Crossness STC Bioaerosol Risk Assessment

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EPR/PB3239AW/V005

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Crossness STC Bioaerosol Risk Assessment

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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 Crossness Sludge Treatment Centre (STC), EPR/PB3239AW/V005.

1.1 Site description

The Crossness STC is located within the Crossness Sewage Treatment Works (STW) immediately south of the River Thames, separated by the Thames Path, in an area of the London Borough of Bexley.

Although the site is immediately bounded by open and green space on all sides, the wider area is suburban in nature with a mixture of uses. To the east is the Riverside Resource Recovery Waste Incinerator (approx. 300 m to the east) and a number of warehouses and distribution centres (approx. 500 m to the east). To the south, is the A2016 Eastern Way and further warehouse units (approx. 300 m to the south) and a large school (approx. 700 m to the south). To the west is a large residential development with some commercial premises (approx. 250m to the west).

The whole of the STW and STC is within a Flood Zone 3 in an area that benefits from flood defences. This indicates that the land within this zone would have a high probability of flooding without the local flood defences. These protect the area against a river flood with a 1:100 annual probability of flooding as a result. The site sits outside the boundaries of any Source Protection Zones.

The site is located within the boundaries of AQMA, namely the Bexley AQMA, which was declared by Bexley Borough Council for Particulate Matter PM10 (24-hour mean) and Nitrogen Dioxide NO2 (Annual Mean).

The Crossness STW is in close proximity to a number of designated habitats and the nearest one to the site, Crossness Local Nature Reserve (LNR) is located along the eastern perimeter of the site. A second LNR, Lesnes Abbey Woods, is located approximately 1.2 km to the south-west of the site and the Abbey Wood SSSI is located approximately 1.5 km to the south-west of the site.

There are no Ramsar sites, Special Protection Areas (SPAs), Marine Protection Areas (MPAs) or Special Areas of Conservation (SACs) within 10 km of the site.

The closest area of ancient and semi-natural woodland habitat is Lesnes Abbey Woods located approximately 1.2km to the south-west of the site.

There are 20 LWSs within 200m of the site including Crossness Sewage Treatment Works Pond (within the wider sewage treatment works site), Erith Marshes (adjacent) and River Thames and Tidal Tributaries (immediate North of the site).

There are also records of protected species and habitat within the specified screening distance of the site.

There are also records of protected species (protected fish and protected fish migratory routes) located within the specified screening distance (up to 500m) of the site associated with the River Thames and its tidal tributaries. There are also protected habitats (Mudflats, Coastal and Floodplain Grazing Marsh and Mudflats) located within the specified screening distance (up to 500m) of the site associated with the southern banks of the River Thames. The Coastal Saltmarsh Mudflats at this location are a designated Priority Habitat.

The address of the installation is:

Crossness Sludge Treatment Centre;
Crossness Sewage Treatment Works,
Belvedere Road,
Thamesmead,
London,
SE2 9AQ.

1.2 Site Activities

Crossness STC, is located at the Crossness 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 Directive (UUWTD) regulated works.

There are a number of Directly Associated Activities (DAAs), including the operation of biogas fuelled Combined Heat and Power (CHP) engines and boilers for the generation of electricity and heat at the site.

The site includes the following DAAs:

- Storage of biogas;
- Operation of Emergency flare;
- Oil Storage;
- Drainage – surface water drainage system;
- Drainage – condensate drainage system;
- Water treatment – demineralisation plant;
- Imports of waste, including sludge from other sewage treatment works for treatment
- Blending of indigenous sludges and imported waste sludge prior to treatment
- Storage of digestate prior to de-watering
- Pre-treatment of sewage sludge by Thermal Hydrolysis Plant (THP)
- Dewatering of digested sewage sludge
- Transfer of dewatering liquors via site drainage back to the head of the sewage treatment works
- Storage of dewatered digested sludge cake prior to offsite recovery
- Operation of siloxane filter plant
- Storage of raw materials

There are waste management activities for the imports of waste to the works inlet for treatment through the UWWTD route and the imports of digested sludge cake for temporary storage pending off-site removal.

The STC can treat up to 7,530,000m^3 of sludge per year (equating to approximately 7,530,000 tonnes). The STC has a total maximum treatment input of 2,220 m^3 per day (equating to approximately 2,220 tonnes per day).

The facility has a second listed activity, for a Section 1.1 Combustion Activities – Part A (1) (a) burning any fuel in an appliance with a rated thermal input of 50 or more megawatts..

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 are eight Odour Control Units (OCUs) and other OCUs which are outside of the permit boundary. These are all linked to specific tanks or processes which produce potentially odorous air. These units treat the air through a variety of means, including 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 flares can handle.

1.3 Regulatory requirements

The sludge treatment activity 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 Crossness STC is not within 250m of sensitive receptors, as defined by M9.

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.

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 groups 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 Crossness STC does not undertake any aerobic composting activities and the anaerobic digestion process on site, undertaken in the Primary Digester Tanks, 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 STC; 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 bioaerosol release at the Crossness STC, which meets the M17 guidance, only the storage and handling (movement within an enclosed Cake Barn and during export) of sludge cake 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

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

[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

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

[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 Crossness 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.
- Local wind direction data.

2.2 Processing equipment and techniques

2.2.1 Waste Reception

Biological treatment processes at the installation are for indigenous sludges separated from the UWWTD areas of the site and for treatment process for imported sludge that arrives at Crossness STC by tanker and consists of sludge from other Thames Water sites, which forms a waste activity for the site.

The site currently accepts imports of cess waste to an offloading point for permitted imported wastes which can be found close to the inlet of the STW. These wastes are imported by tanker and are discharged into the works, through a data logger and join the incoming flow to the STW and are treated outside of this permit. Indigenous sludge in a mixture with other material is subject to preliminary treatment before separation of sludge from the main flow. Sludge is then subject to thickening processes.

If a sludge spillage occurs, operators will follow the site's spillage response plan in a timely manner and inform the relevant site personnel and authorities. Sludge is relatively viscous and not highly mobile. Spill kits are available around the site to contain a spill and direct it to the site drainage.

2.2.2 Waste Treatment

The waste treatment process of the sludge covered by this permit, starts at the six covered Picket Fence Thickeners (PFT), which thicken sludge separated from the main flow within the Primary Settlement Tanks (PST). Storage of sludge prior to any thickening stage falls outside of the scope of the installation and this assessment.

Primary sludge from PSTs in the A and B stream is pumped via a subsurface pipe into one of the six PFTs. The PFTs are steel construction reinforced with fibreglass, with fixed roofs. The PFTs are connected to an Odour Control Unit (OCU) to manage odour emissions. The thickened sludge is pumped via an above ground pipe to the Primary Sludge Blending Tank. The PFTs are fitted with safety features and one-way valves on the feed pumps. Liquor from the PFTs is returned via Liquor Return Pumping Station 2 to the site drainage system for additional treatment through the STW. Liquor Return Pumping Station 2 is connected to an OCU.

A second sludge stream is from the PSTs in C stream which is thickened by the Primary Sludge Thickening Plant. The Thickening Plant is connected to odour abatement. The generated liquor is returned via the site drainage and Liquor Return Pumping Station 1 to the Works Inlet for additional treatment. Thickened sludge

is then pumped via a subsurface pipe to the Primary Sludge Blending Tank. The Liquor Return Pumping Station 1 is connected to an OCU.

The third sludge stream is Surplus Activated Sludge (SAS) from the UWWTD process, which is pumped via a subsurface pipe to the SAS Buffer Tank, which is outside of the scope of this Environmental Permit. Pumps transfer the SAS to the SAS Thickening Plant that are located within two buildings. Liquors are returned via Liquor Return Pumping Station 1 to the site drainage to the Works Inlet for additional treatment. The thickened sludge falls into a hopper and is transferred via a subsurface pipe to the SAS Blending Tank.

The Primary Sludge Blending Tank and SAS Blending Tank are of concrete construction, covered with fixed roofs and are connected to an OCU. The Primary Sludge Blending Tank can receive a mixture of thickened primary sludge and thickened SAS while SAS Blending Tank receives thickened SAS. Both Sludge Blending Tanks are subject to mixing via dedicated mixer pumps. As required, sludge can be transferred from the Sludge Blending Tanks to Sludge Buffer Tanks.

From the Sludge Blending Tanks, sludge is pumped to the Thermal Hydrolysis Process (THP) High Energy Blending Tank. In the event of there being insufficient THP capacity to process sludge, e.g. if the THP is offline for maintenance, both sludge can be stored in Sludge Storage Tanks.

From the THP High Energy Blending Tank, sludge is pumped to the THP Blended Sludge Tanks. The THP Blended Sludge Tanks are both of steel construction, covered and odour abated. Levels within the THP Blended Sludge Tanks are monitored and is controlled via the Site Supervisory Control and Data Acquisition (SCADA) system. The mixed sludge is then pumped to Sludge Screens (which remove further rag and inorganic material).

The screened sludge enters into two Pre THP Dewatering Feed Tanks. The Pre THP Dewatering Feed Tanks are of steel construction, covered, odour abated via an OCU, and feeds sludge via dedicated pumps to the Pre THP Dewatering Plant, which dewaters the sludge prior to the THP Process. The THP Centrifuge Feed Tanks have high level floats to prevent overfilling and are monitored via SCADA.

The liquors from the Pre THP Dewatering Plant combines and returns via a common line to site drainage Liquor Return Pumping Station 3 and Liquor Return Pumping Station 1, where it is pumped back to the Works Inlet for further treatment. Thickened sludges fall into hoppers and is pumped, via dedicated pumps, to the top of the THP Feed Silo. Malodourous air from the sludge hoppers is subject to odour abatement via an OCU.

There are two aboveground THP Feed Silos, which are each dedicated to a THP Process stream. The THP Feed Silos are monitored by high level alarms linked to SCADA and if the levels within the THP Feed Silos reaches the high set point, all of the Pre THP Dewatering Plant are inhibited. The THP Feed Silos act as a buffer capacity for the THP Process and are connected to an OCU. Sludge is discharged from the THP Process into THP Coolers that use final effluent from site to lower the temperature to be more optimal for anaerobic digestion in the Primary Digester Tanks. At this point, anti-foam from an Intermediate Bulk Containers (IBC) located on a bund is dosed in, prior to transfer of sludge to the Primary Digester Tanks

Digester feed pumps transfer the hydrolysed sludge from the THP to the eight Primary Digester Tanks via THP coolers. The Primary Digester Tanks are fitted with PRVs for safety. After the appropriate duration, digested sludge is pumped to two Digested Sludge Buffer Tanks prior to dewatering. The Digested Sludge Buffer Tanks are located outside of the Cake Barn and operate in parallel. Sludge is dewatered by the Digested Sludge Dewatering Plant found on the first floor of the Cake Barn. Dedicated feed pumps transfers sludge from the Digested Sludge Buffer Tanks to Digested Sludge Dewatering Plant. A common line returns all of the dewatering liquors by gravity to the site drainage, via Liquor Return Pumping Station 4 and Liquor Return Pumping Station 1 to the Works Inlet for additional treatment. Digested sludge cake is deposited onto the floor of the Cake Barn.

Biogas from the Primary Digester Tanks is captured in roof-mounted double membrane Biogas Storage Holders on top of each Primary Digester Tank. Methane gas detectors linked to SCADA are fitted to detect any biogas leaks in the air space between the inner and outer biogas bag and level transmitters monitor the biogas volume within the inner bag which is linked to SCADA. Each Biogas Storage Holder is fitted with two pressure/vacuum relief valves (PVRVs) for safety that would vent to atmosphere in the event of excess

pressure or relieve any vacuum in the biogas holder. Biogas is stored prior to combustion in three CHP Engines, two boilers or two emergency flares

2.2.3 Digested cake

The Cake Barn is a totally enclosed and subject to air abstraction and discharges to atmosphere. The barn is a large area of engineered hardstanding with three cake bays that receive digested sludge cake from the plant above. Digested sludge cake is removed from the three bays by shovel loader vehicles and temporarily stored within one large bay prior to being removed from the site.

Digested sludge cake is subject to removal from site under the Sludge Use in Agriculture Regulations 1989 (SUiAR), and in accordance with the Biosolids Assurance Scheme (BAS). Although there is no drainage within the cake barn, any excess liquid would be absorbed by the digested sludge cake. As the cake barn is fully enclosed and equipped with an abated air extraction system there is a low risk from bioaerosols from stored digested sludge cake or from its disturbance during handling or export.

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 all OCUs with biofilters and within the permit installation boundary have been included for consideration in this assessment.

There are a total of eight OCUs at Crossness STC which provide odour abatement to a number of different tanks and pumping stations within the treatment process.

2.2.5 Seasonality

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

However, digested sludge 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, digested 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 digested sludge cake within the storage bays during the autumn and winter, under normal conditions, than during the summer period.

2.3 Potential Sources

There are thirty-two 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?
A1 – A3	CHP Engines 1,2,3	X
A4 – A5	Auxillary Boilers 1,2	X

Air emission reference	Source	In scope?
A6 - A7	Emergency Flares 1,2	X
A8 – A11	Paxman Engines	X
A12 – A13	MTU Engines	X
A14	Powerhouse Emergency Generator	X
A15 – A16	Hot Water Boiler	X
A17	SPG Standby Generator	X
A18 – A25	Biogas Storage Holder PRVs	X
A26	OCU 1	✓
A27	OCU 4	✓
A28	OCU 5	✓
A29	OCU 8	✓
A30	OCU 9	✓
A31	OCU 10	✓
A32	THP Tanks PRVs	X
A33	Cake Barn Stack (for Cake Barn ventilation system)	✓
A34	OCU 11	✓
A35	OCU 12	✓

The Cake Barn is an additional source for consideration of bioaerosol releases to atmosphere. This is also illustrated in Appendix B.

2.3.1 Source Assessment

The CHP engines, boilers and emergency flares 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.

The remaining engines and generators are diesel fuelled and are therefore not linked to any source of bioaerosols. The boilers may also be operated on diesel, which again excludes them as a source of bioaerosols.

There are eight OCUs (points A26 – A31, A34 and A35) serving the STC. OCU 5, OCU 8 and OCU 9 are biofilter systems. Extracted air from the tanks is passed through the support media (calcified seaweed or LavaRock), within the biofilter, while water is irrigated from above. The microbes on the support media, remove potentially odorous contaminants.

OCU 1, OCU 4 and OCU 10 are two stage biofilter and scrubber systems. Extracted air from the tanks is passed through the support media (calcified seaweed or LavaRock), within the biofilter, while water is irrigated from above. The microbes on the support media, remove potentially odorous contaminants and the

partially treated air from the bio-trickling filter is passed to Activated Carbon adsorbers to achieve a stack emission standard of <= 1000 $OuEm^3$ at the outlet. Treated air discharges via the stack. The configuration of the OCU means that any bioaerosols emitted from the biofilter stage should be captured by the activated carbon stage, and therefore, the likelihood of bioaerosol release is anticipated to be minimal, if at all. OCU 11 and OCU 12 are two stage biofilter and dry scrubbing systems. Extracted air is passed through the support media (rock) while water is irrigated through the system. The second stage is a polishing stage using a dry scrubber before treated air is discharged via a stack.

The PRVs (points A18 – A25 and A32) are normally closed and do not emit to atmosphere. However, in the event of an abnormal situation such as the failure of the flare stacks and/or CHP engines, the PRV's 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.

The Cake Barn has an air extraction system which is discharged to air via point A33.

In addition to the point sources identified above, there is also a potential fugitive release from treated, dewatered sludge cake which is stored within an enclosed Cake Barn.

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 digested sludge cake is handled and stored within a fully enclosed Cake Barn, with continuous air extraction. Fast acting doors are installed on the vehicle entrance and exit and vehicles pass through a wheel-wash after exiting to reduce transfers to site roads. Therefore, fugitive releases of bioaerosols would be minimised.

The sludge cake is likely to have low concentrations of bioaerosols as a result of the THP and treatment processes and is moist on deposition within the enclosed Cake Barn. The probability of exposure from this source is considered low.

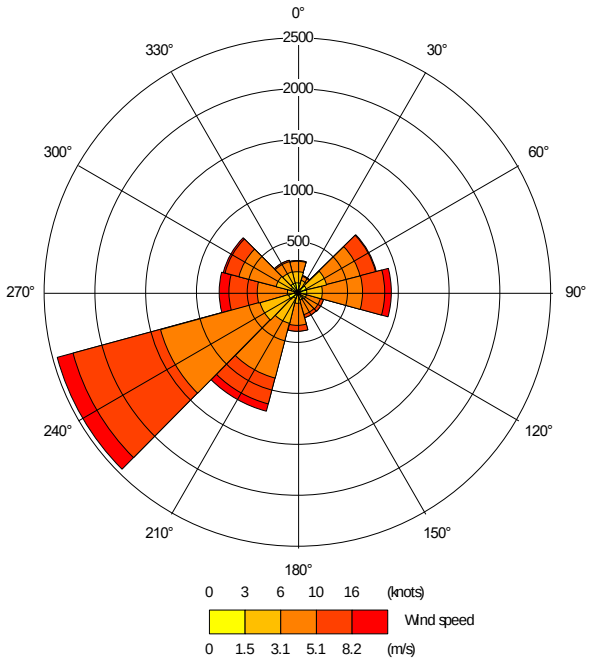
All storage tanks, treatment tanks and associated pipework are enclosed. The wet wells used to receive incoming sludge are below ground and covered with metal plates. Sludge screening and dewatering takes place in enclosed units. In addition, the PRVs are only open in abnormal situations which are temporary and unlikely. The two-stage bio-filter process fitted to the OCUs and the maintenance of these assets make the probability of exposure from these sources, low under normal operating conditions.

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, London City airport (located approximately 6.4 km West of the Site centre), is shown in Figure 1.

The wind rose data shows that the site experiences strong prevailing South westerly and West south westerly winds, predominantly in excess of 6 knots. The Crossness STC and surrounding area has a relatively flat topography. The site benefits from mature tree coverage along its western boundary, which provide some screening.

Figure 1 – London City 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 any empirical evidence for the levels of bioaerosols that might be associated with the potential sources at their STCs.

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 barn, 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 period. 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 installation, their staff when they are at work or to visitors to the site, as their health

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

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.

There are no sensitive receptors within 250m of potential bioaerosol sources. Therefore, there is likely no risk to human health as a result of a bioaerosol release.

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 bioaerosol emissions from a facility.

Three potential bioaerosol emission sources have been identified:

- OCUs (emission points A26 – A31 and A34 and A35);
- Cake Barn Stack; and
- Cake Barn.

There are no sensitive receptors within 250m of the release points.

The maximum daily throughput of sludge is 2,220m^3/day. The fully digested sludge is dewatered. Polymer coagulants are added to reduce its water content, although it remains damp and is transferred into the fully enclosed Cake Barn, which is equipped with an air extraction system. The moisture content in the cake prevents it drying out and the cake forms a crust after 24 hours in storage, so does not give rise to dust readily. The sludge cake is shovelled to the storage area in the Cake Barn and is not disturbed until it is removed for export, further minimising the potential to generate bioaerosol releases. Roller shutter doors are operated in the Cake Barn, minimising releases of dust or bioaerosols and wheel wash facilities further reduce the risk of entrainment of sludge cake out of the Cake Barn onto the site. The sludge cake bioaerosol content is considered to be small and colony forming units are anticipated to be within acceptable levels, particularly at distances in excess of 250m from source.

Storage tanks, treatment tanks and associated pipework are enclosed. Where tanks are not gas tight and vent to atmosphere, these are connected to an OCU. The OCUs are either a biofilter system or a two-stage biofilter and activated carbon scrubber. Given the types of OCU, the likelihood of bioaerosol release is anticipated to be negligible to low.

The prevailing wind direction is Southwest / West Southwest. Retail, industrial /commercial and community spaces are the closest receptors and predominantly upwind of the prevailing wind direction. However, these are located beyond 250m of potential bioaerosol emission sources and as such would likely experience 'background levels' in the event of a release.

The probability of exposure from bioaerosols generated from the permitted processes on site is considered to be **Low.** However, when considering the location of receptors, receptor distances from source, the prevailing wind direction and the onsite management and mitigation measures in place, the overall risk is reduced to **Very 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 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 stacks and/or CHP Engines. Such an event would result in releases of biogas from the PRV's located on the roofs of the Primary Digester Tanks and in the Biogas Storage Holder compound, which would release bioaerosols. This occurs to prevent over pressurisation of the Primary Digester Tanks 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 Crossness 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.

A small number of potential sources of bioaerosols within the site processes have been identified, connected to the storage and movement of treated digestate sludge cake in the Cake Barn and the operation of odour control units. The risk from abnormal releases from pressure relief valves was scoped out.

Although only qualitative data is available at this stage, the overall bioaerosol risk from the permitted process on site are considered to be **Very Low** based on receptor distances being greater than 250m (and located predominantly upwind) and onsite management and maintenance, which would minimise the likelihood and magnitude of any releases.

3.1 Sampling

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

Appendix A. Site Location Plan

KEY:

Site Location

P01	JUN. 2022	FOR INFORMATION	AR	SK	JK	MM
Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd

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Client

Thames Water

Project

STC IED PERMIT
CROSSNESS STW

Drawing title

APPENDIX A
SITE LOCATION PLAN

Drawing status

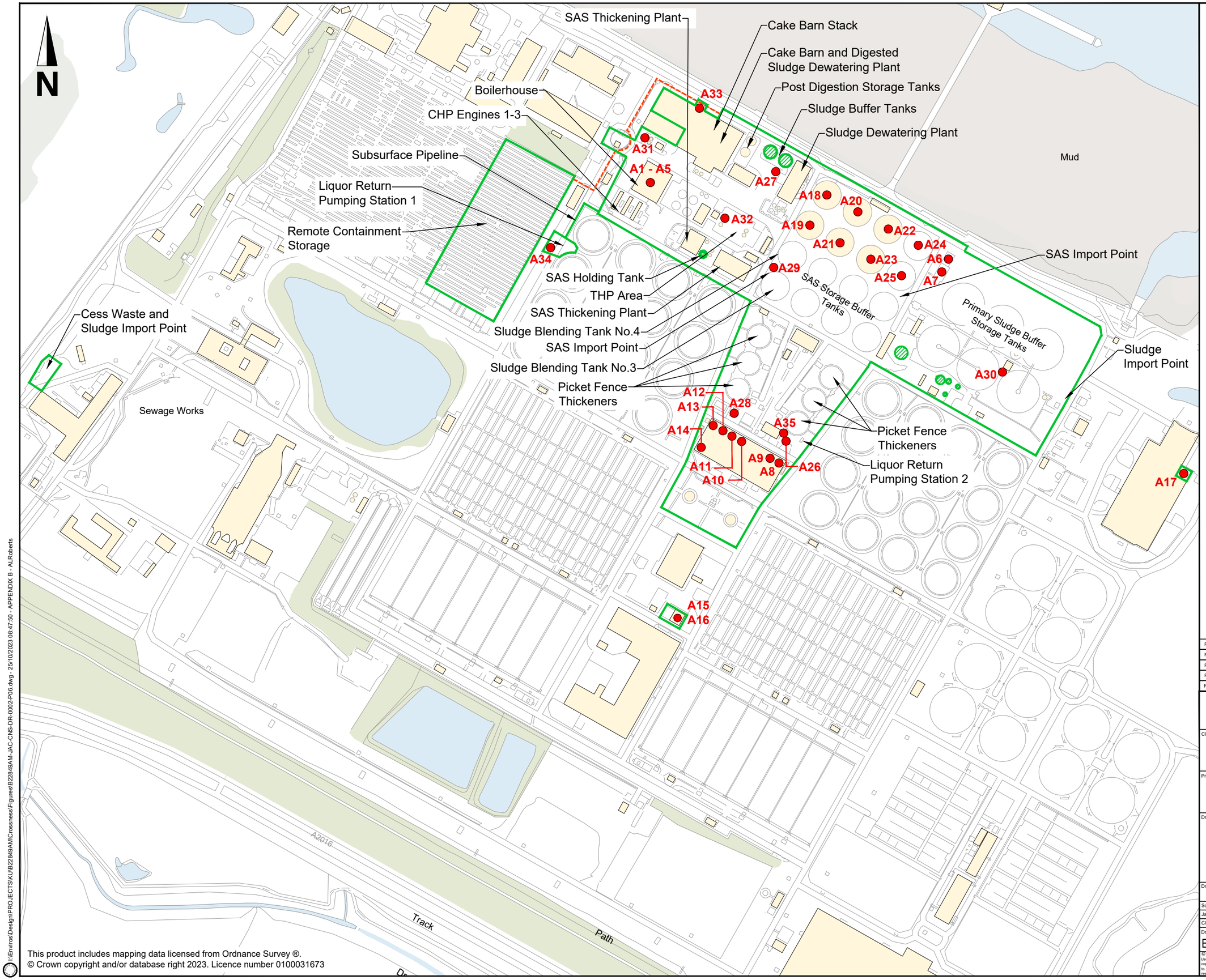
PERMITTING

Scale	1:25,000	DO NOT SCALE
Jacobs No.	B22849AM	Rev P01
Client no.		

Drawing number

B22849AM-JAC-CNS-DR-0001

Appendix B. Installation Boundary and Air Emission Points



KEY:

- Installation Boundary
- Tanks Excluded from Permit Scope
- Subsurface Gravity Pipeline
- Air Emission Point

A1 - CHP Engine1
A2 - CHP Engine 2
A3 - CHP Engine 3
A4 - CHP Auxiliary Boiler 1
A5 - CHP Auxiliary Boiler 2
A6 - Emergency Flare 1
A7 - Emergency Flare 2
A8 - Paxman Engine
A9 - Paxman Engine
A10 - Paxman Engine
A11 - Paxman Engine
A12 - MTU Engine
A13 - MTU Engine
A14 - Powerhouse Emergency Generator
A15 - Hot Water Boiler
A16 - Hot Water Boiler
A17 - SPG Standby Generator
A18 - Biogas Holder PRV
A19 - Biogas Holder PRV
A20 - Biogas Holder PRV
A21 - Biogas Holder PRV
A22 - Biogas Holder PRV
A23 - Biogas Holder PRV
A24 - Biogas Holder PRV
A25 - Biogas Holder PRV
A26 - OCU 1
A27 - OCU 4
A28 - OCU 5
A29 - OCU 8
A30 - OCU 9
A31 - OCU 10
A32 - THP PRV
A33 - Cake Barn Stack
A34 - OCU 11
A35 - OCU 12

0 20 40 60 80 100
METRES

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

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Client: Thames Water

Project: STC IED PERMIT
CROSSNESS STW

Drawing title: APPENDIX B
INSTALLATION BOUNDARY
AND AIR EMISSION POINTS

Drawing status: PERMITTING

Scale	AS SHOWN	DO NOT SCALE
Jacobs No.	B22849AM	Rev P04
Client no.		

Drawing number: B22849AM-JAC-CNS-DR-0002