Rye Meads STC Bioaerosol Risk Assessment

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Thames Water Utilities Ltd
EPR/EB3030DF/V003

IED STC Permitting
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Rye Meads STC Bioaerosol Risk Assessment

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Contents

Appendices

Tables

No table of contents entries found.

Figures

No table of contents entries found.

1. Introduction

The purpose of this Bioaerosols risk assessment is to provide supplementary information to support the permit variation application for a bespoke installation permit for the Rye Meads Sewage Treatment Centre (STC), EPR/EB3030DF/V003.

1.1 Site description

The Rye Meads STC is located at the Rye Meads Sewage Treatment Works (STW), to the south of the A414, 700m to the east of the town of Hoddesdon and approximately 10km north of the M25 near junction 26. The STW is immediately bounded to the north by Rye Meads Nature Reserve and is bounded to the east by agricultural land and open water. The Southern boundary of the site is contained by a train track and the River Stort. To the west of the site is Tollhouse stream and the River Lee, and to the south is the River Stort Navigation and Marina.

The majority of the STW sits within Flood Zone 3 (Land having 1 in 100 or greater annual probability of river flooding) with a high risk from flooding. While the majority of the STC is within Flood Zone 3, there are small parts within Flood Zone 2 and 1. This is land with a medium (between a 1:100 and 1:1000 annual probability of flooding) and low (greater than1:1000 annual probability of river flooding) annual probability of flooding, respectively. The site has flood defences along the east, south and west boundary, as well as defences which appear to protect the sludge cake storage area.

The site is located within proximity of three Air Quality Management Areas (AQMAs) for Annual Mean Nitrogen Dioxide (NO_2) and is inside a Zone 2 and 3 Source Protection Zone (SPZ).

There are seven habitat sites within the appropriate distances of the STC. Rye Meads Site of Special Scientific Interest (SSSI) and Hunsdon Mead SSSI are 1.9km and 0.1km from the site, respectively. Lee Valley Ramsar site is split over multiple areas, the closest being 0.1km from the site. Lee Valley Special Protection Area (SPA) is also split over multiple areas with the closest 0.1km from the site. Lee Valley SPA and Lee Valley Ramsar site both cover similar areas. Wormley-Hoddesdon Park Woods Special Area of Conservation (SAC) is also split over several areas 3.7km from the site. Stanstead Lodge Ancient Woodland is 1.5km from the Rye Meads site. There are no Local Nature Reserves (LNR) or National Nature Reserves (NNR) within 2km of the site. There are 11 non-statutory designated local wildlife sites (LWS) within 2 km of the site including one LWS that is within 50 m of the cess waste import point of the STC installation.

The site location plan is shown in Appendix A and the address of the installation is:

Rye Meads Sludge Treatment Centre;

Rye Meads Sewage Treatment Works,

Stanstead Abbotts,

Ware,

SG12 8JY

1.2 Site Activities

Rye Meads STC is located at the Rye Meads STW, operated by Thames Water Utilities Ltd (Thames Water). The STC undertakes the biological treatment of sewage sludge, both indigenous and imported from other wastewater treatment sites, by anaerobic digestion, with a capacity above the relevant thresholds for requiring an environmental permit. It also includes the importation of specified wastes to the works inlet for treatment through the Urban Waste Water Treatment (UWWTD) directive regulated works.

There are a number of directly associated activities, including the operation of a biogas fuelled CHP engine and boiler for the generation of electricity and heat at the site.

The site includes the following Directly Associated Activities (DAA):

- Imports of waste, including sludge from other sewage treatment works

- Blending of indigenous sludges and imported wastes/waste sludge prior to treatment.
- Storage of digestate prior to dewatering.
- Dewatering of digested sewage sludge.
- Transfer of dewatering liquors via site drainage to the sewage treatment works.
- Transfer of surface water runoff back to the sewage treatment works.
- Storage of dewatered digested sludge cake prior to offsite recovery.
- Storage of fuel including biogas and fuel oil.
- Pressurisation of biogas.
- Biogas scrubbing and removal of siloxanes.
- Combustion of biogas in Medium Combustion Plant Directive (MCPD) and Specified Generator (SG) compliant biogas Combined Heat and Power (CHP) Engines and boiler units.
- Combustion of fuel oil in MCPD compliant boiler units.
- Transfer of biogas condensate via site drainage back to the sewage treatment works.
- Operation of biogas Emergency Flare stack.
- Storage of raw materials.
- Storage of diesel; and.
- Storage of waste.

The STC can treat up to 2,450,000m^3 (equating to approximately 2,450,000 tonnes) of sludge per year (including indigenous UWWTD derived sludge from the wider STW). The STC has a total treatment input of more than 1,700m^3 per day (equating to approximately 1,700 tonnes per day).

Some of this throughput is sludge, which is subject to dewatering and storage as treated sludge cake at the site prior to removal from site for application to land. Within the area covering the permitted activities, there is one Odour Control Unit (OCU) linked to specific tanks or processes which produce potentially odorous air. This unit treats the air through a variety of means, including the use of biofilters.

The anaerobic digestion process gives rise to biogas, a mixture of biomethane and carbon dioxide, in a mixture with trace components. This biogas is combusted through CHP Engines at the site with excess biogas being subject to flaring. The biogas handling system is equipped with a number of pressure relief valves (PRVs) which activate as a safety precaution when there is excess biogas over what the CHP Engines and Emergency Flare can handle.

1.3 Regulatory requirements

The STC has not previously required an environmental permit as the digested sewage sludge from the site is normally sent for recovery to land. However, a permit application has been submitted based on the Environment Agency's recent conclusion that sewage sludge is a waste and therefore the treatment of sewage sludge by anaerobic digestion for recovery is a permittable activity under Schedule 1 of the EPR 2016, specifically Chapter 5, Section 5.4, Part A 1(b)(i).

For new permits, if the site is within 250m of sensitive receptors then there is a requirement to monitor bioaerosols in accordance with the EA technical guidance note[1] '*M9: environmental monitoring of bioaerosols at regulated facilities*'. M9 describes bioaerosols and the risks that they pose, as well as identifying potential sources within biological treatment facilities.

The Rye Meads Sludge Treatment installation is not within 250m of sensitive receptors, as defined by M9. These are detailed in Section 2.5 of this report.

1.4 Bioaerosols

Bioaerosols are found naturally within the environment. They consist of airborne particles that contain living organisms, such as bacteria, fungi and viruses or parts of living organisms, such as plant pollen, spores and endotoxins from bacterial cells or mycotoxins from fungi. The components of a bioaerosol range in size from around 0.02 to 100 micrometres (µm) in diameter. The size, density, and shape of a bioaerosol will affect its behaviour, survivability and ultimately its dispersion in the atmosphere.

[1] Environment Agency. 2018. Technical Guidance Note (Monitoring) M9: Environmental monitoring of Bioaerosols at regulated facilities, v2, July 2018.

Bioaerosols are easily breathed into the human respiratory system, potentially causing allergic responses and inflammation. They also have the potential to cause eye irritation, gastrointestinal illness, and dermatitis.

Bioaerosols are associated with composting, anaerobic digestion and mechanical biological treatment, which are the main processes used to treat organic wastes in the UK. As organic waste material breaks down it goes through different temperature dependent stages that are dominated by certain groups of bacteria and fungi. Bacteria are the most numerous group of microorganisms. Aspergillus fumigatus is a mesophilic fungus that is thermotolerant and is present throughout the different stages of the organic breakdown process. This fungus can cause severe respiratory infection if inhaled.

The dependence on microorganisms to degrade organic material and the way in which the material is processed make biological treatment facilities a potential source of bioaerosols. However, we note that the 2012 EA guidance note[2] for developments requiring planning permission and environmental permits states that the EA do not consider bioaerosols from anaerobic digestion to be a serious concern. This is due to the fact, that anaerobic digestion is generally a wet process undertaken in enclosed tanks and equipment, whereas composting is often undertaken using open systems such as windrows and static piles.

The Rye Meads STC does not undertake any aerobic composting activities and the anaerobic digestion process on site, undertaken in the primary digesters, is an enclosed process with all produced gases captured within the biogas system.

1.4.1 High Risk Activities

The M17 guidance document, in section 3.3.3, outlines a number of potential sources and release mechanisms of particulate matter, including bioaerosols from waste management facilities. These potential sources are not graded for importance within M17 and include: the movement of waste to and from the facility; storage of waste (under certain conditions) on site; the handling and processing of waste materials e.g., shredding of green waste, turning of windrows, daily cover; and wind scouring of waste surfaces.

In terms of potential sources of bioaerosols release at the Rye Meads STC, which meets the M17 guidance, only the storage of sludge cake, the handling of sludge cake (movement into storage and during export) and wind scouring of waste surfaces would apply. There is no shredding of waste or turning of stockpiles as part of the management process and all sewage waste is contained and received via pipes.

1.4.2 Relevant Thresholds

Based on the accepted Levels at sensitive receptors as set out in the Environment Agency M17 guidance[3] '*M17 Monitoring of particulate matter in ambient air around waste facilities*', and in line with the Governments regulatory position statement (RPS) 209 outlining when a specific bioaerosol risk assessment and/or monitoring is required and use of the Environment Agency Technical Guidance Note M9[4]; key bioaerosols of interest and their respective threshold Levels (including background) at sensitive receptors are outlined below:

- Total bacteria: 1000 cfu/m^3
- Aspergillus Fumigatus: 500 cfu/m^3

[2] Environment Agency. October 2012. Guidance for developments requiring planning permission and environmental permits

[3] Environment Agency. 2013. Technical Guidance Note (Monitoring) M17: Monitoring Particulate Matter in Ambient Air around Waste Facilities, v2, July 2013 *https://www.gov.uk/government/publications/m17-monitoring-of-particulate-matter-in-ambient-air-around-waste-facilities*

[4] Environment Agency. 2018. Technical Guidance Note (Monitoring) M9: Environmental monitoring of Bioaerosols at regulated facilities, v2, July 2018.

2. Bioaerosol risk assessment

2.1 Introduction

A source-pathway-receptor risk assessment has been undertaken to appraise the potential for risk to human health at sensitive receptors within the relevant distance from operations at the Rye Meads STC. This risk assessment follows a standardised approach, namely:

- Hazard identification: what sources of bioaerosols are present on site;
- Exposure assessment: what are the mechanisms or pathways allowing bioaerosols to migrate off site and reach a sensitive receptor; and
- Risk evaluation: who is potentially exposed to bioaerosols; what is the probability, magnitude, and duration of that exposure.

The assessment describes:

- The processing techniques and equipment used within the installation;
- Feedstock, tonnages processed and any seasonal variations;
- Potential sources of bioaerosols;
- The site layout, including any screens, bunds, or trees around the site;
- What is beyond the site boundaries and the location of sensitive receptors; and
- Local wind direction data.

2.2 Processing equipment and techniques

2.2.1 Waste Reception

The STC comprises an offloading point for imported permitted tankered wastes close to the main entrance to the wider STW on land owned by Thames Water. This material is passed to the inlet where it joins the main works flow and is subject to aerobic treatment under the Urban Waste Water Treatment Directive (UWWTD) permitted process outside of the permit boundary.

Sludge from the UWWTD process is drawn off and primary sludge is pumped to the Primary Sludge Buffer Tank 1, or a Surplus Activated Sludge (SAS) is pumped to the SAS Buffer Tank. Primary sludge can be pumped to either one of two Primary Picket Fence Thickeners (PPFTs) or to the Primary Sludge Buffer Tank 2 and then to Primary Sludge Thickening plant. The Primary Sludge Buffer Tank 1 and Primary Sludge Buffer Tank 2 are outside of the scope of this permit.

There is a second import point at Rye Meads STC for permitted imports of sludge from other sites via an offloading point consisting of a data logger and transfer hose. Waste is discharged directly into the Sludge Import Tank, an above ground tank of concrete construction that is covered and odour abated by an Odour Control Unit (OCU). From this Sludge Import Tank, the waste is screened to remove inorganic material which is deposited into a skip for offsite disposal and then the screened sludge is pumped to the Sludge Blending Tank to be mixed with indigenous sludge. Rye Meads STC is able to accept sludge 24 hours per day. In the event of high sludge levels within the Sludge Blending Tank, further imports are inhibited.

SAS can also be imported to the SAS Buffer Tank. The imported SAS is screened before it is discharged into the SAS Buffer Tank and subject to the SAS Thickening process.

If a sludge spillage occurs, spill kits are available on site and staff are trained in their use. Sludge is viscous and not highly mobile, and operators would clean-up in a timely manner. Wheel wash facilities are available.

2.2.2 Waste Treatment

The waste treatment process of the sludge within the scope of this assessment, starts at the thickening stage. Primary sludge from the Primary Sludge Buffer Tank 1 can transfer equally to one of the two Primary Picket Fence Thickeners (PFT), which are uncovered, concrete tanks. Sludge is thickened and gravitates to the bottom of each tank and is pumped to a Sludge Blending Tank. Alternatively, sludge from the Primary Sludge Buffer Tank 1 may first be pumped to Primary Sludge Buffer Tank 2, then pumped to the Primary Sludge Thickening plant via subsurface pipework for thickening. The thickened sludge is pumped via a subsurface

pipeline to the Sludge Blending Tank. SAS from elsewhere in the aerobic treatment process is pumped to the SAS Buffer Tank via a subsurface pipeline to the SAS Thickening plant in the SAS dewatering building. A liquid polymer coagulant is added and thickened SAS is pumped via subsurface pipework to the Sludge Blending Tank. Liquors from the primary sludge thickening and SAS Thickening is returned to the UWWTD Process via Liquor Return Pumping Station 1 and the site drainage.

The Sludge Blending Tank mixes SAS, primary and imported sludge. It is odour abated via an OCU with a fixed roof. The sludge level in the tank is monitored and connected to SCADA which is monitored 24/7. In the event of a high-level alarm, all feed pumps are inhibited to prevent overfilling of the Sludge Blending Tank. Three digester feed pumps, pump the blended sludge via subsurface pipes into one of the six Primary Digester Tanks (PDT).

There are six PDTs on site, each with a Floating Roof Biogas Holder over the tanks for biogas storage. For safety, there are two Pressure Release Valves (PRV) on each tank, the sludge level within each tank is monitored, and temperature probes monitor the water and sludge temperature, which are all connected to SCADA. Sludge is fed at the top and removed from the bottom. Additional heat is provided into the PDTs via heat exchanges, which use either Combined Heat and Power (CHP) heat, or auxiliary boilers. After an appropriate time, sludge gravitates via subsurface pipes to the Secondary Digester Tanks (SDT). There are four SDTs followed by two Digested Sludge Buffer Tanks. SDTs are filled on a rotation basis and fitted with level alarms to prevent overfilling.

After an appropriate time, sludge is transferred from the SDT to either Digested Sludge Buffer Tank and then for dewatering in either the Digested Sludge Centrifuge Dewatering plant or the Digested Sludge Belt Dewatering plant. The belt dewatering use a bulk powder polymer system while the centrifuges use a liquid polymer. Dewatered and digested sludge cake is conveyed to the open cake pad via covered conveyors.

Biogas produced from the six PDTs is captured within the roof mounted Floating Roof Biogas Holders. Each of the floating roofs is fitted with PRVs and sensors as a safety precaution in the event of over pressurising the system and would vent to atmosphere in the event of excess pressure within the biogas holder. Biogas is withdrawn from the Floating Roof Biogas Holders and joins a common biogas transfer pipeline where it is transferred to the CHP engines or boilers for combustion onsite. In the event of an emergency, biogas may be diverted to the site emergency flare. The above ground biogas transfer pipeline is equipped with condensate pots that capture entrained moisture from the generated biogas. Biogas is also passed through dehumidifiers and biogas boosters prior to combustion. The CHP engines generate electricity for use within the site, and recoverable heat which is passed via heat exchange to maintain the PDTs temperature. There are four carbon-based siloxane filters on site, located upstream of the CHP engines on the biogas line to remove impurities from the biogas prior to combustion in the CHP engines.

In the event there is excess biogas, i.e., more than the CHP Engines can utilise, or in the event that the CHP Engines are unavailable, there is a ground mounted Emergency Flare which is used during periods of essential maintenance and emergency use. The Emergency Flare is utilised under 10% of the year, less than 876 hours per year and its use is recorded.

2.2.3 Digested cake

The Cake Pad receives digested sludge cake via a covered conveyor and is an open pad of concrete construction. Vehicles exiting the cake pad pass through a wheel wash. There is a second Cake Pad area for storage of digested sludge cake consisting of imports to 6 bays in 3 lanes for Cake Imports from other wastewater treatment sites. Imports of waste are normally delivered to the site by road with records maintained of what waste is received, the quantity and the site of production. The location of each waste delivery is recorded. Non-compliant cake is accepted by exception into segregated and marked bays and held for an extended period of time to achieve the required level of pathogen kill. Digested sludge cake is subject to removal from both of the cake pads at Rye Meads STC under the Sludge Use in Agriculture Regulations 1989 (SUiAR), and in accordance with the Biosolids Assurance Scheme (BAS). There is a low risk from bioaerosols as there are no sensitive receptors within 250 m who may be present for more than six hours.

2.2.4 Odour Control Units

Sewage treatment works have a number of potentially odorous sources within their boundary. Some of these sources may be linked to OCUs to treat potentially odorous compounds given off by the process. These units

take air extracted from the above-mentioned tanks or process areas and treat the odour compounds by means of different methodologies dependent upon the nature of the odour compounds. Treatment methodologies include activated carbon systems; biofilters or other biological treatment; and chemical scrubbing. Individual OCUs may use one or more of these methodologies in series.

Under the M9 guidance documents, the Environment Agency has identified that biofilters may give rise to bioaerosols during operation. For completeness, OCUs with biofilters and within the permit installation have been included in this assessment.

2.2.5 Seasonality

Sewage treatment is undertaken at the STC on a continuous basis, 24 hours a day 365 days of the year. Sludge cake is, therefore, produced daily and at similar levels across the whole year.

However, cake storage on site, both in relation to duration and volume, varies across time. Cake is removed from site for spreading to land. Land spreading is controlled under the Biosolids Assurance Scheme and Sludge Use in Agriculture Regulations (1989), as well as the Farming Rules for Water. As such, sludge will remain on site longer during wet periods and during autumn and winter periods where there would be limited uptake of nutrients from the solids. This means that there will be more cake within the storage bays during the autumn and winter, under normal conditions, than during the summer period.

2.3 Potential Sources

There are thirteen point-source emissions to air from the processes within the installation boundary, as presented in Table 1 and illustrated in Appendix B. The references and source descriptions match those in the permit:

Table 1: Point source emissions to air

Air emission reference	Source	In scope?
A4	Boiler 2a (new MCP)	X
A5	Boiler 2b	X
A6	Boiler 3a	X
A7	Boiler 3b	X
A9a	CHP Engine 1	X
A9b	CHP Engine 2	X
A10	Emergency Flare stack	X
A11	Primary Digester PRV	X
A12	Primary Digester PRV	X
A13	Primary Digester PRV	X
A15	Primary Digester PRV	X
A16	Primary Digester PRV	X
A17	OCU 2	✓

The Cake Pad is also illustrated in Appendix B. These are additional sources for consideration of bioaerosols releases to atmosphere.

2.3.1 Source Assessment

The CHP engines, boilers and emergency flare (A4-A10) combust the produced biogas at high temperatures (in excess of 450°C). Due to the combustion of the biogas, these points can be discounted as sources of bioaerosols emissions.

There is one OCU (A17) serving the STC. The unit extracts odorous air from the Primary Sludge Thickening Plant, Sludge Import Tank and Sludge Blending Tank.

The OCU is a biofilter system. Extracted air from the tanks is passed through the support media, within the biofilter, while water is irrigated from above. The microbes on the support media, remove potentially odorous contaminants to achieve a stack emission standard of <= 1000 $OuEm^3$ at the outlet and the treated air discharges via the stack. The likelihood of bioaerosol release is anticipated to be minimal.

The Pressure Relief Valves (PRVs) (A11 – A16) are normally closed and do not emit to atmosphere. However, in the event of an abnormal situation such as the failure of the flare stack and/or CHP engines, the PRVs would open to relieve excess biogas pressure, potentially resulting in the release of bioaerosols. While the problem is rectified, biogas generation would be limited by reducing or inhibiting the digester feed. These abnormal events are unlikely, temporary, and infrequent due to the extensive monitoring and maintenance programmes undertaken at the site, as well as the procedures and warning systems in place.

In addition to the point sources identified above, there is also an unchanneled potential release from treated, dewatered sludge cake which is transferred via conveyor and deposited on the Cake Pad, with additional storage on the adjacent to the Cake Pad.

2.3.2 Risk

The overall treatment process is considered to be a low source of bioaerosols. As discussed above, there are control measures in place at the site to reduce and contain emissions of bioaerosols. These control measures are regularly maintained to sustain their efficacy and reduce the risk of equipment failure.

The greatest probability of exposure from bioaerosols emitted from the site is from uncovered operations such as the Cake Pad. However, the sludge cake is likely to have low concentrations of bioaerosols as a result of the treatment processes and is moist on deposition onto the pad. The cake is managed by dozer and deposited within storage bays on the Cake Pad, where it forms a crust within 24 hours and is less easily disturbed by wind abrasion. The cake storage areas are monitored for row height and arrangement and require no further treatment or disturbance prior to export onto agricultural land, further minimising the likelihood of a bioaerosols release. The probability of exposure from this source is medium.

There are no receptors within 250m of the OCU emission point. Therefore the risk of bioaerosol emissions from the bio-filter OCU is considered to be negligible.

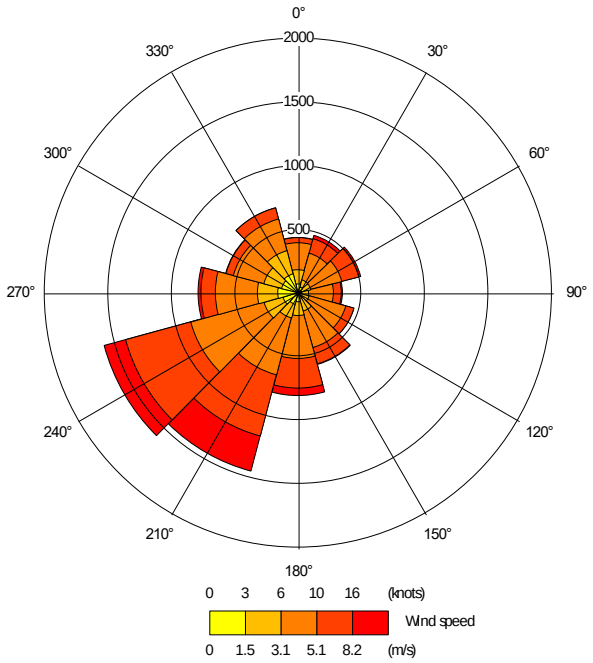
In addition, most storage tanks, treatment tanks and associated pipework are enclosed. The wet wells used to receive incoming sludge are below ground and covered. Sludge screening and dewatering takes place in enclosed units. In addition, the PRVs are only open in abnormal situations which are temporary and unlikely.

2.4 Pathways

Bioaerosols are very small and light in weight so can easily be transported by the wind from their source to a receptor. The 2020 wind rose for the most representative meteorological site, Stanstead airport (located approximately 19.7 km Northeast of Rye Meads STW Site centre), is shown in figure 1.

The wind rose data shows that the site experiences strong prevailing West southwest and Southwest winds, predominantly in excess of 6 knots. The Rye Meads STC and surrounding area has a relatively flat topography. The site is surrounded by mature trees that provide some screening along southern, eastern, and western boundaries. The northern boundary is RSPB nature reserve with pockets of woodland.

Figure 1 – Stanstead Airport Wind rose (2020)



Because of the dilution effect in open air, bioaerosol concentrations fall away rapidly with distance from the source. It has been shown by research by the HSE[5] that by 100 to 200m away, the bioaerosol concentration has mostly returned to background levels. Between 50m and 100m distances downwind of the process, bioaerosol concentrations were substantially reduced by comparison to those level measurements at source. Research Report (RR)786 confirmed previous published studies which showed that at a distance of 250m from composting activity, in most cases, the bioaerosol concentrations will be reduced to background levels. Note that this research was undertaken on aerobic composting sites, which generate higher levels of bioaerosols than anaerobic digestion sites, although the 250m separation distance has been retained.

At present, Thames Water do not have quantitative data for the levels of bioaerosols that might be associated with the potential sources at their sludge treatment centres. As a responsible operator, Thames Water are arranging for bioaerosol monitoring at a number of typical STC's in order to confirm that the understanding of the wider waste water treatment industry, that sewage sludge treatment processes do not give rise to elevated levels of bioaerosols, is correct. The sampling will be in accordance with the requirements of M9 and M17, and consist of a series of agar gel plates being placed downwind and upwind of the cake pad, including sampling points both directly upwind of the downwind sampling point and additional samples in the direction of the nearest sensitive receptors.

2.5 Receptors

Environment Agency guidance note M9 recommends a screening distance of 250m from bioaerosol emission sources to static receptor locations. Sensitive receptors are defined as: 'permitted activities where people are likely to be for prolonged periods. This term would therefore apply to dwellings (including any associated gardens) and to many types of workplaces. We would not normally regard a place where people are likely to be present for less than 6 hours at one time as being a sensitive receptor. The term does not apply to those controlling the permitted facility, their staff when they are at work or to visitors to the facility, as their health is covered by Health and Safety at Work legislation, but would apply to dwellings, commercial or industrial premises nearby where people might be exposed for the requisite period.

[5] Research Report 786 - Bioaerosol emissions from waste composting and the potential for workers' exposure https://www.hse.gov.uk/research/rrhtm/rr786.htm

Sensitive receptors (as identified for the OMP) have been considered. There are no receptors located within 250m of potential bioaerosols emission sources. Table 2 presents the closest receptor (R13) for completeness.

Table 2: Static Receptor closest to identified Potential Bioaerosol Sources

Receptor	Description	Source	Distance from closest source (m)	Direction from the source
R13	Marina – Residential	Cake Pad	300	East Southeast
		Cake Pad	278	East
		OCU 2 (A17)	390	Southeast

2.6 Risk Assessment

The method used for this bioaerosol risk assessment is adapted from the EA's standard guidance on risk assessments for environmental permitting, which recommends using a Source-Pathway-Receptor model[6] to help determine the magnitude of the risk associated with bioaerosols emissions from a facility.

The assessment has demonstrated that the potential sources of bioaerosols emissions are more than 250m from the closest sensitive receptor (R13). A dispersion distance greater than 250m would likely result in concentrations of bioaerosols falling to within background levels i.e., 'acceptable level' thresholds set out within the EA guidance. Receptors beyond 250m are not required to be considered. The location of R13 is also upwind of the prevailing West Southwest / Southwest wind direction, so the likely frequency of a bioaerosol event at this receptor would also be low.

The magnitudes of release from the sources considered would be small, by the nature of the releases and the site's monitoring, maintenance, mitigation, and management practices undertaken (as presented in Section 2.3). The probability of exposure under normal operating conditions would be low.

Planned monitoring of bioaerosol emissions by Thames Water is expected to validate the expectation that process contributions of bioaerosols from sewage sludge treatment works, would comply with the 'acceptable level' thresholds, set out within EA guidance.

[6] Risk assessments for your environmental permit - GOV.UK (www.gov.uk)

2.7 Abnormal Situations

In the event of plant failures or abnormal situations, an alarm would be raised on the Site Supervisory Control and Data Acquisition (SCADA) or telemetry systems, which will be reacted to by on-site or regional control room operators and Duty Managers. Depending upon the nature of the fault or emergency, where required, an operator would contact a mechanical or electrical technician, both of whom are on-call 24-hours, to attend site as soon as practicable.

If the on-call technicians are already engaged upon other response work, there is the facility to access staff from other TW geographic divisions, coordinated by the Duty Manager. All faults, breakdowns and emergencies are logged electronically together with records of the action taken and the solutions reached. One such abnormal event would be failure of the flare stack and/or CHP engines. Such an event would result in releases of biogas from the PRV's located on the roofs of the digesters and in the biogas holder compound, which would release bioaerosols. This occurs to prevent over pressurisation of the digesters and biogas systems. While the problem is rectified, biogas generation is reduced by reducing or inhibiting the digester feed.

3. Conclusions

A source-pathway-receptor risk assessment has been undertaken to appraise the potential for risk to human health in dwellings and other nearby buildings/ community spaces from bioaerosols arising from operations at the Rye Meads STC. The risk assessment followed a standardised approach, namely:

- Hazard identification: what sources of bioaerosols are present;
- Exposure assessment: what are the mechanisms or pathways allowing bioaerosols to migrate off site and reach a receptor; and
- Risk evaluation: what is the probability, magnitude, and duration of exposure. This considered control measures in place to reduce the probability or magnitude of release.

Two potential sources of bioaerosols within the site processes have been identified, connected to the storage and movement of treated digestate sludge cake at the site, and the operation of the two-stage biofilter OCU. These sources were considered to have a small magnitude potential for release. The risk from abnormal releases from PRVs was scoped out.

The assessment identified no receptors within 250m of these potential bioaerosols emission sources. The closest receptor was noted as an upwind location to the prevailing wind direction.

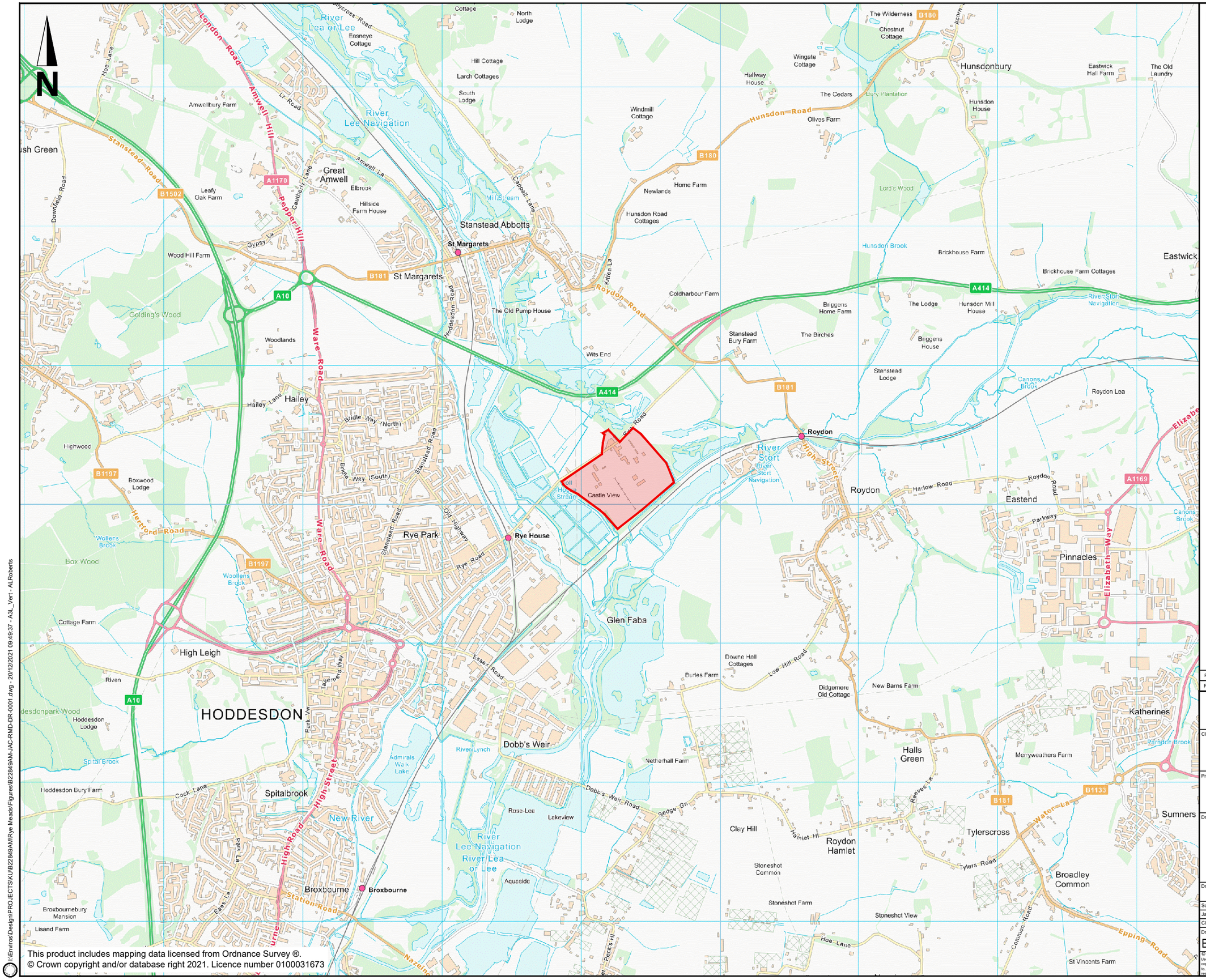
Taking the site control measures, maintenance and management practices into consideration, the probability of exposure would likely be low and duration of release short.

Therefore, with the dispersion distances being equivocal to a likely 'background concentration' of bioaerosols, the risk of bioaerosol effects at sensitive receptors, from normal operating conditions at Rye Meads would be **negligible**.

3.1 Sampling

Due to the lack of sensitive receptors within 250m of potential bioaerosol emissions at Rye Meads STC, no sampling locations are proposed.

Appendix A. Site Location Plan



Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd
P01	JUL 2021	FOR INFORMATION	AR	MM	JK	MM

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Project: STC IED PERMIT
RYE MEADS STW

Drawing title: FIGURE 1
SITE LOCATION PLAN

Drawing status: PERMITTING

Scale	1:25,000	DO NOT SCALE
Jacobs No.	B22849AM	Rev P01
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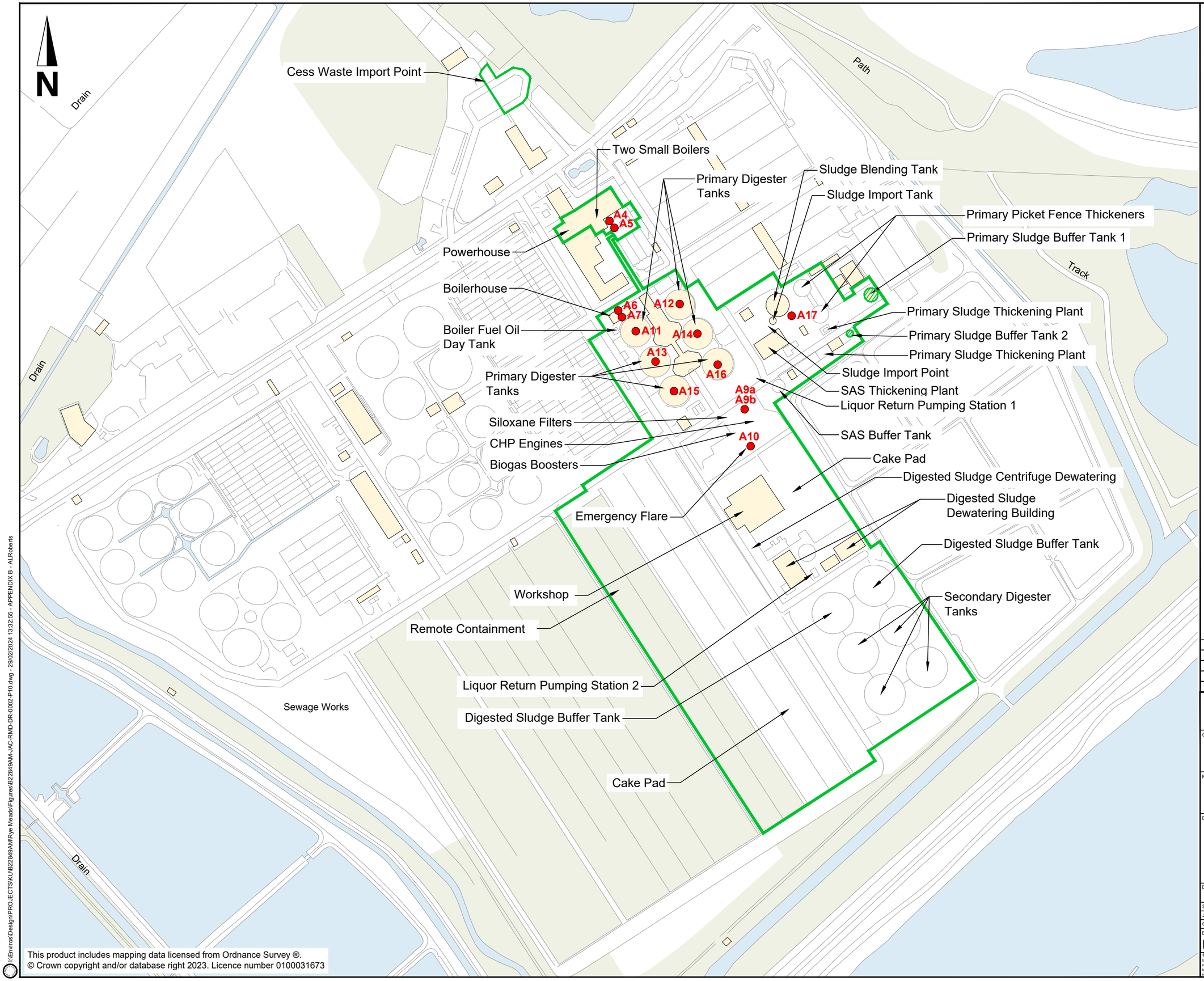
I:\Environ\Design\PROJECTS\KU\B22849AM\Rye Meads\Figures\B22849AM-JAC-RMD-DR-0001.dwg - 20/12/2021 09:49:37 - A3L_Vert - ALRoberts

Appendix B. Installation Boundary and Air Emission Points



KEY:

Installation Boundary

Air Emission Point

A4 - Boiler 2a
A5 - Boiler 2b
A6 - Boiler 3a (new MCP)
A7 - Boiler 3b
A9a - CHP Engine 1
A9b - CHP Engine 2
A10 - Flare Stack
A11 - Primary Digester PRV
A12 - Primary Digester PRV
A13 - Primary Digester PRV
A14 - Primary Digester PRV
A15 - Primary Digester PRV
A16 - Primary Digester PRV
A17 - OCU 1

0 20 40 60 80 100
METRES

Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd
P04	FEB 2024	FOR INFORMATION	AR	SK	JK	MM
P03	DEC 2023	FOR INFORMATION	AR	SK	JK	MM
P02	FEB 2023	FOR INFORMATION	AR	SK	JK	MM
P01	JUN 2022	FOR INFORMATION	AR	SK	JK	MM

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Drawing title: APPENDIX B
INSTALLATION BOUNDARY
AND AIR EMISSION POINTS

Drawing status: PERMITTING

Scale	1:2500 @A3	DO NOT SCALE
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Drawing number: B22849AM-JAC-RMD-DR-0002