon, L.J., Pankhurst, L., Pollard, S.J.T. and Tyrrel, S.F. (2009). Guidance on the evaluation of bioaerosol risk assessments for composting facilities. Environment Agency.

2 Methodology

2.1 Overview

Bioaerosols are naturally present in the air, but they are also associated with composting, anaerobic digestion (AD) and mechanical biological treatment, which are the main processes used to treat organic waste in the UK.

Bioaerosols are micro-organisms which are suspended in the air; these can include bacteria, fungi and viruses, or parts of living organisms, such as spores and plant pollen. Bioaerosols range in size from 0.02-100µm but are generally smaller than 10µm in diameter so can easily be breathed into the human respiratory system where they can cause adverse health impacts such as respiratory and gastrointestinal illnesses. Especially relevant to waste treatment facilities are infections of the respiratory system caused by *Aspergillus fumigatus*, which can be fatal, especially for at-risk and immuno-compromised patients. Bioaerosols can also cause eye irritation and dermatitis if they come into contact with the eyes and skin.[3]

2.2 Guidance

There is minimal regulatory guidance available for assessing bioaerosol emissions from AD facilities. Regulatory Position Statement (RPS) 031[4] states that bioaerosol concerns would normally be associated with composting activities, which are defined as: *'biological decomposition of biodegradable waste under conditions that are predominantly aerobic and that allow the development of thermophilic temperatures as a result of biologically produced heat'*.

This RPS also defines operations which are *'likely to result in the uncontrolled release of high levels of bioaerosols'* as including '*the shredding of waste and the turning of waste in the sanitisation, stabilisation and maturation stages of composting where these operations are not contained or are not subject to exhaust ventilation and scrubbing/filtering'*.

These activities do not occur at the Site as the biological decomposition of waste occurs under controlled, anaerobic conditions. Therefore, the Site is unlikely to be a high-risk site for bioaerosol emissions. This is supported by a 2012 Environment Agency guidance note[5] which states that the Environment Agency do not consider bioaerosols from anaerobic digestion to be of serious concern (provided composting activities are not undertaken at the facility).

Nonetheless, current Environment Agency guidance[6] requires any facility which could release bioaerosols to provide a site-specific bioaerosol risk assessment if there are sensitive receptors within 250m of activities. For new permits there is also a requirement to monitor bioaerosols if the Site is within 250m of a sensitive receptor[7].

[3] Drew, G.H., Deacon, L.J., Pankhurst, L., Pollard, S.J.T. and Tyrrel, S.F. (2009). Guidance on the evaluation of bioaerosol risk assessments for composting facilities. Environment Agency.

[4] Environment Agency. 2011. Composting and potential health effects from bioaerosols: our interim guidance for permit applicants. Regulatory Position Statement 031.

[5] Environment Agency. 2012. Guidance for developments requiring planning permission and environmental permits' (England)

[6] Environment Agency (2018) Bioaerosol monitoring at regulated facilities - use of M9: RPS 209. Available online at: https://www.gov.uk/government/publications/bioaerosol-monitoring-at-regulated-facilities-use-of-m9-rps-209/bioaerosol-monitoring-at-regulated-facilities-use-of-m9-rps-209

[7] *"Sensitive receptor – any building, other structure or installation, in which at least one person normally lives or works, other than a building, structure or installation within the same ownership or control as the operator/owner of the composting facility."* Taken from 'Guidance on the evaluation of bioaerosol risk assessments for composting facilities.'

However, following a Schedule 5 notice from the Environment Agency for another similar WTW, a conservative approach has been undertaken and human receptors within 500m of the Site have been considered instead of the 250m specified in the Environment Agency guidance[8].

2.3 Methodology

The method used for this bioaerosol risk assessment is adapted from the Environment Agency's '*Guidance on the evaluation of bioaerosol risk assessments for composting facilities*'[9], which recommends using a Source-Pathway-Receptor model to help determine the magnitude of the risk associated with bioaerosol emissions from a facility.

The magnitude of risk is a function of both the probability of exposure and the consequences of the hazard. The probability of exposure to bioaerosols can be described as:

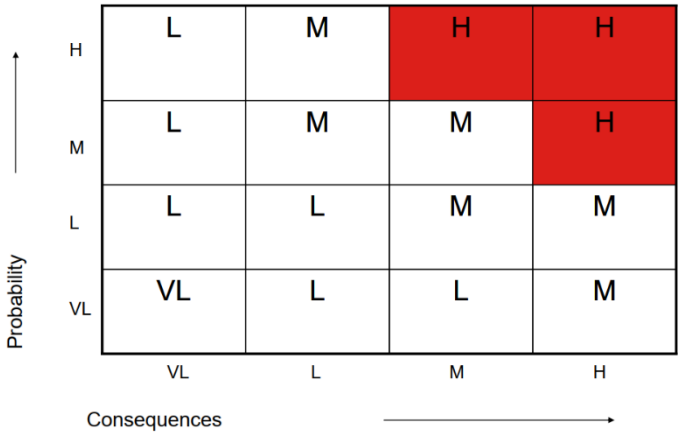
- High – exposure is probable, direct exposure likely with no/few barriers between source and receptor
- Medium – exposure is fairly probable, barriers less controllable
- Low – exposure unlikely, barriers exist to mitigate
- Very low – exposure very unlikely, effective and multiple barriers

The consequence of the hazard considers the nature of the source, the hazard and receptor. These consequences can be described as:

- 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
- Very low – negligible consequences, no evidence for adverse changes

The probability of exposure and consequence of the hazards are then combined to determine the overall magnitude of the risk, as demonstrated in Figure 2.1.

Figure 2.1: Magnitude of risk matrices



[8] Environment Agency (2018) Bioaerosol monitoring at regulated facilities - use of M9: RPS 209. Available online at: https://www.gov.uk/government/publications/bioaerosol-monitoring-at-regulated-facilities-use-of-m9-rps-209/bioaerosol-monitoring-at-regulated-facilities-use-of-m9-rps-209

[9] Drew, G.H., Deacon, L.J., Pankhurst, L., Pollard, S.J.T. and Tyrrel, S.F. (2009). Guidance on the evaluation of bioaerosol risk assessments for composting facilities. Environment Agency.

Source: Environment Agency, 2009

For this bioaerosol risk assessment, a Source-Pathway-Receptor model has been used to help assess the probability of exposure associated with different processes at the Site (Section 3). Existing control measures have also been identified to help inform the probability of exposure (Section 4). This has then been combined with the consequence of the hazard in Section 5 to determine the overall magnitude of risk associated with the different sources of bioaerosols at the Site, using the risk matrix above.

3 Source – Pathway – Receptor model

3.1 Overview

This section provides a summary of the sources of bioaerosols at the Site and the potential pathways that the bioaerosols could travel to sensitive human health receptors.

3.2 Sources

3.2.1 Overview

The Site includes the following assets which could release bioaerosols:

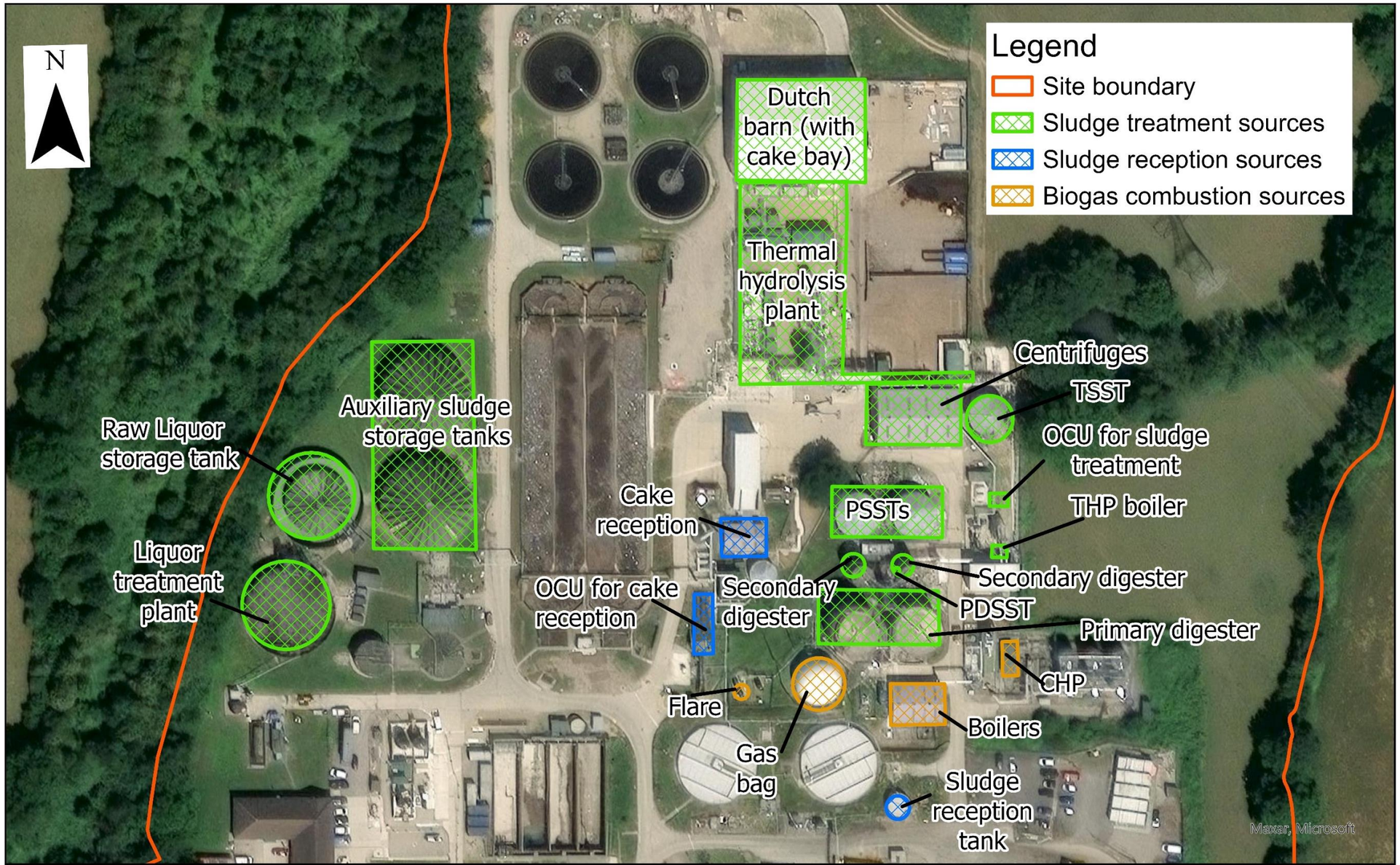
- Sludge reception and cake reception
- Storage tanks:
  - 2 No. Post Screening Storage Tanks (500m^3 each)
  - 2 No. Post Digestion Storage Tanks (384m^3 each)
  - 2 No. Auxiliary Sludge Storage Tank (2,500m^3 each)
  - 1 No. Thickened Sludge Storage Tank (400m^3)
  - 1 No. Cake blending tank (57m^3)
  - 1 No. Sludge reception tank (98m^3)
  - 1 No. Raw Liquor Storage Tank (aka CASS plant) (2,500m^3)
- 2 No. Boilers (duty and standby) (0.88 MWth each)
- 1 No. Biogas fuelled CHP (1.79 MWth)
- 1 No. Diesel generator (1.73 MWth)
- 1 No. Auxiliary diesel generator (0.43 MWth)
- 1 No. Biogas burner (flare)
- 2 No. Odour Control Units serve the STC area
- 2 No. Primary Digesters (3,960m^3)
- 2 No. Secondary Digesters (312m^3 each)
- 1 No. Gas Bag (920m^3)
- 1 No. Liquor Treatment Plant (2,626m^3)
- 1 No. Cake bay (stored in Dutch barn)
- 2 No. Centrifuges (duty and standby) in centrifuge building
- 1 No. THP
- 1 No. THP Boiler (1.11 MWth when operating on biogas)

The following processes undertaken at the Site involving these assets, therefore, have the potential to release bioaerosols:

- Sludge/cake reception and distribution
- Sludge treatment (sludge storage, thickening, digesters, centrifuges and cake bay)
- Biogas combustion

Figure 3.1 shows the locations of these different processes and assets across the Site. A summary of the activities which occur at the Site involving these assets is then presented below.

Figure 3.1: Potential sources of bioaerosols at the Site



3.2.2 Cess/sludge/cake reception and distribution

Currently the Site accepts cess, and both imported and indigenous sludge and cake waste derived from the wastewater treatment process. On average the Site accepts 44 tankers containing sludge, cess, septic, and chemical toilet waste. This consists of approximately 21 tankers per day of liquid sludge imports, and an average of 23 tankers of imported cess, septic and chemical toilet waste per day is accepted at the Site. All imported liquid waste and sludges are transported in enclosed tankers and liquid sludge is unloaded via a hose.

3.2.3 Sludge treatment

The Site treats indigenous sludge from the wastewater treatment processes as well as imported liquid sludge and cake. Imported sludge and indigenous sludge is screened by strain presses then thickened by drum thickeners. Imported sludge cake is then blended with the indigenous liquid sludge and screened in strain presses. The blended and thickened sludge is mixed and stored in a TSST.

The sludge from the TSST is then fed into the anaerobic digesters. The anaerobic digestion process provides a controlled environment where micro-organisms, including bacteria and fungi, can grow, multiply and break-down organic material to form water, carbon dioxide and methane (biogas). Secondary digesters are available at the Site for advanced anaerobic digestion (AAD), but these are currently not operated. In the future, once the thermal hydrolysis reactor has been installed, the secondary digestions will be used for the AAD process.

After digestion, the sludge is stored in two PDSST before being dewatered by the centrifuges and treated with lime. The resulting cake is then transferred to the cake bay which is within the Dutch Barn, this allows the cake to mature before it is recycled to farmland.

Sludge liquors from the drum thickeners is pumped to the raw liquor storage tank and then fed to the liquor treatment plant. Treated liquor is then combined with the liquid effluent treated in the aeration lanes in the wastewater treatment processes.

3.2.3.1 Odour control

Two OCUs serve the STC. Odours are drawn from covered process tanks and buildings to the OCUs where odorous chemicals are removed by biological actions and absorption.

3.2.4 Biogas combustion

Biogas produced by the digesters during anaerobic digestion is transferred to the gas bag and then to the CHP/backup boilers where it is combusted to generate heat and electricity, which is used on-site to assist with the wastewater and sludge treatment processes. When more biogas is produced on-site than can be combusted within the CHP and there is insufficient space in the gas bag to store surplus biogas, excess biogas is sent to the flare to be burned. However, the flare is only used for approximately 20-30 hours per year during emergencies and maintenance of the CHP engines.

3.3 Pathways

Bioaerosols are very small and light in weight so can easily be transport by the wind from their source to a receptor. The 2019-2023 wind rose for the nearest meteorological site, Shoreham Airport (located approximately 17.3km south west of the Site), is shown in Figure 3.2.This monitoring site experiences strong prevailing winds from the south west, with frequent mild winds from the north. However, this meteorological site is located within a wide valley by the

coast which channels winds from the north, resulting in the frequent mild northerly winds. The Site is in a more sheltered location from winds from the north as to the north of the Site are a crest of hills within the South Downs National Park. Therefore, an atmospheric hindcast model (Vortex) has also been used to assess the wind conditions at the Site.

The Vortex model uses historic ERA5 data from the European Centre for Medium-Range Weather Forecasts (ECMWF) and works by combining past meteorological data with current weather models. This allows meteorological parameters, such as wind speed and direction, to be predicted at any location for any time period from the past 40 years, accounting for some localised effects. The data from this model is a popular dataset for climate modellers and is used by the World Meteorological Organization for their annual State of the Climate report.

Figure 3.3 presents the wind rose generated for the Site from the Vortex model for the period from 2019-2022. The wind rose demonstrates that historically this location experiences strong prevailing winds from the south west, with occasional gusts from the north east. This suggests that sensitive receptors located to the north east of the Site would be at the greatest risk from bioaerosol emissions from the Site as they would be downwind of the prevailing wind direction.

Overall, the two datasets show general agreement with the modelled data indicating the predominant wind originating from a south westerly direction.

Figure 3.2: Average wind rose for Shoreham Airport meteorological site 2019-2023

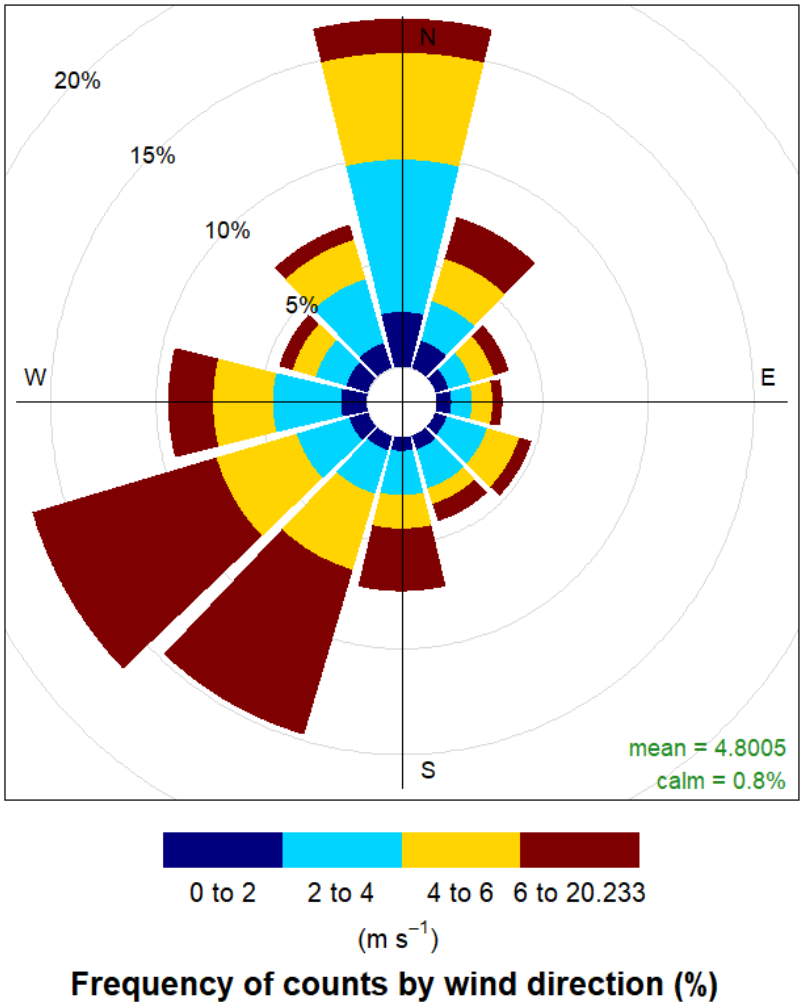
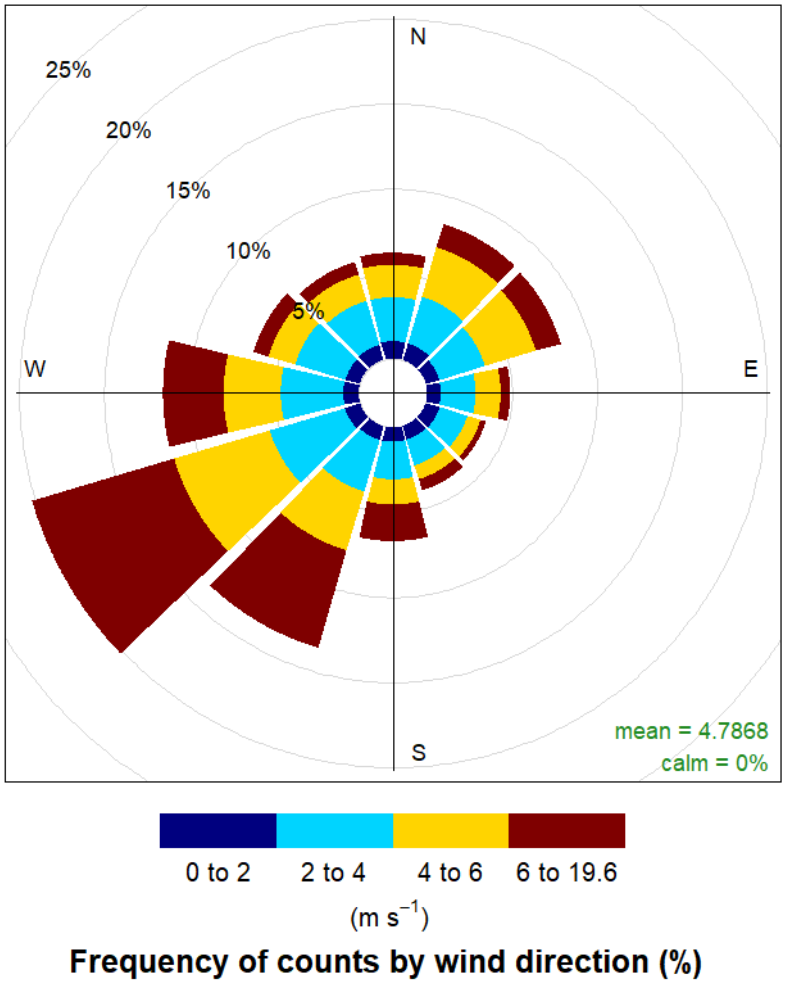


Figure 3.3: Average wind rose for the Site from the Vortex model, 2019-2023



Concentrations of bioaerosols decline rapidly within the first 100m from a source and generally decrease to background concentrations within 250m[10,11]. Much of the Site is screened by trees and heavy vegetation. This could present a natural barrier to the transportation of bioaerosols by the wind. However, this would be dependent on the release height of bioaerosols on Site. The area surrounding the Site has relatively flat terrain.

3.4 Receptors

Although Environment Agency guidance[12] recommends a screening distance of 250m from bioaerosol emission sources to static receptor locations, a screening distance of 500m has been used as a conservative approach. Sensitive receptors are defined as:

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

There is six sensitive receptors found within 500m of potential bioaerosol emission sources at the Site. As demonstrated in Figure 3.4, three areas of residential land use are located to south east, south west and north west of the Site, whilst two areas of industrial land use are located to south east and south west of the Site and one area of hospital land use to the south of the Site. The nearest of these areas to a potential bioaerosol source is the area of industrial land use approximately 200m south of the Liquor treatment plant.

For these six areas of receptors, the distance and direction from each potential bioaerosol emission source on Site to the receptors has been identified below in Table 3.1. Where multiple assets exist for the same process, such as digesters or settlement tanks, only the closest asset to the receptors has been presented.

[10] Environment Agency. 2011. Composting and potential health effects from bioaerosols: our interim guidance for permit applicants. Regulatory Position Statement 031.

[11] Health and Safety Executive, 2010. Bioaerosol emissions from waste composting and the potential for workers' exposure.

[12] Environment Agency (2018) Technical Guidance Note (Monitoring) M9 – Environmental monitoring of bioaerosols at regulated facilities. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/730226/M9_Environmental_monitoring_of_bioaerosols_at_regulated_facilities.pdf

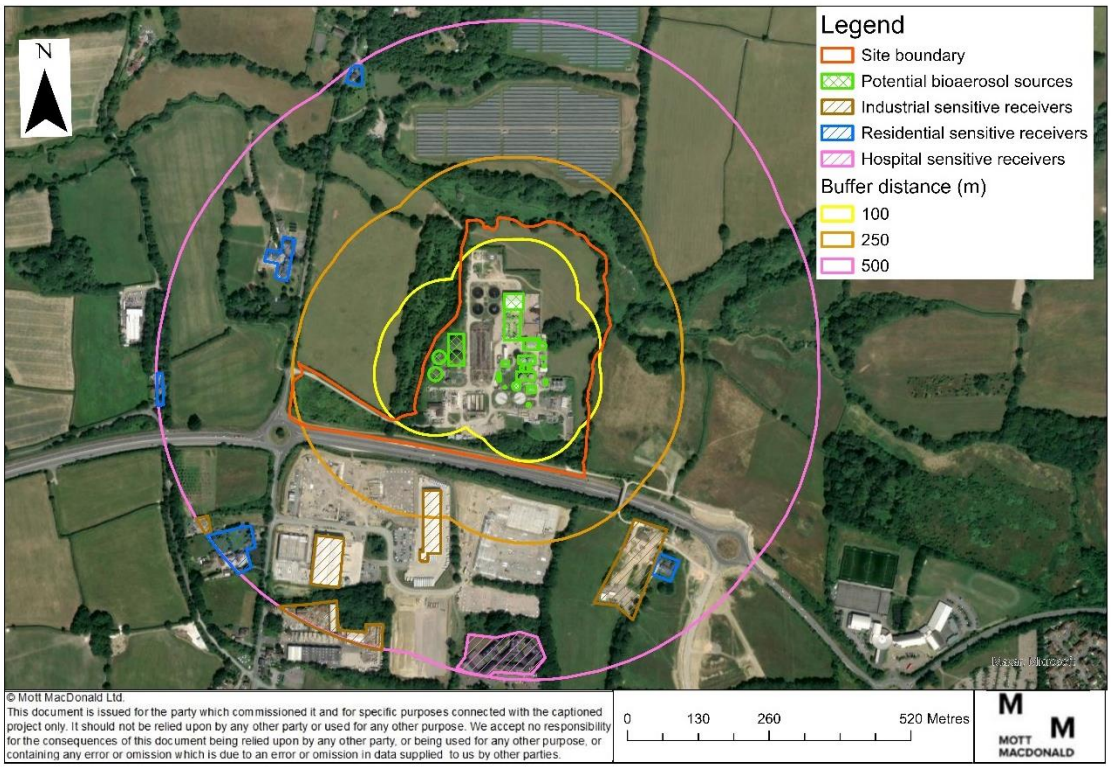
Table 3.1: Receptors within 500m of potential emission sources at the Site

Nearest potential emission source to receptor	Process	Distance (m) and direction of different receptors[a] from nearest potential emission source [b]					
		Residential land use to southeast of the Site (m)	Residential land use to southwest of the Site (m)	Residential land use to northwest of the Site (m)	Industrial land use to southeast of the Site (m)	Industrial land use to southwest of the Site (m)	Hospital land use to south of the Site (m)
Sludge reception tank	Sludge/cake reception and distribution	360, southeast	555, southwest	495, northwest	285, southeast	**220**, southwest	410, south
Cake reception	Sludge/cake reception and distribution	440, southeast	550, southwest	420, northwest	360, southeast	**250**, southwest	485, south
OCU for cake reception	Sludge/cake reception and distribution	430, southeast	525, southwest	420, northwest	350, southeast	**225**, southwest	460, south
Auxiliary sludge storage tank	Sludge treatment	495, southeast	465, southwest	310, northwest	420, southeast	**230**, southwest	490, south
Anaerobic digesters	Sludge treatment	390, southeast	555, southwest	455, northwest	315, southeast	**245**, southwest	460, south
PSSTs	Sludge treatment	415, southeast	575, southwest	445, northwest	335, southeast	**270**, southwest	490, south
Centrifuges	Sludge treatment	435, southeast	595, southwest	445, northwest	355, southeast	**300**, southwest	515, south
TSST	Sludge treatment	430, southeast	630, southwest	475, northwest	355, southeast	**320**, southwest	520, south
Thermal hydrolysis plant	Sludge treatment	450, southeast	575, southwest	400, northwest	370, southeast	**295**, southwest	535, south
Dutch Barn (with cake bay)	Sludge treatment	510, southeast	610, southwest	400, northwest	435, southeast	**350**, southwest	590, south
OCU for sludge treatment	Sludge treatment	415, southeast	615, southwest	490, northwest	335, southeast	**305**, southwest	500, south
Raw Liquor storage tank	Sludge treatment	530, southeast	455, southwest	300, northwest	455, southeast	**230**, southwest	495, south
Liquor treatment plant	Sludge treatment	515, southeast	425, southwest	310, northwest	445, southeast	**200**, south	465, southeast
PDSST	Sludge treatment	415, southeast	585, southwest	470, northwest	335, southeast	**275**, southwest	480, south
THP Boiler	Sludge treatment	400, southeast	610, southwest	495, northwest	325, southeast	**295**, southwest	485, south
Gas bag	Biogas combustion	395, southeast	545, southwest	455, northwest	320, southeast	**230**, southwest	445, south

Nearest potential emission source to receptor	Process	Distance (m) and direction of different receptors[a] from nearest potential emission source [b]					
		Residential land use to southeast of the Site (m)	Residential land use to southwest of the Site (m)	Residential land use to northwest of the Site (m)	Industrial land use to southeast of the Site (m)	Industrial land use to southwest of the Site (m)	Hospital land use to south of the Site (m)
CHP unit	Biogas combustion	370, southeast	595, southwest	505, northwest	295, southeast	**270**, southwest	455, south
Boilers	Biogas combustion	375, southeast	565, southwest	480, northwest	295, southeast	**240**, southwest	440, south
Flare	Biogas combustion	415, southeast	530, southwest	445, northwest	335, southeast	**220**, southwest	445, south

Note: (a) Number refers to the receptor number presented within Figure 3.4.
(b) Distance from source to receptor is rounded to the nearest 5m
Value in bold represents the nearest potential emission source for each process which is closest to a sensitive receptor.

Figure 3.4: Sensitive receptors within 500m



3.5 Summary

Table 3.2 below summarises the potential sources of bioaerosol emissions at the Site, the sensitive receptors most at risk and the pathways through which the bioaerosols could travel from source to receptor.

Table 3.2: Source-Pathway-Receptor model

Source process	Potential emission source	Pathway	Nearest receptor
Sludge/cake reception and distribution	Sludge reception tank	Air transport then: • Inhalation (through nose or mouth) • Ingestion (eating or swallowing) • Absorption/contact (through skin or eyes) • Injection (by high pressure equipment/ contaminated sharp objects)	Industrial site - 220m southwest
	Cake reception		Industrial site - 250m southwest
	OCU for cake reception		Industrial site - 225m southwest
Sludge treatment	Auxiliary sludge storage tanks		Industrial site - 230m southwest
	Anaerobic digesters		Industrial site - 245m southwest
	PSSTs		Industrial site - 270m southwest
	Centrifuges		Industrial site - 300m southwest
	TSST		Industrial site - 320m southwest

Source process	Potential emission source	Pathway	Nearest receptor
	Thermal hydrolysis plant		Industrial site - 295m southwest
	Dutch barn (with cake bay)		Industrial site - 350m southwest
	OCU for sludge treatment		Industrial site - 305m southwest
	Raw liquor storage tank		Industrial site - 230m southwest
	Liquor treatment plant		Industrial site - 200m south
	PDSST		Industrial site - 275m southwest
	THP boiler		Industrial site – 295m southwest
Biogas combustion	Gas bag		Industrial site - 230m southwest
	Combined Heat and Power (CHP) unit		Industrial site - 270m southwest
	Boilers		Industrial site - 240m southwest
	Flare		Industrial site - 220m southwest

4 Control measures

4.1 Overview

The three primary ways to mitigate emissions of bioaerosols[13] is to:

- Reduce emissions
- Contain emissions
- Enhance dispersion

The sections below outline the different control measures in place at the Site for sludge reception cake and distribution, sludge treatment and biogas combustion processes. These control measures aim to reduce and contain emissions of bioaerosols to prevent the source-pathway-receptor link associated with each of the potential emission sources identified in Section 3.5.

4.2 Control measures

4.2.1 Sludge/cake reception and distribution

The transfer of liquid sludge from the tankers has a short duration and, under normal operations takes place up to 20 times a day for liquid sludge. Therefore, the potential for release of bioaerosols is minimal. Tankers are unloaded via hose directly into the respective imported cess and sludge storage tank.

The Site also receives imports of cake. During normal operation, the Site will generally receive deliveries of between 1 and 3 trucks a day. These imports arrive to the Site via covered tipper trucks and are offloaded directly into strain press. As with the tanks, the unloading of cake from the trucks has a short duration so the potential for release of bioaerosols is minimal.

Unloading and loading procedures are also designed to limit emissions. For example, covered trucks will only able to unload imported cake once the shutters in the building are closed. Meanwhile, during loading, processed cake is transported via a conveyor belt from the centrifuges to cake bays. The handling of cake in the bays is through the use of telehandlers. When cake is removed off-site each vehicle is then covered prior to leaving the loading bay in the cake storage/ loading area.

If a spillage of sludge/cake occurs, operators will carry out clean up as soon as possible (using disinfectant where necessary). If the spillage is caused by a lorry or tanker, the driver is responsible for cleaning up the spill before leaving the Site. If a lorry or tanker left a spillage behind, operators will log and report any incident observed and the driver or company involved will be asked to return to the Site immediately to clean up. Significant spillage incidents will be recorded in the Site diary.

Appropriate wash up facilities are also provided for drivers to clean the vehicles after loading or unloading in sludge storage bays and loading points. Lorry and tanker drivers are required to hose down any spillage after each loading or unloading and clean contaminated wheels before leaving the Site.

[13] Wheeler P.A., Stewart, I., Dumitrean, P. and Donovan, B., 2001. Health Effects of Composting: A Study of Three Compost Sites and Review of Past Data. R&D Technical Report P1-315/TR, Environmental Agency, Bristol.

To further limit emissions of bioaerosols at the reception facilities, odours from the cake reception area are extracted and treated. The scrubbed air is then released to atmosphere.

4.2.2 Sludge treatment

4.2.2.1 Containment of emissions

To contain emissions of bioaerosols during sludge treatment, the doors to the building housing the centrifuges are kept closed at all times except when access is required. The cake storage areas are currently uncovered. When access is required for operation and maintenance, the doors to these treatment facilities will only be opened for minimum periods. If access is required for an extended period of time, such as for maintenance activities, additional mitigation measures are implemented to minimise the impact associated with bioaerosols. This includes using spray bars and a wet suppression system on site to suppress odour.

To further contain bioaerosol emissions, all of the tanks used for sludge treatment are covered, and the inlet works, sludge treatment and cake reception are odour controlled.

4.2.2.2 Reduce emissions

Throughout the wastewater sludge treatment process, biological material which could give rise to emissions of bioaerosols is broken down. This primarily occurs during anaerobic digestion which removes microorganisms which could give rise to bioaerosols. Therefore, at each stage of the sludge treatment process, the potential quantity of bioaerosols decreases, reducing the risk of exposure; the concentration of bioaerosols that could potentially be emitted from the PSSTs and cake bays (at the end of the sludge treatment process) is much lower than the sludge prior to anaerobic digestion.

To further reduce potential bioaerosol emissions associated with sludge treatment, sludge produced on-site is processed immediately. This prevents processing of old sludge which is more odorous and difficult to process. Liquid sludge arriving on-site is also processed immediately to help minimise bioaerosol emissions.

4.2.3 Biogas combustion

Biogas produced during anaerobic digestion is stored within the gas bag before being combusted at high temperatures within the CHP, backup boilers or flare. The gas bag stores the biogas within an air-tight container which prevents the release of bioaerosol emissions. During combustion, any bioaerosols present within the biogas would be destroyed. Therefore, emissions of bioaerosols associated with biogas combustion would be de minimis.

4.3 Maintenance of control measures

Daily checks, measurements and sampling of the treatment processes on-site are conducted to ensure the equipment is working correctly. The parameters measured include: sludge blanket thickness, raw sludge volume, turbidity and temperature (full list of parameters monitored are found within the operating plan for the Site). The OCUs also record hydrogen sulphide levels and the Site operator completes sniff tests daily. Where desired operating parameters are not met, various corrective actions and operating procedures are in place to rectify the problem. Performance issues and equipment problems are also reported promptly to the Field Performance Manager or Process Scientist.

Daily, weekly and monthly maintenance tasks/servicing are also performed on key equipment across the Site by Southern Water staff and specialist contractors. Southern Water has also

issued generic maintenance task manuals for use across all their sites which include protocols for the maintenance of equipment such as absorbers, biological filters, fresh air supply ducting, wet scrubber (cleaning, pre-winter service, pH probe calibration, redox probe calibration), direct driven fan, belt driven fan and dryer exhaust ducting.

Currently bioaerosols are not directly monitored, however, future monitoring will be accordance with Environment Agency's Technical Guidance Note (TGN) M9[14] requirements to monitor effectiveness of control measures, where appropriate. Alternatively, the Odour Management Plan requires routine sniff tests and mitigation to odours, and therefore the Plan will indirectly aid the prevention and monitoring of bioaerosol.

The Site has two OCUs serving the STC area. The OCU for the sludge dewatering building is an activated carbon filter. Odours are drawn from covered process tanks and buildings to the OCUs where odorous chemicals are removed by biological actions and absorption. Odour is controlled with an odour removal efficiency of 98% (average and peak) and total flow rate of 7,666 m^3/hour.

Treated odour streams are discharged into the environment through each OCU stack as shown in 790101_SiteLayourPlan_GOD and are monitored hourly to ensure the absence of odorous compounds.

The OCU is maintained in accordance with manufacturer's requirements to ensure treatment of bioaerosols and odours are effective.

Most of the Site operations are fully enclosed or covered with the exception of the cake bays. Diffuse emissions from the cake bays, are minimised by:

- Reducing movement of cake across the Site, cake is only moved when required;
- Limiting, or ceasing, the volume of cake to be dropped during windy weather, to ensure cake lands within the bay walls and limit transport of VOCs and bioaerosols;
- Ensuring the bays receiving cake from the conveyor belt remains sheltered

To minimise odour nuisance, it is important to ensure that the Site is operating as designed. Covers and hatches are replaced to maintain the integrity of enclosures provided to collect odorous air.

The effectiveness of measures to prevent and limit bioaerosols, as well as odour, is undertaken by reviewing the Supervisory Control and Data Acquisition (SCADA) system to identify out of specification operation of assets. Whereby alerts are raised the measures within the Odour Management Plan will be followed to bring the operations in line with normal conditions.

Stocks of chemicals on-site are also carefully managed to ensure there are sufficient stocks of chemicals on-site so that the necessary treatment processes, control measures and maintenance activities can be undertaken when required.

4.4 Emergency procedures

In the event of plant failures or emergency situations, an alarm would be raised on the Site SCADA or telemetry systems, which will be reacted to by on-site or regional control room operators and Duty Managers.

[14] Environment Agency (2018) Technical Guidance Note (Monitoring) M9 - Environmental monitoring of bioaerosols at regulated facilities. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/730226/M9_Environmental_monitoring_of_bioaerosols_at_regulated_facilities.pdf

Depending upon the nature of the fault or emergency, a mechanical or electrical technician, both of whom are on-call 24-hours, would be contacted and would attend the Site as soon as practicable if required. Where the on-call technicians are already engaged upon other response work, there is the facility to access staff from other Southern Water geographic divisions, coordinated by the Duty Manager. All faults, break-downs and emergencies are logged electronically together with records of the action taken and the solutions reached.

One such emergency event would be failure of the flare stack and/or CHP. Such an event would result in releases of biogas from the Whessoe Valves located on the roofs of the digesters and the gas bag, which would release bioaerosols. This occurs to prevent over pressurisation of the digesters and gas systems. While the problem is rectified, biogas generation is reduced by reducing or inhibiting the digester feed by 50%.

4.5 Monitoring

4.5.1 Overview

Bioaerosol emissions associated with the operation of the Site will be monitored in line with the Environment Agency Technical Guidance Note (TGN) M9[15] requirements to monitor effectiveness of control measures.

Sampling of bioaerosols using either impaction, filtration or impingement samplers will be undertaken by an MCERTS accredited organisation. The final approach would be determined prior to appointment in accordance with the requirements of TGN M9.

4.5.2 Monitoring Locations

As detailed in Section 3.3, the prevailing wind direction at the Site is from the south west, therefore, in accordance with TGN M9, three samplers will be positioned to the north east of the Site to capture downwind bioaerosol concentrations and one sampler will be located upwind, to the south west of the Site.

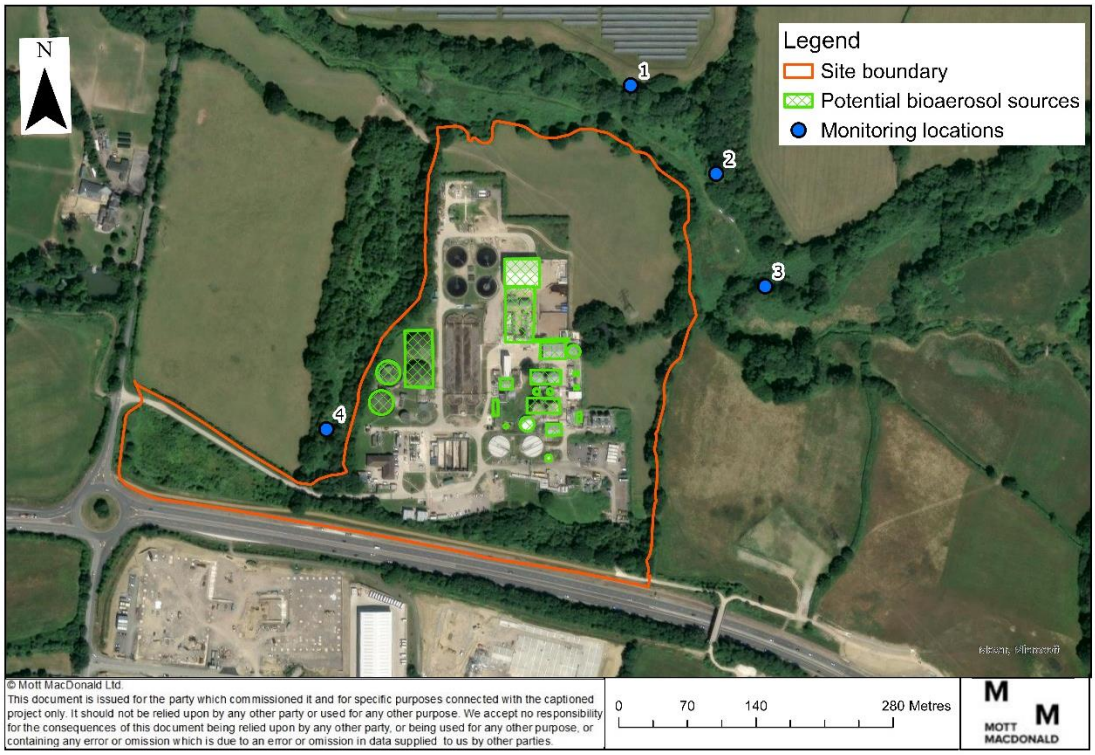
Figure 4.1 presents the indicative sampling locations identified for the Site. Locations 1, 2 and 3 represent the proposed locations for the three downwind samplers and are located at the same distance as the closest sensitive receptor (200m) from the nearest source of bioaerosols. The downwind samplers are arranged in a fan shape to ensure the maximum concentrations of bioaerosols are captured and variable wind directions will be accounted for.

The indicative monitoring location 4 represents the upwind sampler and is positioned approximately 50m from the nearest bioaerosol source. This location will provide a baseline concentration of bioaerosols, representative of background concentrations and any neighbouring sources of bioaerosols, such as agricultural activities, without contributions from the Site.

The exact sampling locations are dependent on the accessibility of each location and will be confirmed by the MCERTS accredited organisation that will conduct the sampling.

[15] Environment Agency (2018) Technical Guidance Note (Monitoring) M9 - Environmental monitoring of bioaerosols at regulated facilities. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/730226/M9_Environmental_monitoring_of_bioaerosols_at_regulated_facilities.pdf

Figure 4.1: Indicative bioaerosols monitoring locations



4.5.3 Sampling methodology and frequency

Appropriate sampling of bioaerosols will be conducted by an MCERTS accredited organisation using procedures relevant to the sampler type, as described in TGN M9. Sampling at the upwind and downwind locations will be undertaken concurrently so that results can be compared. Monitoring will be undertaken on a quarterly basis for the first 12months after permit issue and then six monthly thereafter. Where the bioaerosol action limit is exceeded, then quarterly monitoring will resume until such time that is it demonstrated that the Site has adequate mitigation for a 12-month period. Where it is confirmed that the risk is very low or low, Southern Water will make the decision as to whether further monitoring will be needed and under what circumstances it may need to be resumed, if at all.

Sampling will be undertaken during appropriate weather conditions such as avoiding rain, sleet and snow, depending on the sampling technique, and will consider the wind speed and direction at the time of sampling. Meteorological conditions including wind speed, wind direction, cloud cover, temperature, relative humidity, and atmospheric conditions will be recorded by an automatic weather station with an integral data logger during monitoring periods and this data will be recorded. The meteorological station will be positioned in a suitable location, away from anything which could influence measurements, such as at locations very close to buildings.

A minimum of three measurements of Aspergillus fumigatus and mesophilic bacteria will be taken from each sampler during each monitoring visit. Appropriate equipment and methodologies for each sampler type are described in TGN M9 and this guidance will be followed during the bioaerosol monitoring.

Following the measurements, samples will be stored and transported appropriately before being analysed in a laboratory.

Detailed and accurate records of the bioaerosol monitoring will be kept and the data will be recorded using the standard report forms provided in TGN M9 or an appropriate alternative.

4.6 Summary

As discussed above, there are a number of control measures in place at the Site to reduce and contain emissions of bioaerosols. These control measures are regularly maintained to sustain their efficacy and reduce the risk of equipment failure.

Across the Site, the potential for bioaerosol emissions which could result in significant consequences is limited. The greatest risk of significant bioaerosol emissions from the Site where there would be the greatest consequence of the hazard, is associated with emergency situations such as a failure of the flare or CHP/boilers, which could result in uncontrolled emissions of bioaerosols. However, such an emergency event would be unlikely, temporary, and infrequent due to the extensive monitoring and maintenance programmes undertaken at the Site as well as the emergency procedures and warning systems in place.

5 Risk assessment

5.1 Overview

This section assesses the probability of exposure and consequence of the hazard associated with potential emissions of bioaerosols at the Site to determine the overall magnitude of risk. The descriptors used ('very low' to 'high') are based on the descriptors outlined in the Environment Agency guidance[16], as summarised in Section 2.3.

5.2 Probability of exposure

As described in Section 3, the main potential sources of bioaerosols at the Site are associated with:

- Cess/sludge/cake reception and distribution
- Sludge treatment (sludge storage, thickening, digesters, centrifuges and cake bay)
- Biogas combustion

These processes have the potential to emit bioaerosols, which are transported through the air by the wind and could cause harm to nearby human health receptors. However, as discussed in Section 4, there are multiple control measures in place at the Site which restrict the Source-Pathway-Receptor link by reducing and containing emissions of bioaerosols from these processes. The overall probability of exposure of sensitive receptors to bioaerosols at the majority of cess/sludge/cake reception and distribution, sludge treatment and biogas combustion bioaerosol sources at the Site is considered to be '**very low**' as exposure of the receptors to bioaerosols is "very unlikely" due to the "effective and multiple barriers" (control measures) in place.

The final probability of exposures to bioaerosols assessed for each emission source is presented below in Table 5.1.

Table 5.1: Probability of exposure to bioaerosols from different sources at the Site

Process	Potential source of bioaerosols	Probability of exposure	Justification
Sludge/cake reception and distribution	Sludge reception tank	Very Low	Stringent loading and unloading procedures – uncontrolled release of bioaerosols very unlikely
	Cake reception	Very Low	Stringent loading and unloading procedures – uncontrolled release of bioaerosols very unlikely
	OCU for cake reception	Very Low	OCU is air tight and treats air released to remove bioaerosols, process monitored and regularly maintained –uncontrolled release of bioaerosols unlikely
Sludge treatment	Auxiliary sludge storage tanks	Very Low	Tanks covered, process monitored and regularly maintained – uncontrolled release of bioaerosols very unlikely
	Anaerobic digesters	Very Low	Digesters covered, process monitored and regularly maintained – uncontrolled release of bioaerosols very unlikely

[16] Drew, G.H., Deacon, L.J., Pankhurst, L., Pollard, S.J.T. and Tyrrel, S.F. (2009). Guidance on the evaluation of bioaerosol risk assessments for composting facilities. Environment Agency.

Process	Potential source of bioaerosols	Probability of exposure	Justification
	PSSTs	Very Low	Tanks covered, process monitored and regularly maintained – uncontrolled release of bioaerosols very unlikely
	Centrifuges	Very Low	Located within a building and are covered, process monitored and regularly maintained – uncontrolled release of bioaerosols very unlikely
	TSST	Very Low	Tanks covered, process monitored and regularly maintained – uncontrolled release of bioaerosols very unlikely
	Thermal hydrolysis plant	Very Low	Process will be monitored and regularly maintained, will be located within a building and covered –uncontrolled release of bioaerosols very unlikely
	Dutch Barn (with cake bay)	Very Low	Process monitored and regularly maintained, will be located within a building and covered – uncontrolled release of bioaerosols very unlikely
	OCU for sludge treatment	Very Low	OCU is air tight and treats air released to remove bioaerosols, process monitored and regularly maintained –uncontrolled release of bioaerosols unlikely
	Raw Liquor storage tank	Very Low	Tank covered, process monitored and regularly maintained – uncontrolled release of bioaerosols very unlikely
	Liquor treatment plant	Very Low	All processes are covered, process monitored and regularly maintained – uncontrolled release of bioaerosols very unlikely
	PDSST	Very Low	Tanks covered, process monitored and regularly maintained – uncontrolled release of bioaerosols very unlikely
	THP boiler	Very Low	Process monitored and regularly maintained, will be located within a building and covered – uncontrolled release of bioaerosols very unlikely
Biogas combustion	Gas bag	Very Low	Gas bag sealed to prevent uncontrolled release of bioaerosols – uncontrolled release of bioaerosols very unlikely
	CHP	Very Low	Combustion of biogas at very high temperatures which would destroy bioaerosols – uncontrolled release of bioaerosols very unlikely
	Boilers	Very Low	Combustion of biogas at very high temperatures which would destroy bioaerosols – uncontrolled release of bioaerosols very unlikely
	Flare	Very Low	Combustion of biogas at very high temperatures which would destroy bioaerosols – uncontrolled release of bioaerosols very unlikely

5.3 Consequence of hazard

While the probability of exposure of receptors to bioaerosols is ‘very low’ as a result of the control measures in place or the nature of processes on Site, there is still a risk that nearby receptors could be exposed to bioaerosols, for example when sludge and cake is unloaded/loaded into trucks or tankers or if there was a failure of the control equipment. Should this occur, any exposure to bioaerosols would likely be temporary, any fault would be detected

by the SCADA system and the emergency protocols would be undertaken to rectify the fault as soon as possible.

However, if exposure to bioaerosols did occur, this could result in adverse health impacts at sensitive receptors. These impacts could include (but are not limited to):

- Respiratory infections and inflammation of the respiratory system
- Reduced lung function
- Allergic reactions
- Gastro-intestinal disorders
- Dermatitis
- Eye irritation

The consequence of the hazard at sensitive receptors (i.e. the severity of impacts on human health) is largely determined by the proximity of the receptor to the emission source; concentrations of bioaerosols decline rapidly within the first 50-100m from a source (and generally decrease to background concentrations within 250m) [17,18]. Therefore, receptors within 100m of bioaerosol emission sources will experience a greater hazard consequence than those more than 100m from the emission source.

For the purpose of this assessment, receptors within 50m of bioaerosol sources and downwind of the prevailing wind direction are considered to be '**high**' consequence of hazard. This is because within 50m of a source, consequences could be "severe", and "exposure may result in significant damage", as being downwind of the prevailing wind direction also increases the likelihood of exposure. Receptors within 50m of bioaerosols that are upwind of the prevailing wind direction are considered to have a '**medium**' consequence of hazard, as though they are in close proximity to a bioaerosol source, they are less likely to be exposed due to the prevailing wind direction.

Sources of bioaerosols within 50-100m of receptors are also considered to have a '**medium**' consequence of hazard, irrespective of whether they are upwind or downwind of the emission source. This is because within 50-100m of the source, concentrations of bioaerosols would reduce, so temporary exposure could result in "significant consequences" and potentially result in "damage that is not severe and is reversible". Beyond 100m, up to 250m, the consequence of the hazard is considered to be '**low**' as concentrations of bioaerosols would be lower so the consequence of the hazard would also be lower, resulting in "minor consequences" where damage is "not apparent, reversible adverse changes possible". Beyond 250m, the consequence is considered '**very low**' as concentrations of bioaerosols generally decrease to background concentrations at this distance so there would be "no evidence for adverse changes" at sensitive receptors at this distance. Beyond 500m, the consequence is not applicable (n/a).

The final consequence of hazard assessed for each emission source is presented below in Table 5.2. Across all potential bioaerosol emission sources at the Site, the consequence of hazard is '**very low**' to '**low**'.

[17] Environment Agency. 2011. Composting and potential health effects from bioaerosols: our interim guidance for permit applicants. Regulatory Position Statement 031.

[18] Health and Safety Executive, 2010. Bioaerosol emissions from waste composting and the potential for workers' exposure.

Table 5.2: Consequence of hazard from bioaerosols at the Site

Source process	Potential source of bioaerosols	Nearest receptor	Consequence of hazard	Justification
Sludge/cake reception and distribution	Sludge reception tank	220m southwest – industrial site	Low	Nearest receptor <250m from potential source, not downwind of the prevailing wind direction
	Cake reception	250m southwest – industrial site	Very Low	Nearest receptor >250m from potential source, not downwind of the prevailing wind direction
	OCU for cake reception	225m southwest – industrial site	Low	Nearest receptor <250m from potential source, not downwind of the prevailing wind direction
Sludge treatment	Auxiliary sludge storage tanks	230m southwest – industrial site	Low	Nearest receptor <250m from potential source, not downwind of the prevailing wind direction
	Anaerobic digesters	245m southwest – industrial site	Low	Nearest receptor <250m from potential source, not downwind of the prevailing wind direction
	PSSTs	270m southwest – industrial site	Very Low	Nearest receptor >250m from potential source, not downwind of the prevailing wind direction
	Centrifuges	300m southwest – industrial site	Very Low	Nearest receptor >250m from potential source, not downwind of the prevailing wind direction
	TSST	320m southwest – industrial site	Very Low	Nearest receptor >250m from potential source, not downwind of the prevailing wind direction
	Thermal hydrolysis plant	295m southwest – industrial site	Very Low	Nearest receptor >250m from potential source, not downwind of the prevailing wind direction

Source process	Potential source of bioaerosols	Nearest receptor	Consequence of hazard	Justification
	Dutch barn (with cake bay)	350m southwest – industrial site	Very Low	Nearest receptor >250m from potential source, not downwind of the prevailing wind direction
	OCU for sludge treatment	305m southwest – industrial site	Very Low	Nearest receptor >250m from potential source, not downwind of the prevailing wind direction
	Raw liquor storage tank	230m southwest – industrial site	Low	Nearest receptor <250m from potential source, not downwind of the prevailing wind direction
	Liquor treatment plant	200m south – industrial site	Low	Nearest receptor <250m from potential source, not downwind of the prevailing wind direction
	PDSST	275m southwest – industrial site	Very Low	Nearest receptor >250m from potential source, not downwind of the prevailing wind direction
	THP boiler	295 southwest – industrial site	Very Low	Nearest receptor >250m from potential source, not downwind of the prevailing wind direction
Biogas combustion	Gas bag	230m southwest – industrial site	Low	Nearest receptor <250m from potential source, not downwind of the prevailing wind direction
	CHP unit	270m southwest – industrial site	Very Low	Nearest receptor >250m from potential source, not downwind of the prevailing wind direction
	Boilers	240m southwest – industrial site	Low	Nearest receptor <250m from potential source, not downwind of the prevailing wind direction

Source process	Potential source of bioaerosols	Nearest receptor	Consequence of hazard	Justification
	Flare	220m southwest – industrial site	Low	Nearest receptor <250m from potential source, not downwind of the prevailing wind direction

5.4 Magnitude of risk

Table 5.3 below summarises the probability of exposure, consequence of hazard and resulting magnitude of risk for each potential bioaerosol emission source at the Site. Across all sources, there is a **'very low'** probability of exposure due to the nature of the processes and control measures in place which would prevent uncontrolled releases of bioaerosols. The consequence of hazard is described as **'very low'** to **'low'** depending on the proximity of the potential emission source to a sensitive receptor.

In accordance with Environment Agency guidance[19], across all potential bioaerosol emission sources, the magnitude of risk is described as '**very low**' to '**low**'. Therefore, based on the maximum level of risk assessed, operation of the Site is unlikely to lead to significant impacts at nearby sensitive receptors from bioaerosol emissions.

Nonetheless, due to the proximity of the Site to sensitive receptors, monitoring of bioaerosols should be undertaken at the Site[20]. The requirements for bioaerosol monitoring at the Site will need to be agreed with the Environment Agency within the Environmental Permit issued for the Site.

[19] Drew, G.H., Deacon, L.J., Pankhurst, L., Pollard, S.J.T. and Tyrrel, S.F. (2009). Guidance on the evaluation of bioaerosol risk assessments for composting facilities. Environment Agency.

[20] Environment Agency (2018) Bioaerosol monitoring at regulated facilities - use of M9: RPS 209. Available online at: https://www.gov.uk/government/publications/bioaerosol-monitoring-at-regulated-facilities-use-of-m9-rps-209/bioaerosol-monitoring-at-regulated-facilities-use-of-m9-rps-209

Table 5.3: Magnitude of risk from bioaerosols at the Site

Process	Potential source of bioaerosols	Probability of exposure	Consequence of Hazard	Magnitude of risk	Justification
Sludge/cake reception and distribution	Sludge reception tank	Very Low	Low	Low	Nearest receptor <250m from potential source, not downwind of the prevailing wind direction. Stringent loading and unloading procedures – uncontrolled release of bioaerosols very unlikely
	Cake reception	Very Low	Very Low	Very Low	Nearest receptor >250m from potential source, not downwind of the prevailing wind direction. Stringent loading and unloading procedures – uncontrolled release of bioaerosols very unlikely.
	OCU for cake reception	Very Low	Low	Low	Nearest receptor <250m from potential source, not downwind of the prevailing wind direction. OCU air tight and treats air released to remove bioaerosols, process monitored and regularly maintained – uncontrolled release of bioaerosols unlikely
Sludge treatment	Auxiliary sludge storage tanks	Very Low	Low	Low	Nearest receptor <250m from potential source, not downwind of the prevailing wind direction. Tanks covered, process monitored and regularly maintained – uncontrolled release of bioaerosols very unlikely.
	Anaerobic digesters	Very Low	Low	Low	Nearest receptor <250m from potential source, not downwind of the prevailing wind direction. Digesters covered, process monitored and regularly maintained – uncontrolled release of bioaerosols very unlikely.
	PSSTs	Very Low	Very Low	Very Low	Nearest receptor >250m from potential source, not downwind of the prevailing wind direction. Tanks covered, process monitored and regularly maintained – uncontrolled release of bioaerosols very unlikely.

Process	Potential source of bioaerosols	Probability of exposure	Consequence of Hazard	Magnitude of risk	Justification
	Centrifuges	Very Low	Very Low	Very Low	Nearest receptor >250m from potential source, not downwind of the prevailing wind direction. Located within a building and are covered, process monitored and regularly maintained – uncontrolled release of bioaerosols very unlikely.
	TSST	Very Low	Very Low	Very Low	Nearest receptor >250m from potential source, not downwind of the prevailing wind direction. Tanks covered, process monitored and regularly maintained – uncontrolled release of bioaerosols very unlikely.
	Thermal hydrolysis plant	Very Low	Very Low	Very Low	Nearest receptor >250m from potential source, not downwind of the prevailing wind direction. Process monitored and regularly maintained, will be located within a building and covered – uncontrolled release of bioaerosols very unlikely.
	Dutch barn (with cake bay)	Very Low	Very Low	Very Low	Nearest receptor >250m from potential source, not downwind of the prevailing wind direction. Process monitored and regularly maintained, will be located within a building and covered – uncontrolled release of bioaerosols very unlikely.
	OCU for sludge treatment	Very Low	Very Low	Very Low	Nearest receptor >250m from potential source, not downwind of the prevailing wind direction. OCU air tight and treats air released to remove bioaerosols, process monitored and regularly maintained – uncontrolled release of bioaerosols unlikely
	Raw liquor storage tank	Very Low	Low	Low	Nearest receptor <250m from potential source, not downwind of the prevailing wind direction.

Process	Potential source of bioaerosols	Probability of exposure	Consequence of Hazard	Magnitude of risk	Justification
					Tank covered, process monitored and regularly maintained – uncontrolled release of bioaerosols very unlikely.
	Liquor treatment plant	Very Low	Low	Low	Nearest receptor <250m from potential source, not downwind of the prevailing wind direction. All processes are covered, process monitored and regularly maintained – uncontrolled release of bioaerosols very unlikely.
	PDSST	Very Low	Very Low	Very Low	Nearest receptor >250m from potential source, not downwind of the prevailing wind direction. Tanks covered, process monitored and regularly maintained – uncontrolled release of bioaerosols very unlikely
	THP boiler	Very Low	Very Low	Very Low	Nearest receptor >250m from potential source, not downwind of the prevailing wind direction. Process monitored and regularly maintained, will be located within a building and covered – uncontrolled release of bioaerosols very unlikely
Biogas combustion	Gas bag	Very Low	Low	Low	Nearest receptor <250m from potential source, not downwind of the prevailing wind direction. Gas bag sealed to prevent uncontrolled release of bioaerosols – uncontrolled release of bioaerosols very unlikely.
	CHP unit	Very Low	Very Low	Very Low	Nearest receptor >250m from potential source. Combustion of biogas at very high temperatures which would destroy bioaerosols – uncontrolled release of bioaerosols very unlikely.
	Boilers	Very Low	Low	Low	Nearest receptor <250m from potential source, not downwind of the prevailing wind direction. Combustion of biogas at very high temperatures which would destroy bioaerosols

Process	Potential source of bioaerosols	Probability of exposure	Consequence of Hazard	Magnitude of risk	Justification
					– uncontrolled release of bioaerosols very unlikely.
	Flare	Very Low	Low	Low	Nearest receptor <250m from potential source, not downwind of the prevailing wind direction. Combustion of biogas at very high temperatures which would destroy bioaerosols – uncontrolled release of bioaerosols very unlikely.

6 Summary

At the Site, there is the potential for bioaerosol emissions from:

- Cess/sludge/cake reception and distribution
- Sludge treatment (sludge storage, thickening, digesters, centrifuges and cake bay)
- Biogas combustion

Bioaerosol emissions associated with these processes could be transported by the wind to the nearby sensitive human health receptor bordering the Site, resulting in adverse health effects. As this sensitive human health receptor is within 250m of potential emission sources at the Site, a bioaerosol risk assessment has been undertaken in accordance with Environment Agency guidance. However, based on the latest comments from the Environment Agency on a bioaerosol risk assessment undertaken for another similar WTW, a conservative approach has been undertaken and human receptors within 500m of the Site have been considered instead of 250m in the bioaerosol risk assessment.

To inform the assessment, a Source-Pathway-Receptor model was developed and the control measures at the facility to reduce and contain bioaerosol emissions were reviewed. This was undertaken to determine the probability of exposure, consequence of hazard and overall magnitude of risk associated with different processes at the Site.

Based on the ‘very low’ probability of exposure and ‘very low’ to ‘low’ consequence of hazards associated with different processes at the Site, the overall magnitude of the risk associated with bioaerosols emissions from the Site is considered to be ‘very low’ to ‘low’. Operation of the Site is therefore unlikely to lead to significant impacts at nearby sensitive receptors from bioaerosol emissions. This is primarily due to the control measures in place which are considered to be effective at reducing and containing emissions of bioaerosols, inhibiting the pathway between source and receptor.