Riverside Energy Park

Environmental Permit Appendices

APPENDIX:

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AIR QUALITY ASSESSMENT

BIOAEROSOL RISK ASSESSMENT

December 2018 | Revision 0 |

CORY RIVERSIDE ENERGY

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1 Introduction

1.1.1 Cory Environmental Holdings Limited (trading as Cory Riverside Energy) (Cory or the Applicant) is applying to the Environment Agency (EA) under The Environmental Permitting (England and Wales) Regulations 2016 (Environmental Permitting Regulations) for an Environmental Permit (EP) to operate an integrated Energy Park, to be known as Riverside Energy Park (REP or the Proposed Development). REP would comprise waste treatment facilities together with an associated Electrical Connection.

1.2 Project Description

1.2.1 A detailed description of REP is presented in Sections 1.4 to 1.6 of the Supporting Information. REP would be constructed on land immediately adjacent to Cory's existing Riverside Resource Recovery Facility (RRRF), within the London Borough of Bexley and would complement the operation of the existing facility.

1.2.2 The main elements of REP would be as follows:

- Energy Recovery Facility (ERF): to provide thermal treatment of Commercial and Industrial (C&I) residual (non-recyclable) waste with the potential for treatment of (non-recyclable) Municipal Solid Waste (MSW);
- Anaerobic digestion facility: to process food and green waste. Outputs from the anaerobic digestion facility would be transferred off-site for use in the agricultural sector as fertiliser or as an alternative, where appropriate, used as a fuel in the ERF to generate electricity;
- Solar Photovoltaic Installation: to generate electricity. Installed across a wide extent of the roof of the Main REP Building;
- Battery Storage: to store and supply additional power to the local distribution network at times of peak electrical demand. This facility would be integrated into the Main REP building; and
- On Site Combined Heat and Power (CHP) Infrastructure: to provide an opportunity for local district heating for nearby residential developments and businesses. REP would be CHP Enabled with necessary on site infrastructure included within the REP site.

1.3 The Objective

1.3.1 The objective of this report is to assess the potential for potential emissions of bioaerosols to pose significant risks to human health at workplaces, dwellings, or public buildings within the vicinity of the REP. This bioaerosol risk assessment has been prepared, notwithstanding the fact that the Anaerobic Digestion process would be fully enclosed, and therefore is not required under the EA's Regulatory Position Statement (see following section).

2 Bioaerosol Risk Assessment

2.1.1 During pre-application discussions with the EA it was requested that a Bioaerosol Risk Assessment is submitted with this application. According to the most recent EA Regulatory Position Statement 031, titled '*Composting and potential health effects from bioaerosols: our interim guidance for permit applicants*' dated 1st November 2010, such 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". "Operations…likely to result in the uncontrolled release of high levels of bioaerosols"* is defined as "*Include the shredding of waste and the turning of waste in the sanitisation, stabilisation and maturation stages of composting where these operations are not contained or are not subject to exhaust ventilation and scrubbing/filtering*". These definitions do not relate to the proposals for REP; however, a bioaerosol risk assessment was requested by the EA during pre-application discussions in accordance with EA Regulatory Position Statement 031.

2.1.2 If the site proposed was an open-air composting site, a Bioaerosol Risk Assessment might be required if there are any receptors of relevant exposure within 250m of the Installation Boundary, and if there are any activities that may have the potential to release bioaerosols such as the anaerobic digestion plant. The operation of the ERF will result in the generation of limited/no bioaerosols released from the ERF. Therefore, the primary focus of this application has been the anaerobic digestion plant.

2.1.3 Although the anaerobic digestion plant is the focus of this Bioaerosol Risk Assessment it should be noted that in terms of distances from the process, it is enclosed, and the nearest workplace receptors are the adjacent RRRF.

2.2 What is a bioaerosol?

2.2.1 Bioaerosol is the collective term for a group of airborne particles which contain micro-organisms and their reproductive structure, cells and cellular waste material.

2.2.2 Bioaerosols are generally less than 10 µm in size and therefore are not filtered out by the hairs and specialised cells that line the nose. They can therefore penetrate into the lungs, causing respiratory inflammation, coughs and fever exacerbating respiratory diseases. Bioaerosols have also been known to cause gastrointestinal illness, eye irritation and dermatitis. Particularly relevant 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 immune-suppressed patients.

2.2.3 Dose-response relationships are not well understood, and it is not certain that a given concentration will result in a particular health impact. Responses vary, depending on individual sensitivity.

2.3 Guidelines

2.3.1 There is little regulatory guidance available for bioaerosol emissions from facilities involving anaerobic digestion of waste. The EA guidance note, dated October 2012, '*Guidance for developments requiring planning permission and environmental permits*' states that bioaerosols from anaerobic digestion plants are not considered to be a serious concern, although for some facilities it may be necessary to refer to the risk assessment guidance for composting facilities. Therefore, the principles of this composting guidance have been applied in developing this Bioaerosol Risk Assessment.

2.4 Health Criteria

2.4.1 As recommended in the guidance published by Cranfield University on behalf of the Environment Agency, '*Guidance on the evaluation of bioaerosol risk assessments for composting facilities*', the

EA suggest the following threshold levels at receptors should not be exceeded. The unit is colony forming units (cfu) per cubic metre:

- 300 cfu/m^3 gram-negative bacteria;
- 1,000 cfu/m^3 total bacteria; and
- 500 cfu/m^3 *Aspergillus fumigatus*.

2.4.2 These criteria are based on those recommended by Wheeler *et al.* 2001[1].

[1] Wheeler PA, Stewart I, Dumitrean P, and Donovan B (2001) Health effects of composting - A Study of Three Compost Sites and Review of Past Data Environment Agency R&D Technical Report P1-315/TR, 2001, Environment Agency, Bristol

3 Technology Description

3.1 Anaerobic Digestion facility

3.1.1 The anaerobic digestion plant will operate a single anaerobic digestion line fed with organic material. The anaerobic digestion plant will have a design capacity of approximately 40,000 tonnes per annum. The biogas generated by the anaerobic digestion plant would be upgraded to a CNG and/or upgraded for injection into a local gas network. CNG would be the preferred option if feasible and viable. However, if a CNG option is not feasible or viable then REP will incorporate a "CHP engine" which would use the biogas to generate electricity and heat, which could be used to support the anaerobic digestion process or added to energy available for export from REP.

Anaerobic Digestion waste reception

3.1.2 Organic waste would be delivered to REP and deposited into the enclosed anerobic digestion waste bunker which is retained at negative pressure by extracting the air to the ERF to be used as combustion air.

Shredding

3.1.3 The organic waste would be picked up by a crane grab and loaded into a shredder within the waste reception bunker. The shredded output would be conveyed to the digester.

Anaerobic Digester

3.1.4 The organic material would be moistened by using harvested rainwater or mains water, and inoculum from the digester outlet is recirculated and fed through the inlet.

3.1.5 The anaerobic digestion process will take place at a dry solids content of 35 – 45% and an optimum temperature of 57°C. The digester is a horizontal cylinder. The digester would be constructed of steel, and clad in a weather-proof housing which is insulated to reduce heat losses from the digester. The digester also comprises a central heat distribution system to reach and maintain the process temperature.

3.1.6 The biological process involves several steps, each requiring a different type of bacteria, but essentially the organic material is broken down in the following way:

$$C_6H_{12}O_{6(s)} \rightarrow 3CO_{2(g)} + 3CH_{4(g)}$$

3.1.7 The digester would be installed with an agitator located inside the digester for mixing. The organic waste moves slowly horizontally across the digester, with the residue withdrawn from the digester at the digester outlet. The average retention time of organic material in the digester would be 14 days.

Anaerobic Digestion biogas cleaning and combustion

3.1.8 Hydrogen sulphide (H_2S) would be removed from the biogas produced, in order to avoid corrosion and to reduce sulphur concentrations in the emissions when the biogas is combusted, through the dosing of either iron chloride or iron hydroxide to the mixing unit.

3.1.9 The biogas will pass through a chiller which will condense out water vapour and carbon filter system to polish the biogas and remove impurities.

3.1.10 As explained in paragraph 3.1.1, the biogas will either be upgraded to a CNG, or if upgrading to a CNG option is not feasible or viable then it would be combusted in a biogas engine, with an electrical generating capacity of approximately 1MWe.

3.1.11 A gas flare would be used to combust the biogas during periods of plant shutdown or excess biogas production.

Digestate Dewatering

3.1.12 The digestate would be transferred in an enclosed conveying system from the digester to the digestate dewatering system. The digestate dewatering system would be an enclosed containerised system. The digestate would be transferred into a hopper. The digestate will fall from the hopper onto a belt drier. Hot air would be blown through the digestate pile on the belt drier to evaporate-off moisture from the digestate.

3.1.13 The dried digestate would be processed (through maturation) in the digestate storage area until it achieves compliance to PAS:110 that would be required before use in agriculture or for onward transportation to a further maturation facility.

3.1.14 Air from the dryer and digestate storage area would be ducted to the ERF to be used as combustion air.

Anaerobic Digestion exhaust air collection and treatment

3.1.15 Organic waste will be delivered to REP in enclosed vehicles, and the anaerobic digestion process would be fully enclosed and would not give rise to the release of bioaerosols. The anaerobic digestion bunker, is located in the waste reception area, would be an enclosed area and would be maintained at a negative pressure. This area would be maintained at a negative pressure with air from the anaerobic digestion bunker being extracted to the ERF to be used as combustion air; therefore, reducing the risk of bioaerosols being released from REP.

3.1.16 Doors to the waste reception area will remain closed except for those short periods of waste delivery or removal of the reject containers.

3.1.17 Air from the digestate drying process would be ducted to the ERF to be used as combustion air.

4 Hazard Identification

4.1.1 There is the potential for bioaerosols to be released from the following sources:

- the handling and preparation of incoming waste;
- fugitive emissions from the anaerobic digestion process; and
- the handling and storage of digestate prior to transfer off-site.

4.2 Handling and preparation of waste

4.2.1 The anaerobic digestion process provides a controlled environment where micro-organisms, including bacteria and fungi, can grow, multiply and break-down organic material. Bioaerosols from anaerobic digestion arise when micro-organisms are released into the air when disturbed.

4.2.2 All waste reception and storage operations would be undertaken within buildings which would be held under a negative pressure. All external doors would be kept closed when not in use as necessary and appropriate.

4.2.3 The organic feedstock to the anaerobic digestion process would be prepared by shredding to reduce its particle size so that it is suitable for anaerobic digestion. During the shredding process, the material would be dry. As such, any disturbance of material will have the potential to release bioaerosols. The waste reception area would be enclosed and held under a slight negative pressure. All external doors would be kept closed, except for short periods for waste delivery. These measures will reduce the risk of any fugitive releases of bioaerosols which may have been entrained during the shredding process, to the external environment.

4.2.4 Once the organic waste is shredded it would be fed into the digester. This will eliminate the potential for bioaerosol release.

4.3 Anaerobic Digestion facility

4.3.1 The anaerobic digestion process would be an enclosed wet process. Therefore, the there is no potential for the release of bioaerosols from the anaerobic digestion process. Any bioaerosols within the anaerobic digestion process will remain within the waste until it becomes dry again. All ‘dirty’ air in contact with the anaerobic digestion process which would have the potential for high levels of odour would be ducted to the ERF to be used as combustion air.

4.4 Handling and storage of digestate prior to transfer off-site

4.4.1 Digested material would be dewatered and transported to a digestate storage area. The digestate storage area will be held at negative pressure as air will be extracted from the digestate storage area and used within the ERF as combustion air. Therefore, there is no risk of fugitive bioaerosols being released to the external atmosphere.

5 Baseline

5.1.1 REP will be located on land adjacent to the existing RRRF.

5.1 Sensitive receptors

5.1.1 EA's guidance, 23 January 2018, titled '*Bioaerosol monitoring at regulated facilities - use of M9: RPS 209*' states a screening distance of 250m between workplace or dwellings and a potential new source (REP). The policy considers static receptor locations and does not include transient exposure along public footpaths or highways. Therefore, only workplaces or dwellings have been included as sensitive receptors. Based on this screening criterion, one sensitive receptor has been identified, as listed in **Table 5-1**. A plan showing the location of sensitive receptors, within 250m of REP, is presented in Appendix A.1.

Table 5-1: Sensitive Receptors

ID	Receptor Name	Receptor Category	Distance (m) at closest point
1	RRRF	Workplace	0m from boundary, and >100m from the storage of organic waste.

5.2 Meteorological conditions

5.2.1 The primary bioaerosol pathway is direct transport by air from REP to the sensitive receptor. This pathway will primarily be influenced by the local wind direction.

5.2.2 An assessment of the location of the sensitive receptor in relation to REP has been conducted, including the determination of a range of wind directions which would result in potential bioaerosol exposure from REP. The results from this are presented in **Table 5-2**.

Table 5-2: Wind Range

ID	Receptor Name	Direction from source	Wind directions with potential to include bioaerosols from REP(°)
1	RRRF	East	225 – 315

5.2.3 The level of exposure at the sensitive receptor would be dependent on the frequency that the wind blows within the range outlined above. A review of meteorological data from London City Airport, supplied by the Meteorological Office, for the years 2013 – 2017 shows that local winds are predominantly from the west-south-west (240°). Wind roses for each year are displayed in Appendix A.2.

5.2.4 The wind frequency at the sole receptor has been assessed using the five years of meteorological data from London City Airport and is presented in Table 5-3.

Table 5-3: Risk of Exposure

ID	Receptor Name	Wind frequency with potential to include bioaerosols from REP					
		2013	2014	2015	2016	2017	Average
1	RRRF	34.1%	35.9%	42.8%	39%	54%	41.1%

5.3 Other sources of bioaerosols

5.3.1 A desktop study has not identified any significant sources of bioaerosols within 250m of the Installation Boundary.

6 Risk Assessment

6.1 Problem definition

6.1.1 The aim of this report is to assess the potential emissions of bioaerosols to pose significant risks to human health at workplaces, dwellings, or public buildings within the vicinity of REP. In addition, the study is intended to demonstrate that the design of REP will ensure that, should there be a risk of release during any operations, bioaerosols would be maintained at acceptable levels.

6.1.2 Based on the EA's screening criteria, the assessment has focused on risks within 250 m of the Main REP Building. As identified within Section 5.1, there is one workplace receptor located within this distance.

6.2 Conceptual model

6.2.1 Potential hazards are summarized in the conceptual model in **Table 6-1**

Table 6-1: Conceptual Model

Source	Waste – release of micro-organisms and biological particles. Especially where waste is disturbed such as waste unloading areas, handling, organic waste shredding and digestate handling
Hazard	Allergic reactions, Gastro-intestinal disorders, 'inhalation fever', bronchitis, reduced lung function
Transport Mechanism	Airborne
Pathway	Inhalation, ingestion, absorption, injection
Medium of exposure	Air and deposited materials
Receptor	Humans, residential occupiers and users of commercial facilities

6.3 Risk screening and prioritisation

Probability of harm

6.3.1 The probability of harm examines the likelihood of someone being exposed, which assists in assessing the scale of the consequence of the harm being realised. The EA guidance '*Guidance on the evaluation of bioaerosol risk assessments for composting facilities*' provides the following descriptors for probability of harm:

- 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.

6.3.2 As explained in Sections 4 and 4, there are multiple effective barriers to prevent the release of bioaerosols to the outdoor environment. There are no outdoor waste handling processes as these are all controlled within enclosed buildings. All air from waste storage and processing activities is used as combustion air within the ERF. This will destroy any bioaerosols as the temperature within the combustion chamber would be more than 850^{o}C. In addition, the only receptor is approximately 100m from the Main REP Building. As such the probability of harm is very low.

Consequence of risk

6.3.3 The consequence of the risk considers the nature of the source, the hazard and the receptor. The EA guidance '*Guidance on the evaluation of bioaerosol risk assessments for composting facilities*' provides the following descriptors for probability of harm:

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

6.3.4 The consequence of risk will also be influenced by the distance between the source and receptor and any mitigating factors, such as activities enclosed within buildings. As set out previously in section 4, there are a number of control measures incorporated into the design of REP to prevent the release of bioaerosols, and only one receptor has been identified within 250m of the Main REP Building (which is the main potential source of release of bioaerosols from REP). Based on the descriptors provided by the EA guidance '*Guidance on the evaluation of bioaerosol risk assessments for composting facilities*', the consequence of risk from REP is considered to be very low.

Magnitude of risk

6.3.5 By examining the probability of harm and consequence of the risk together the magnitude of risk can be determined. The EA '*Guidance on the evaluation of bioaerosol risk assessments for composting facilities*' contains the matrix presented in **Table 6-2** for determining the magnitude of bioaerosol risk.

Table 6-2: Magnitude of Risk Matrix

Probability of harm	Consequence			
	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

Residual risk

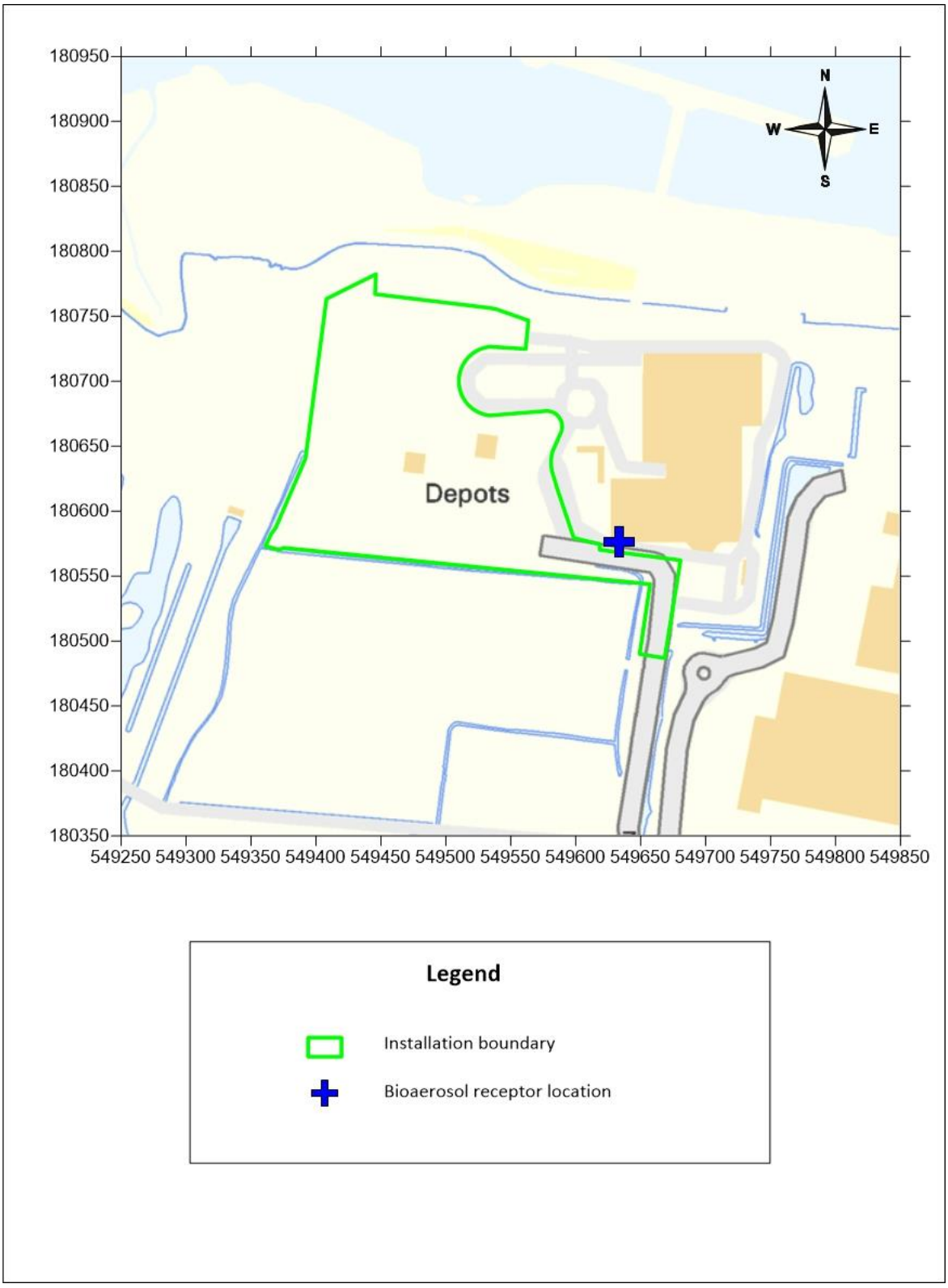
6.3.6 The residual risk to the RRRF receptor as a result of waste processing activities at REP is presented in **Table 6-3**. This risk considers the probability of harm, consequence, and the magnitude of risk for each potential bioaerosol source. This is assessed against the measures of risk management to be implemented at REP to determine whether the bioaerosol risk can be considered significant or not. As shown, none of the potential bioaerosol sources at REP are considered to contribute a significant risk at the receptor (the RRRF).

Table 6-3: Risk Assessment

Receptor	Source	Harm	Pathway	Probability of harm	Consequence	Magnitude of Risk	Justification	Risk Management	Residual Risk
RRRF	Reception, handling, and preparation of incoming waste. Potential for bioaerosol release from the disturbance of dry waste material through handling, separating and shredding	Human health – respiratory irritation, allergic reactions and illness	Air transport then inhalation or ingestion	Very Low	Low	Low	Receptor >100m away from the enclosed organic waste reception area; Receptor down-wind for less than an average of approximately 40% of the year, refer to Table 5-3.	All reception, handling, and preparation of waste to occur within an enclosed area; Waste reception areas held under negative pressure.	Low, Not significant
				Very Low	Low	Low			Low, Not significant
RRRF	Anaerobic digestion process. Potential for bioaerosol release from anaerobic digestion emissions to air	Human health – respiratory irritation, allergic reactions and illness	Air transport then inhalation or ingestion	Very Low	Low	Low	Receptors >100m away from the enclosed organic waste reception area; Receptor down-wind for less than an average of approximately 40% of the year, refer to Table 5-3.	Enclosed wet process with air extraction to the ERF to be used as combustion air.	Low, Not significant
				Very Low	Low	Low			Low, Not significant

Appendix A Plans and Figures

A.1 Sensitive Receptors Plan



A.2 Windrose - London City Airport