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Northacre Facility

Response to Odour Assessment review and further Odour Modelling

1 Introduction

In reference to the planning application ref 20/06775/WCM for the Northacre Facility (the Facility), Arla Foods, has requested additional information and clarification regarding the impacts of odour from the Facility. Arla Foods commissioned Redmore Environmental Ltd to review the air quality chapter of the Environmental Statement (ES) (the ES Chapter) submitted in support of the planning application. They produced a short document (the Review), which this technical note provides a response to. It includes the requested clarifications (within sections 2 and 3) and quantifications (within section 4) of the odour impacts at the Facility.

2 Summary

This technical note has been produced to respond to the Review carried out by Redmore Environmental Ltd on behalf of Arla Foods in relation to the planning application for the Northacre Facility. Points raised were in relation to the potential impact of odour and bioaerosols at Arla Foods. In summary:

- Additional information has been provided to clarify the assumption that the odour source potential is 'small' which has included further details of the odour mitigation measures included in the design.
- A quantitative assessment of odour from the Facility has been carried out. This has shown that the impact of odour at Arla Dairies is well below the Environment Agency (EA) criterion of 1.5 OU_E/m^3 and well below the odour criterion for hypersensitive populations of 1 OU_E/m^3, and so there would be "*no reasonable cause for annoyance*". Additional consideration has been made to the maximum 1-hour impact, interannual variability, the likelihood of the odour abatement system operating in the worst-case weather conditions for dispersion, and the assumptions used in the modelling. This has concluded that the results are conservative, and the likelihood occurrence is low, and therefore the risk of odour is not considered to be significant to the operations of Westbury Dairies.
- A quantitative assessment of bioaerosols from the Facility has been carried out. This has shown that the change in bioaerosols from background levels at Arla Dairies air intake can be considered to be 'insignificant'. Therefore, bioaerosol emissions from the Facility are not considered to be of significant risk to operations at Arla Dairies.

The results for both the odour and bioaerosol impact assessments are only relevant for periods in which the Facility is offline, when the carbon filter odour abatement system is used. In other operating circumstances, all air from within the tipping hall and bunker is used within the Facility as combustion air and is not released to the atmosphere. Therefore, the predicted impacts are considered to be conservative.

3 Odour source potential

The Review note an inconsistency within the Chapter, as follows:

- *The source potential is defined as 'small' in 8.4.44;*
- *8.4.49 states that effects have been determined based on a 'large' odour source potential as a conservative assumption.*

As stated in 8.4.44 of the ES, the odour source potential from the Facility is considered to be 'small'. The statement in 8.4.49 that it is 'large' is a typographical error and was not followed through within any of the assessment. The following section justifies why the odour source potential is considered to be 'small'.

The 'small' odour source potential was assigned to be most representative of the Facility, considering the following three factors as outlined in the IAQM *"Guidance on the assessment of odour for planning July 2018* (the IAQM guidance).

1. **Magnitude** - the magnitude of the release from the odour source, taking into account the effectiveness of any odour control or mitigation measures that are already in place. This involves judging the relative size of the release rate after mitigation and taking account of any pattern of release (intermittency).
2. **Odour level** – how inherently odorous the emission is. In some cases this can be assigned if it is known whether the release has a low, medium or high odour detection threshold (ODT); this is the concentration at which an odour becomes detectable to the human nose. In most instances the odours released by a source will be a complex mixture of compounds and the detectability will not be known. However, for some industrial processes the odour will be due to one or a small number of known compounds and the detection thresholds will be a good indication of whether the release is highly odorous or mildly odorous.
3. **Unpleasantness** – the relative pleasantness/unpleasantness of the odour. Lists of relative pleasantness of different substances are given in the Environment Agency (EA) guidance H4 Odour Management and in more detail in the SEPA document Odour Guidance 2010.

Table 9 of the IAQM Guidance defines the odour source potential criteria as set out in the table below:

Table 1: Odour source potential criteria

Source Potential	Description
Large	• Larger Permitted processes of odorous nature or large Sewage Treatment Works (STWs). • Materials usage hundreds of thousands of tonnes/m^3 per year. • Area sources of thousands of m^2. • Compounds involved are very odorous, having very low Odour Detection Thresholds (ODTs) where known. • Process classes as "most offensive" or compounds/odours having unpleasant to very unpleasant hedonic score. • Open air operation with no containment, reliance solely on good management techniques and best practice.
Medium	• Smaller Permitted processes or small STWs. • Materials usage thousands of tonnes/m^3 per year. • Area sources of hundreds of m^2.

Source Potential	Description
	• Compounds involved are very odorous, having very low Odour Detection Thresholds (ODTs) where known. • Process classified in EA guidance H4 as “moderately offensive” or compounds/odours having unpleasant to very unpleasant hedonic score. • Some mitigation measures in place, but significant residual odour remains.
Small	• Smaller Permitted processes or small STWs. • Materials usage hundreds of tonnes/ m^3 per year. • Area sources of tens m^2. • Processes classed in EA guidance H4 as “less offensive”. • Effective, tangible mitigation measures in place (e.g. Best Available Techniques (BAT), Best Practicable Means (BPM) leading to little or no residual odour.

Source: IAQM Guidance

The surface area of the waste within the bunker is estimated to be approximately 1,400 m^2 and would include putrescible wastes which would be considered to be unpleasant. In accordance with the IAQM guidance this could warrant a descriptor of ‘large’ odour source potential. However, it has been deemed that the odour source potential is ‘small’ as:

- The waste would be contained within a building. It is considered that the surface area criteria in the IAQM guidance is relevant for open air sources such as landfill and sewerage works rather than enclosed processes such as the Facility.
- Not all the waste will be putrescible and unpleasant. The waste will be a complex mixture of wastes from domestic municipal solid waste (MSW), Commercial and Industrial Wastes (C&I) and Solid Residual Fuel (SRF) from the MBT plant. It is reasonable to assume that the more odorous materials found within these wastes will be of a similar in make-up to household organic waste and would be considered to be unpleasant, but this will not make up the entire composition of waste, and would be mixed with less / none odorous wastes.
- Effective tangible mitigation measures would be in place with represent BAT for the sector as set out in 8.4.2 of the ES and expanded upon in section 3.1 of this note. These are a mixture of management techniques, design measures, and technology solutions. These measures will ensure that odour levels are controlled and ensure little residual odour from the abatement system or from fugitive sources.

Therefore, in relation to the Review, we maintain that the statement in 8.4.44 is correct, that the statement in 8.4.49 is a typographical error, and this does not change the conclusions of the ES.

3.1 Odour mitigation measures

The Facility will be designed in accordance with the requirements of the EA Guidance Note H4: Odour Management. The Facility will include a number of controls to minimise odour from the installation during normal and abnormal operations. These include:

1. The waste reception area, including the tipping hall and the waste bunker, will be maintained under negative pressure, to ensure that no odours are able to escape the building. The negative pressure will be created by drawing process air from the waste reception areas, to be used in

the combustion process. Where the demand for process air drops below the air flow required to maintain negative pressure, there will be a carbon filter system (see section 2.1.1), which will be used to treat any 'excess air'. The treated air from the carbon filters will be released via an odour abatement stack. This stack will be 11 m in height, but will be situated on top of the bunker parapet, so will reach 43 m above ground level.

2. All incoming waste will be delivered to the Facility by enclosed road vehicles which are suitable for bulk transfer of waste.
3. Bunker management procedures (mixing and periodic emptying and cleaning) will be developed and implemented to avoid the development of anaerobic conditions in the waste bunker, which could generate odorous emissions.
4. Prior to periods of planned maintenance of the Facility quantities of waste within the tipping bunker and the storage bunker will be run down to minimise the quantity of waste stored at the Facility. In addition, during short periods of unplanned maintenance, the doors to the building will be closed to prevent the escape of odour.
5. During long periods of unplanned shutdown fuel deliveries to the Facility will be stopped, and backloading of the bunker could be done using crab crane maintenance opening if necessary. There will be facilities in place for waste to be back-loaded from the bunker if required for transport off-site to suitable waste treatment facilities.
6. The Industrial Emissions Directive (IED) requires that any combustion gases passing through a waste incineration plant must experience a temperature of 850°C or more for at least two seconds. Due to the high temperature experienced by the gases, most odorous chemicals would be destroyed. Any surviving odorous chemicals may become trapped on the bag filters.
7. Ammonia solution will be injected into the furnace as part of the NOx abatement system, which converts into ammonia during the process, and there may be some occasional "ammonia slip" during operation. However, this will be released as part of the emissions from the main flue. The maximum predicted concentration of ammonia at ground level are at least an order of magnitude below the detection threshold[1].
8. Incinerator bottom ash (IBA) will have reached a temperature of 850°C or higher during combustion for at least two seconds, and that it will have a Loss on Ignition (LOI) of less than 5% or a Total Organic Carbon of less than 3%, as required by the IED. Therefore, no organic or putrescible solid material would be present within the IBA and there will be not be any discernible odours from the handling and storage of IBA.
9. Air Pollution Control residues (APCr) will be stored in a silo. This residue will consist of ash which will have reached a temperature of 850°C or higher during combustion within the boiler or the flue gas treatment chemicals (lime or activated carbon) within the FGT system. Therefore, no organic or putrescible solid material would be present within the APCr silos. Consequently, there will be no odour from the storage of APCr.

3.1.1 Odour abatement technology

It is proposed to use the abatement technique of adsorption through a carbon filtration system which the EA considers represents BAT for the abatement of odour from this type of facility

Adsorption is a process in which gas molecules are removed from a gaseous stream via capture on the surface of a solid adsorbent. Adsorbents are chosen so that they preferentially adsorb specific

[1] Odour detection threshold stated to be 0.0266 – 39.6 mg/m^3 – SEPA Odour Guidance 2010. Maximum predicted 1-hour impact of ammonia is 2.13 µg/m^3 (or 0.00213 mg/m^3)

chemical compounds. When a gaseous stream passes through a bed of appropriate adsorbent material, odorous molecules that contact the adsorbent surface are captured.

In general, adsorption is a relatively simple, robust, efficient and economic technology. Although the technology is sensitive to high temperatures (approximately 100°C), humidity, and high particulate content, this should not be a concern for air extracted from the waste reception area. The adsorbent typically has to be replaced after its surface is saturated. Due to the low frequency which the adsorbent will be used, it is estimated that it will require replacement every 12 months.

Adsorption is an appropriate odour abatement technique for gas streams with low concentrations of organic compounds, such as those associated with the Facility. Adsorption is used in various types of facilities for odour abatement, such as waste reception buildings, sewage treatment plants, petrol stations, and food processing facilities. Some operators of adsorption abatement systems have experienced problems with saturation of the filters. However, a preventative maintenance regime as proposed will minimise the chance of problems occurring.

4 Risk of odour exposure at Westbury Dairies

The Review notes an inconsistency within the ES Chapter, as follows:

> *“In Table 8.18, the risk of odour exposure at Westbury Dairies (receptor OR13) has been classified as 'low' risk. However, using the Institute of Air Quality Management (IAQM) methodology, if the source odour potential is 'large' and the pathway effectiveness 'highly effective', the risk is classified as 'high'. In turn, the likely magnitude of odour effect at a receptor of 'high' sensitivity is 'substantial adverse', which would be considered 'significant'.”*

This is a continuation of the typographical error in paragraph 8.4.49. Table 8.18 in fact is based on the odour source potential being ‘small’, which is correct, as explained in section 2 of this technical note. Therefore, the results stated in Table 8.18 are correct and the typographical error in paragraph 8.4.49 does not change the conclusions of the assessment at any receptor and in particular at Westbury Dairies (the Arla Foods site).

5 Odour and bioaerosol impact assessment

The Review states:

> *“Notwithstanding the above, we would also request that a quantitative assessment of impacts associated with odour and bioaerosol emissions from the odour abatement plant is undertaken. This should consider impacts during planned and emergency events, as well as site commissioning, and analyse normal operation of the odour abatement plant and any periods when this may not be functional. Experience of similar facilities has indicated significant emissions during certain events and it is essential to ensure these do not cause adverse impacts at Westbury Dairies.”*

In response to this request, dispersion modelling has been carried out to quantify the impact of odour and bioaerosols from the odour extraction system.

The original the assessment of odour in the ES Chapter was qualitative, in following with the IAQM 2018 Odour Guidance. This ES Chapter assessment found the likely magnitude of odour effects to be negligible at all identified receptors, excluding Westbury Dairies, which had a slight adverse magnitude of effect due to its close proximity to the Facility. However, according to the IAQM 2018 odour guidance this is not significant and the overall odour effect of the operation of the Facility was assessed to be not significant. However, as requested, we have conducted the following assessment to quantify this at Westbury Dairies.

The original the assessment of bioaerosols in the ES Chapter was qualitative. Due to the mitigation measures in place, the potential for bioaerosol releases from the Facility were deemed to be negligible and the risk to human health not significant. However, as requested, we have conducted the following assessment to quantify bioaerosol impacts at Westbury Dairies.

5.1 Receptor locations

The incentive for these assessments is to assess the risk of contamination to dairy products produced at Westbury Dairies. Activities include the production of powdered milk which requires the introduction of air, which is brought in through air intake vents on the eastern side of the Dairy, facing the Northacre Facility. Therefore, these air intake vents are the receptors of concern for the purpose of these assessments. However, due to the suction effect of the vents, it is not appropriate to use the exact location of the vents as receptors, and they will draw in air from the surrounding area. Therefore, the area of influence of the intake vent has been calculated. The calculation has been undertaken assuming that the area of influence of the intake vent is comparable to a flanged opening extraction vent within a building and applying standard equations for the design of exhaust hoods[2]. Arla Dairies has provided the following information needed to carry out the calculation:

- . The dimensions of the air intake vents are 3.86 m by 3.5 m,
- the flow rate is 137,500 kg/hr; and
- the capture velocity is 0.1 m/s.

Given these values, the area of influence is determined to be 7.79 m from the air intake by application of the following equation:

$$Q = 0.75v(10(\sqrt{R})X^2 + A)$$

Where:

Q = Air volume = 46.79 m^3/s *(Intake rate (137,500 kg/hr) multiplied by density of air (1.225 kg/m^3) dived by 3,600.*

v = Capture velocity = 0.1 m/s

R = Ratio of length to width = 1.10 (3.86/3.5)

X = Capture distance from source (to be determined)

A = Area of opening = 13.51 m^2 (3.86 m x 3.5 m)

The calculated capture distance value of 7.79 m has been rounded up to 8 m for the purpose of this assessment. To ensure the entire potential area of influence from the vents is covered, 5 receptors have been modelled at 3 different heights; ground level, 5 m (the height of the vents), and 13 m (the height of the vents plus 8 m potential air capture distance). This is the same approach that was used by the planning application for the MBT plant, with updated vent dimensions and intake rates. The receptors are listed in Table 2 below and included on Figure 1.

Table 2: Air intake receptor locations

Receptor	Elevations (m above ground level)	X (m)	Y (m)
R1	0,5,13	385609	152092
R2	0,5,13	385598	152084

[2] L J Stewart (1985) Design Guidelines for Exhaust Hoods. BSRIA Technical Note TN 3/85

Receptor	Elevations (m above ground level)	X (m)	Y (m)
R3	0,5,13	385611	152098
R4	0,5,13	385605	152090
R5	0,5,13	385603	152086

The air intake vents are fitted with an air filtration system to remove airborne particles. This has not been considered within the assessment, so the results are conservative.

5.2 Odour impact assessment

Detailed dispersion modelling has been undertaken to quantify the impact associated with the release of potentially odorous air from the odour extraction system for the Facility, at Westbury Dairies. This would be the only source of potential odour, because the negative pressure within the bunker hall and reception area directs all air through the odour extraction system. This has been carried out using ADMS 5.2. The modelling has used the same dispersion model which supported the planning application. For the purposes of modelling the odour impacts from the Facility, it has been assumed that the odour is caused by a substance which disperses in the atmosphere, in the same way that any other pollutant (such as dust or sulphur dioxide) disperses.

The location of the Westbury Dairies air intake is approximately 96 m to the north west of the odour extraction system stack on the Facility. As the predominant wind direction is from the south west (See Figure 4).

For the purpose of this analysis it has been assumed that the odour extraction system from the Facility is continually operating. However, as explained in section 2.1, the odour extraction system will only operate when the demand for process air drops below the air flow required to maintain negative pressure, such as when the Facility is offline. Assuming the odour extraction system continually operates will ensure that the model captures the operation of the odour extraction system during the worst-case atmospheric conditions for dispersion.

The results of the modelling have been compared to the odour exposure criteria set out in the IAQM's Odour Guidance. This guidance recommends some indicative odour exposure criteria for ground level concentrations of mixtures of odorant, below which there would be "*no reasonable cause for annoyance*". For "*highly offensive odours*", including those from activities involving putrescible waste, the criterion is 1.5 OU_E/m^3 as the 98th percentile of hourly averages. This has been used as the evaluation criterion for the odour assessment. It is noted that the guidance also states that a local adjustment factor for hypersensitive populations this criterion should be reduced to 1 OU_E/m^3.

5.2.1 Input data

The model inputs for the odour modelling are as follows:

Table 3: Emission source Data

Item	Unit	Facility
Height	m	43
Internal diameter	m	1.57
Location (E'ings,N'ings)	m, m	385705, 152021
Flue gas exit velocity	m/s	18.9

Item	Unit	Facility
Temperature	°C	15°C
Volume at actual conditions	Am^3/h	132,000
	Am^3/s	36.67
Odour release	OU_E/m^3	1,000
	OU_E/s	36,667

5.2.1.1 Odour release assumptions

There are no UK guidelines relating specifically to the types of waste to be processed at the Facility. Therefore, the calculation of odour emissions has been derived from the Netherlands Emission Guidelines. This approach has been considered appropriate for recent PPC applications where in a similar nature to this the exact odour release rate is unknown.

It is reasonable to assume that the more odorous materials found within the feedstock waste will be similar in make-up to household organic waste. Therefore, the odour calculations for the Facility have used the 'Key Odour Emission Factor' for 'Receipt of household organic waste: Storage' ($5x10^5$ $OU_E/m^2/h$). The footnote in the guidance confirms that this factor describes the number of odour units per m^2 of stored household organic waste per hour. The depth of waste is not included as a factor, but the empirical nature of the 'Key Odour Emission Factor' suggests that while the odour arising may be from the bulk of the material, the emission is assumed to be from the surface of the waste pile for the purposes of the calculation.

The 'Key Odour Emission Factor' is based on household organic waste. The Facility will process a mixture of wastes from domestic municipal solid waste (MSW), Commercial and Industrial Wastes (C&I) and Solid Residual Fuel (SRF) from the MBT plant. Whilst it is reasonable to assume that the more odorous materials found within these wastes will be similar in make-up to household organic waste, it is not reasonable to assume the entirety of waste received for processing at the Facility will be household organic waste. Therefore, an analysis of the waste composition has been conducted to determine the likely putrescible waste content of the feedstock.

The three fractions of waste which would be expected to produce odours are '*organic putrescible*', '*absorbent hygiene products*' and '*fines*'. The percentages of these fractions found in MSW and C&I waste have been summed, using data from *Environment Agency Wales/SLR: "Determination of the Biodegradability of Mixed Industrial and Commercial Waste Landfilled in Wales", 2007* and *"DEFRA EV0801 National compositional estimates for local authority collected waste and recycling in England, 2010/11", 2013.* The percentages of putrescible waste found in each waste type are displayed in Table 3. As a conservative assumption, it is assumed that the SRF from the MBT is odorous and so this percentage has been set to 100%.

Table 4: Percentages of putrescible waste in feedstock wastes

Waste	Fines	Organics	Adsorbent hygiene products	TOTAL
MSW	2.31%	40.23%	6.95%	49.49%
C&I	6.77%	5.65%	0.00%	12.42%
SRF from MBT	-	-	-	100%

Feedstock from the MBT is expected to be approximately 20% of the total feedstock. Feedstocks of MSW and C&I are not yet fully defined and are subject to change. In a worst-case scenario, in terms of amount of putrescible waste, assuming a feedstock of 20% MBT and 80% MSW would result in 60% of waste being considered putrescible, and this assessment has used a putrescible content factor of 0.6. This is very much a worst case and conservative value, and in reality it is likely that the putrescible content will be much lower than this.

At this stage of design of the Facility, a detailed 3D model of the waste within the bunker is not available, but it is expected to be developed by the technology provider as part of the detailed design of the bunker. However, the concept design produced by to support the application includes consideration of the bunker sizings to determine the maximum waste capacity. From these calculations the following assumptions have been used:

- Bunker length: 45 m
- Exposed width at top of pile: 4.6 m
- Exposed width at tipping hall level: 5 m
- Height of the waste pile: 18 m

Using the above data, the exposed surface area of the waste in the bunker has been calculated as 1,367.67 m^2. This conservatively assumes that bunker is full to its maximum capacity. However, in the event of a planned shutdown the waste in the bunker would be run-down and in the event of a prolonged emergency shutdown there are measures in place to enable backloading of waste from the bunker and transfer off-site to an alternative waste management facility.

Assuming the waste within the bunker has a putrescible content of 60%, the odour emissions have been calculated as:

$$Surface\ area\ of\ the\ waste\ in\ the\ bunker\ \times Key\ Odour\ Emission\ Factor\ \times 0.6$$

$$1{,}367.67\ m^2\ \times\ 5\ \times 10^5\ OU_E m^{-3} hr^{-1}\ \times 0.6 = 410{,}296{,}115\ OU_E hr^{-1}$$

In order to obtain the odour concentration in OU_E/m^3 this has been divided by the volumetric flow rate, assuming three air changes per hour:

$$\frac{410{,}296{,}115\ OU_E hr^{-1}}{132{,}000\ m^3 hr^{-1}} = \mathbf{3{,}108.3\ OU_E m^{-3}}$$

The volumetric flow rate has been calculated from the total air volume within the tipping hall, the bunker (from the height of the tipping hall floor to the level of the feed hopper), and the enclosed area within the bunker above the feed hopper level. The calculated volume is conservative because it does not consider the space that will be taken up by equipment and waste.

3,108.3 OU_E/m^3 has been calculated as the unabated odour release concentration from the waste within the bunker. This value has not considered the carbon filter odour abatement system, which will remove the majority of the odour. The Waste Treatment BREF reports the efficiency of this technique to be between 70% and 99%. Therefore, using the lower value, in order to be conservative, the abated odour release concentration from the waste within the bunker is 932.4 OU_E/m^3, which has been rounded up to be **1,000 OU_E/m^3.**

5.2.2 Results

Detailed results tables of modelled odour concentrations at each receptor for each year are provided in Appendix B for both the 98th percentile 1 hour means and 100th percentile 1 hour means.

The maximum 98th percentile of 1-hour odour concentration modelled at the air intake receptors at Westbury Dairies was 0.155 OU_E/m^3. This is well below the criterion of 1.5 OU_E/m^3 (and the more stringent criteria for hypersensitive communities) and it can therefore be concluded that there would be "*no reasonable cause for annoyance*". As shown in Appendix B there is considerable variation in the 98th percentile with results for some years being 36% of the maximum using the full 5-years of weather data.

The maximum 100th percentile of 1-hour odour concentration modelled at the air intake receptors at Westbury Dairies was 3.336 OU_E/m^3. This is in exceedance of the 1.5 OU_E/m^3 criterion. However, there is considerable variations in the predicted impacts with results for some years being 30% of the maximum using the full 5-years of weather data.

Further analysis has been taken on the results. Table 5 shows the number of hours each year which the concentrations exceed 1.5 OU_E/m^3.

Table 5: 100th %ile odour results: number of 1-hour periods where at any receptor there is an exceedance of 1.5 OU_E/m^3

Year	2015	2016	2017	2018	2019
Hours of exceedences	3	0	12	6	3

This shows that this is an infrequent event.

It should be noted that the odour control system for the Facility would only be used in the event that the demand for process air drops below the air flow required to maintain negative pressure, such as when the Facility is offline. The majority of the time, all air from within the bunker will be used for combustion air and so used within the Facility and any outstanding would be released from the main emissions stack post flue gas treatment.

Therefore, there is a very low likelihood of these worst-case weather conditions coinciding with when the odour control system is required. Furthermore, the results above are based on the conservative assumption that the odour abatement system runs at a 70% efficiency. This is the lower value of the expected 70-99% efficiency. Factoring the results for higher efficiencies shows that the efficiency would only need to be increased to between 79 and 86% (dependent on the year of meteorological data used) for all 100 percentile results at the receptors to be below the 1.5 OU_E/m^3 criterion.

Therefore, the results presented above are conservative. They provide results for the worst-case scenario, in which the worst-case meteorological conditions and the requirement for use of the odour abatement system coincide, and the abatement system runs at the lower end of the abatement efficiency. Therefore, the likelihood of this occurrence is extremely low and the risk of odour from the Facility is not considered to be significant to the operations of Westbury Dairies.

Figure 2 shows the spatial distribution of the odour impacts for the wider area.

5.3 Bioaerosol impact assessment

Bioaerosols are airborne particles which contain micro-organisms. They are found naturally in the environment and can include bacteria, fungi, viruses, pollen, spores, endotoxins and mycotoxins.

The Facility uses incineration and so does not rely on micro-organisms to break down waste. However, the natural composting of wastes delivered to the bunker and some composting within the bunker provides a small potential of producing bioaerosol emissions before waste is burnt.

To quantify the impact of bioaerosol releases from the Facility, detailed dispersion modelling has been undertaken. For the purposes of modelling the bioaerosol impacts from the Facility, it has been assumed that bioaerosols disperse in the atmosphere, in the same way that any other pollutant (such as dust or sulphur dioxide) disperses.

There is little regulatory guidance available for bioaerosol emissions from energy-from-waste facilities, or widely published background levels. The EA guidance note “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. The proposed facility is neither an anaerobic digestion plant or a composting facility, and it is not expected for there to be a significant quantify of bioaerosols released from the feedstock. Nevertheless, as requested, a quantitative assessment of the potential bioaerosol levels from the Facility at Westbury Dairies has been undertaken.

All air from the bunker, during normal operating conditions and periods when the Facility is offline, will be filtered through a dust filtration system. As bioaerosols are particles, a large proportion of them will be extracted at this part of the process. As set out in the ES, under regular operational conditions, all air from the bunker will be used within the Facility as combustion air, so any remaining bioaerosols would be incinerated. When the demand for process air drops below the air flow required to maintain negative pressure, the odour abatement system would operate and air would be released into the atmosphere from the odour stack. Therefore, the risk of bioaerosol release to the atmosphere would be limited to this scenario, and would be limited to the bioaerosols which have not been extracted by the dust filtration process or the odour abatement system.

5.3.1 Approach and background levels

We have taken an approach similar to that used for other pollutants, by comparing our bioaerosol contributions to background levels, to ensure that the process contribution (PC) from the Facility is not significant. The assessment adopts the Environment Agency’s Air Emissions Guidance used for other pollutants from the Facility: that to screen out contributions as ‘insignificant’;

- the long-term PC must be less than 1% of the long-term environmental standard; and
- the short-term PC must be less than 10% of the short-term environmental standard.

A study by Stagg et al[3] measured background levels of bioaerosols at 50 m from a composting facility in the UK to be 1,000 colony forming units (cfu)/m^3. In lieu of any other guidance or background levels, we have used this value in our assessment to be representative of typical background levels. However, previous air quality assessments undertaken for the Northacre Facility and adjacent MBT plant have used a different approach. The 2014 Hills report focuses only on annual averages, as the purpose was to assess the amount of bioaerosols caught in the vent filters, in the context of annual maintenance costs. The 2008 SLR assessment, which was done for the adjacent MBT plant, did not use the EA screening criteria but indicated that an increase in levels of bioaerosols within 1 order of magnitude of existing background levels was broadly acceptable, but then estimates background levels to be 50 cfu/m^3, despite previously stating background levels can range from 0 to 2,968 cfu/m^3.

5.3.2 Input data

The model inputs for the bioaerosol modelling are as follows:

[3] Stagg et al (2010) - Bioaersol emissions from waste composting and the potential for worker's exposure

Table 6: Emission Source Data

Item	Unit	Facility
Height	m	43
Internal diameter	m	1.57
Location (E'ings,N'ings)	m, m	385705, 152021
Flue gas exit velocity	m/s	18.9
Temperature	°C	15°C
Volume at actual conditions	Am^3/s	36.67
Bioaerosol release	cfu/m^3	34,700

The bioaerosol release value has been taken from a study by Gladding et al[4]. As part of this study bioaerosols release from residual household waste bins were measured. The aim was to assess the change in bioaerosol release of bins with an extended or missed collection cycle. The maximum recorded value of total bacteria from the waste within an 8-week period was given to be 34,700 cfu/m^3. The 8 week period is considered to cover the length of time waste may have the potential to decompose and release bioaerosols (including collection time and time within the bunker) and the type of waste is considered representative of the majority of the waste to be received by the Facility. Therefore, this has been used as the release rate for the modelling. This concentration is based on bioaerosols release directly from waste, and does not consider the removal of bioaerosols by the dust filtration system or odour abatement system. As we do not know the removal efficiencies of these systems in relation to bioaerosols, it is not possible to accurately consider them within our calculations. Therefore, we have maintained the use of a 34,700 cfu/m^3 release rate, but this should be considered a very conservative value as actual levels are likely to be lower.

5.3.3 Results

The impact of bioaerosols released from the Facility at the air intake receptors at Westbury Dairies is displayed in Table 5, including the relative impact compared to background levels . Results are the maximum predicted impact at all modelled receptors and using the 5 years of weather data used for the original dispersion modelling exercise for the Facility.

Table 7: Bioaerosol analysis results at Westbury Dairies Air Intake

Averaging period	Maximum 1 -hour mean bioaerosols	Maximum annual mean bioaerosols
Concentration (cfu/m^3)	115.8	0.38
As a percentage of background levels (1,000 cfu/m^3)	11.6%	0.04%

As shown, the modelling results at the Westbury Dairies air intake receptors show that the long term PC of bioaerosols is less than 1% of background levels, so for long term PC the change in bioaerosols levels from background levels as a result of the operation of the Facility during abnormal operations is considered to be 'insignificant' using the EA screening criteria.

[4] Gladding et al (2017) - A study of the potential release of bioaerosols from containers as a result of reduced frequency residual waste collections

For short term PC of bioaerosols, the change is slightly greater than 10% of background levels and would therefore would not be able to be classed as 'insignificant' according to the EA screening criteria. However, the odour control system for the Facility would only be used in the event that the demand for process air drops below the air flow required to maintain negative pressure, such as when the Facility is offline. The majority of the time, all air from within the bunker will be used for combustion air and all bioaerosols would be incinerated. Therefore, the results presented here will only occur for a few brief periods each year. The assessment also does not consider the further reduction in concentration by the dust filtration system and odour abatement systems from the Facility and the Dairy air filtration system to remove airborne particles within the air vents. The results presented here are also for the worst-case meteorological conditions assumed within the modelling, which would not necessarily coincide with the times when the odour extraction system is operating. Therefore, it is assumed that these results are conservative and for a worst-case scenario. Considering the above points, the slight change from background levels for short term bioaerosols is not considered to be of significant risk to operations at Arla Dairies.

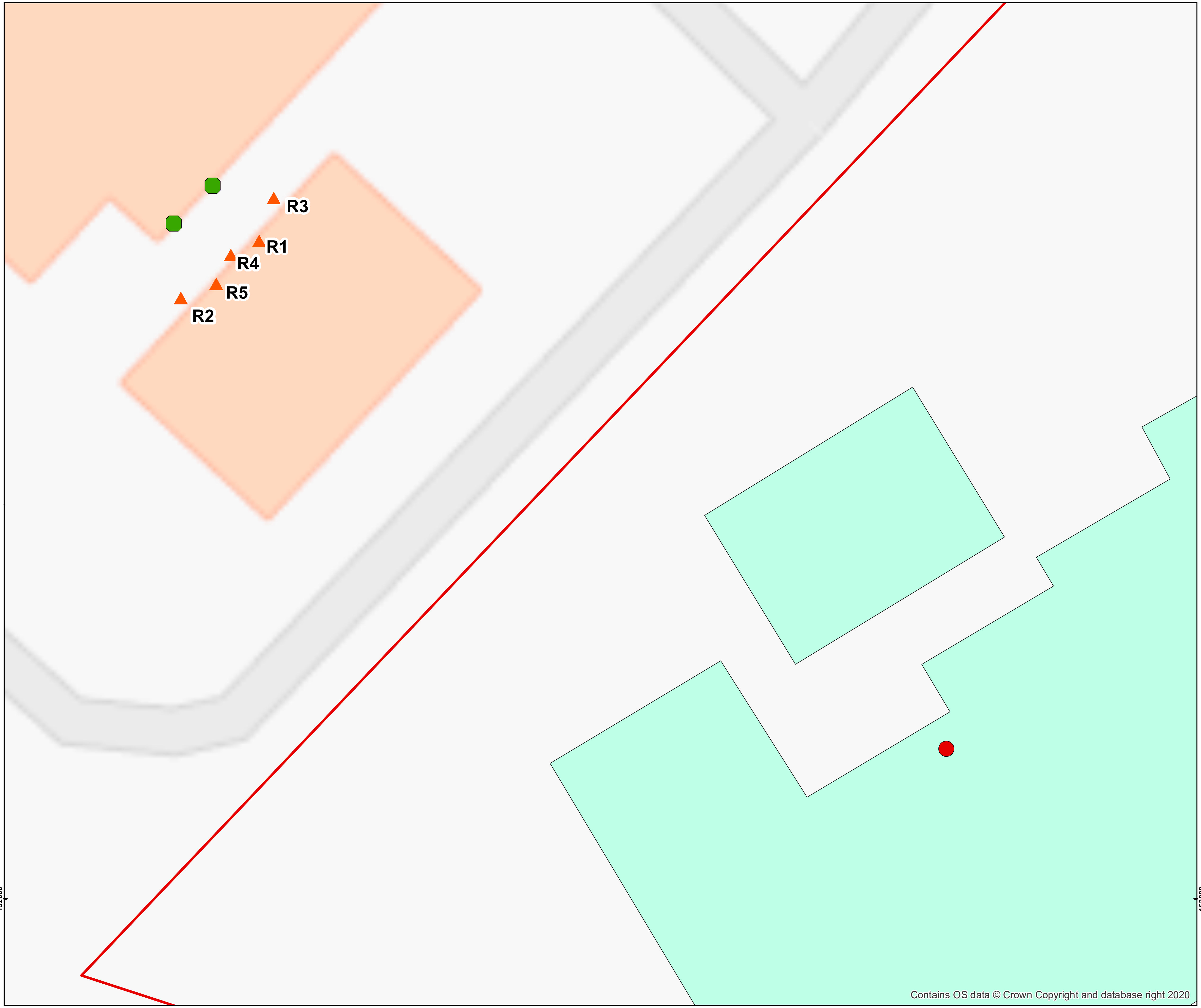
5.3.3.1 Sensitivity analysis

A sensitivity analysis has been undertaken to quantify the point at which the long term contribution from the Facility may no longer be considered 'insignificant'. For contributions of bioaerosols from the Facility to be 1% of the background levels at Westbury Dairies, the emission concentration of bioaerosols from the waste would have to exceed 1,480,170 cfu/m^3. This emission value is approximately 42 times greater than the expected and modelled bioaerosols concentration.

According to the 1 order of magnitude approach as in the SLR 2008 report for the MBT plant, bioaerosol concentration from the Facility would have to reach 10,000 cfu/m^3 before being considered significant. Our modelled concentrations for both long and short term bioaerosols are well within this. Even if we were to use this method and a lower background concentration of 50 cfu/m^3, our results remain well within the 500 cfu/m^3 criteria (i.e. 1-order of magnitude greater than the assumed background),

Appendices

A Figures



Legend

- Vent locations
- Receptors (8 m distance from vents, at 0, 5 and 13 m heights)
- Odour stack
- Northacre Facility building outline
- Northacre Facility Site boundary

Client:	Northacre Renewable Energy Ltd
Site:	Northacre ERF
Project:	2862

Title:

Figure 1 - Vent and receptor locations

Drawn by: Hannah Lederer | Date: 07/01/2021

0 0.005 0.01 0.02 km

N

Scale: 1:500

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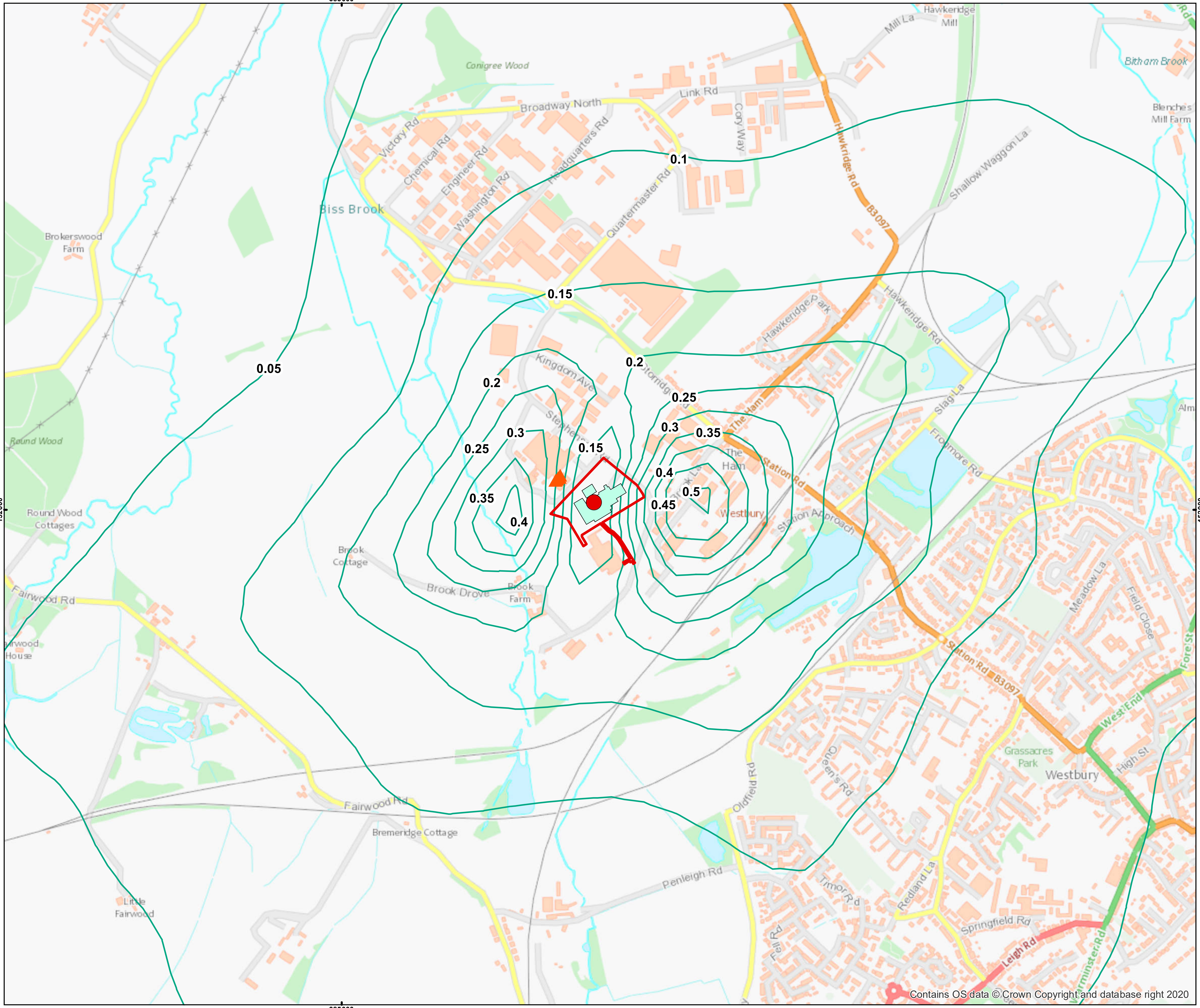
Kingsgate, Wellington Road North,
Stockport, Cheshire, SK4 1LW
Tel: 0161 476 0032
Fax: 0161 474 0618



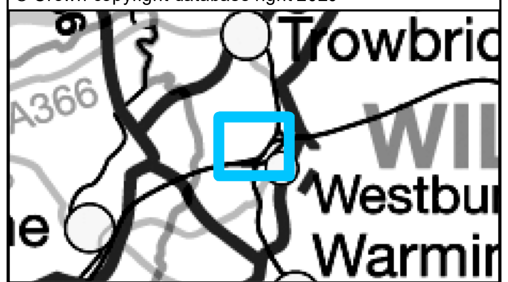
Legend

- Receptors (8 m distance from vents, at 0, 5 and 13 m heights)
- Odour stack
- Northacre Facility building outline
- Northacre Facility Site boundary
- Odour emissions (OUe/m3)

Note: Odour emissions are using the 98th %ile of 1-hour means

Client:	Northacre Renewable Energy Ltd
Site:	Northacre ERF
Project:	2862
Title:	Figure 2 - Odour dispersion

Drawn by: Hannah Lederer | Date: 07/01/2021



0 3.75 7.5 15 km

N

Scale: 1:357,303

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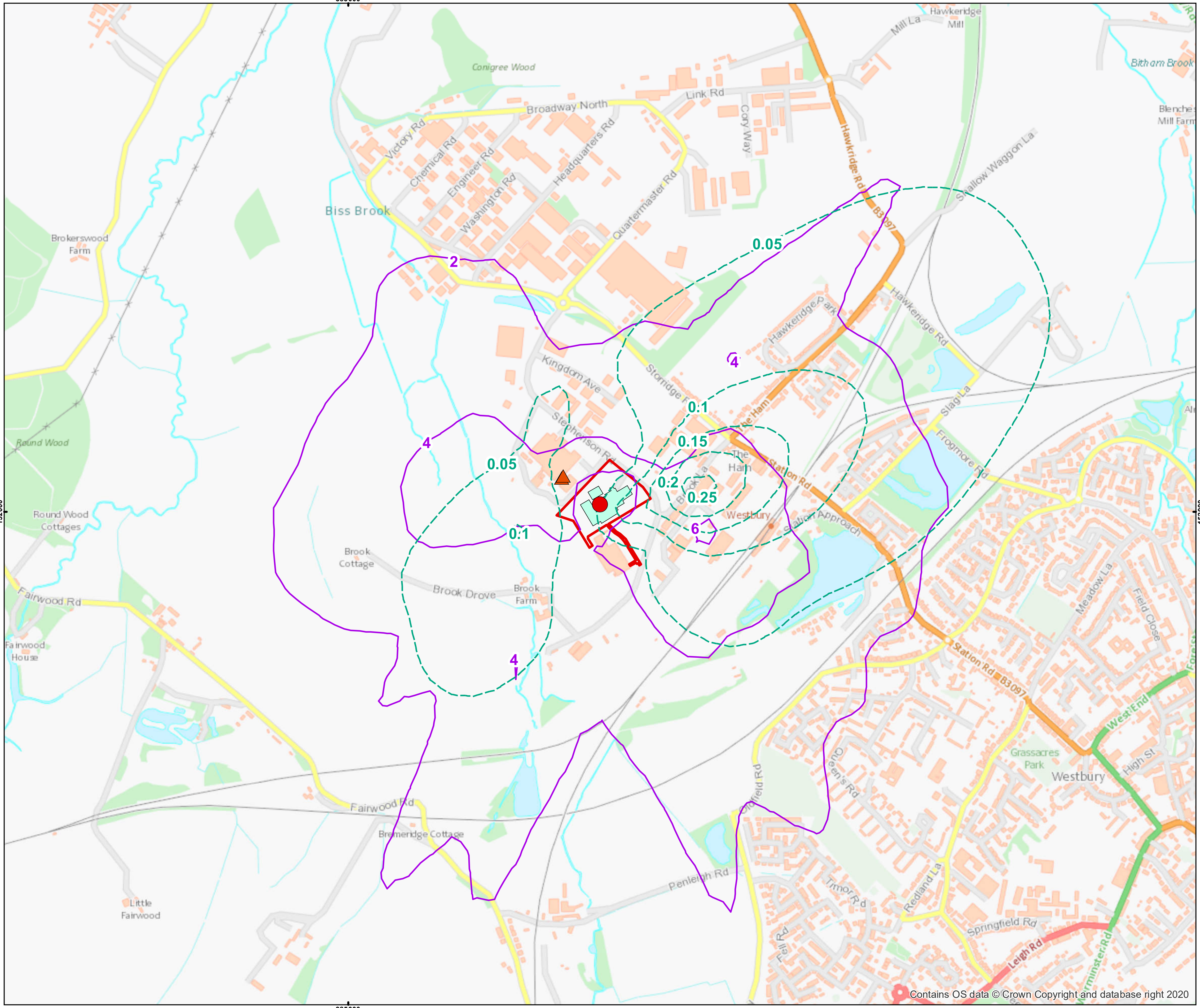


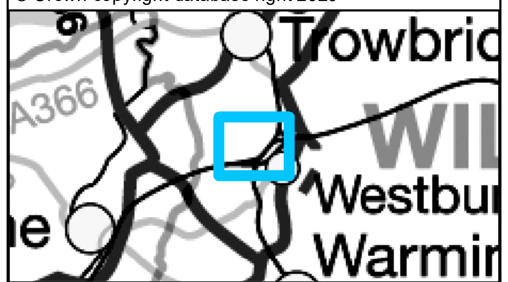
Legend

- Vent locations
- Odour stack
- Site boundary
- Building outline
- Annual mean
- 1-hour mean

Note:
Bioaerosol contirbutions are displayed in cfu/m3

Client:	Northacre Renewable Energy Ltd
Site:	Northacre ERF
Project:	2862
Title:	Figure 3 - Bioaerosol dispersion

Drawn by: Hannah Lederer | Date: 01/12/2020



0 0.1 0.2 0.4 km

Scale: 1:10,000

N

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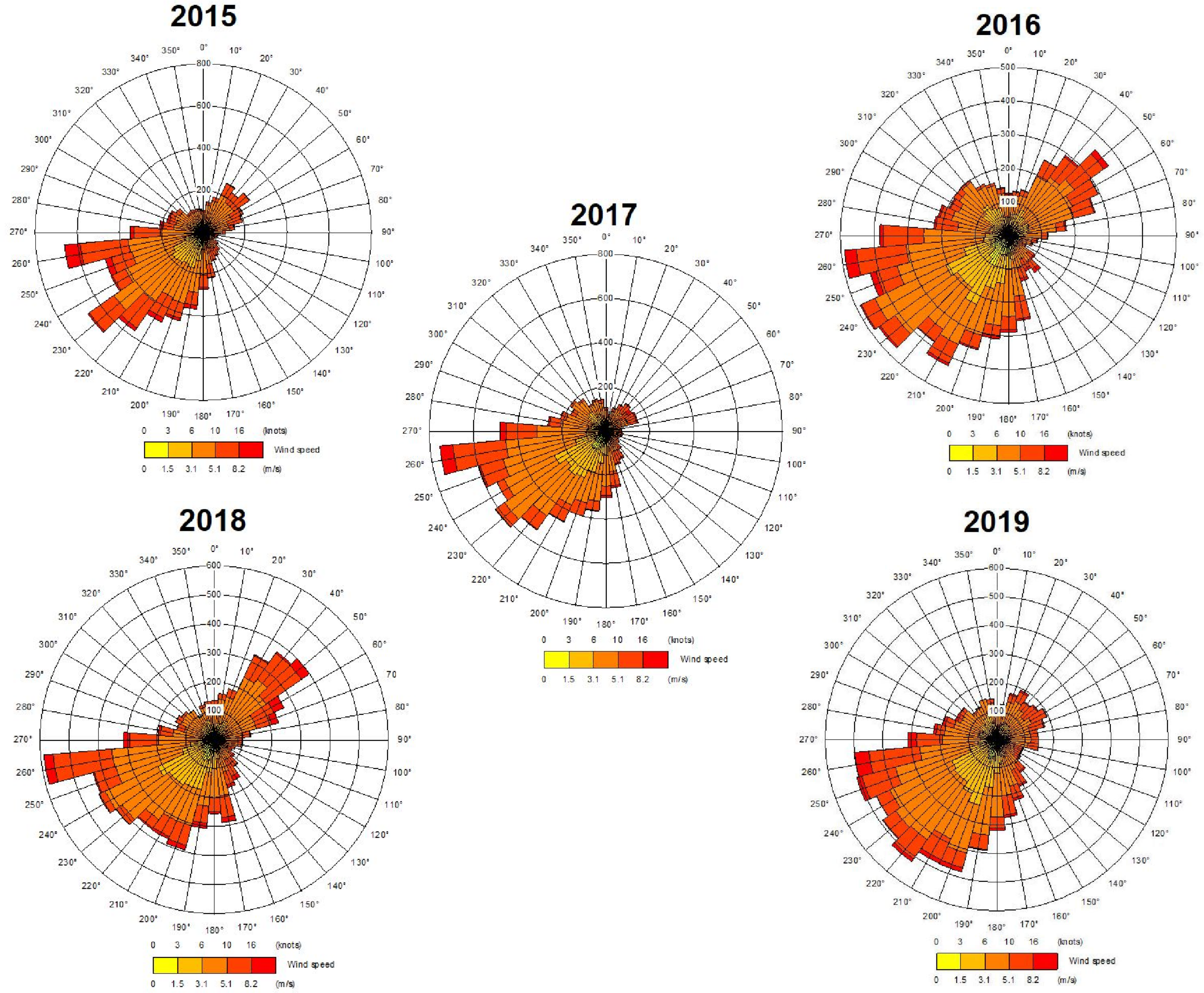

Client:	Northacre Renewable Energy Ltd
Site:	Northacre Facility
Project:	2862
Title:	Figure 4 - Wind Roses

Drawn by: Hannah Lederer	Date: 09/11/2020

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B Detailed results tables

Table 8: Detailed receptor and annual results 98th percentile of annual means (OUe/m³)

Receptor	Year of modelled meteorological data					Maximum
	2015	2016	2017	2018	2019	
R1.1	0.038	0.042	0.072	0.063	0.106	0.106
R1.2	0.040	0.047	0.080	0.067	0.112	0.112
R1.3	0.056	0.062	0.104	0.087	0.129	0.129
R2.1	0.047	0.043	0.081	0.074	0.111	0.111
R2.2	0.051	0.051	0.087	0.081	0.115	0.115
R2.3	0.063	0.064	0.114	0.095	0.155	0.155
R3.1	0.055	0.077	0.087	0.085	0.122	0.122
R3.2	0.056	0.084	0.092	0.086	0.125	0.125
R3.3	0.058	0.077	0.097	0.079	0.110	0.110
R4.1	0.042	0.049	0.081	0.074	0.111	0.111
R4.2	0.046	0.053	0.087	0.076	0.115	0.115
R4.3	0.055	0.075	0.103	0.087	0.140	0.140
R5.1	0.036	0.037	0.067	0.055	0.096	0.096
R5.2	0.039	0.041	0.075	0.063	0.107	0.107
R5.3	0.061	0.060	0.095	0.089	0.141	0.141
Maximum	0.063	0.084	0.114	0.095	0.155	0.155

Table 9: Detailed receptor and annual results 100th percentile of annual means (OUe/m³)

Receptor	Year of modelled meteorological data					Maximum
	2015	2016	2017	2018	2019	
R1.1	1.144	0.854	1.449	1.249	1.080	1.449
R1.2	1.147	0.854	1.444	1.249	1.076	1.444
R1.3	**1.977**	0.854	**2.276**	**2.818**	**2.077**	**2.818**
R2.1	**2.236**	**1.497**	**3.077**	**3.336**	**2.349**	**3.336**
R2.2	**2.227**	**1.500**	**3.055**	**3.319**	**2.339**	**3.319**
R2.3	**2.168**	**1.707**	**2.930**	**3.220**	**2.277**	**3.220**
R3.1	1.087	0.854	1.273	1.249	0.901	1.273
R3.2	1.087	0.854	1.273	1.249	0.901	1.273
R3.3	**2.423**	**2.249**	**2.316**	**2.463**	**2.334**	**2.463**
R4.1	1.015	0.929	1.273	1.249	1.203	1.273
R4.2	1.019	0.932	1.273	1.249	1.197	1.273
R4.3	**2.174**	**2.008**	**2.438**	**3.097**	**2.230**	**3.097**
R5.1	0.954	1.094	1.273	1.249	1.389	1.389
R5.2	0.954	1.096	1.273	1.249	1.383	1.383

Receptor	Year of modelled meteorological data					Maximum
	2015	2016	2017	2018	2019	
R5.3	**2.201**	1.400	**2.699**	**3.329**	**2.309**	**3.329**
Maximum	**2.423**	**2.249**	**3.077**	**3.336**	**2.349**	**3.336**