Odour Assessment

Earlstrees Road, Corby

Client: Waste4Generation Ltd

Reference: 6430r1

Date: 13th April 2023

Report Issue

Report Title: Odour Assessment - Earlstrees Road, Corby

Report Reference: 6430

Field	Report Version			
	1	2	3	4
Prepared by	Ger Parry			
Position	Director			
Reviewed by	Lauren Casey			
Position	Senior Air Quality Consultant			
Date of Issue	13th April 2023			
Comments	-			

Taylor Road, Urmston, Manchester, M41 7JQ

info@red-env.co.uk | 0161 706 0075 | www.red-env.co.uk

Executive Summary

Redmore Environmental Ltd was commissioned by Waste4Generation Ltd to undertake an Odour Assessment in support of an Environmental Permit Variation Application for the Anaerobic Digestion facility operated by the company on land off Earlstrees Road, Corby.

Odour emissions from the facility have the potential to cause impacts at sensitive locations. An Odour Assessment was therefore undertaken to quantify effects in the vicinity of the plant.

Emissions from relevant sources were defined based on the nature and size of the plant, as well as information on operations provided by Waste4Generation Ltd. Impacts at sensitive receptors were quantified using dispersion modelling and the results compared with the relevant odour benchmark level.

Predicted odour concentrations were below the relevant benchmark at all sensitive receptor locations in the vicinity of the site for all modelling years. As such, potential impacts associated with odour emissions from the facility are not considered to be significant.

Table of Contents

1.0 INTRODUCTION

1.1 Background

1.1.1 Redmore Environmental Ltd was commissioned by Waste4Generation Ltd to undertake an Odour Assessment in support of an Environmental Permit Variation Application for the Anaerobic Digestion (AD) facility operated by the company on land off Earlstrees Road, Corby.

1.1.2 Odour emissions from the facility have the potential to cause impacts at sensitive locations. An Odour Assessment was therefore undertaken to quantify effects in the vicinity of the plant.

1.2 Site Location and Context

1.2.1 The AD facility is located on land off Earlstrees Road, Corby, at National Grid Reference (NGR): 488750, 290780. Reference should be made to Figure 1 for a map of the site and surrounding area.

1.2.2 The plant is currently authorised to operate as a biological treatment facility under an Environmental Permit issued by the Environment Agency (EA) (Permit No: CB3902XP). Activities include the receipt of a range waste types followed by processing within an AD plant to generate biogas which is combusted within a Combined Heat and Power (CHP) unit. Two flares are also included at the plant for venting of biogas during abnormal operation.

1.2.3 An Environmental Permit Variation Application is currently being made to the EA in order to authorise a number of changes to operations. These include:

- Upgrade of the site to an installation and an increase in the daily capacity to 300m^3/day;
- An increase in the consented water discharge limit to 300m^3/day;
- The receipt, de-watering & blending of waste streams to produce high quality AD feedstocks, with up to 300 m^3 of prepared material leaving site per day;

- Additional processing within the warehouse for Research and Development (R&D) purposes plus continued processing and optimisation of complex wastes and fats, oils and greases (FOGs);
- Further optimisation of the FOG process to provide an alternative and sustainable AD feedstock;
- Addition of a solids treatment bay to receive materials such as fruits;
- Onsite leachate and complex waste treatment as proof of concept that the process can achieve consented water discharge limits and by integrating existing processes with nano-bubble technology, operations can be made more cost effective and efficient;
- Introduction of a nano-bubble polishing system for ozone treatment and additional tertiary/quaternary treatment of effluent;
- Addition of a centralised Odour Control System (OCS); and,
- Addition of a number of European Waste Codes (EWCs) to the Environmental Permit.

1.2.4 The operation of the plant under the proposed configuration may result in odour 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 the following report.

2.0 ODOUR BACKGROUND

2.1 Odour Definition

2.1.1 The Department for Environment, Food and Rural Affairs (DEFRA) guidance[1] defines odour as follows:

> "An odour is the organoleptic attribute perceptible by the olfactory organ on sniffing certain volatile substances. It is a property of odorous substances that make them perceptible to our sense of smell. The term odour refers to the stimuli from a chemical compound that is volatilised in air. Odour is our perception of that sensation and we interpret what the odour means. Odours may be perceived as pleasant or unpleasant. The main concern with odour is its ability to cause a response in individuals that is considered to be objectionable or offensive.
>
> Odours have the potential to trigger strong reactions for good reason. Pleasant odours can provide enjoyment and prompt responses such as those associated with appetite. Equally, unpleasant odours can be useful indicators to protect us from harm such as the ingestion of rotten food. These protective mechanisms are learnt throughout our lives. Whilst there is often agreement about what constitutes pleasant and unpleasant odours, there is a wide variation between individuals as to what is deemed unacceptable and what affects our quality of life."

2.1.2 Although it is recognised that the DEFRA guidance[2] has been formally withdrawn, the definition of odour provided within the document is still considered to be relevant in the context of the assessment.

2.2 Odour Impacts

2.2.1 The magnitude of odour impact depends on a number of factors and the potential for complaints varies due to the subjective nature of odour perception. The **FIDOR** acronym is a useful reminder of the factors that will determine the degree of odour pollution:

[1] Odour Guidance for Local Authorities, DEFRA, 2010.

[2] Odour Guidance for Local Authorities, DEFRA, 2010.

- **F**requency of detection - frequent odour incidents are more likely to result in complaints;
- **I**ntensity as perceived - intense odour incidents are more likely to result in complaints;
- **D**uration of exposure - prolonged exposure is more likely to result in complaints;
- **O**ffensiveness - more offensive odours have a higher risk of resulting in complaints; and,
- **R**eceptor sensitivity - sensitive areas are more likely to have a lower odour tolerance.

2.2.2 It is important to note that even infrequent emissions may cause loss of amenity if odours are perceived to be particularly intense or offensive.

2.2.3 The FIDOR factors can be further considered to provide the following in regards the potential for an odour emission to cause an impact:

- The rate of emission of the compound(s);
- The duration and frequency of emissions;
- The time of the day that this emission occurs;
- The prevailing meteorology;
- The sensitivity of receptors to the emission i.e. whether the odorous compound is more likely to cause nuisance, such as the sick or elderly, who may be more sensitive;
- The odour detection capacity of individuals to the various compound(s); and,
- The individual perception of the odour (i.e. whether the odour is regarded as unpleasant). This is greatly subjective and may vary significantly from individual to individual. For example, some individuals may consider some odours as pleasant, such as petrol, paint and creosote.

2.3 Odour Legislative Control

2.3.1 The main requirement with respect to odour control from industrial activities is the Environmental Permitting (England and Wales) Regulations (2016) and subsequent amendments. If a process is deemed potentially odorous then the relevant regulator will usually include an appropriate condition in the site's Environmental Permit to restrict impacts beyond the facility boundary through the implementation of an Odour Management Plan (OMP).

2.3.2 Enforcement of the condition is by the relevant regulator, either the EA for Part A(1) processes, or the Local Authority for Part A(2) and B processes. If the regulator is satisfied that odour from a facility is causing pollution beyond the site boundary, then they can serve an improvement notice that requires remedial works to be undertaken to reduce impacts to an acceptable level. The measures that are deemed appropriate will depend on the industry sector and site-specific circumstances and will take costs and benefits into account. Should appropriate actions not be taken by the operator then the regulator has a number of available options, cumulating in the revocation of the Environmental Permit and cessation of all activities on site.

2.4 Odour Benchmark Levels

2.4.1 There is no statutory limit in the UK for ambient odour concentrations, whether set for individual chemical species or for mixtures. However, the EA has issued guidance on odour[3] which contains indicative benchmark levels for use in the assessment of potential impacts from industrial facilities.

2.4.2 Benchmark levels are stated as the 98th percentile (%ile) of hourly mean concentrations in European odour units (ou_E) over a year for odours of different offensiveness. In practice this means that for 2% of the year, or 175-hours, concentrations will be higher than this value, whilst for 98% of the year, or 8,585-hours, they will be lower. This parameter reflects the previously described **FIDOR** factors, where an odour is likely to be noted on several occasions above a particular threshold concentration before an annoyance occurs. EA odour benchmark levels are summarised in Table 1.

Table 1 Odour Benchmark Levels

Relative Offensiveness of Odour	Benchmark Level as 98th %ile of 1-hour Means (ou_E/m^3)
Most offensive odours: • Processes involving decaying animal or fish • Processes involving septic effluent or sludge • Biological landfill odours	1.5

[3] H4: Odour Management, EA, 2011.

Relative Offensiveness of Odour	Benchmark Level as 98th %ile of 1-hour Means (ou_E/m^3)
Moderately offensive odours: • Intensive livestock rearing • Fat frying (food processing) • Sugar beet processing • Well aerated green waste composting	3.0
Less offensive odours: • Brewery • Confectionery • Coffee roasting • Bakery	6.0

2.4.3 In order to provide a worst-case assessment, an odour benchmark level of $1.5ou_E/m^3$ as the 98th %ile of 1-hour mean concentrations has been utilised throughout the report.

2.4.4 In order to provide some context to the odour benchmark values, DEFRA have provided the following descriptors[4]:

- $1ou_E/m^3$ is the point of detection;
- $5ou_E/m^3$ is a faint odour; and,
- $10ou_E/m^3$ is a distinct odour.

2.4.5 An odour at a strength of $1ou_E/m^3$ is in reality so weak that it would not normally be detected outside the controlled environment of an odour laboratory by the majority of people (that is individuals with odour sensitivity in the "normal" range - approximately 96% of the population[5]). It is important to note that these values are based on laboratory measurements and in the general environment other factors affect our sense of odour perception. These include:

- The population is continuously exposed to a wide range of background odours at a range of different concentrations, and usually people are unaware of there being any background odours at all due to normal habituation. Individuals can also

4 Odour Guidance for Local Authorities, DEFRA, 2010.

5 Odour Guidance for Local Authorities, DEFRA, 2010.

develop a tolerance to background and other specific odours. In an odour laboratory the determination of detection threshold is undertaken by comparison with non-odorous air, and in carefully controlled, odour-free, conditions. Normal background odours such as those from traffic, vegetation, grass mowing etc, can provide background odour concentrations from 5 to 60ou_E/m^3 or more[6];

- The recognition threshold may be about $3ou_E/m^3$ [7], although it might be less for offensive substances or higher if the receptor is less familiar with the odour or distracted by other stimuli; and,
- An odour which fluctuates rapidly in concentration is often more noticeable than a steady odour at a low concentration.

6 Odour Guidance for Local Authorities, DEFRA, 2010.

7 Odour Guidance for Local Authorities, DEFRA, 2010.

3.0 METHODOLOGY

3.1 Introduction

3.1.1 The facility may result in odour emissions during normal operation. Associated impacts were assessed in accordance with the following stages:

- Identification of odour sources;
- Identification of odour emission rates;
- Dispersion modelling of odour emissions; and,
- Comparison of modelling results with relevant criteria.

3.1.2 The following Sections outline the methodology and inputs used for the assessment.

3.2 Odour Sources

3.2.1 Potential odour sources associated with the facility were identified from information provided by Waste4Generation Ltd. These are summarised in Table 2.

Table 2 Odour Sources

Source		Source Description	Emission Point	Emission Characteristics
1	Carbon Filter 2	Air displaced from the ABP/ MBT holding tanks is treated by a carbon filter prior to release to atmosphere	-(a)	Treated air from the system is released to atmosphere via a dedicated vent on the top of the filter
2	Carbon Filter 3	Air displaced from the Dissolved Air Flotation (DAF) 1 break tank is treated by a carbon filter prior to release to atmosphere	-(a)	Treated air from the system is released to atmosphere via a dedicated vent on the top of the filter
3	Carbon Filter 4	Air displaced from tanks RT1 and R1 is treated by a carbon filter prior to release to atmosphere	-(a)	Treated air from the system is released to atmosphere via a dedicated vent on the top of the filter

Source		Source Description	Emission Point	Emission Characteristics
4	Centralised OCS	Air displaced from all other existing/ proposed closed waste tanks at the site will be treated by a centralised OCS. This will utilise nano-bubble, ozone and chemical scrubbing technology to abate odours in channelled emissions prior to discharge to atmosphere	6	Treated air from the system will be released to atmosphere via a dedicated vent
5	Inlet DAF Tank	Odours generated by effluent within the DAF tank	29	The surface of the DAF tank is covered by heavy duty plastic which is only removed for cleaning practices. This is anticipated to provide effective containment of odour releases during normal operation. However, there may be the potential for diffuse emissions from the cover
6	Effluent DAF Tank	Odours generated by effluent within the DAF tank	31	The surface of the DAF tank is covered by heavy duty plastic which is only removed for cleaning practices. This is anticipated to provide effective containment of odour releases during normal operation. However, there may be the potential for diffuse emissions from the cover

Note: (a) Emission point reference not provided.

3.2.2 It should be noted that the actual AD process itself is sealed and therefore does not form a source of odour, or other emissions such as methane (CH_4) or hydrogen sulphide (H_2S) under normal operation. Should releases of these species occur then this would indicate a fault with the plant and immediate remedial measures would be taken to eliminate the problem to avoid affecting the AD process, with associated financial consequences for the operator. Similarly, the CHP unit and flares only emit products of combustion which do not typically have any associated odour. As such, they have not been considered as potential sources in the context of this assessment.

3.3 Odour Emission Rates

3.3.1 Estimations of odour emission rates were identified for use in the assessment based on monitoring data reported at similar facilities. These are summarised in Table 3.

Table 3 Odour Emission Rates

Source	Odour Emission Rate	Unit	Reference
DAF Tank	2.73	$ou_E/m^2/s$	WSP(1)

NOTES: (1) Master Plan - Air Quality and Odour Assessment - Parks Special Activation Precinct, WSP, 2019.

3.3.2 The European Commission (EC) guidance 'Best Available Techniques (BAT) Reference Document for Waste Treatment'[8] suggests that an odour Associated Emission Level (AEL) range of $200ou_E/m^3$ to $1{,}000ou_E/m^3$ is applicable to channelled emissions to air from the biological treatment of waste. The upper range AEL of $1{,}000ou_E/m^3$ is routinely specified by the EA as an appropriate odour Emission Limit Value (ELV) in compliance monitoring schedules for abatement plant at other regulated facilities. As such, this value was utilised to calculate emissions from the carbon filters and centralised OCS for use in the model.

3.4 Dispersion Modelling

3.4.1 Dispersion modelling was undertaken using ADMS-6 (v6.0.0.1), which is developed by Cambridge Environmental Research Consultants (CERC) Ltd. ADMS-5 is a short-range dispersion modelling software package that simulates a wide range of buoyant and passive releases to atmosphere. It is a new generation model utilising boundary layer height and Monin-Obukhov length to describe the atmospheric boundary layer and a skewed Gaussian concentration distribution to calculate dispersion under convective conditions.

3.4.2 The model utilises hourly meteorological data to define conditions for plume rise, transport and diffusion. It estimates the concentration for each source and receptor combination for each hour of input meteorology and calculates user-selected long-term and short-term averages.

8 Best Available Techniques Reference Document for Waste Treatment, EC, 2018.

3.4.3 The model requires input data that details the following parameters:

- Assessment area;
- Process conditions;
- Pollutant emission rates;
- Terrain information;
- Building dimensions;
- Meteorological data;
- Roughness length (z_0); and,
- Monin-Obukhov length.

3.4.4 These are detailed in the following Sections.

3.5 Modelling Scenarios

3.5.1 The scenarios considered in the modelling assessment are summarised in Table 4.

Table 4 Assessment Scenarios

Parameter	Modelled As	
	Short Term	Long Term
Odour	98th %ile 1-hour mean	-

3.6 Process Conditions

3.6.1 The inputs used to describe the relevant emission sources within the model were derived from the data shown in Table 3, information provided by Waste4Generation Ltd and assumptions where appropriate. A summary of the data is provided in Table 5.

Table 5 Process Conditions

Source		Characteristics and Assumptions
1	Carbon Filter 2	• A single point source was used to represent emissions from the vent of the carbon filter within the model • The outlet vent is 4.5m above ground level and has a diameter of 0.05m

Source		Characteristics and Assumptions
		• The maximum air volumetric flow rate through the unit is equivalent to 0.0056m^3/s. This was calculated based on information provided by Waste4Generation Ltd • The efflux velocity of air at the outlet to the unit is 2.83m/s. This was calculated based on the stated volumetric air flow rate and the vent diameter • The odour concentration of treated air vented from the unit is 1,000ou_E/m^3 which is the upper range BAT AEL for channelled emissions to air specified in EC guidance[9] • The emission rate for the unit is 5.56ou_E/s. This was calculated by multiplying the stated volumetric air flow rate by the upper range BAT AEL • Emissions were assumed to be constant between the hours of 07:00 and 17:00, 365-days per year, in order to reflect operating periods and the intervals when releases from the unit can potentially occur
2	Carbon Filter 3	• A single point source was used to represent emissions from the vent of the carbon filter within the model • The outlet vent is 4.5m above ground level and has a diameter of 0.05m • The maximum air volumetric flow rate through the unit is equivalent to 0.0056m^3/s. This was calculated based on information provided by Waste4Generation Ltd • The efflux velocity of air at the outlet to the unit is 2.83m/s. This was calculated based on the stated volumetric air flow rate and the vent diameter • The odour concentration of treated air vented from the unit is 1,000ou_E/m^3 which is the upper range BAT AEL for channelled emissions to air specified in EC guidance[10] • The emission rate for the unit is 5.56ou_E/s. This was calculated by multiplying the stated volumetric air flow rate by the upper range BAT AEL • Emissions were assumed to be constant, 24-hours per day, 365-days per year, in order to reflect operating periods and the intervals when releases from the unit can potentially occur. This is considered to be a worst-case assessment scenario as periods of reduced operating capacity are not reflected in the modelled emissions

9 BAT Reference Document for Waste Treatment, EC, 2018.

10 BAT Reference Document for Waste Treatment, EC, 2018.

Source		Characteristics and Assumptions
3	Carbon Filter 4	• A single point source was used to represent emissions from the vent of the carbon filter within the model • The outlet vent is 4.5m above ground level and has a diameter of 0.05m • The maximum air volumetric flow rate through the unit is equivalent to 0.033m^3/s. This was calculated based on information provided by Waste4Generation Ltd • The efflux velocity of air at the outlet to the unit is 16.98m/s. This was calculated based on the stated volumetric air flow rate and the vent diameter • The odour concentration of treated air vented from the unit is 1,000ou_E/m^3 which is the upper range BAT AEL for channelled emissions to air specified in EC guidance[11] • The emission rate for the unit is 33.3ou_E/s. This was calculated by multiplying the stated volumetric air flow rate by the upper range BAT AEL • Emissions were assumed to be constant between the hours of 07:00 and 17:00, 365-days per year, in order to reflect operating periods and the intervals when releases from the unit can potentially occur
4	Centralised OCS	• A single point source was used to represent emissions from the vent of the carbon filter within the model • The outlet vent is 5.29m above ground level and has a diameter of 0.5m • The maximum air volumetric flow rate through the unit is equivalent to 0.24m^3/s. This was calculated based on information provided by Waste4Generation Ltd • The efflux velocity of air at the outlet to the unit is 0.85m/s. This was calculated based on the stated volumetric air flow rate and the vent diameter • The odour concentration of treated air vented from the unit is 1,000ou_E/m^3 which is the upper range BAT AEL for channelled emissions to air specified in EC guidance[12] • The emission rate for the unit is 239.7ou_E/s. This was calculated by multiplying the stated volumetric air flow rate by the upper range BAT AEL • Emissions were assumed to be constant between the hours of 07:00 and 17:00, 365-days per year, in order to reflect operating periods and the intervals when releases from the unit can potentially occur

[11] BAT Reference Document for Waste Treatment, EC, 2018.

[12] BAT Reference Document for Waste Treatment, EC, 2018.

Source		Characteristics and Assumptions
5	Inlet DAF Tank	• A single area source was used to represent emissions from the source within the model • The emission rate for material within the DAF tank is 2.73ou$_E$/m^2/s, as shown in Table 3 • The tank has a maximum emitting area of 3.7m^2 • The tank is covered during normal operation and material is not directly exposed to atmosphere. The SCAIL-Agriculture Update report[13] indicates that a reduction of 90% would be expected from engineered covers. As such, the stated emission rate was reduced by this factor in order to represent containment of digestate and associated emissions during storage • Emissions were assumed to be constant, 24-hours per day, 365-days per year. This is considered to be a worst-case assessment scenario as periods of reduced operating capacity are not reflected in the modelled emissions
6	Effluent DAF Tank	• A single area source was used to represent emissions from the source within the model • The emission rate for material within the DAF tank is 2.73ou$_E$/m^2/s, as shown in Table 3 • The tank has a maximum emitting area of 9.4m^2 • The tank is covered during normal operation and material is not directly exposed to atmosphere. The SCAIL-Agriculture Update report[14] indicates that a reduction of 90% would be expected from engineered covers. As such, the stated emission rate was reduced by this factor in order to represent containment of digestate and associated emissions during storage • Emissions were assumed to be constant, 24-hours per day, 365-days per year. This is considered to be a worst-case assessment scenario as periods of reduced operating capacity are not reflected in the modelled emissions

3.6.2 Reference should be made to Figure 2 for a graphical representation of the source locations.

[13] SCAIL-Agriculture Update Sniffer ER26: Final Report, Sniffer, 2014.

[14] SCAIL-Agriculture Update Sniffer ER26: Final Report, Sniffer, 2014.

3.7 Assessment Area

3.7.1 The assessment area was defined based on the site location, anticipated pollutant dispersion patterns and the positioning of sensitive receptors. Ambient concentrations were predicted over NGR: 488250, 290250 to 489250, 291250. One Cartesian grid with a resolution of 10m was used within the model to produce data suitable for contour plotting using the Surfer software package.

3.7.2 Reference should be made to Figure 2 for a graphical representation of the assessment grid extents.

3.7.3 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. These are summarised in Table 6.

Table 6 Sensitive Receptor Locations

Receptor		NGR (m)	
		X	Y
R1	Commercial/ Industrial - Earlstrees Road	488827.1	290778.0
R2	Commercial/ Industrial - Earlstrees Road	488864.7	290806.1
R3	Commercial/ Industrial - Earlstrees Road	488890.2	290756.3
R4	Commercial/ Industrial - Earlstrees Road	488759.2	290827.8
R5	Commercial/ Industrial - Earlstrees Road	488831.9	290869.8
R6	Commercial/ Industrial - Off Causeway Road	488645.4	290816.0
R7	Commercial/ Industrial - Off Causeway Road	488670.5	290755.2
R8	Commercial/ Industrial - Off Causeway Road	488728.2	290677.6
R9	Commercial/ Industrial - Earlstrees Road	488698.9	290886.1
R10	Commercial/ Industrial - Earlstrees Road	488758.9	290713.2
R11	Residential - Hooke Close	488424.2	290677.6
R12	Residential - Hooke Close	488458.9	290620.5
R13	Residential - Pascal Close	488556.7	290390.7

3.7.4 Reference should be made to Figure 3 for a map of the receptor locations.

3.8 Building Effects

3.8.1 The dispersion of substances released from elevated sources can be influenced by the presence of buildings close to the emission point. Structures can interrupt the wind flows and cause significantly higher ground-level concentrations close to the source than would arise in the absence of the buildings.

3.8.2 Analysis of the site layout and immediate surrounding area indicated that a number of structures should be included within the model in order to take account of effects on pollutant dispersion. Building input geometries are shown in Table 7.

Table 7 Building Geometries

Building	NGR (m)		Height (m)	Length / Diameter (m)	Width (m)	Angle (°)
	X	Y				
B1	488789.4	290777.3	7.4	59.0	60.0	152.3
B2	488749.7	290750.5	7.4	12.2	30.0	152.3
B3	488712.9	290744.9	7.4	29.7	12.3	152.3
B4	488596.8	290662.2	10.0	169.9	210.9	152.3
B5	488750.0	290851.3	7.4	45.0	59.0	152.3
B6	488717.1	290765.9	6.7	12.0	7.6	152.3
B7	488721.8	290758.0	6.3	3.1	7.3	152.3
B8	488711.8	290775.6	3.3	5.8	10.7	152.3
B9	488726.9	290767.6	3.2	9.6	2.3	152.3

3.9 Meteorological Data

3.9.1 Meteorological data used in the assessment was taken from Wittering meteorological station over the period 1st January 2017 to 31st December 2021 (inclusive). This observation station is located at NGR: 503490, 302412, which is approximately 19.5km north-east of the facility. It is anticipated that conditions would be reasonably similar over

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

3.9.2 All meteorological files used in the assessment were provided by Atmospheric Dispersion Modelling Ltd, which is an established distributor of data within the UK. Reference should be made to Figure 4 for wind roses of utilised meteorological records.

3.10 Roughness Length

3.10.1 A z_0 of 0.5m was used within the model to describe the modelling extents. This value is considered appropriate for the morphology of the area and is suggested within ADMS-5 as being suitable for 'parkland, open suburbia'.

3.10.2 A z_0 of 0.3m was used within the model to describe the meteorological site. This value is considered appropriate for the morphology of the area and is suggested within ADMS-5 as being suitable for 'agricultural areas (max)'.

3.11 Monin-Obukhov Length

3.11.1 The Monin-Obukhov length provides a measure of the stability of the atmosphere. A minimum Monin-Obukhov length of 30m was used to describe the modelling extents. This value is considered appropriate for the nature of the area and is suggested within ADMS-5 as being suitable for 'mixed urban/ industrial'.

3.11.2 A minimum Monin-Obukhov length of 10m was used to describe the meteorological site. This value is considered appropriate for the nature of the area and is suggested within ADMS-5 as being suitable for 'small towns < 50,000'.

3.12 Terrain Data

3.12.1 Ordnance Survey OS Terrain 50 data was included in the model for the site and surrounding area in order to take account of the specific flow field produced by variations in ground height throughout the assessment extents. This was pre-processed using the method suggested by CERC[15].

[15] Note 105: Setting up Terrain Data for Input to CERC Models, CERC, 2016.

3.13 Assessment Criteria

3.13.1 Predicted ground level odour concentrations were compared with the odour benchmark level of $1.5ou_E/m^3$ as a 98th percentile of 1-hour means, as a worst case.

3.14 Modelling Uncertainty

3.14.1 Uncertainty in dispersion modelling predictions can be associated with a variety of factors, including:

- Model uncertainty - due to model limitations;
- Data uncertainty - due to errors in input data, including emission estimates, operational procedures, land use characteristics and meteorology; and,
- Variability - randomness of measurements used.

3.14.2 Potential uncertainties in the model results were minimised as far as practicable and worst-case inputs used in order to provide a robust assessment. This included the following:

- Choice of model - ADMS-6 is a commonly used atmospheric dispersion model and results have been verified through a number of studies to ensure predictions are as accurate as possible;
- Meteorological data - Modelling was undertaken using five annual meteorological data sets from a local observation station to the site to account for inter-year variability. The assessment was based on the worst-case year to ensure maximum concentrations were considered;
- Surface characteristics - The z_0 and Monin-Obukhov length were determined for both the dispersion and meteorological sites based on the surrounding land uses and guidance provided by CERC;
- Plant operating conditions - Information was provided by Waste4Generation Ltd to describe the activities at the facility and associated durations. As such, these are considered to be representative of likely operating procedures;
- Emission rates - Emission rates were derived from monitoring undertaken at similar facilities and relevant guidance levels. As such, they are considered to be representative of potential releases during normal operation;

- Receptor locations - A Cartesian Grid was included in the model in order to provide suitable data for contour plotting. Receptor points were also included at sensitive locations to provide additional consideration of these areas; and,
- Variability - All model inputs are as accurate as possible and worst-case conditions were considered as necessary in order to ensure a robust assessment of potential pollutant concentrations.

3.14.3 Results were considered in the context of the relevant EA odour benchmark level. It is considered that the use of the stated measures to reduce uncertainty and the use of worst-case assumptions when necessary has resulted in model accuracy of an acceptable level.

4.0 ASSESSMENT

4.1.1 Dispersion modelling of potential odour emissions was undertaken using the input data specified previously. Predicted odour concentrations at the discrete receptor locations are summarised in Table 8. It should be noted that the odour concentrations are presented as a 98th %ile of 1-hour mean values over the relevant assessment year. The maximum concentration across the five years of results is highlighted in **bold**.

Table 8 Predicted Odour Concentrations

Receptor		Predicted 98th %ile 1-hour Mean Odour Concentration (ou_E/m^3)				
		2017	2018	2019	2020	2021
R1	Commercial/ Industrial - Earlstrees Road	**0.07**	0.06	0.05	0.06	0.06
R2	Commercial/ Industrial - Earlstrees Road	**0.03**	**0.03**	**0.03**	**0.03**	**0.03**
R3	Commercial/ Industrial - Earlstrees Road	**0.03**	0.02	**0.03**	**0.03**	**0.03**
R4	Commercial/ Industrial - Earlstrees Road	0.75	1.10	0.80	0.98	**1.20**
R5	Commercial/ Industrial - Earlstrees Road	**0.03**	**0.03**	**0.03**	**0.03**	**0.03**
R6	Commercial/ Industrial - Off Causeway Road	0.01	**0.03**	**0.03**	0.02	0.02
R7	Commercial/ Industrial - Off Causeway Road	0.11	0.11	0.10	0.10	**0.12**
R8	Commercial/ Industrial - Off Causeway Road	0.45	0.58	0.49	0.49	**0.64**
R9	Commercial/ Industrial - Earlstrees Road	**0.03**	**0.03**	**0.03**	**0.03**	**0.03**
R10	Commercial/ Industrial - Earlstrees Road	0.03	0.05	0.03	0.02	**0.06**
R11	Residential - Hooke Close	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
R12	Residential - Hooke Close	0.00	0.00	0.00	0.00	**0.01**
R13	Residential - Pascal Close	0.00	**0.01**	0.00	**0.01**	**0.01**

4.1.2 As indicated in Table 8, predicted odour concentrations were below the EA odour benchmark of $1.5ou_E/m^3$ at all receptor locations for all modelling years.

4.1.3 Reference should be made to Figure 5 to Figure 9 for graphical representations of predicted odour concentrations throughout the assessment extents. These indicate

maximum levels in close proximity to the odour sources with levels reducing sharply over a short distance.

5.0 CONCLUSION

5.1.1 Redmore Environmental Ltd was commissioned by Waste4Generation Ltd to undertake an Odour Assessment in support of an Environmental Permit Variation Application for the AD facility operated by the company on land off Earlstrees Road, Corby.

5.1.2 Odour emissions from the facility have the potential to cause impacts at sensitive locations. An Odour Assessment was therefore undertaken to quantify effects in the vicinity of the plant.

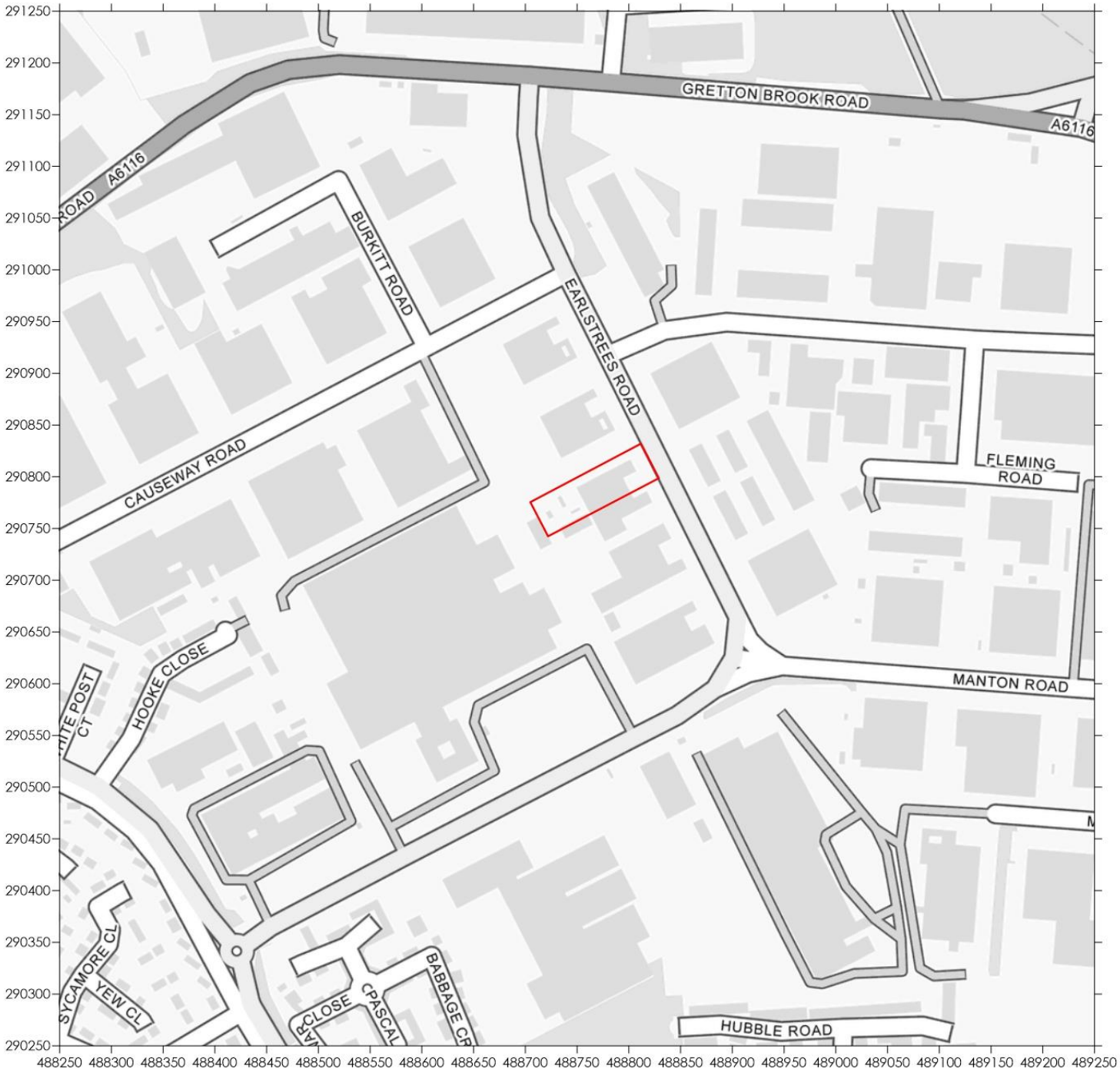
5.1.3 Potential odour releases were defined based on the size and nature of the facility. These were represented within a dispersion model produced using ADMS-6. Impacts at sensitive receptor locations in the vicinity of the site were quantified, the results compared with the relevant odour EA benchmark level.

5.1.4 Predicted odour concentrations were below the relevant EA odour benchmark level at all residential receptor locations for all modelling years. As such, potential odour emissions from the facility are not considered to be significant.

6.0 ABBREVIATIONS

AD	Anaerobic digestion
BAT	Best Available Techniques
CERC	Cambridge Environmental Research Consultants
CH_4	Methane
CHP	Combined Heat and Power
DAF	Dissolved Air Flotation
DEFRA	Department for Environment, Food and Rural Affairs
EA	Environment Agency
EC	European Commission
EWC	European Waste Code
FOG	Fat, oil and grease
H_2S	Hydrogen sulphide
NGR	National Grid Reference
OMP	Odour Management Plan
R&D	Research and Development
z_0	Roughness length
%ile	Percentile

Figures



Legend

Site Boundary

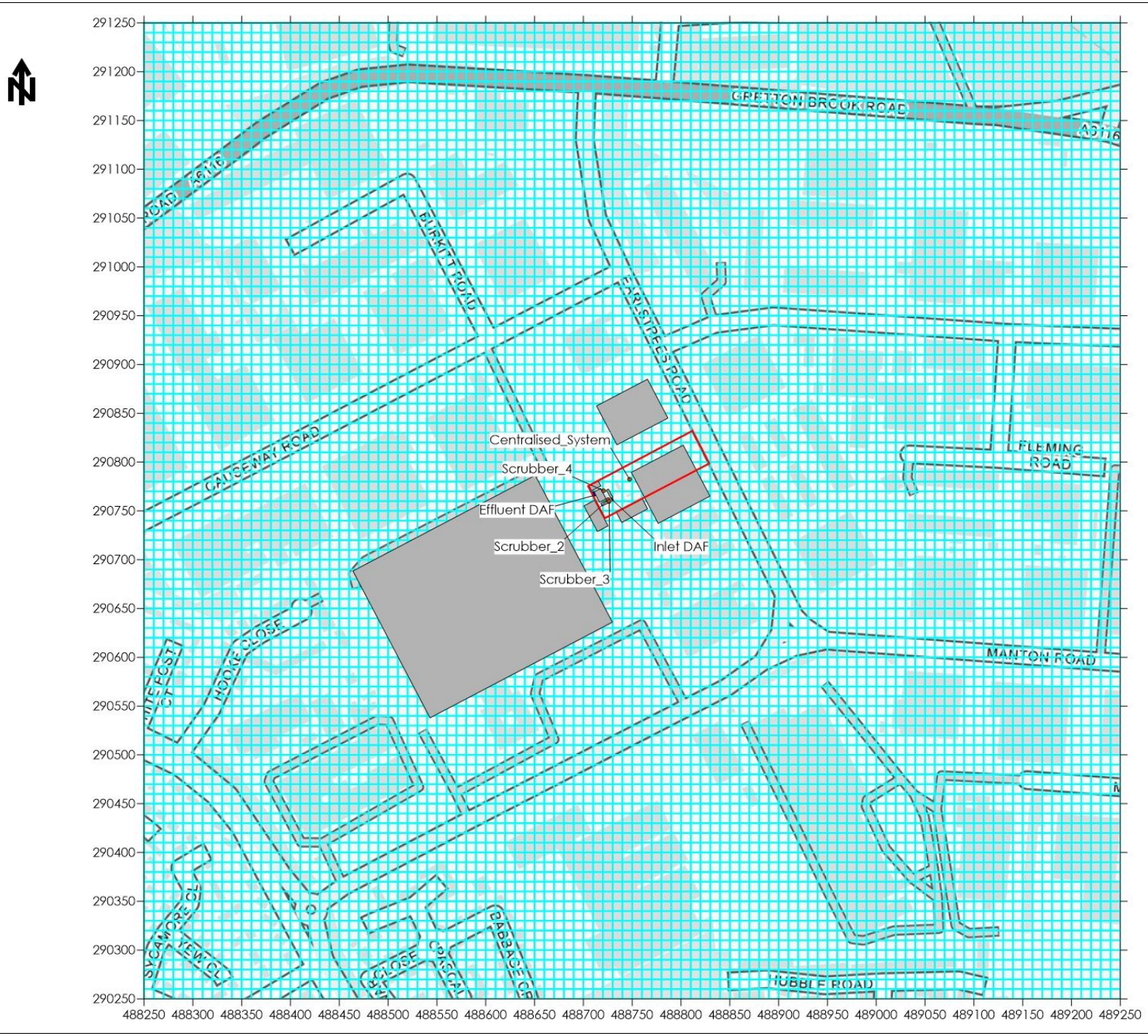
Title
Figure 1 - Site Location

Project
Odour Assessment
Earlstrees Road, Corby

Project Reference
6430

Client
Waste4Generation Ltd

Redmore environmental
www.red-env.co.uk | 0161 7060075



Legend

- Site Boundary
- Point Source
- Area Source
- Building
- Output Grid

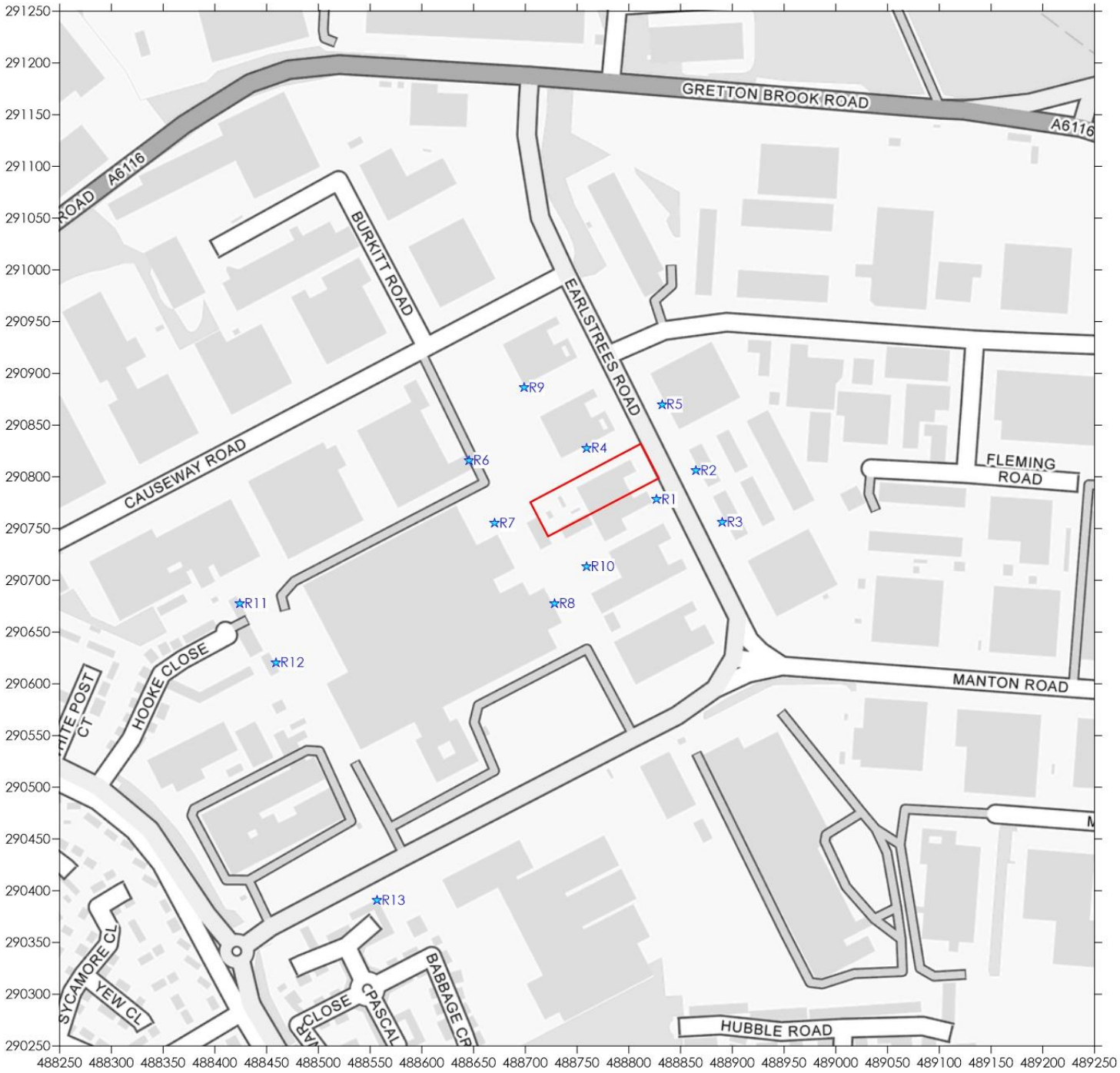
Title
Figure 2 - ADMS-6 Inputs

Project
Odour Assessment
Earlstrees Road, Corby

Project Reference
6430

Client
Waste4Generation Ltd

Redmore environmental
www.red-env.co.uk | 0161 7060075



Legend

Site Boundary

Sensitive Receptor

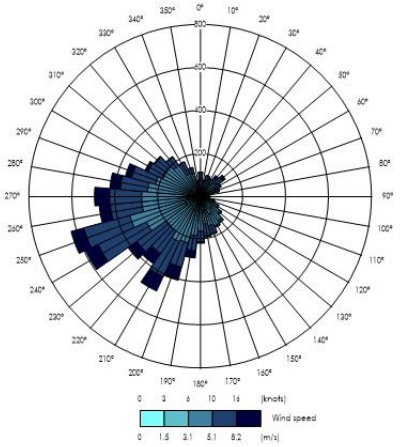
Title
Figure 3 - Sensitive Receptors

Project
Odour Assessment
Earlstrees Road, Corby

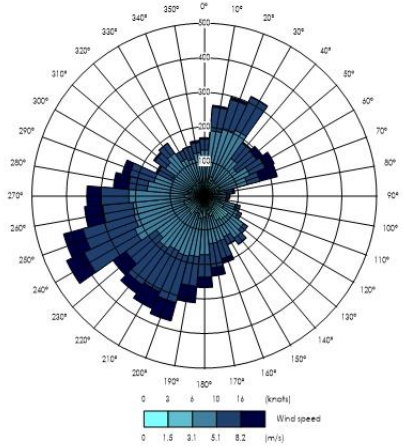
Project Reference
6430

Client
Waste4Generation Ltd

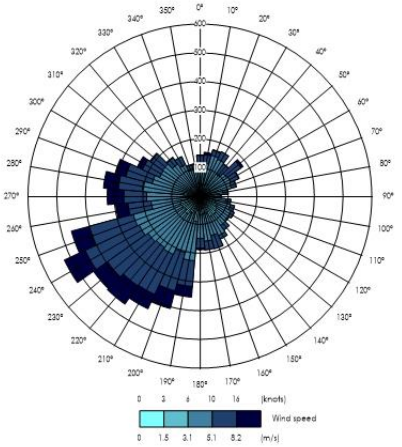
Redmore environmental
www.red-env.co.uk | 0161 7060075



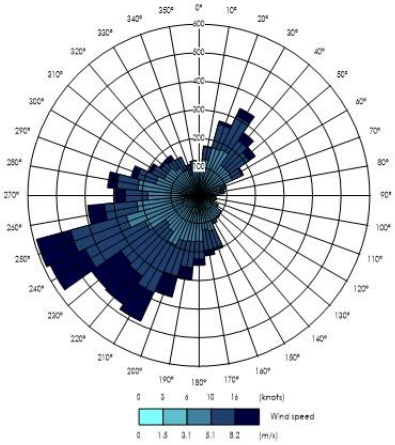
2017 Meteorological Data



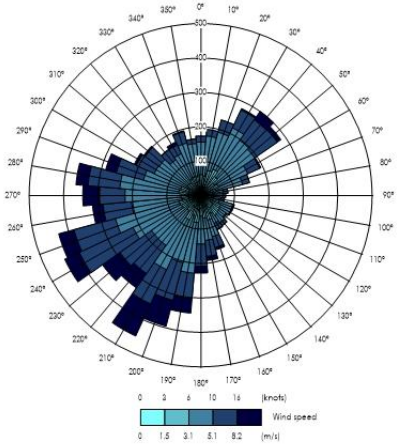
2018 Meteorological Data



2019 Meteorological Data



2020 Meteorological Data



2021 Meteorological Data

Legend

Title
Figure 4 - Wind Roses of 2017 to 2021 Wittering Meteorological Station Data

Project
Odour Assessment
Earlstrees Road, Corby

Project Reference
6430

Client
Waste4Generation Ltd

Redmore environmental
www.red-env.co.uk | 0161 7060075

Legend

Site Boundary

Predicted 98th %ile 1-hour Mean Odour Concentration (ou_E/m^3)

10
5
3
1.5
0.5

Title

Figure 5 - Predicted 98th %ile 1-hour Mean Odour Concentration (ou_E/m^3) 2017 Meteorological Data

Project

Odour Assessment
Earlstrees Road, Corby

Project Reference

6430

Client

Waste4Generation Ltd

Redmore environmental
www.red-env.co.uk | 0161 7060075

Legend

Site Boundary

Predicted 98th %ile 1-hour Mean Odour Concentration (ou_E/m^3)

10
5
3
1.5
0.5

Title

Figure 6 - Predicted 98th %ile 1-hour Mean Odour Concentration (ou_E/m^3) 2018 Meteorological Data

Project

Odour Assessment
Earlstrees Road, Corby

Project Reference

6430

Client

Waste4Generation Ltd

Redmore environmental
www.red-env.co.uk | 0161 7060075

Legend

Site Boundary

Predicted 98th %ile 1-hour Mean Odour Concentration (ou_E/m^3)

10
5
3
1.5
0.5

Title

Figure 7 - Predicted 98th %ile 1-hour Mean Odour Concentration (ou_E/m^3) 2019 Meteorological Data

Project

Odour Assessment
Earlstrees Road, Corby

Project Reference

6430

Client

Waste4Generation Ltd

Redmore environmental
www.red-env.co.uk | 0161 7060075

Legend

Site Boundary

Predicted 98th %ile 1-hour Mean Odour Concentration (ou_E/m^3)

10
5
3
1.5
0.5

Title

Figure 8 - Predicted 98th %ile 1-hour Mean Odour Concentration (ou_E/m^3) 2020 Meteorological Data

Project

Odour Assessment
Earlstrees Road, Corby

Project Reference

6430

Client

Waste4Generation Ltd

Redmore environmental
www.red-env.co.uk | 0161 7060075

Legend

Site Boundary

Predicted 98th %ile 1-hour Mean Odour Concentration (ou_E/m^3)

10
5
3
1.5
0.5

Title

Figure 9 - Predicted 98th %ile 1-hour Mean Odour Concentration (ou_E/m^3) 2021 Meteorological Data

Project

Odour Assessment
Earlstrees Road, Corby

Project Reference

6430

Client

Waste4Generation Ltd

Redmore environmental
www.red-env.co.uk | 0161 7060075