Chertsey STC Bioaerosol Risk Assessment

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Thames Water Utilities Ltd
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IED STC Permitting
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Chertsey 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 Chertsey STC, EPR/DP3090SF.

1.1 Site description

The site is located to the west of Chertsey in a largely rural area and is bounded on the north and west by the M3 and M25 motorways and interchange.

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

Chertsey Sludge Treatment Centre;

Chertsey Sewage Treatment Works,

Lyne Crossing Road

Chertsey

Surrey

KT16 0AR

Immediately to the south of the site is the Lyne community recycling centre, a Surrey County Council household waste and recycling centre. This gives way to a railway line, open green spaces and agricultural land along with isolated domestic properties and commercial properties. To the west of the site is more green space, agricultural land and a motocross site.

The whole of the wider site including the area of the STC to be permitted sits within a Flood Zone 1, indicating a low probability of flooding (<1:1000 annual probability of flooding). The site sits outside any source protection zones and is outside of an Air Quality Management Area (AQMA). There are a number of habitat sites within the appropriate distance of the STC, including a RAMSAR and SPA, a SAC, a SSSI and LNR. There are 21 areas of Ancient Woodland habitat within 2 km of the site and there are also nine non-statutory designated Local Wildlife Sites (LWS) within 2 km of the site. There are no protected habitat or species records within the specified screening distance of the site.

1.2 Site Activities

Chertsey Sludge Treatment Centre (STC) is located at the Chertsey Sewage Treatment Works (STW), and is 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 (UWWTD) regulated works.

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

The site includes the following DAA:

- Imports of waste, including sludge from other sewage treatment works for treatment
- Blending of indigenous sludges and imported wastes/waste sludge prior to treatment;
- Pre-treatment of sewage sludge by thermal hydrolysis plant (THP)
- Storage of digestate prior to dewatering;

- Dewatering of digested sewage sludge;
- Transfer of treated dewatering liquors and transfer of untreated thickening liquors back to the head of the sewage treatment works;
- Transfer of surface water runoff back to the head of the sewage treatment works;
- Storage of dewatered digested sludge cake prior to offsite recovery;
- Storage of biogas;
- Transfer of biogas condensate via site drainage back to the head of the sewage treatment works;
- Combustion of biogas in a MCPD and Specified Generator (SG) compliant biogas CHP engines;
- Combustion of biogas/diesel in a new MCP, DAA, dual fuel boiler
- Combustion of diesel in a MCPD compliant diesel generator;
- Emergency flare;
- Operation of siloxane filter plant;
- Storage of diesel;
- Storage of wastes, including waste oils; and,
- Storage of raw materials;

The facility can treat up to 710,000m^3 of sludge per year (equating to approximately 710,000 tonnes). The sludge treatment facility has a total maximum treatment input of 260m^3 per day (equating to approximately 260 tonnes per day).

The facility has a second listed activity, for the operation of a liquor treatment plant at the site, which pre-treats dewatering liquors prior to their return back to the works inlet for treatment within the urban waste water treatment directive compliant processes on site, which are outside of the permit scope.

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 a number of Odour Control Units (OCUs) 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, boiler and flare 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) and the treatment of liquors prior to disposal above the relevant threshold, Chapter 5, Section 5.4, Part A 1(a)(i).

For 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*

[1] Environment Agency. July 2018. M9: Environmental monitoring of bioaerosols at regulated facilities v2, July 2018

at regulated facilities'. M9 describes bioaerosols and the risks that they pose, as well as identifying potential sources within biological treatment facilities.

The Chertsey STC is 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.

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 Chertsey 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 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 bioaerosol release at the Chertsey STC, which meets the M17 guidance, only the storage of waste (under certain conditions) 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 M17guidance[3] 'M17 Monitoring of particulate matter in ambient air around waste facilities', and in line with the Governments regulatory position statement (RPS) 209 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

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

[3] Environment Agency April 2014 M17 monitoring of particulate matter in ambient air around waste facilities 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

interest and their respective threshold Levels (including background) at sensitive receptors are outlined below:

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

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 Chertsey 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

Waste is delivered into the covered works inlet channel through an enclosed connection, before being processed through the STW outside of the permit boundary. Incoming sludge, in a mixture with other sewerage material is subjected to preliminary treatment through screening and degritting, before separation of sludge from the main flow in the primary settlement tanks. Settled sludge is transferred to the Unthickened Indigenous Sludge Tanks. From here it is then transferred to the Sludge Buffer Tank where it is mixed with the imported sludge and transferred to the Pre-THP Dewatering Feed Tank. The blended sludge is subject to thickening within Pre-THP Dewatering Plant and thickened sludge is then subject to a pre-treatment stage within the Thermal Hydrolysis Plant (THP). The Pre-THP Dewatering Feed Tank and Pre-THP Dewatering Plant are connected to an Odour Control Unit (OCU).

Sludge may also enter the process, via tanker transfer from other TWUL sewage treatment works or from third parties. These imports are transferred by sealed pipeline from tankers into a Sludge Import Tank within the process and pumped to the Sludge Buffer Tank where it is mixed with the indigenous sludge. The blended sludge is subject to thickening and pre-treatment (as above). The Sludge Import Tank is connected to an OCU.

THP is pre-treatment process prior to anaerobic digestion. The THP uses elevated heat and pressure to pre-treat sludge by sterilising it and breaking down cell structures and larger organic molecules in order to ease their anaerobic digestion.

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.

Digested sludge cake can also be imported to the Cake Barn from other STWs via lorries.

2.2.2 Waste Treatment

The treatment process of the sludge covered by this permit is for anaerobic digestion of sludge within two Primary Digester Tanks. There is a pre-treatment stage at the THP which treats incoming sludge on a continuous batch process, using the injection of steam into a reaction vessel to elevate its temperature and raise the vessel pressure. The sludge is held at the elevated temperature and pressure for a set time period, before being discharged to the Primary Digester Tanks for anaerobic digestion.

The pre-treated sludge is then directed to one of two Primary Digester Tanks equipped with fixed roofs. From the Primary Digester Tanks, digested sludge is transferred to the Digested Sludge Buffer Tank prior to dewatering using Digested Sludge Dewatering Plant. Dewatered sewage cake is stored in a semi enclosed cake barn. The Digested Sludge Buffer Tank and Digested Sludge Dewatering Plant are connected to an Odour Control Unit (OCU).

Biogas is captured from the Primary Digester Tanks and transferred to a Biogas Storage holder for storage prior to combustion in one of two CHP engines on site, or within the boiler.

2.2.3 Digested cake

De-watered digested cake from the Digested Sludge Dewatering Plant is carried by a conveyor and deposited in a concrete surfaced partially enclosed cake barn. Conveyors are covered to minimise the risk of cake escaping. The cake is deposited from the conveyor onto the cake barn surface from a distance of approximately 2m. This height allows the operation of the conveyor to be continued without requiring immediate removal of cake into the stockpile within the barn. Cake is generally stored in the barn below the level of the surrounding walls. The barn walls are approximately 3m high concrete, with fly mesh filling the sides to the roof line at approximately 5m. There is no storage outside of the cake barn.

The cake is transferred onto trucks using an excavator and loading shovel and removed from the site under the Sludge Use in Agriculture Regulations 1989 (SUiAR), and in accordance with the Biosolids Assurance Scheme (BAS).

2.2.4 Liquor Treatment

Liquor from the Pre-THP Dewatering Plant and Digested Sludge Dewatering Plant is transferred to open Liquor Treatment Plant tanks prior to discharge of treated liquors to the head of the works via the site drainage. Although the tanks are open, liquors are stored below the level of the tank wall.

2.2.5 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. Biofilters are considered to be a potential emission source for bioaerosols, whether used in isolation or with a second methodology.

The Sludge Import Tank, Pre-THP Dewatering Feed Tank and Pre-THP Dewatering Plant is equipped with an OCU, this is a two stage biofilter, with the first stage using polypropylene rings as the support medium and the second using wood chip. As the final stage of the OCU is a biofilter, this unit is a potential source of bioaerosols.

A second OCU serves the Liquor Return Pumping Station, Liquor Treatment Buffer Tank, Digested Sludge Buffer Tank and Digested Sludge Dewatering Plant. The first stage is a biofilter and the second stage is a carbon polishing unit. Although the final stage of the OCU is a carbon stage, this unit is considered a potential source of bioaerosols.

2.2.6 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 cake 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 twelve 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 as a source?
A1	CHP Engine 1	X
A2	CHP Engine 2	X
A4	Emergency Flare	X
A6	LTP Generator	X
A7	Biogas Storage PRV	X
A8	OCU1	✓
A9	OCU2	✓
A10	THP PRV	X
A11	Digester PRV	X
A12	Digester PRV	X
A13	Siloxane Filter	X
A14	Dual Fuel Steam Boiler	X

The Cake Barn is also illustrated in Appendix B and is an additional potential source for consideration of bioaerosols release to atmosphere.

2.3.1 Source Assessment

The CHP engines (A1 & A2), emergency flare (point A4) and Dual Fuel Steam Boiler (A14) 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.

Points A6 relate to diesel fuelled generators at the site, which are not linked to any source of bioaerosols.

Biofilters are considered to be a potential emission source for bioaerosols, whether used in isolation or with a second methodology.

There are two odour control units (OCUs) at the installation, (points A8 & A9). A8 serves the Sludge Import Tank, Pre-THP Dewatering Feed Tank and Pre-THP Dewatering Plant and is a two stage biofilter system. Extracted air is first treated in a biofilter stage with a support media of polypropylene rings, which is then passed for additional treatment in a biofilter with a woodchip substrate. Cleaned air is then discharged from this second stage biofilter with no additional treatment. This OCU could potentially be a source of bioaerosols, based on the M9 guidance.

The second OCU, A9, serves the Sludge Import Tank, Pre-THP Dewatering Feed Tank and Pre-THP Dewatering Plant. This odour control unit is a two stage unit comprising a biofilter and dry scrubber system. Extracted air from the tank is passed through the support media, which is pumice stone, 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 2 No. 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 most 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 although not totally eliminated

The Pressure Relief Values (PRVs) (points A7 and A10 – A12) 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 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.

Finally, there is a siloxane filter (A13) which is not considered to be a potential source of bioaerosols due to the design, which is designed to remove siloxanes and VOC, prior to the release of waste air via the siloxane filter stack.

In addition to the point sources identified above, there is also an unchanneled potential release (diffuse source) from treated, dewatered sewage cake which is stored in the cake barn at the site, however this is limited as the cake barn is partially enclosed

2.3.2 Risk

The overall treatment process is considered to a be a low source of bioaerosols. As discussed above, there are a number of 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 within the cake barn.

However, the cake is at the end of the sludge treatment process and the sludge cake is likely to have low bioaerosol content as a result of the treatment processes. Sludge cake forms a crust within 24 hours of deposition is managed to control height and arrangement, and is located within a building minimising water infiltration and air flow. The cake storage areas are monitored for row height and arrangement and require no further treatment or disturbance prior to export onto agricultural land.

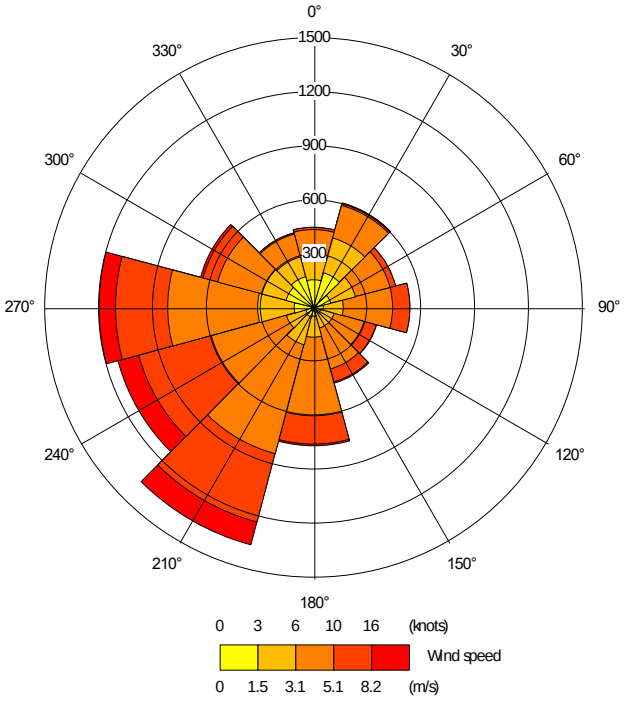
In addition, some of the storage tanks, treatment tanks and associated pipework are enclosed. The wet wells used to receive incoming sludge are below ground and covered with metal plates. Sludge screening and dewatering takes place in enclosed units. In addition, the PRVs are only open in abnormal situations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

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 2019 wind rose for the most representative meteorological site, Heathrow airport (located approximately 9 km North-East of the Site), is shown in Figure 1.

The wind rose data shows that the site experiences strong prevailing south westerly winds, predominantly in excess of 6 knots. The Chertsey STC and surrounding area has a relatively flat topography. The site has screening to the south by mature trees along the site boundary..

Figure 1. Heathrow Airport Wind rose (2019)



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. RR786 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 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

[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 a number of potentially sensitive receptors found within 250m of potential bioaerosol emission sources at the site. As demonstrated in the site plan found in Appendix C, these receptors are found to the East, South, and North of the Site.

Three areas of sensitive receptors have been identified below in Table 2 based on their location and receptor type. For each of these areas, the distance and direction from each potential bioaerosol emission source to sensitive receptors within the area have been identified. Where multiple assets exist for the same process, such as the cake barn, only the closest location has been presented. The receptor closest to a potential emission source is the Household Recycling Centre to which is located approximately 70m South-East of the OCU labelled as A8 serving the THP Plant.

Table 2. Static Receptors within 250m of Potential Bioaerosol Sources

Receptor	Description	Source	Distance from source (m)	Direction from the site
R1	Commercial Properties: Household recycling centre	OCU2 (A9)	140m	South-East
		OCU1 (A8)	70m	South-East
		Cake Barn	150m	South-East
R2	Commercial / Residential premises Lyne Farm	OCU2 (A9)	110m	South
		OCU1 (A8)	150m	South-West
		Cake Barn	110m	South
R3	Leisure Properties Lyne Motocross Track	OCU2 (A9)	210m	North-East
		OCU1 (A8)	235m	North
		Cake Barn	145m	North

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.

There are three potential sources of bioaerosol release within 250m of static receptors:

- Cake Barn
- OCU1 (A8)
- OCU 2 (A9)

The receptors are situated to the North, South and South-East of the release points and the prevailing wind direction is from the South-West. Whilst the receptors are not situated immediately down-wind of these sources, there is potential for wind-borne transportation of bioaerosols. The risk of bioaerosols being generated from the permitted processes on site is low.

Most storage tanks, treatment tanks and associated pipework are enclosed. Where tanks are not gas tight and vent to atmosphere, these are connected to an odour control unit. There are two types of odour control, a

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

two-stage biofilter and activated carbon scrubber (labelled as A9). Given the type of Odour Control unit, the likelihood of bioaerosol release is anticipated to be minimal. The other odour control unit, (labelled as A8) is a two stage biofilter process, with the second stage being a wood chip based system. This unit monitored for key process parameters such as compaction and moisture content. The wood chip is subject to a planned replacement programme.

Following digestion, the waste is passed through Digested Sludge Dewatering Presses to reduce its water content, although it remains relatively damp and forms a crust after 24 hours in storage, so does not give rise to dust readily. In addition, the waste is not handled whilst stored until it is removed from the site, therefore minimizing potential to generate dust due to disturbance.

Digestate cake is stored in a semi-enclosed cake barn, which has a covered roof and solid walls to approximately 3.5 metres, provide protection from the prevailing South westerly winds, with the remaining sides being fly mesh. The cake conveyor end within the cake barn and their output is monitored to ensure that the height of the cake pile does not exceed the height of the walls.

Overall, the probability of bioaerosols being released from the sludge treatment process and the identified potential sources is considered to be low.

The potential duration of release of bioaerosols varies from infrequent to frequent. The magnitude of release is considered to be low.

There is one residential receptor (Lyne Farm, R2) approximately 110m South of the cake barn and OCU 2 (A9). Given that the identified potential sources are considered to represent a low risk, the intervening distance and the screening provided by the vegetation bund, it is considered that the risk of exposure to occupants of this property from bioaerosols emitted from the site is likely to be low.

One commercial property (Household Recycling Centre, R1) has been identified, approximately 70m South-East of OCU 1 (A8). At this receptor it is likely that people will be present working for extended periods of time, including working outdoors. However, given that the identified potential sources are considered to represent a low risk and the intervening distance and barriers, it is considered that the risk of exposure to workers at this property from bioaerosols emitted from the site is also low.

One leisure facility has been identified approximately 145m north of the cake barn. The facility is a motocross track, which may involve people being present for extended periods of time. The identified potential sources are considered to represent a low risk as they are within a building and the intervening distance is lengthy. It is considered that the risk of exposure to the public at this facility from bioaerosols emitted from the site is also Low.

Table 3 summaries the risk assessment.

Table 3. Risk Assessment of Potential Bioaerosols Sources

What has the potential to cause harm? Source	How can the source reach the receptor? Pathway	Who can be affected? Receptors	Assessing the risk Probability of Exposure	Consequence (what is the harm that can be caused)	Managing the risk (Control Measures)	Overall/residual risk
Odour Control Unit 1 - (A8)	Inhalation via wind-borne transportation	R1, R2, R3	Receptors are >70m away at closest, none are downwind and also screened by vegetation and trees. Probability of exposure from is considered to be **low**.	Impact on human health (considered to be a sensitive receptor).	The odour control unit is a 2 stage biofilter unit, with the second state being a wood chip based biofilter, which is designed to achieve a stack standard of <= 1000 OuEm3. The wood chip section is subject to regular checking for compaction and moisture content, with programmed media replacement The odour control unit is monitored and regularly maintained making the uncontrolled release of bioaerosols very unlikely.	Low
Odour Control Unit 2 - (A9)	Inhalation via wind-borne transportation	R1, R2, R3	Receptors are >110m away and screened by vegetation and trees. R1 and R2 are also not downwind. Probability of exposure from is considered to be **low**.	Impact on human health (considered to be a sensitive receptor).	The odour control unit is a 2 stage unit, with the final state being an activated carbon absorber, which is designed to achieve a stack standard of <= 1000 OuEm3. In addition, the odour control unit is monitored and regularly maintained making the uncontrolled release of bioaerosols very unlikely.	Low
Cake Barn	Inhalation via wind-borne transportation	R1, R2, R3	Receptors are >110m away, and also screened by vegetation and trees. R1 and R2 are also not downwind. Probability of exposure from is considered to be **low**.	Impact on human health (considered to be a sensitive receptor).	The cake stockpile levels are managed so that under normal operating conditions it does not exceed the height of the solid barn wall. In addition, the site has mature trees on the southern boundary that provides some screening along the site boundary to receptor R2.	Low

What has the potential to cause harm? Source	How can the source reach the receptor? Pathway	Who can be affected? Receptors	Assessing the risk Probability of Exposure	Consequence (what is the harm that can be caused)	Managing the risk (Control Measures)	Overall/residual risk
					The cake stockpiles levels are managed to minimise storage time, cake can also be removed off site for storage in the event of land spreading being unable (poor weather conditions) to ensure the site does not store excessive volumes at any time.	

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 Engine. 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 from bioaerosols arising from operations at the Chertsey 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 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 digested sludge cake at the site and operation of odour control units.

Although only qualitative data is available at this stage, the overall bioaerosol risk to the identified, potential, receptors within 250m of potential bioaerosol sources associated with the sludge treatment process is considered to be Low risk based on the receptor distances and directions, probability of exposure and onsite management and maintenance, which would minimise the magnitude and likelihood of any releases..

3.1 Sampling

Thames Water confirms it will use MCERTS accredited providers for the sampling of bioaerosols from location A8, which has an NGR of TQ 01607 67396, and A9 which has an NGR of TQ 01508 67403 (NGR for the OCU stacks) and will sample on a bi-annual basis.

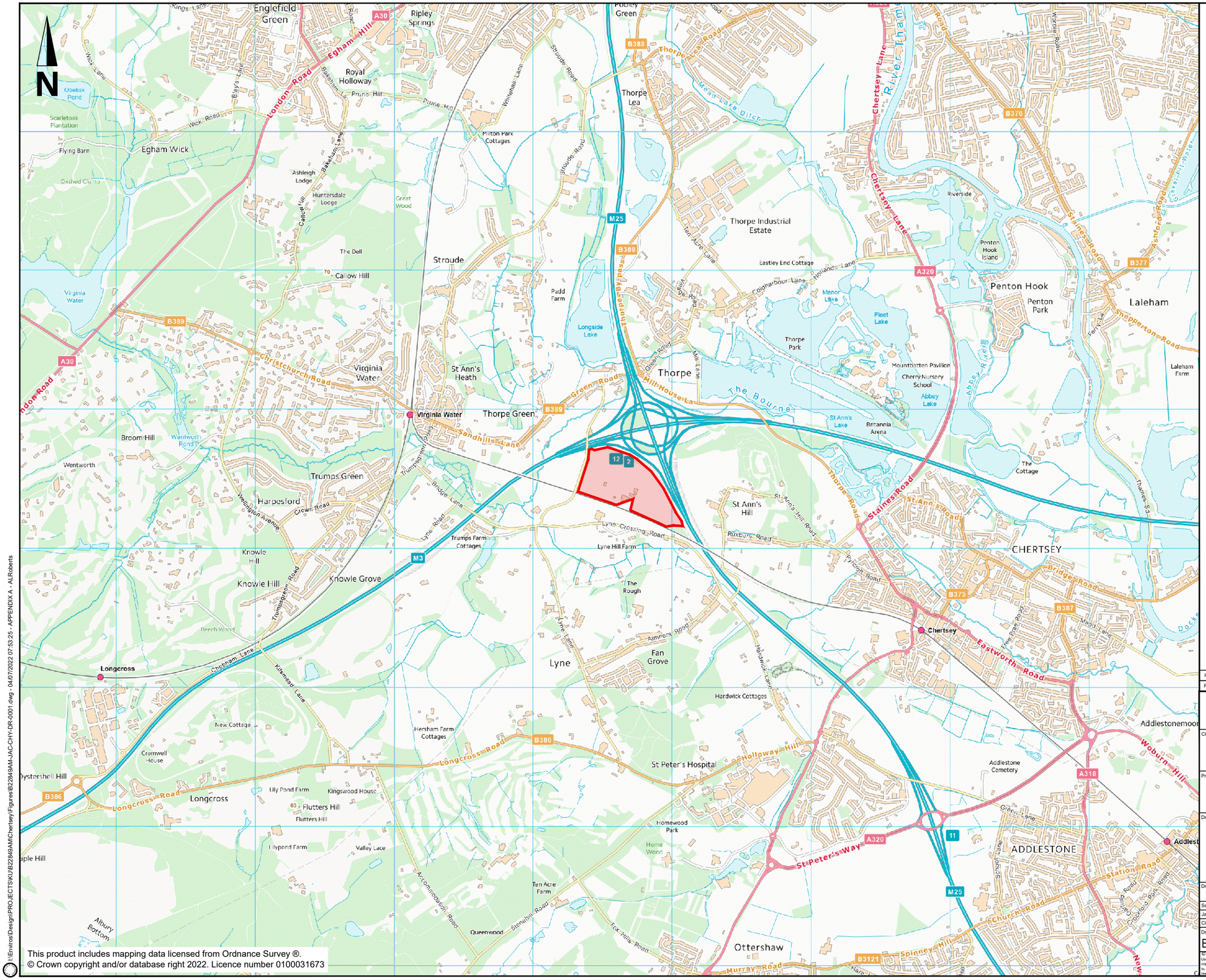
In addition, sampling will also take place in relation to TQ 01452 67435 (approx. NGR of centre of cake barn) which is a diffuse source and hence will be monitored purely by agar plates.

In line with M9, ambient sampling will be conducted to identify background emissions. A sampling round, consisting of four individual sampling points, each with its own agar plate will be carried out. One point will be located 50m upwind to give a background concentration, and three points will be located in a fan like arrangement downwind and at the same distance to the nearest sensitive receptor:

- Upwind sample location (approx.) which is 50 m SW of OCU 1: NGR TQ 0158 6735
- Downwind sample location which is approx. 70 m N of OCU 1: NGR TQ 0160 6746
- Downwind sample location which is approx. 70 m NNE of OCU 1: NGR TQ 0164 6745
- Downwind sample location which is approx. 70 m NE of OCU 1: NGR TQ 0166 6743
- Upwind sample location (approx.) which is 50 m SW of OCU 2: NGR TQ 0147 6735
- Downwind sample location which is approx. 110 m N of OCU 2: NGR TQ 0150 6750
- Downwind sample location which is approx. 110 m NNE of OCU 2: NGR TQ 0155 6749
- Downwind sample location which is approx. 110 m NE of OCU 2: NGR TQ 0158 6745
- Upwind sample location (approx.) which is 50 m SW of the Cake Barn: NGR TQ 0142 6739
- Downwind sample location which is approx. 110 m N of the Cake Barn: NGR TQ 0145 6758
- Downwind sample location which is approx. 110 m NNE of the Cake Barn: NGR TQ 0152 6756
- Downwind sample location which is approx. 110 m NE of the Cake Barn: NGR TQ 0157 6751

NGR's for sampling locations are only 8 digits at present, to allow the contractor flexibility as to precise location, taking into account access (and security) for the sampling plates. Placement of sampling plates to the south may be restricted due to the proximity of the railway line.

Appendix A. Site Location Plan



KEY:

Site Location

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

Jacobs
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Client: Thames Water

Project: STC IED PERMIT
CHERTSEY STW

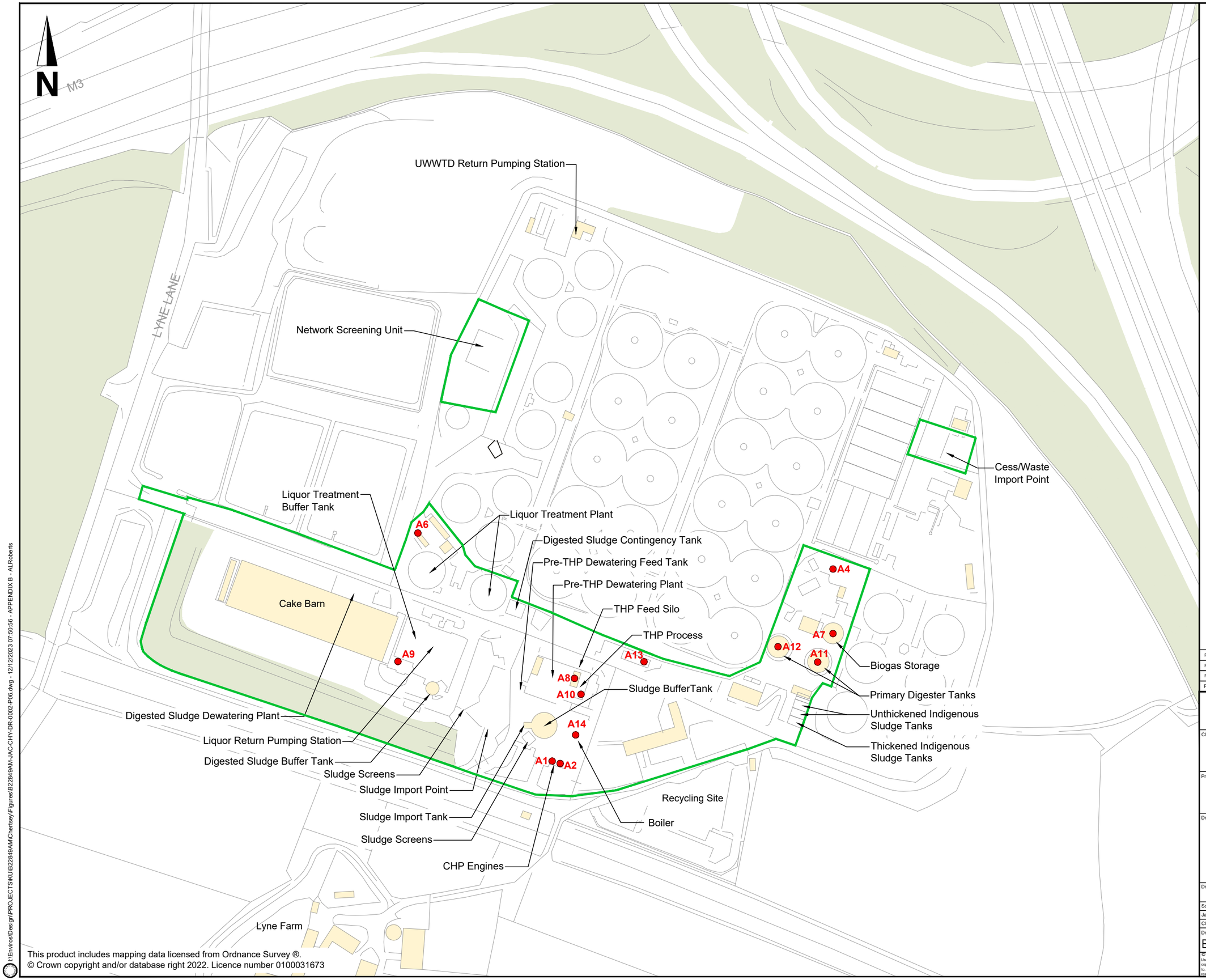
Drawing title: APPENDIX 1
SITE LOCATION PLAN

Drawing status: PERMITTING

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

Drawing number: B22849AM-JAC-CHY-DR-0001

Appendix B. Potential Bioaerosol Emission Points



KEY:

- Installation Boundary
- Air Emission Point

A1 - CHP Engine 1
A2 - CHP Engine 2
A4 - Emergency Flare
A5 - SBR Generator
A7 - Biogas Holder PRV
A8 - OCU 1
A9 - OCU 2
A10 - THP Process PRV
A11 - Primary Digestion Tank PRV
A12 - Primary Digestion Tank PRV
A13 - Siloxane Filter
A14 - Dual Fuel Steam Boiler

0 20 40 60 80 100
METRES

P03	DEC. 2023	FOR INFORMATION	AR	JK	JK	MM
P02	NOV. 2023	FOR INFORMATION	AR	HEK	JK	MM
P01	JUL. 2022	FOR INFORMATION	AR	HEK	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
CHERTSEY STW

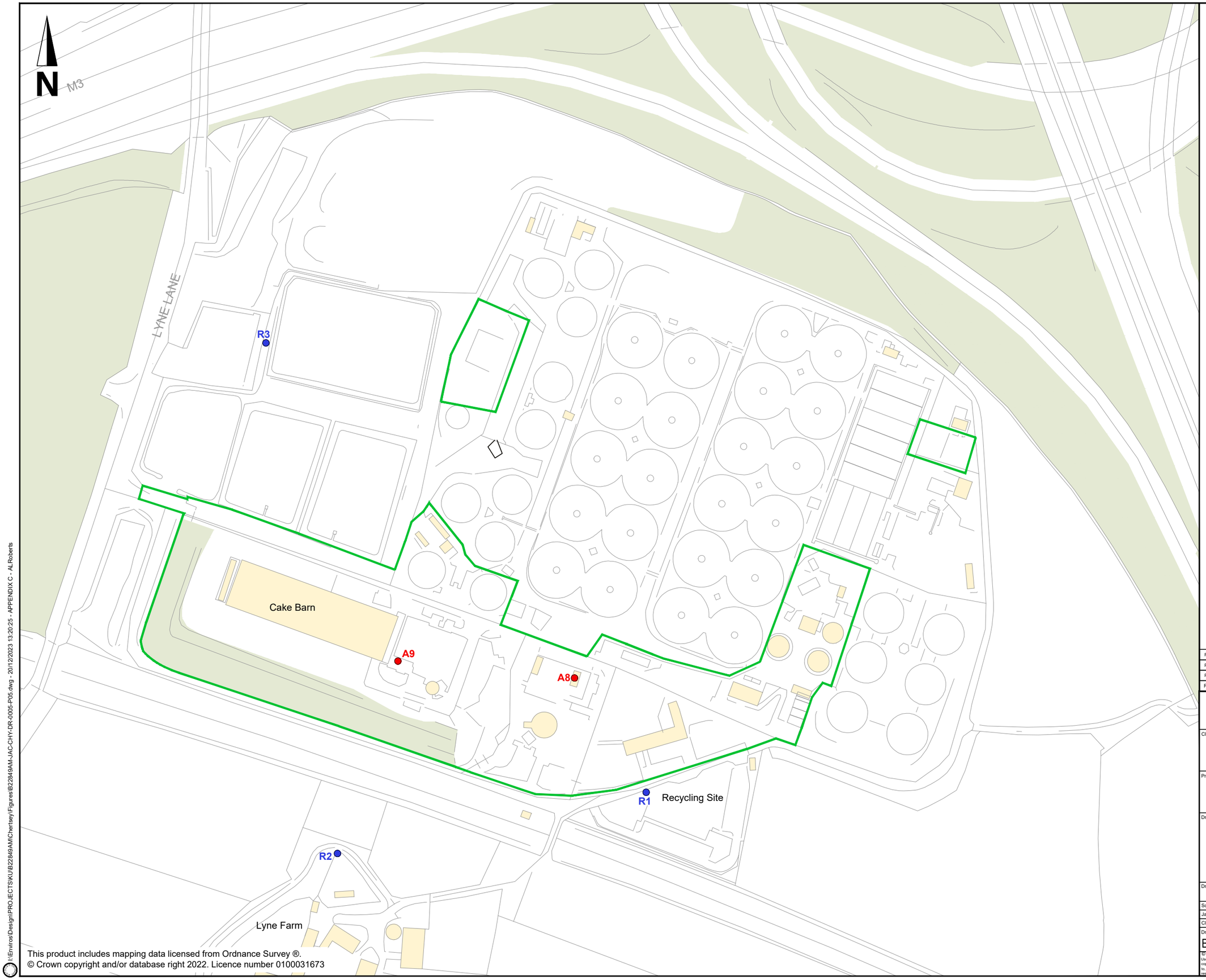
Drawing title: APPENDIX B
POTENTIAL BIOAEROSOL
EMISSION POINTS

Drawing status: PERMITTING

Scale	1:2000	DO NOT SCALE
Jacobs No.	B22849AM	Rev P03
Client no.		

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

Appendix C. Receptors within 250m of potential emission points



KEY:

- Installation Boundary
- Air Emission Point
- Receptor Point

A8 - OCU 1
A9 - OCU 2

R1 - Recycling Site
R2 - Lyne Farm
R3 - Lyne Motorcross Track

0 20 40 60 80 100
METRES

Rev	Rev. Date	Purpose of revision	Drawn	Checkd	Rev'd	Apprv'd
P03	DEC. 2023	FOR INFORMATION	AR	JK	JK	MM
P02	JUL. 2023	FOR INFORMATION	AR	HEK	JK	MM
P01	JUL. 2022	FOR INFORMATION	AR	HEK	JK	MM

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Client: Thames Water

Project: STC IED PERMIT
CHERTSEY STW

Drawing title: APPENDIX C
RECEPTORS WITHIN 250m
OF POTENIAL EMISSION POINTS

Drawing status: PERMITTING

Scale	1:2000	DO NOT SCALE
Jacobs No.	B22849AM	Rev P02
Client no.		

Drawing number: B22849AM-JAC-CHY-DR-0005