Wargrave STC Bioaerosol Risk Assessment

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Thames Water Utilities Ltd
EPR/UP3737QP/V002

IED STC Permitting
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Wargrave 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 Wargrave STC, EPR/UP3737QP/V002.

1.1 Site description

The site is located in a mainly semi-rural location within the administrative area of Wokingham. The site is surrounded by fields, woodland and the River Loddon to the west and the fruit wholesaler operations of Sheeplands Farm / Hall Hunter Partnership to the immediate north, east and south of the site. Beyond this the edges of the settlements of Twyford and Wargrave are located approximately 490 m and 960 m to the South-East and North-East of the site respectively. The nearest sensitive receptors are commercial premises located approximately 25m to the south and include a furniture installation company and a sketch studio. The nearest residential dwellings are static homes at Sheeplands Farm located approximately 195m to the north-east of the site.

The STC and associated assets are located predominately within Flood Zone 2 (area with medium risk of flooding, with between a 1:100 and 1:1,000 annual probability of river flooding). The western areas of the wider Wargrave STW are located within Flood Zone 3 (area with high risk of flooding indicating a 1:100 or greater annual probability of river flooding or 1:200 or greater annual probability of sea flooding). In terms of assets, parts of the Cake Pad and the Primary Digester Tanks are located within a Flood Zone 1, indicating a low risk of flooding but parts of the wider STW are located in areas identified as Flood Zone 3 with a high risk of flooding.

The site sits within the boundaries of Source Protection Zones (SPZ) 2 and 3. The site is not located within or adjacent to the boundaries of an Air Quality Management Area (AQMA).

Chilterns Beechwoods Special Area of Conservation (SAC) represents the only statutory designated nature conservation site located within the specified screening distance from the site situated approximately 9.7km to North-East of the site. There are no Sites of Special Scientific Interest (SSSI), National Nature Reserves (NNRs) or Local Nature Reserves (LNRs) within 2km of the site and no Special Protection Areas (SPA), Marine Protection Areas (MPA) or Ramsar sites within 10 km of the site.

There are six non-statutory designated Local Wildlife Sites (LWS's) within 2 km of the site, the closest of which is located within 50m of the western boundary of the Wargrave STW and is associated with the River Loddon. There are no areas of Ancient Woodland within 2 km of the site.

There are also designations for protected species within the screening distance of the site.

The address of the installation is:

Wargrave Sludge Treatment Centre

Wargrave Sewage Treatment Works

Wargrave Rd,

Wargrave,

Reading,

RG10 8DJ

1.2 Site Activities

Wargrave Sludge Treatment Centre (STC), is located at the Wargrave 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 Wastewater Treatment Directive (UWWTD) 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 for treatment;
- 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 back to the head of the sewage treatment works;
- Transfer of surface water runoff via site drainage 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 biogas CHP engine (that is a Tranche B Specified Generator) and biogas or diesel oil in a boiler;
- Operation of an emergency flare;
- Operation of a siloxane filter;
- Storage of diesel;
- Storage of wastes, including waste oils; and,
- Storage of raw materials.

The STC can treat up to 600,000m^3 of sludge per year (equating to approximately 600,000 wet tonnes). The STC has a total maximum treatment input of 379m^3 per day (equating to approximately 379 wet 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 using a biofilter.

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 engine or a boiler 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 engine, boiler and emergency 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).

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

The Wargrave 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

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

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 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 Wargrave 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 Wargrave 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[2] '*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[3]; 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. 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*

[3] 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 Wargrave 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

Waste is delivered to an offloading point for permitted imported tankered waste through an enclosed connection to a Cess Waste Import Tank. The imported waste and incoming sewer flows are combined before being passed to the UWWTD permitted process for aerobic treatment, outside of the permit boundary. Sludge is drawn off and thickened before being pumped to the Digester Feed Tank.

Imports of sludge from other sites can also be made to Wargrave STC and sludge is screened before combining with indigenous sludge in a Digester Feed Tank. A data logger records the volume of sludge transferred.

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. Sludge is transferred from this tank, screened and pumped to the Digester Feed Tank where it is mixed with the indigenous thickened sludges.

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 Pad from other STWs via lorries.

2.2.2 Waste Treatment

The treatment process of the sludge covered by this permit is for the anaerobic digestion of sludges within two Primary Digester Tanks. There are no pre-treatment stages at Wargrave STC.

Indigenous primary sludge is drawn off the Primary Settlement Tanks (PSTs) and is pumped to a Primary Sludge Buffer Tanks, which sit outside the scope of the permit application, where the primary sludge is pumped out and thickened on a Primary Thickening Plant and then pumped to the Digester Feed Tank. SAS is drawn off from elsewhere in the process and pumped to the SAS Buffer Tanks. SAS is thickened in the SAS Thickening Plant and is pumped to the Digester Feed Tank. Liquors from both thickening plants are returned to the works inlet for further treatment. The SAS Thickening Plant, Primary Thickening Plant, Digester Feed Tank and Liquor Buffer Tank 1 are connected to an Odour Control Unit (OCU). Indigenous thickened sludge and imported sludge are both pumped to the Digester Feed Tank where they are mixed.

The sludge pumped to the Digester Feed Tank, once thickened, then is pumped to one of the two Primary Digester Tanks on the site. Sludge within the Primary Digester Tanks is heated via dedicated heat exchange

systems using heat generated on site by the CHP engine or boiler. The Primary Digester Tanks are above ground and of steel construction with fixed roofs and fitted with Pressure Relief Valves (PRVs).

Following treatment over an appropriate number of days within the Primary Digester Tanks, sludge is pumped to one of four Secondary Digester Tanks. Digested sludge is held in the Secondary Digester Tanks for an appropriate retention time to ensure that the required level of pathogen kill is achieved in order to comply with digested sludge cake output quality requirements.

Digested sludge is then pumped from the Secondary Digester Tanks by dedicated pumps to the Dewatering Plant for dewatering. Digested sludge is dewatered with a polymer that is automatically made up from a bulk bag system using final effluent / potable water in a Make-up Tank and dosed from a Day Tank. Digested sludge cake falls to a conveyor inside the Digested Sludge Dewatering Building and is transferred outside to the cake pad area. Liquor gravitates to a common line and the liquor is then pumped to the site drainage system and is returned to the inlet for treatment via the Liquor Buffer Tank 2 and Liquor Return Pumping Station 3.

Biogas is transferred for use in either the CHP engine, boiler, or emergency flare. A slam shut valve is present on the main biogas line, which would automatically isolate the Biogas Storage holder in the event of an emergency situation. A siloxane filter is located upstream of the CHP engine on the biogas line to remove impurities from the biogas prior to combustion in the CHP engine. Use of siloxane filters reduces incidence of operational issues for the CHP engine. There is one CHP engine on site, located within the boiler house and it receives biogas for combustion, generating electricity and recoverable heat. In the event there is excess biogas, i.e., more than the CHP engine or boiler can utilise, or in the event that the CHP engine or boiler is unavailable, there is a ground mounted emergency flare. This is utilised under 10% of the year, less than 876 hours per year.

2.2.3 Digested cake

Dewatered digested sludge cake is carried by a conveyor. Conveyors are covered to minimise the risk of cake escaping. The cake is deposited from the conveyor onto the Cake Pad 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 stockpiles on the cake pad. 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. Sludge cake is stored on the cake pad below the level of the surrounding walls.

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 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 it is 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. Digested sludge cake is, therefore, produced daily and at similar levels across the whole year.

However, digested sludge cake storage on site, both in relation to duration and volume, varies across time. Digested sludge 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 seven 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	CHP Engine 1	X
A2	Boiler	X
A3	Emergency Flare	X
A4	Primary Digester Tank PRV	✓
A5	Primary Digester Tank PRV	✓
A6	Biogas Storage holder PRV	✓
A7	OCU1	✓

The open Cake Pad and Conveyors 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 engine, boiler and emergency flare (points A1 – A3) 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 Odour Control Unit (OCU) (point A7) serving the STC, connected to the SAS Thickening Plant, Primary Thickening Plant, Liquor Buffer Tank 1 and the Digester Feed 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. Treated air discharges via the stack. The configuration of the OCU means that bioaerosols could be emitted from the biofilter stage and therefore, the likelihood of bioaerosol release is anticipated to be medium.

The PRVs (points A4 – A6) 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 engine, 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.

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

There is a risk exposure from bioaerosols emitted from the site is from uncovered operations such as the cake conveyor and cake pad (as shown in Appendix B) and from the fugitive releases due to handling operations. However at this stage, the sludge cake is likely to have low bioaerosol content as a result of the treatment processes and is moist on deposition from the conveyor to the pad. The cake is managed by dozer and deposited within the storage areas where it forms a crust within 24 hours. The cake storage areas are monitored for row height and arrangement and require no further treatment or disturbance prior to export onto agricultural land. The probability of exposure from this source is **medium**.

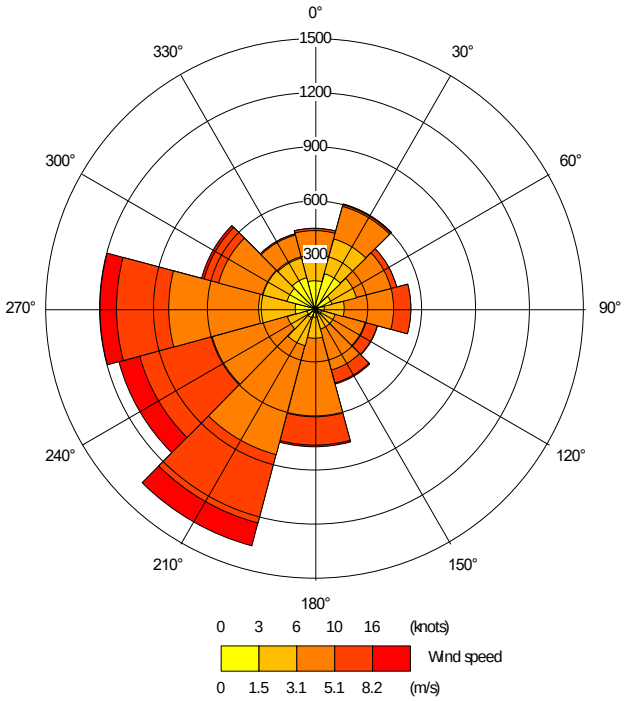
In addition, treatment tanks and associated pipework are enclosed. The Sludge Import Tank and Secondary Digester Tanks are open and a wet process. The wet wells used to receive incoming sludge are below ground and covered with metal plates. Sludge screening and dewatering takes place in enclosed units. In addition, the PRVs are only open in abnormal situations which are temporary and unlikely. The bio-filter process fitted to the OCU makes the probability of exposure from this source as **medium** 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 2019 wind rose for the most representative meteorological site, Heathrow airport (located approximately 27 km 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 Wargrave STC and surrounding area has a relatively flat topography. The site has screening to the south and west by mature trees along the site boundary and some receptors are screened by trees located on the north and east of the site.

Figure 1 – Lyneham AB Meteorological Site Windrose



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[4] 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 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.

[4] RR786 - Bioaerosol emissions from waste composting and the potential for workers' exposure https://www.hse.gov.uk/research/rrhtm/rr786.htm

Sensitive receptors (identified for the Odour Management Plan (OMP)) and within 250m of potential bioaerosol sources, have been considered and are presented in Table 2 and shown in Appendix C. The distance and direction from each potential bioaerosol emission source to the closest sensitive receptor has been reported.

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 the closest sensitive receptor within the area has been identified. Where multiple assets exist for the same process, such as the cake pad, only the closest location has been presented. The receptor closest to a potential emission source are the commercial buildings south of the STC, which is located approximately 45m south of the primary digester, labelled as A4.

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

Receptor	Description	Source	Distance from closest source (m)	Direction from the Source
R1	Sheeplands Farm greenhouses/poly tunnels and premises	OCU 1 (A7)	70m	North
		Cake Pad / Conveyors	20m	East
R2	Commercial Properties	OCU 1 (A7)	125m	South-east
		Cake Pad / Conveyors	25m	South
R3	Mobile Home Estate (residential properties)	Cake Pad / Conveyors	200m	North-east

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 to help determine the magnitude of the risk associated with bioaerosol emissions from a facility.

There are two potential sources of bioaerosol releases within 250m of static receptors:

- Odour control unit 1 (A7)
- Cake pad / conveyors

The receptors are situated to north, north-east, east, south and south-east of the release points and the prevailing wind is from the South-west. Whilst not all of the receptors are situated immediately down-wind of these sources, there is potential for wind-borne transportation of bioaerosols with a medium probability of exposure at Receptors R1 and R3. Receptor R2 is not downwind of the of the site, reducing the frequency of an effective pathway to this location but is within close proximity of a source (Cake Pad).

Receptor R1 is 20m from the cake pad at the closest point but poly tunnels or greenhouses where people may work for more than six hours can be found to the north, east and south of sources of bioaerosols. However, the potential for exposure to bioaerosols is reduced as receptors are not likely to work within the same area at all times and the agricultural structures will provide shielding from this exposure. Some vegetation also provides shielding from bioaerosols.

Receptor R3 is domestic properties that are downwind of the potential sources of bioaerosols. However, they are at the upper limit of the screening distance and protected by agricultural structures and vegetation meaning that a dilution effect reduces the concentration of any potential releases.

The daily throughput of sludge is 379 m3/day (equivalent to 379 tonnes per day). The fully digested sludge is digested and remains damp as it passes from the covered Conveyors onto the Cake Pad, thus minimising windblown transmissions. The sludge cake forms a crust after 24 hours in storage, so does not give rise to dust readily. The sludge cake is shovelled from the Conveyor deposits to storage areas within the Cake Pad and then left until it is disturbed for export, further minimising the potential to generate bioaerosols emissions to air.

The probability of exposure from bioaerosols generated from the permitted processes on site is considered to be **Medium** and the potential duration of release of bioaerosols varies from infrequent to frequent.

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 risks of bioaerosols being generated from the permitted processes on site is likely to 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.

Table 3 summarises the risk assessment.

Table 5: Risk Assessment of Potential Bioaerosol 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
Cake Pad and conveyors	Inhalation via wind-borne transportation	R1, R2, R3	Receptor R1 is the closest receptor to the Cake Pad, approximately 20m from the Cake Pad wall but further from the conveyors. Receptor R2 is also within close proximity but Receptor R3 is further away and would receive a lower concentration in the event of a release. The closest receptors are downwind of the Cake Pad. The concrete wall surrounding the Cake Pad reduces the likelihood of wind-blown transmission during handling and export. The bioaerosol content is considered to be small in digested sludge cake. Due to the proximity the probability of exposure is considered to be **medium**.	Impact on human health (considered to be a sensitive receptor).	The cake Conveyors are covered, reducing likelihood of bioaerosol release. The cake Conveyor drop heights and the drop heights from dozers handling the sludge cake are minimised to reduce the risk of wind borne transportation during deposition onto the Cake Pad, and via handling and movement around the Cake Pad or off site. Water content in the sludge cake reduces susceptibility of wind-borne releases. The cake pad is enclosed on all sides by a low-level wall which protects it from the wind. Stockpile levels are managed so that under normal operating conditions they do not exceed the height of the surrounding bund wall Sludge cake is moved only when required to minimise disturbance and does not occur every day. Spillages are cleaned up in a timely manner to reduce generating windblown bioaerosols or resuspension via vehicle movements. Staff are trained in managing spills.	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
Odour Control Unit	Inhalation via wind-borne transportation	R1, R2	Receptor R1 is the closest receptor, approximately 70m to the North of OCU 1 with some screening afforded by vegetation. Other receptors are greater distance from the OCU. Due to the proximity the probability of exposure is considered to be **medium**.	Impact on human health (considered to be a sensitive receptor).	The OCU is maintained regularly by an agreed Framework contractor to reduce the likelihood of equipment failure. The OCU and associated tanks are connected by enclosed pipework.	Low

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 Wargrave 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 digestate sludge cake at the site and the operation of the bio-filter OCU. 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 to the identified, potential, receptors within 250m of potential bioaerosol sources associated with the sludge treatment process is considered to be a **Low** risk based on the receptor distances, 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 the following locations and will sample the OCU on a bi-annual basis:

- OCU 1 (A7) SU 77898 77287

In addition, sampling will also take place in relation to SU 78015 77297 (approx. NGR of centre of the cake pad) which are diffuse sources 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 induvial sampling points, each with its own agar plate will be carried out. One point will be located 50m upwind of the OCU stack to give a background concentration, and three will be located in a fan like arrangement downwind and at the same distance to the nearest sensitive receptor (as per M9):

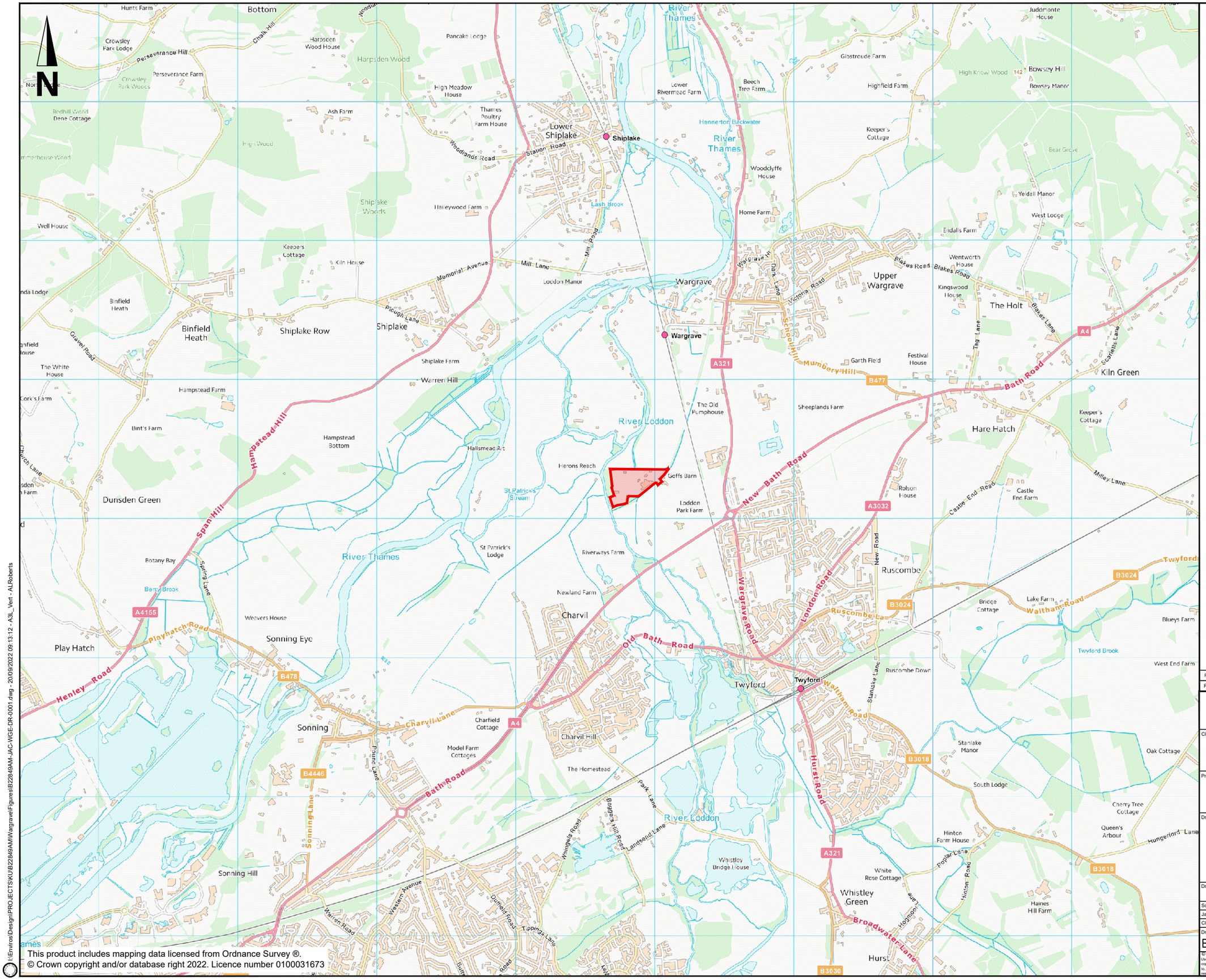
Source	Upwind Location NGR	Downwind Location 1 NGR	Downwind Location 2 NGR	Downwind Location 3 NGR
OCU1	SU 7787 7724	SU 7789 7737	SU 7794 7736	SU 7797 7733

*Location points may require to be changed due to the presence of existing structures making access unsafe or impractical

Cake Pad:
Upwind sample location which is approx. 50m SW of the cake pad: NGR SU 7799 7725
Downwind sample location 1 which is approx. 25m N of the cake pad: NGR SU 7801 7732
Downwind sample location 2 which is approx. 25m NE of the cake pad: NGR SU 7807 7731
Downwind sample location 3 which is approx. 25m E of the cake pad: NGR SU 7803 7731

NGR's for sampling locations are only 8 digits at present, to allow the contractor flexibility as to precise location, taking into account the ability to safely locate and access (and security) of the sampling plates.

Appendix A. Site boundary and emission points



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KEY:

Site Location

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

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Client: Thames Water

Project: STC IED PERMIT
WARGRAVE STW

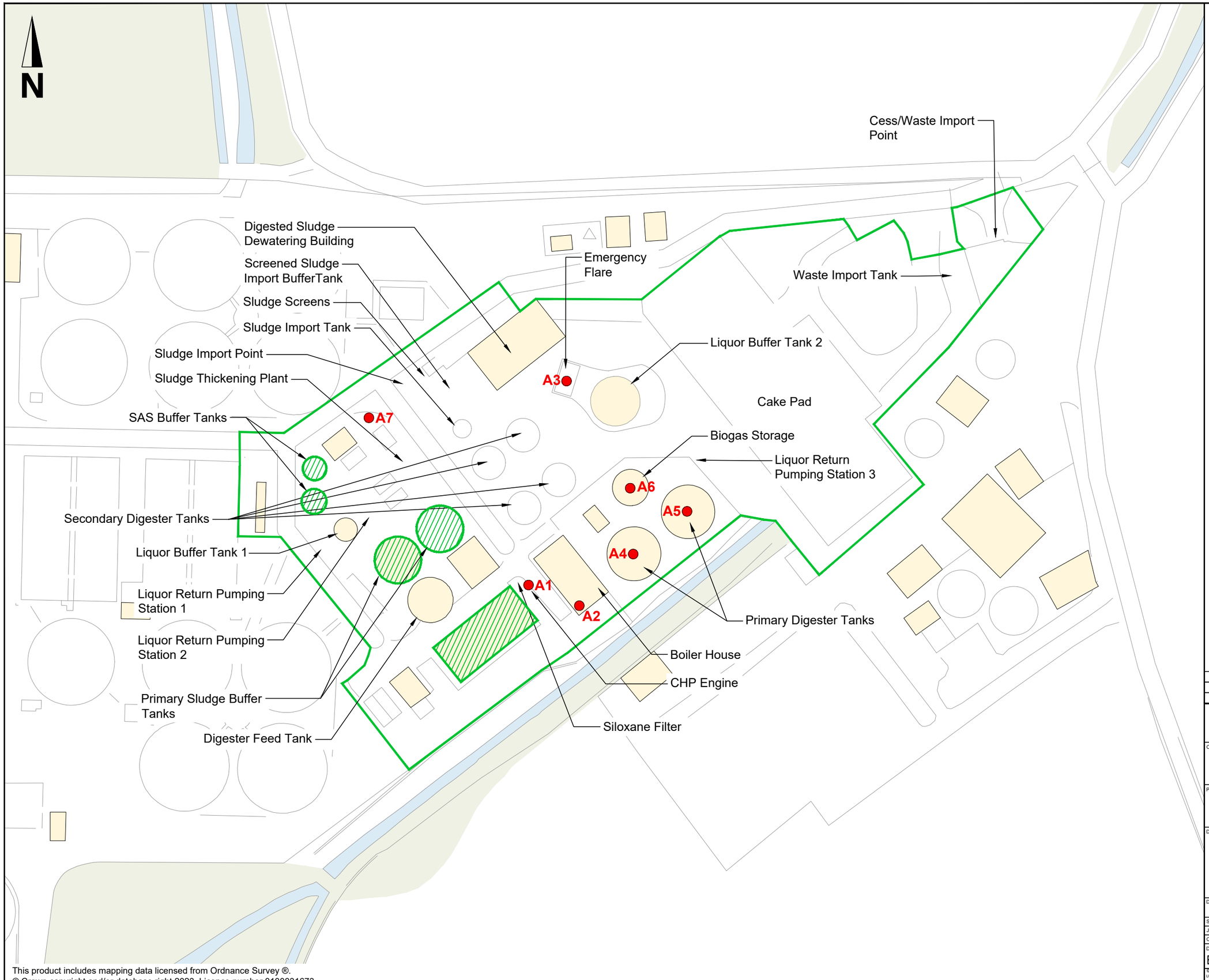
Drawing title: FIGURE 1
SITE LOCATION PLAN

Drawing status: PERMITTING

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

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

Appendix B. Site plan showing static receptors within 250m of potential bioaerosol sources



KEY:

- Installation Boundary
- Area/Tanks Excluded from Permit Scope
- Air Emission Point

A1 - CHP Engine 1
A2 - Boiler
A3 - Emergency Flare
A4 - Digester PRV
A5 - Digester PRV
A6 - Gas Holder PRV
A7 - OCU 1
A8 - Standby Generator 1
A9 - Standby Generator 2
A10 - OCU 2

0 10 20 30 40 50
METRES

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

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Project: STC IED PERMIT
WARGRAVE STW

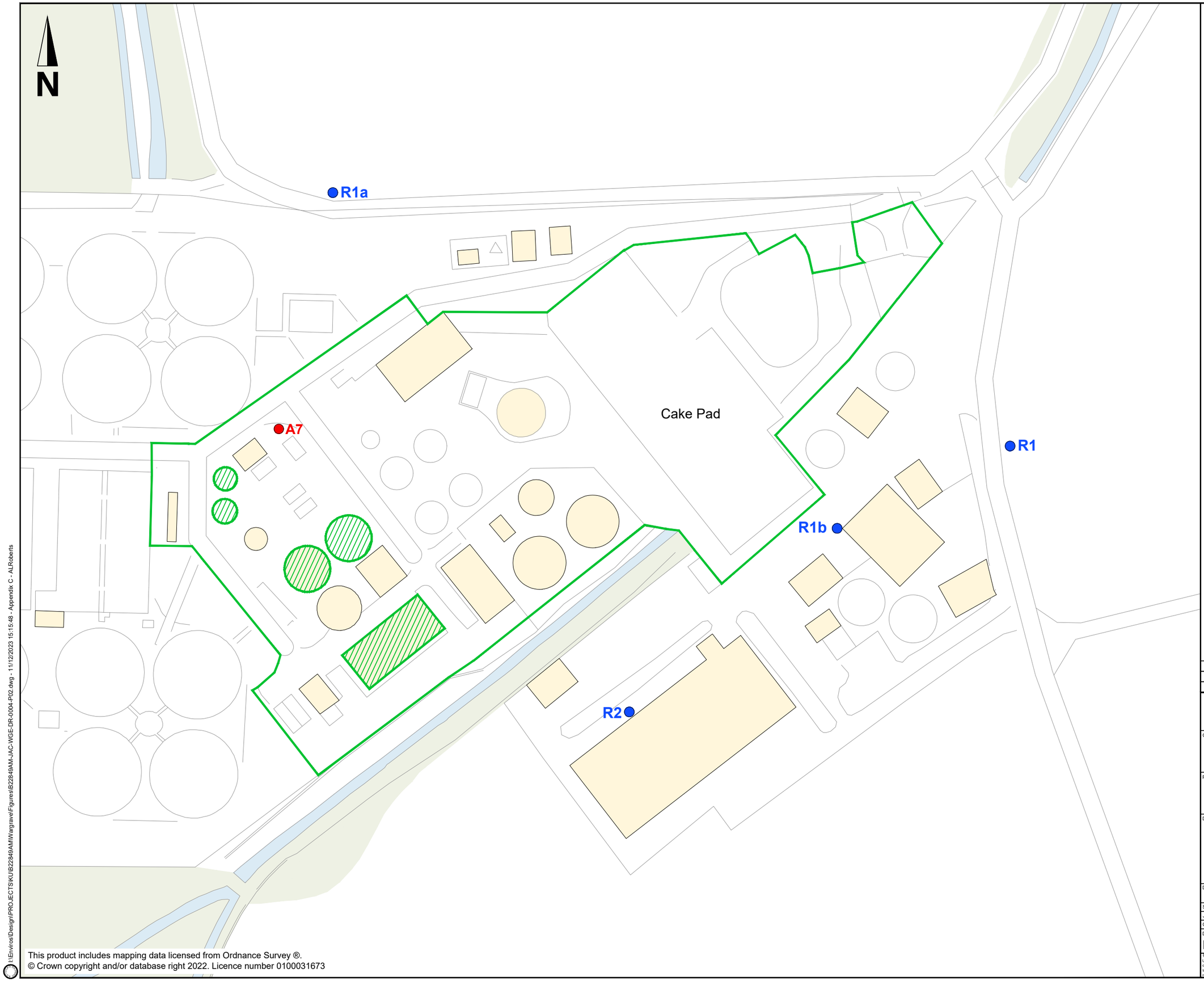
Drawing title: APPENDIX B
INSTALLATION BOUNDARY
AND AIR EMISSION POINTS

Drawing status: PERMITTING

Scale	1:1000	DO NOT SCALE
Jacobs No.	B22849AZ	Rev P02
Client no.		

Drawing number: B22849AZ-JAC-WGE-DR-0002

Appendix C. Receptors within 250m of potential emission points



KEY:

- Installation Boundary
- Area/Tanks Excluded from Permit Scope
- Receptor Point

A7 - OCU 1

0 10 20 30 40 50
METRES

P02	DEC 2023	FOR INFORMATION	AR	JK	JK	MM
P01	SEP 2022	FOR INFORMATION	AR	TJ	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
WARGRAVE STW

Drawing title: APPENDIX C
RECEPTORS WITHIN 250m
OF BIOAEROSOL
EMISSION SOURCES

Drawing status: PERMITTING

Scale	1:1000	DO NOT SCALE
Jacobs No.	B22849AZ	Rev P02
Client no.		

Drawing number: B22849AZ-JAC-WGE-DR-0004