Leigh WwTW Sludge Treatment Facility

Permit Number EPR/NP3601LR

Odour Management Plan

October 2023

Contents

Site Details

Site name:	Leigh WwTW Sludge Treatment Facility
Site address:	Leigh WwTW Sludge Treatment Facility, Hope Carr Lane, Leigh, WN7 3XB
Operator name:	United Utilities Water Limited
Application number:	EPR/NP3601LR
National Grid Reference	NGR: SJ 66302 99084

Document Owner

Document author: Production Manager

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Revisions

Revision Reference	Revision authorised by	Date submitted to Environment Agency	Revision owner
Draft for EA review	Production Manager	27.05.22	
Final for EA review	Production Manager	24/10/23	

The OMP will be reviewed annually, or in the event of complaints, incidents, or relevant changes to operations/infrastructure.

Who this plan is for:

The OMP will be accessible on the Quality Assurance SharePoint site and is intended for holders of the following roles:

Production Manager
Environmental Regulatory Advisor
Production Engineer
Digester Safety Controller
Hub Technical Officer
Field Technical Officer
Area Business Manager
Area Production Manager
H&S Business Partner

Incident Response contacts:

Environment Agency	0800 80 70 60
ICC Duty Manager	07713 887302

1. Introduction

1.1. Purpose of the Odour Management Plan

The purpose of this odour management plan (OMP) is to provide guidance to all Operations and Maintenance staff with regards to practices that will minimise the risk of odour emissions being discharged from the Leigh WwTW Sludge Treatment Facility which could then impact on Customers and the Environment.

This document describes the odour management practices that have been considered as part of the design of the facility and those that must be adhered to during the operation of the treatment plant.

Adherence to the practices indicated within the OMP is vital to ensure that the plant complies with the relevant permit conditions within the (IED) Environmental Permit for the facility which is regulated by the Environment Agency (EA).

This OMP is an operational document that is developed following the identification and review of risk areas for odour release. It details the application of best available techniques (BAT) both in design and operational control measures to reduce or minimise the potential impact of odours from the site. It provides detail to allow Operators and Maintenance staff to understand the operational procedures for both normal and abnormal conditions.

This is a 'live' document and will be subject to further review and updating over the operational life of the site.

1.2. Site Description

Leigh Wastewater Treatment Works (WwTW) serves the Greater Manchester area and is located approximately 1.3 kilometres southeast of Leigh town centre and 460m east of the Pennington Brook. The area surrounding the site generally comprises a mixture of residential, industrial and agricultural land use. Sludge arising from the WwTW is treated on site within an 'installation' area that is permitted by the Environment Agency under the Environmental Permitting (England and Wales) Regulations 2016 (the EPR 2016). The treatment of imported sludge and indigenous sewage sludge arising from the wastewater treatment process at Leigh comprises:

- Sludge screening (solids separation);
- Sludge dewatering and thickening by centrifuge (x4);
- Thermal hydrolysis;
- Anaerobic digestion;
- Degassing;
- Biogas storage;
- Combustion of biogas in CHP engines (x2) and a dual fuel boiler;
- Flaring of excess biogas;
- Siloxane removal from the biogas;
- Raw material storage;
- Treatment and disposal of process liquors;
- Odour abatement; and
- Storage of digestate cake.

The waste to be treated consists of sludges imported from other WwTW by road tanker and indigenous sludges produced from Leigh WwTW (on-site) from the urban wastewater flow.

The maximum design throughput at the facility is limited by the feed rate to the centrifuges, providing a total maximum capacity of 630,720 m^3 per year. The current operational treatment capacity of the digester per year is 180,206 m^3, based on the feed into the digester. The daily throughput varies depending on operational needs.

Biogas is combusted in two on-site combined heat and power (CHP) engines, generating electricity for the process.

The treatment process is automated and operates 24 hours per day, 365 days per year. Indigenous sludge is fed automatically from the four primary settlement tanks into a receiving wet well. Imported sludge is received by road tanker during the hours of:

Monday to Friday – 07:00 to 19:00 (Normal operation)

Saturday - 07:00 to 13:00

Sunday and Bank Holiday – No operation

The site cannot be used for waste import and export outside the hours stated above except in cases of emergency in order to prevent pollution or harm to human health.

1.3. Maintenance and Review of the OMP

The OMP is held on the company's Environmental Management system (EMS) electronically, which can be viewed on site.

The WwTW Production Manager (PM) is responsible for compliance and review of the OMP, with support from the wastewater operations technical team and WwTW operations staff.

The PM is to ensure all operational controls such as SOPs/SSIs/Management of Change are carried out, documented, and followed.

The OMP is to be reviewed, as minimum, annually to identify trends in odour complaints and persistent complainers, or sooner if any of the following occur:

- The Environment Agency or Local Authority EHO conducts an investigation in response to complaints or requests an updated report;
- Regulations or guidelines are updated;
- An internal audit or post incident review dictates an update; or
- There are significant changes on site e.g., due to capital spend.

1.4. Odour Management Training

Competence assessments are carried out as part of the UUW appointments procedure, and all staff receive bi-annual performance reviews.

Process Controllers receive externally accredited training to gain competence on treatment process units. All operators receive general training in the maintenance and operation of the Odour Control Unit (OCU) and any additional training as identified through personal development plans.

All staff are required to complete the 'Introduction to Odour Management' course available on the company's Educate website: Introduction to Odour Management eLearning

1.5. Relevant Sector Guidance

This report has been prepared taking due regard to the Environment Agency (EA) Technical Guidance Note H4 Odour Management – How to Comply with Your Environmental Permit (March 2011).

2. Receptors

2.1. Receptor List

The WwTW is situated in a semi-urban area with the Pennington Brook flowing approximately 460m to the west of the installation boundary. The area surrounding the site to the west generally comprises housing, whilst to the north and east there is a mix of housing and industrial/commercial properties. To the south the land use is predominantly agricultural. Receptors within 2km of the site installation boundary are detailed in Table 2.1.1 and shown on Figures 2.1.1 and 2.1.2. There is no recent history of substantiated odour complaints at the site (within the last 3 years).

Table 2.1.1 Receptor List

Receptor	Description	Closest distance from Installation boundary (m)	Direction from the site	Sensitivity to odour
R1	Industrial premises, off Greenfold way	20	E	Medium
R2	Residential and Commercial Premises, off Hope Carr Road	190	NNE	Medium/ High
R3	Leisure facility, Hope Carr Nature Reserve	160	SSW	Medium
R4	Residential Properties, Leigh	315	E	High
R5	Residential Properties, Leigh	430	NWW	High
R6	Residential Properties, Leigh	185	NW	High
R7	Commercial Premises, Hurstwood Court	460	SW	Medium
R8	Residential properties, Leigh	500	NNE	High
R9	Commercial and leisure premises, Spinngate Shopping Centre	700	NNW	Medium
R10	Leisure Facility, Leigh Cricket Club	650	WWS	Medium
R11	Belford Hall Methodist Primary School	650	E	High
R12	Leisure Premises, Greyhound Hotel	750	SSW	Medium
R13	Christ Church Pennington C of E Primary School	805	NW	High
R14	Residential Premises, Glazenby	1230	SSE	High
R15	Leisure Premises, Leisure Centre and Sports village	1,270	NNW	High
R16	Residential and Commercial Premises, Off A580	1,025	SSW	High
R17	Commercial Premises, Off Land Lane	1,090	SWS	Medium
R18	Commercial Premises, Farms off East Lancashire Road	1,500	SSE	Medium
R19	Bedford High School, Manchester Road	1,370	ENE	Medium
R20	Industrial Premises, Off Hooten Lane	1,100	E	Low
R21	Pennington Flash, local wildlife site	1,660	W	Medium

Figure 2.1.1 Map showing the location of receptors within 1km of the site

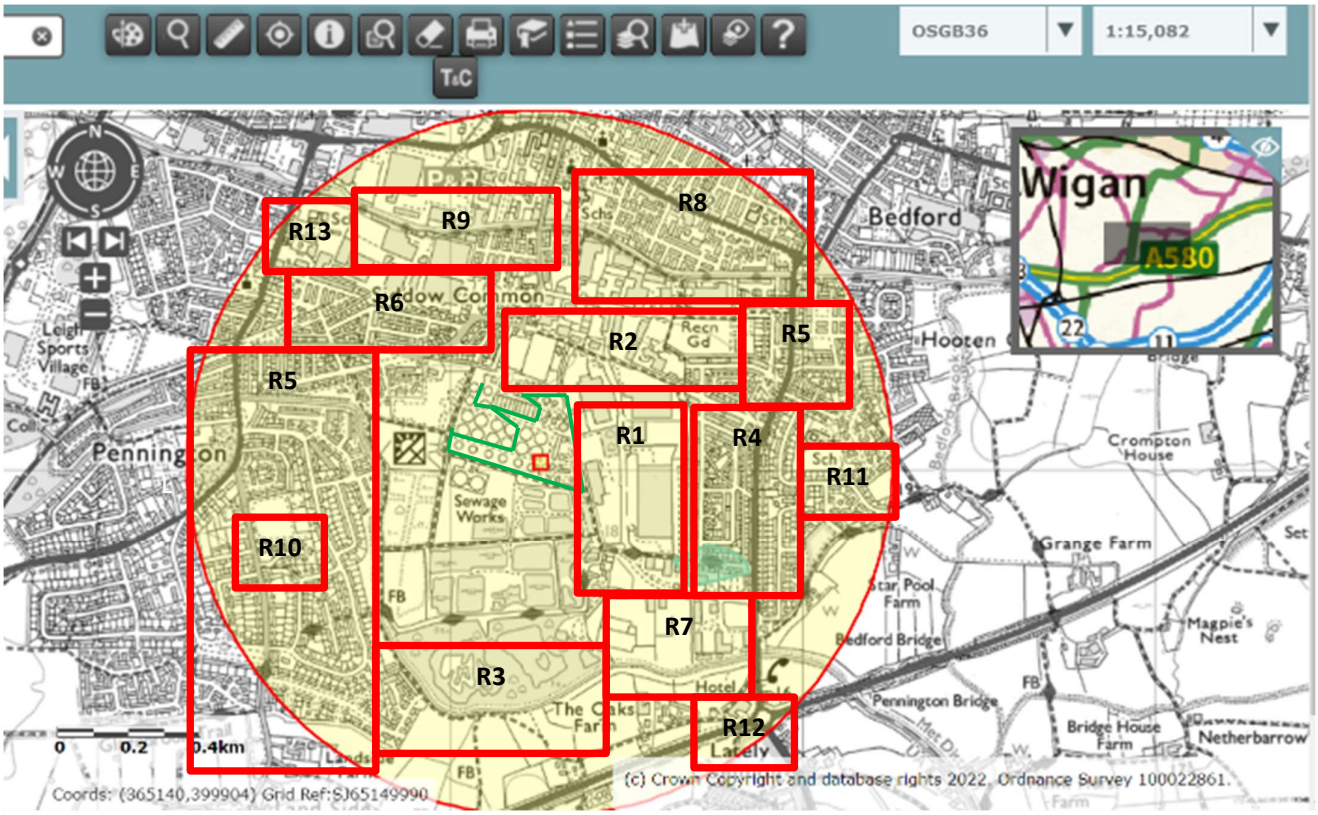
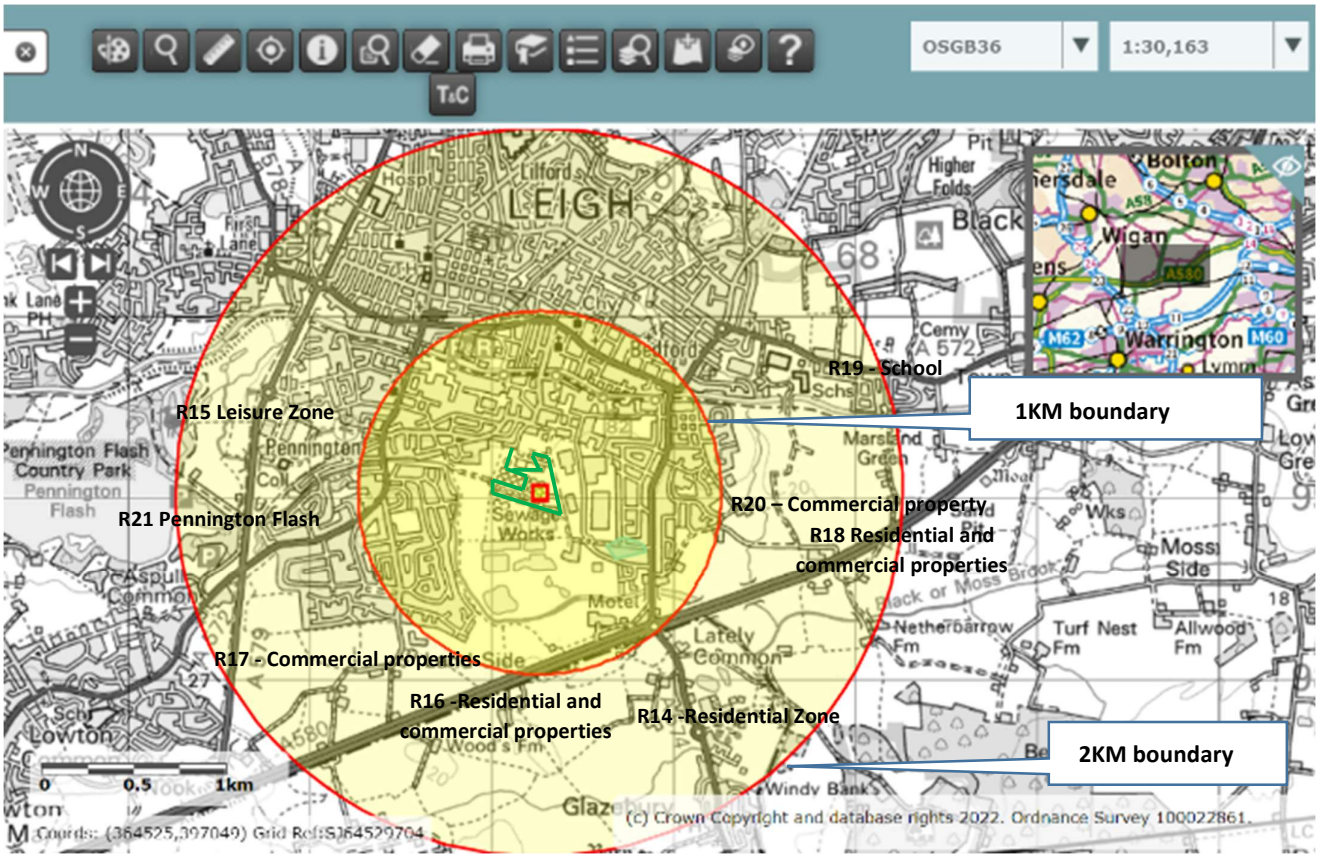


Figure 2.1.2 Map of site location and receptors within 1 to 2km



2.2. Wind Rose and Source of Weather Data

Wind rose data from 2015-2019 for Manchester Airport is shown in Appendix A (Manchester Airport meteorological station is located approximately 20.5 km to the southeast of the site and is considered the closest most representative meteorological monitoring station to the site). The wind rose data shows that the site experiences strong prevailing southerly winds, predominantly in excess of 6 knots, meaning any odorous emissions released from site are likely to be dispersed to the north of the works.

The Leigh Sludge Treatment Facility and surrounding area has a relatively flat topography.

Live data on wind speed and direction can be obtained from numerous websites, including the Wind finder website which provides information for a local weather station at Leigh/ The Flash to the north east:

- Leigh/The Flash: Wind, waves & weather forecast Leigh/The Flash - Windfinder

Past data on wind speed and direction can be obtained from the following website for Manchester Airport. Whilst some distance from the site, this data can be helpful in establishing the general wind direction and strength if investigating an odour complaint where there has been a delay in receiving notification from the complainant:

Weather in the United Kingdom (timeanddate.com)

3 Sources of Odour and Site Processes

3.1 Odorous Materials Entering and Leaving Site

Only waste codes EWC 19 08 05 (urban wastewater sludges) and 19 02 06 (sewage sludges from physio/chemical treatment) may be accepted at the facility.

Waste accepted at the facility is limited to sewage sludges, imported and indigenous sludges arising from UUW facilities only. The process has been designed to treat sewage sludges generated within the UUW network in compliance with the Biosolids Assurance Scheme (BAS). A BAS risk assessment is carried out for each source of sewage sludge, indigenous sewage sludge and imported raw sludge. Under Leigh's Waste Characterisation and Acceptance Procedure SSI, each incoming waste stream is subject to pre-acceptance checks and records are retained in electronic format for a minimum of 3 years.

All movements of sludge wastes within UUW are planned and tracked using planning software (Podfather) for all sewage sludge movements and the business collaborator system for all sludge cake movements. Whilst there will be some minor variation in the composition of the sludges, due to the different composition of sewerage flows into the works producing the sludges and seasonal variability in those flows, the anaerobic digestion process easily manages these variables with no significant impact upon the process or the outputs.

Indigenous sludge from the WwTW is fed from the primary settlement tanks via enclosed pipework, to an enclosed wet well at the sludge treatment facility, and thus there is limited potential for diffuse emissions to atmosphere.

Raw sludge imports from other wastewater treatment works are delivered to site by enclosed road tankers. These imports are off-loaded and pumped directly via the tanker off-loading point where it joins the indigenous sludge and passes though the sludge screening plant. The tanker off-loading point is a flexible pipe and bauer coupling. Thus there is limited potential for diffuse emissions to atmosphere.

The sludge screening plant (raw sludge screens) removes solids from the sludge, the separated solids are deposited in open skips behind the units, before being collected and removed off site for disposal. Once full, skips are sheeted and removed from site within 48 hours.

Following digestion, sludge is dewatered and the digestate cake is carried by a conveyor to a dedicated building and deposited in a concrete surfaced and enclosed (on three sides and roofed) cake storage bay. The cake is transferred onto covered trailers via a telehandler and removed off site for agricultural land spreading. Cake storage amounts vary depending upon production and availability of the land bank for spreading. Sufficient capacity is provided to enable storage to manage these variables.

3.2 Overview of Odorous Processes and Emissions

A process flow diagram for the sludge treatment operation is contained in Appendix B.

Waste accepted at the facility is limited to sewage sludges arising from UUW facilities only (indigenous and imported).

Indigenous sludge from the WwTW is pumped from the primary settlement tanks via enclosed pipework to a wet well at the sludge treatment facility. The imported sludge arrives at site via tanker. From the off-loading point, it joins the indigenous sludge and passes through the sludge screening plant.

The sludge screening plant comprises two Strain press units (raw sludge screens). The separated solids are deposited in open skips, next to the units. The raw sludge screens are connected to an odour control unit (OCU) that serves the sludge facility. The screening area is bunded and connected to the discharge network.

The screened sludge is then pumped into the screened sludge tank. Surplus activated sludge (SAS) also enters the screened sludge tank. From the screened sludge tank, sludge is pumped via two pumps through two thickening centrifuges, where it is dosed with polyelectrolyte. From the centrifuges the thickened sludge is pumped into a thickened sludge tank. The centrate from the centrifuges flows to a centrate buffer tank before entering the liquor treatment plant and being returned to the UWWT process. The screened sludge tank, thickening centrifuges, thickened sludge tank, centrate buffer tank and the centrate balancing tank are connected to the OCU.

The thickened sludge is then pumped into the thickened sludge cake silo, from here the sludge then passes into a thermal hydrolysis plant (THP) which houses four reactor plants where a batch process takes place, before being passed into the digester. Once anaerobic digestion is complete, the sludge is displaced from the digester into either the degassing tank or the digested sludge tank. The primary route is to treat within the degassing sludge tank prior to being passed into the digested sludge tank, however in an abnormal situation (breakdowns, maintenance etc) the facility can bypass the degassing process and send the sludge directly into the digested sludge tank. The thickened sludge cake silo, degassing tank and the digested sludge tank are connected to the OCU.

The digested sludge is then pumped to one of two dewatering centrifuges and dosed with polyelectrolyte to thicken the sludge into a cake. Centrate from the dewatering centrifuge process is sent to the digested centrate buffer tank, followed by the centrate balancing tank (both connected to the OCU) before entering the liquor treatment plant and being returned to the UWWT process.

The sludge cake from the centrifuge falls into a covered cake storage building (concrete surfaced covered cake bay, which has retaining walls around three sides), where it is collected and taken off site to be spread to land for agricultural benefit, in accordance with the Sludge (Use in Agriculture) Regulations 1988. The centrifuges are connected to the OCU.

All sludge treatment tanks, vessels and pipework are enclosed. The only open storage of waste is the screening solids arising from the sludge screen and digestate cake which has a roof covering.

3.3 Potential Sources of Odours

Source materials associated with the treatment process and the nature of odours that these may give rise to are detailed in Table 3.3.1.

Table 3.3.1. Source Materials

Source Material	Odorous Compound	Odour Characteristics	Odour Potential
Raw sludge – indigenous and imported	Hydrogen Sulphide Mercaptans Dimethyl Sulphide	Rotten eggs Decayed cabbage Decayed vegetables	Medium to High
Sludge screening and thickening	Hydrogen Sulphide Mercaptans Dimethyl Sulphide	Rotten eggs Decayed cabbage Decayed vegetables	Medium to High
Digested sludge	Ammonia	Ammoniacal/ fishy	Low to Medium
Centrate	Ammonia/ amines Hydrogen Sulphide	Ammoniacal/ fishy Rotten eggs	Medium to High
Biogas	Hydrogen Sulphide Range of VOCs including amines	Rotten eggs Ammoniacal	Medium to High
Digested cake	Ammonia	Ammoniacal/ fishy	Low
Grit – tank bottoms	Hydrogen Sulphide Mercaptans Dimethyl Sulphide	Rotten eggs Decayed cabbage Decayed vegetables	Medium to High
Polymer	Amines	Fishy	Very Low

Potential source areas of odour associated with the sludge treatment process are detailed in Table 3.3.2. The locations of these potential source areas are shown on the figure contained in Appendix H.

Table 3.3.2 Potential Sources of Odours

Source Area	Source Material	Quantity Stored on Site	Odour Potential	Probability of Release	Additional comments
Receiving wet well	Untreated sludge	TBC	High	Low	Fugitive emissions
Imported sludge tanker off-load	Untreated sludge	N/A	High	Low	Fugitive emissions
Raw sludge screens	Untreated sludge	N/A	High	Medium	Enclosed screens. Point source emissions connected to OCU
Separated solids storage	Solids screened from sludge	2 x 6m^3 skips	High	High	Fugitive emissions

Source Area	Source Material	Quantity Stored on Site	Odour Potential	Probability of Release	Additional comments
Screened sludge tank	Screened sludge	N/A	High	Low	Enclosed tank. Point source emissions connected to OCU
2x Thickening Centrifuges	Undigested and digested sludge	Maximum throughput 1,728m^3/day	High	Medium	Fugitive emissions. Connected to OCU
Centrate balancing tank	Liquors	N/A	High	Low	Enclosed tank. Point source emissions
Centrate buffer tanks	Liquors	N/A	High	Low	Enclosed tank. Point source emissions to OCU
Liquor treatment plant	Liquors	N/A	High	Low	Enclosed tanks
Digester PVRV	Biogas	N/A	Moderate	Low	Point source emissions
Degassing tank	Biogas	N/A	High	Low	Enclosed tank. Point source emissions connected to OCU.
Digested sludge storage tank	Digested sludge	N/A	Moderate	Low	Enclosed tank. Point source emissions connected to OCU.
Gas holder PVRV	Biogas	N/A	Moderate	Low	Point source emissions
CHP stack	Combustion of biogas	N/A	Very low	High	Point source emissions
Flare	Combustion of biogas	N/A	Very low	Medium	Point source emissions
Leaks in gas pipework e.g. around flanges	Biogas	N/A	Moderate	Low	Fugitive emissions
Digestate cake conveyor	Digested sludge cake	N/A	Low	Low	Fugitive emissions
Digestate cake storage building	Digested sludge	Maximum 150 tonnes	Low	Medium	Fugitive emissions
Tank cleaning	Grit	N/A	High	High	Fugitive emissions
Leaks/spills of sludge from process	Digested or undigested Sludge	N/A	Moderate	Low	Fugitive emissions

Control measures for these sources are detailed in Section 4.

A site plan showing the location of the OCU, screening skips and cake storage building (enclosed on three sides and roofed), which are the main potential sources of odour releases (due to their open or partially open status) is provided as Figure 3.1.1.

Figure 3.1.1 Map of site showing the location of the OCU, screening skips and cake storage building

Emission Point*	National Grid Reference
A4 - OCU serving the raw sludge screens, screened sludge tank, sludge thickening centrifuges, thickened sludge cake silo, degassing tank, digested sludge storage tank, dewatering centrifuges, centrate buffer tanks and centrate balancing tank	SJ 66326 99072
Cake storage building	SJ 66291 99138
Screening skips	SJ 66346 99026
*Other than combustion emissions and PVRVs	

3.4 Odour Exposure Pathways

The following section details the causes and routes which can lead to off-site odour impact occurring.

In order for an odour impact to occur all the following conditions must be achieved:

- The formation of odorous compounds in the sludge;
- Transfer of compounds from the sludge to the atmosphere; and

- Transport of compounds from source to receptor, and the degree of dispersion/dilution achieved during the transport process.

Odour management covers a range of strategies and procedures which seeks to mitigate negative impact to the company, its employees and customers against the potential for odour generation within its collection and treatment systems and disposal routes.

If any of those key conditions are prevented through management practices, off site odour impact cannot occur.

4 Control Measures and Process Monitoring

4.1 Control Measures

Odour control is achieved through process optimisation, engineered containment, odour abatement and good operational practice.

All storage tanks, treatment tanks and associated pipework are enclosed. Where tanks are not gas tight and vent to atmosphere, these are connected to the OCU. Tanks that are connected to the gas management system only vent to atmosphere under abnormal operating conditions. Pressure vacuum relief valves (PVRVs) on the digester and gas holder operate on a duty/stand-by configuration to protect against over/under pressurisation of the tank. The PVRVs are a critical safety system and are maintained, monitored, inspected and calibrated on a periodic basis to ensure correct operation of the valves. Where there is a high risk of odorous fugitive emissions, such as the screenings building, these areas are extracted to the odour control unit.

The only open storage of waste is the digestate cake and sludge screenings.

Dewatered digestate cake produced on site is carried by enclosed conveyors and deposited in a concrete surfaced and enclosed (on three sides and roofed) cake storage building. The cake is transferred onto covered trailers using a telehandler and removed off site for agricultural land spreading. Under normal operations, loading a trailer typically takes approximately 30 minutes, before it is automatically covered and removed from site. Storage duration within trailers prior to removal is typically less than 24 hours.

Screening waste is generated from the sludge strain presses. Screenings are directly discharged into skips for transport off site and ultimate disposal by a licensed waste management contractor. Once full, skips are sheeted and removed from site within 48 hours.

Under normal operating conditions there should be no detectable odours at the site boundaries; however, it is recognised that under abnormal event scenarios (including emergencies, maintenance, breakdowns, etc) the ability to control odorous releases may be reduced.

A significant spill or leak of sludge or digestate from the tanks, associated pumps or pipework could result in fugitive odour emissions. Risk scenarios and control measures are considered in detail in the site Accident Management Plan. Any spills must be dealt with promptly and cleaned down to avoid odorous releases.

Maintenance requirements, including prioritisation and consideration of criticality for individual assets, form part of the maintenance strategy within United Utilities (see Section 4.3).

4.2 Process Monitoring

Maintaining the sludge treatment process within the defined operating conditions for the plant is important in maintaining the health of the digesters, the quality of the sludge cake and minimising the potential for odour emissions.

The HACCP (WwP/I/3033/18/39) contains critical control limits to maintain digestate quality, as set out in Table 4.2.1.

Table 4.2.1: HACCP Critical Control Points

Critical Control Point (CCP)	Description	Critical Limit	Frequency of monitoring
CCP1	Thermal Hydrolysis Plant Reactors 1-4	6 Bar g Pressure	Daily, Continuous and Automatic
CCP2	Thermal Hydrolysis Plant Retention Time 1-4	30 mins retention under pressure	Daily, Continuous and Automatic

In addition, target operating parameters for the anaerobic digestion process include:

- pH: 6.8 to 7.6
- Volatile fatty acids: less than 1,000mg/l
- Alkalinity: 2,000 to 3,000mg/l
- VFA ratio: less than 0.3
- Temperature: 35 to 40^{o}C
- Digester dry solids: 5 to 6%
- Ammonia: less than 3,000mg

The monitoring of digester key process parameters and biogas key process parameters is summarised in Table 4.2.2 below.

Table 4.2.2: Summary of Process Monitoring

Parameter	Frequency of measurement	Point of measurement	System of measurement
pH	Weekly	Sample taken (digester feed)	Lab analysis
Alkalinity	Weekly	Sample taken (digester feed)	Lab analysis
Temperature - Digester	Continuous	Temperature probe within digester	SCADA
Temperature - THP	Continuous	Temperature probe within plant vessel	SCADA
Volatile fatty acids concentration	Weekly	Sample taken (digester)	Lab analysis
Ammonia	Weekly	Sample taken (digester)	Lab analysis
Hydraulic loading rate – THP Batch Rate	Continuous	Digester Feed	SCADA
Organic loading rate	Monthly	Calculation from lab analysis and SCADA data	Calculation from lab analysis and SCADA data
Liquid foam levels	Continuous	Level probe	SCADA
Flow	Continuous	Flow meter	SCADA

Parameter	Frequency of measurement	Point of measurement	System of measurement
Methane	Continuous	Gas meter	SCADA
CO_2	Continuous	Gas meter	SCADA
Hydrogen Sulphide	Continuous	H_2S analyser	SCADA
Pressure	Continuous	Pressure Transducer	SCADA

Sludge feed is measured using flowmeters which are also used to control batch timings. Flowmeters are calibrated annually to maintain accuracy. Temperature probes are also calibrated annually.

4.3 Odour Abatement

The facility was designed with the containment and odour control of certain process units. The odour control technologies chosen were designed to comply with Best Available Techniques (BAT) for the treatment process.

The OCU operating at the facility is described below.

4.3.1 Odour Control Unit

There is one OCU serving the main sludge treatment facility. This unit is connected to the raw sludge screens (x 2), screened sludge tank, sludge thickening centrifuges (x 2), thickened sludge cake silo, degassing tank, digested sludge storage tank, dewatering centrifuges (x 2), centrate buffer tank and centrate balancing tank.

The OCU serving the Leigh sludge treatment facility uses a combination of biofiltration, followed by adsorption technology. There are two pumice media biological trickling filters designed to remove a range of compounds including hydrogen sulphide, mercaptans and soluble biodegradable VOCs. The second stage of treatment comprises a copper impregnated carbon filter. The use of adsorption downstream of bio filtration provides process security in the event of operational issues with the first stage and also provides final stages of treatment. The installation of these abatement techniques complies with BAT 34.

The sizing of the treatment processes aligns with industry practice. The biological stage has a design contact time >50 seconds and the carbon stage is designed to achieve a contact time >7 seconds and a minimum of 12 months media life based on average design load.

The OCU discharges via a single 15m high stack fitted with an efflux cone. There is a continuous hydrogen sulphide monitor fitted on the discharge stack.

The trigger for replacement of adsorption media would be either:

- Exceedance of outlet odour concentration (ammonia - 15 mg/Nm^3); or
- Media bed pressure drop exceeding design values (nominally increases of >+20% would be investigated if combined with a reduction in of airflow >10%).

The trigger concentration of 15 mg/Nm^3 ammonia for media replacement represents 75% of the associated emission level (AEL) specified in BAT 34 (20 mg/Nm^3) for odour emissions to air from the biological treatment of waste.

Media may be sampled and sent for external lab analysis to determine the remaining media life/adsorption capacity prior to a decision on change out. The requirement for media change out will be determined by the Production Manager in consultation with the Process Engineering Department. The OCU is designed to provide a minimum of 12 months media life.

The process flow diagram in Appendix B shows the process connections to the odour control unit and the emission point (A4).

The odour control technology was designed in accordance with UUW's Asset Standard for Odour Control and Removal[1]. Odour dispersion modelling was undertaken to identify the sources requiring abatement.

The design operating parameters and odour removal efficiencies for the OCU at Leigh are detailed in Appendix C. The design operating parameters for air flow rate and odour emission concentration were used to conduct odour dispersion modelling using ADMS 5.2.4 software to quantify the odour impacts at relevant sensitive receptor locations, surrounding the site[2]. The dispersion model included the site layout buildings and infrastructure (as appropriate).

For the modelling exercise, emissions of odour from the on-site OCU was assessed against an odour benchmark level of 1.5 ouE/m^3 at nearby sensitive receptors, which is the H4 odour benchmark for the most offensive odours and the UU Odour Control and Removal Asset Standard (for high sensitivity receptors).

The results, as shown in Table 4.3.1, indicate that the maximum predicted 1-hour mean (98th percentile) odour concentration at the assessed sensitive receptors is less than 0.2 ouE/m^3, which is well below the 1.5 ouE/m^3 benchmark.

Table 4.3.1: OCU operating parameters and emission rates

Emission Point	Stack height (m)	Stack diameter (m)	Efflux velocity (m/s)	Design air flow rate (m^3/s)	Temp (K)	Design odour conc. (ou_e/m^3)	Design odour release rate (ou_e/s)
A4	15.00	0.39	15.9	1.905	Ambient	1,000	1,904.72

The odour dispersion modelling demonstrates that the design operation of the OCU at the site is compliant with H4 standards and with the UUW Odour Control and Removal Asset Standard.

The design of the OCU is considered to comply with BAT for the treatment process.

[1] Odour Control and Removal Asset Standard, Document Reference 33412
[2] Odour Impact Assessment, UUW Leigh, Jacobs, December 2022

4.4 Inspection, Maintenance and Monitoring

4.4.1 Inspection & Maintenance

Records of maintenance requirements, including prioritisation and consideration of criticality for individual assets form part of the maintenance strategy within United Utilities. All Environmental Permitted assets are flagged as a priority, as are scheduled inspection tours. All work completed is held on United Utilities' asset inventory and work planning system, MARS.

The MAMS work order system schedules the frequency of inspection tours and the preventative maintenance tasks carried out as part of these tours. This schedule is agreed between the Resource Coordinators and the Production Manager, it is reviewed and amended as deemed necessary.

OCU tours are scheduled through the RCM workbank, which in turn would generate maintenance activities. Certain cyclic task are present in the RCM workbank such as the lubrication of fan bearings and checking drive belt condition/alignment are scheduled but vary from installation to installation depending on the equipment installed.

The company maintains a general Standard Operating Procedure (SOP) for dry media/ activated carbon odour control units utilised at the company's sites. The objective of this SOP is to provide the user with an understanding of the fundamental aspects of the technology and to help them develop best practice management of the Odour Control Units installed on their works in order to prevent odour nuisance. The document aims to provide clear and comprehensive instructions to allow operational and maintenance staff to operate, service and maintain the OCU assets as scheduled, in order to deliver effective treatment and ensure compliance with UU's statutory, regulatory and mandatory obligations.

The SOP provides details of the inspection, maintenance and monitoring tasks required for the relevant units. A summary table of tasks and frequencies is contained at the end of each document. There is also guidance on investigating/rectifying issues in the event an issue is found with operational performance or parameters. The summary tables are provided in Appendix D.

A Site-Specific Instruction (SSI) will be issued for the operation of the OCU detailing local set points and operating parameters. Appendix D summarises the range of activities to be included in the SSI.

4.4.2 Monitoring

The following emissions monitoring is to be undertaken for the odour control unit stack:

- Hydrogen sulphide once every six months; and
- Ammonia once every six months.

Total volatile organic compounds (TVOC) and HCl will be monitored on one occasion to check for their presence in the emissions from the stack and the results provided to the EA. The sampling will be undertaken three times over the course of one day. Dependent upon the results, TVOCs and/or HCl may be added to the bi-annual monitoring schedule. In addition, the stack will be sampled for odour concentration on two occasions during the first year of monitoring to validate that the design odour concentration is being achieved.

A suitable measurement port will be provided to allow access and monitoring of the OCU stack.

In addition, there are hydrogen sulphide monitors fitted on the OCU inlet, biofilter outlet and the emissions stack. The stack outlet monitor continuously records hydrogen sulphide emissions in the range 0-1.5ppm. The biofilter monitor records concentrations in the range 0-50ppm and the inlet monitor in the range 0-200ppm. Hydrogen sulphide for the stack emissions is trended in the HMI and is set to alarm at 0.05ppm.

4.4.3. Responsible Persons & Role

- Process Controller – responsible for completing the scheduled routine monitoring of the plant;
- Production Engineer/Technical Officer - responsible for the ordering of chemicals, media and consumables or 3rd party sampling;
- Field Service Engineer - responsible for completing scheduled routine and reactive maintenance tasks;
- Environmental Regulatory Advisor (ERA) – responsible for reviewing compliance with the OMP; and
- Production Manager – responsible for ensuring monitoring and maintenance tasks are completed and when carbon media change out is required on the OCUs.

Odour control measures are detailed in Table 4.4.1 below.

Table 4.4.1. Odour Control Measures

Source	Nature	Odour Potential	Probability of Release	Control Measures	Residual Risk
Receiving wet well	Untreated sludge	High	Low	• Wet well is below ground and covered with metal plates. • Site inspection tours are carried out daily by site-based staff and monthly by the site's ERA. Any leaks or spillages identified are investigated and actioned promptly. • Provision of masking sprays around area will be considered, if required.	Low
Imported sludge tanker off-load	Untreated sludge	High	Medium	• Imports limited to sewage sludges arising from UUW facilities only. • All movements assessed in advance in accordance with a Biosolids Assurance Scheme (BAS) source material risk assessment. • Driver to remain with the vehicle while discharging to supervise offloading. • Delivery vehicles normally operated by UUW and routinely serviced and maintained, including regular checks to delivery pipework and couplings. • All delivery drivers provided with appropriate training, including the safe use of tanker equipment and safe unloading/loading procedures. • Waste accepted via a fixed offloading point which includes an alarmed, auto-shutoff when the high level is reached. • Sludge is pumped directly into a covered wet well.	Low

Source	Nature	Odour Potential	Probability of Release	Control Measures	Residual Risk
				• In the event of any spillage, clean up measures are implemented in accordance with the Flood and Spill Plan.	
Screenings building and separated solids storage	Untreated sludge	High	Medium	• Air from the sludge screens is extracted through an OCU comprising of an activated carbon/biofilter odour control unit. • Routine operation checks and maintenance to ensure the tank and OCU is functioning as per design. • Six monthly monitoring of the OCU emissions for H_2S and ammonia. Continuous H_2S monitor on emissions stack. • Separated solids are stored in open skips. Once full, skips are sheeted and removed from site within 48 hours. • Routine operation checks and maintenance to ensure the assets are functioning as per design. • Site inspection tours are carried out daily by site-based staff and monthly by the site's ERA. Any leaks or spillages identified are investigated and actioned promptly.	Low to Medium
Screened sludge tank	Screened sludge	High	Low	• Tank enclosed - Hatches are kept shut except for inspections or maintenance. • Tank connected to an OCU comprising an activated carbon/biofilter odour control unit. • Six monthly monitoring of the OCU emissions for H_2S and ammonia. Continuous H_2S monitor on emissions stack.	Low

Source	Nature	Odour Potential	Probability of Release	Control Measures	Residual Risk
				• Routine operation checks and maintenance to ensure the tank and OCU is functioning as per design. • Site inspection tours are carried out daily by site-based staff and monthly by the site's ERA. Any leaks or spillages identified are investigated and actioned promptly. • Raw sludge storage times are minimised to avoid septicity and odour.	
2x Thickening Centrifuges	Undigested and Digested sludge	High	Medium	• The thickening centrifuges units are connected to the OCU comprising an activated carbon/biofilter odour control unit. • Six monthly monitoring of the OCU emissions for H_2S and ammonia. Continuous H_2S monitor on emissions stack. • Routine operation checks and maintenance to ensure the thickening centrifuges and OCU is functioning as per design.	Low
Centrate balancing tank	Liquor	High	Low	• Hatches are kept shut except for inspections or maintenance. • Tank enclosed. • The centrate balancing tank is connected to the OCU comprising an activated carbon/biofilter odour control unit. • Six monthly monitoring of the OCU emissions for H_2S and ammonia. Continuous H_2S monitor on emissions stack. • Routine operation checks and maintenance to ensure the tanks and OCU is functioning as per design.	Low

Source	Nature	Odour Potential	Probability of Release	Control Measures	Residual Risk
				• Site inspection tours are carried out daily by site-based staff and monthly by the site's ERA. Any leaks or spillages identified are investigated and actioned promptly.	
Centrate buffer tank	Liquor	High	Low	• Hatches are kept shut except for inspections or maintenance. • Tank enclosed. • The centrate buffer tanks are connected to the OCU comprising an activated carbon/biofilter odour control unit. • Six monthly monitoring of the OCU emissions for H_2S and ammonia. Continuous H_2S monitor on emissions stack. • Routine operation checks and maintenance to ensure the tanks and OCU is functioning as per design. • Site inspection tours are carried out daily by site-based staff and monthly by the site's ERA. Any leaks or spillages identified are investigated and actioned promptly.	Low
Liquor treatment plant	Liquor	High	Low	• Hatches are kept shut except for inspections or maintenance. • Tanks enclosed. • Routine operation checks and maintenance to ensure the treatment plant is functioning as per design. • Site inspection tours are carried out daily by site-based staff and monthly by the site's ERA. Any leaks or spillages identified are investigated and actioned promptly.	Low

Source	Nature	Odour Potential	Probability of Release	Control Measures	Residual Risk
Degassing tank	Biogas	High	Low	• Hatches are kept shut except for inspections or maintenance. • Tank enclosed. • The degassing tank is connected to the OCU comprising an activated carbon/biofilter odour control unit. • Six monthly monitoring of the OCU emissions for H_2S and ammonia. Continuous H_2S monitor on emissions stack. • Routine operation checks and maintenance to ensure the tank and OCU is functioning as per design. • Site inspection tours are carried out daily by site-based staff and monthly by the site's ERA. Any leaks or spillages identified are investigated and actioned promptly.	Low
Digested sludge storage tank	Digested sludge	Medium	Low	• Tank enclosed - hatches are kept shut except for inspections or maintenance. • Tank connected to an OCU comprising an activated carbon/biofilter odour control unit. • Six monthly monitoring of the OCU emissions for H_2S and ammonia. Continuous H_2S monitor on emissions stack. • Routine operation checks and maintenance to ensure the tank and OCU is functioning as per design. • Sludge storage times are minimised to avoid septicity and odour. • Site inspection tours are carried out daily by site-based staff and monthly by the site's ERA. Any leaks	Low

Source	Nature	Odour Potential	Probability of Release	Control Measures	Residual Risk
				or spillages identified are investigated and actioned promptly.	
Digester PVRV	Biogas	Medium	Low	• Valves sized on design specification to accommodate normal pressure variations and minimise/prevent non-essential releases. • PVRVs calibrated to the safe working limit of the digester. • PVRV set points calibrated every 2 years by a specialist contractor to ensure safe and effective operation within design parameters. • Basic visual inspection of PVRV's undertaken weekly. Annual inspection carried out by a mechanical Field Service Engineer. • Operation of PVRVs is minimised by monitoring pressures within the digester and controlling the feed rate accordingly. • Digester gas pressure monitored via pressure sensors in the Digester, linked to a PLC. Signals derived from the PLC are sent via telemetry to the Dashboard and can also be viewed on the SCADA. A high-pressure alarm is also generated and sent to the ICC. • In the event of a high-pressure alarm activating, actions are taken in accordance with the Digester High Pressure SSI (WwP/I/3024/15/13).	Low
Gas holder PVRV	Biogas	Medium	Low	• Valves sized on design specification to accommodate normal pressure variations and minimise/prevent non-essential releases.	Low

Source	Nature	Odour Potential	Probability of Release	Control Measures	Residual Risk
				• PVRVs calibrated to the safe working limit of the gas holder. • PVRV set points calibrated every 2 years by a specialist contractor to ensure safe and effective operation within design parameters. • Basic visual inspection of PVRV's undertaken weekly. Annual inspection carried out by a mechanical Field Service Engineer. • Operation of PVRVs is minimised by monitoring pressures within the gas holder and controlling the digester feed accordingly. • Gas pressure monitored via pressure sensors in the holder, linked to a PLC. Signals derived from the PLC are sent via telemetry to the Dashboard and can also be viewed on the SCADA. A high-pressure alarm is also generated and sent to the ICC.	
Boiler stack	Combustion of biogas	Very low	High	• On combustion, hydrogen sulphide will predominantly be converted into oxides of sulphur (primarily SO_2), thus hydrogen sulphide is not expected to be present in the stack emissions. • Boiler is maintained in accordance with the manufacturer's maintenance schedule.	Low
CHP stack	Combustion of biogas	Very low	High	• On combustion, hydrogen sulphide will predominantly be converted into oxides of sulphur (primarily SO_2) thus hydrogen sulphide not expected to be present in the stack emissions. • CHPs maintained in accordance with the manufacturer's maintenance schedule for the	Low

Source	Nature	Odour Potential	Probability of Release	Control Measures	Residual Risk
				engines. Additional maintenance scheduled based on UUW's experience of running such plant.	
Flare	Combustion of biogas	Very low	Medium	• Flare emissions are of short duration, under abnormal operating conditions. • Flare operates at high temperatures, combusting volatile organic compounds that typically give rise to odours and converting hydrogen sulphide into oxides of sulphur.	Low
Leaks in gas pipework e.g. around flanges	Biogas	Medium	Low	• Annual VOC leak detection programme of gas related infrastructure and equipment using a thermal infrared gas camera, carried out by a specialist team within the business. • Inspections also arranged on a reactive basis, if required. • On detection of a possible leak, an escalation procedure is followed and repairs or maintenance actioned promptly.	Low
Digestate cake conveyor	Digested sludge cake	Low	Low	• Conveyor is enclosed. • Routine operation checks and maintenance to ensure the assets are functioning as per design. • Site inspection tours are carried out daily by site-based staff and monthly by the site's ERA. Any leaks, odours or spillages identified are investigated and actioned promptly. • Provision of masking sprays around area will be considered, if required.	Low

Source	Nature	Odour Potential	Probability of Release	Control Measures	Residual Risk
Digestate cake storage building	Digested sludge	Low	Medium	• Cake storage building has a roof and is enclosed on three sides by concrete walls approximately 3.5m in height that provide protection from wind dispersion. • Sensor on the cake conveyor ensures height of the cake pile does not exceed the height of the walls. • Site inspection tours are carried out daily by site-based staff and monthly by the site's ERA. Any odours identified are investigated and actioned promptly. • Provision of masking sprays around area will be considered, if required.	Low
Tank cleaning	Grit	High	High	• Opportunities to minimise odour emissions and any potential nuisance are identified when planning maintenance tasks, this may include the timing of routine maintenance tasks. • Provision of masking sprays during activity will be considered, if required.	Medium
Leaks/spills of sludge from process	Digested or undigested sludge	Medium	Low	• Spillages are a risk during maintenance of assets. Possible sources of spillage should be considered during planning of the maintenance task and avoided through design where possible. • Ensure spills are cleaned up promptly. Spill training is provided to operational staff and spill kits/hoses are readily available. • Site inspection tours are carried out daily by site-based staff and monthly by the site's ERA. Any leaks or spillages identified are investigated and actioned promptly.	Low

5 Odour Investigation and Reporting

5.1 Complaints Reporting

5.1.1. Receipt of Customer Odour Complaints

Customers are important to us and we need to minimise any impact we could cause. If customers feel the need to complain, a rapid and thorough response is important.

Customer complaints regarding odour should be directed to the Integrated Control Centre (ICC) Customer Liaison Team to be recorded on the Dynamics System and a case number assigned. The Customer Liaison Team will log details of the complaint and pass the details to the Production Manager for investigation as soon as possible, but in all cases within 2 hours (24 hours at weekends).

If telephone contact is received outside of the Integrated Control Centre (ICC) or written contact is sent direct to a UUW member of staff, the following procedure needs to be actioned.

Table 5.1.1 Recording Receipt of an External Odour Complaint

Telephone Contact	Written contact – letter, email, text	Face to face contact – customer attends site
Details of the contact need to be recorded – name, contact information, query. Details sent to the ICC Duty Desk Manager.	Scanned and sent to Customer Liaison Team along with any details to help respond to the contact.	Collect customer details and send to Duty Desk. Provide customer with the odour hotline number.
01925 233224 DutyDesk@uuplc.co.uk	CustomerRelationsServiceDrafts@uuplc.co.uk	0800 781 7134

If a verbal complaint is received at site and the customer is not happy to be directed to the odour hotline, the site should log the complaint using the Odour Diary Form. A copy of the form is contained in Appendix D and is available on the company's Sharepoint site here:

Odour Diary Form

5.1.2. Receipt of Regulatory Odour Complaints

A customer complaint received via the Environment Agency will usually be directed to the site ERA. The EA maintains a list of ERA contacts for each permitted site. If a complaint is received at site from the EA or Local Authority Environmental Health Department, these should be passed to the ERA who will log the complaint using the Odour Diary Form and liaise with the Production Manager to ensure that the complaint is investigated, and the findings communicated back to the regulator (see Section 5.2).

5.1.3. Investigation of Odour Complaints

As soon as possible upon notification of a complaint, the Production Manager or Technical Officer will discuss the nature of the complaint and appoint suitable members of staff to investigate the complaint and review all site activities.

Odour concerns and complaints will be substantiated by olfactory 'sniff testing' carried out on site and off site at the locations shown in Appendix G. The on-site testing will be carried out by operational staff but where it is reasonably practicable, we will use office staff or people who have not recently been working on the site to conduct the off-site monitoring. It is recognised that employees who are routinely exposed to odours may experience a reduced perception of odour intensity, however, the working environment is not inherently odorous and desensitisation is not considered to be a significant risk at this site.

In order to ensure odours from the site are differentiated from any other potential odour sources in the local area, the assessment locations may be varied to take into account the location of the off-site receptors and their location in relation to the wind direction occurring during the assessment period.

If necessary, the personnel undertaking the assessment will work from the site boundary into the wind to assess sources/direction of odour and to identify if it originates on site.

The sniff testing will also aim to identify any WwTW activities that could be either be the source of the odour, contribute to the odour, or be a confounding factor.

At each location observations shall be made concerning odour intensity, persistence, character and weather conditions.

Odour intensity shall be recorded on a scale from 0 - no odour, to 6 - extremely strong odour, as follows:

- 0 - No odour (no odour can be detected);
- 1 - Very faint odour (only detectable if you specifically sniff for it);
- 2 - Faint odour (detectable if you casually sniff for it);
- 3 - Distinct odour (detectable by just standing there normally);
- 4 - Strong odour (unavoidable odour);
- 5 - Very strong odour (likely to leave lingering smell on clothes, or lingering taste); and
- 6 - Extremely strong odour (likely to causes immediate physical symptoms such as nausea, sore throat and headaches).

The character of the odour shall be noted i.e. whether it can be likened to another smell (e.g. rotten eggs, earthy, musty, fishy, vegetation, cabbage, vinegar/acid, oil, rotten onions, vegetables, sludge, sceptic sludge, normal wastewater, septic wastewater, sweet pear drops, or other descriptor). Also whether the odour is constant or intermittent.

Where odours are substantiated as coming from UUW activities, the following questions should be considered as part of the investigation process:

- Is the process under control?; and
- Have odour containment measures failed, e.g. has a door been left open; have adverse conditions, such as weather, overwhelmed containment structures?

As a minimum the investigation needs to document:

- Sniff testing results;
- Operating conditions at the time of the complaint;
- Weather conditions (including wind direction) at the time of the complaint;
- Conclusions and recommendations;
- Discussions with relevant regulators (if held);
- Communication with the complainant; and
- Preventive measures to reduce the probability of re-occurrence.

The Production Manager/ Technical Officer will report the findings of the investigation to the site ERA who will complete the Odour Investigation Form.

The ERA shall communicate the findings of regulatory complaints directly to the EA or Environmental Health Department.

For complaints originating from the ICC, the ERA shall feedback the investigation findings to the Customer Liaison Team, who will in turn communicate this information to the customer.

All odour complaints shall be investigated and reported to the complainant within ten working days, in line with the company's Customer complaints procedure that requires responses to customers within agreed timeframes set by OFWAT.

The Production Manager or Technical officer shall brief the site team on the number and details of any complaints received and the findings of associated odour investigations shall also be reported. Escalation points for communications are detailed in Section 5.2.

5.1.4. Records of Odour Contacts & Complaints Investigation Procedure

Details of odour complaints received via the ICC can be viewed via Tableau software.

Any Odour Diary Forms completed by the operations team should be held electronically on site. A copy of the Odour Diary Form is provided in Appendix E.

A standard Odour Investigation Form (Reference: WwP/F/001/30/16) is used for all investigations to ensure a consistent approach to recorded keeping. A copy of the form is included in Appendix F.

Investigation forms can be completed electronically on the Odour Page of the Sharepoint site or printed to complete by hand and then scanned and uploaded. The odour investigation form is available here (for UUW staff only):

https://uusp/Asset/QA/QualityAssurance/WasteWater%20Standard%20Forms%20%20Lists/Site%20Odour%20Investigation%20Form.docx?web=1

5.2 Odour Risk Identification and Management Process

The following section sets out the escalation points for communications to internal and external customers for pro-active and reactive communications and to:

- Identify internal and external customers; and
- Set out the expected standard of communications with roles and responsibilities.

Normal Operation

A generic senses tour shall be undertaken as part of the daily EO&M (Effective Operations & Maintenance) site checks which will flag potential odour issues. As part of daily team meetings, Site Operators and Process Controllers will identify and communicate to the wider team any operational issue or condition which they believe has the potential to develop to site risk and this shall be recorded on the site issues board.

When planning maintenance activities, Process Controllers (PCs)/ Field Service Engineers (FSEs) shall review the potential for off-site odour mitigation and the need to provide mitigation or conducting the activities during favorable weather conditions (preferable wind directions and speeds). Where mitigation measures cannot be provided the PC/FSE shall raise an escalation to the Production Manager.

Escalation Levels

Tier 1 On Site Risk - No External Communications

Should the following circumstances arise, the Production Manager will confirm a Tier 1 risk:

- Minor risk of odours generated by maintenance work; and
- Noticeable odour on site – ideally this would be confirmed via an on-site reading with a portable hydrogen sulphide gas analyser and operator Sniff tests.

The site Process Controller will be responsible for initiating the associated actions and communications. The Technical Officer has the discretion not to proceed initiating a Tier 1 response, but the reason for doing so must be documented.

The outcome of which is to be risk assessed by the Technical Officer for consideration of further escalation and if there is a need to inform the customer team to update customers should they contact United Utilities.

The site Process Controller will be responsible for initiating the associated actions and communications.

The Technical Officer has the discretion not to proceed initiating a Tier 1 response, but the reason for doing so must be documented.

If a Tier 1 (internal) escalation point is met, then the following shall be contacted:

- Central Area HUB;
- Maintenance Manager; and
- Environmental Regulatory Advisor

The communication will contain the following information:

- What has occurred or is planned;
- The expected duration;

- The expected impact; and
- Customer/ street map to highlight area of potential impact and communication if applicable.

Tier 2 - (External Communications) – Neighbourhood Risk

Should the following circumstances arise the Production Manager will confirm a Tier 2 risk:

- Knowledge of at least 5 no. of telephone odour complaints/ contacts received with 24hr period.

The site Technical Officer will be responsible for initiating the associated actions and communications.

The Production Manager can, at their own discretion, decide not to proceed initiating a Tier 2 response based on on-site/internal trigger levels being generated, but the reason for doing so must be documented.

If a Tier 2 (external) escalation point is met, then the following shall be contacted:

- External Affairs Manager;
- Area Stakeholder Manager (within impacted area);
- Area Production Manager (within impacted area);
- Area Business Manager (within impacted area);
- Asset Manager (within impacted area);
- Customer Focal Lead (Production Manager within impacted area);
- Area Engineering Manager; and
- Area Deployed Team- Process Engineering or Odour Technical Specialist.

Following internal consultation, the Production Manager shall determine if communication with relevant external stakeholders and is to be conducted. External stakeholders may include:

- The Environment Agency;
- The Local Environmental Health Officer;
- Customers in the impacted area;
- The Parish Council; and
- The local Councilor and/or MP (within impacted area).

The purpose of the internal discussion will be to review the situation and agree the content and nature (e.g. text blast, phone call, e-mail, website, suitable conduit) of communication to external parties.

The messages should be clear and concise. The discussion shall agree what is communicated and by who.

The communication will contain the following information:

- What has occurred or is planned;
- The expected duration;
- The expected impact;
- Risk factors;
- Complications; and
- Customer / street map showing where letters / voice blasts should be focused.

The escalation criteria are summarised in Table 5.2.1.

Table 5.2.1: Escalation Table

	Tier 1 **On site risk - no external communications**	**Tier 2** **Neighbourhood risk – external communications**
Measure	Minor risk of odours generated by maintenance work Noticeable odour on site – confirmed via operator Sniff tests	Knowledge of at least 5 no. of telephone odour complaints/contacts received with 24hr period 10 telephone odour complaints/contacts received with 7-day period
Example	• Minor risk of odours generated by planned or reactive maintenance work has been identified • Noticeable odour on site – confirmed via operator Sniff tests • Septic influent or odorous trade effluent discharge reported by site operations team • Minor sludge or filtrate spillage on site reported by site operations team	• Complete system failure of odour control equipment i.e. loss of all treatment stages and or extract fans • Moderate risk of odours generated by maintenance work has been identified • Noticeable odour on site – confirmed via human senses sniff tests • Moderate sludge or filtrate spillage on site
Internal Contact	• Central Area HUB • Production Manager • ERA	ICC to log details of customer complaint and pass details to the Production Manager (PM) for investigation as soon as possible, but normally within 2 hours (24 hours at weekends). Customer complaints received via the EA are usually directed to the site ERA. The EA maintains a list of ERA contacts for each permitted site. Site ERA is to ensure the complaint is investigated as soon as possible and that the findings are reported back to the EA Site Inspector. PM to initiate investigation and consultation with the following internal stakeholders, as considered appropriate by the PM: • External Affairs Manager • Area Stakeholder Manager • Area Production Manager • Area Business Manager • Asset Manager • Customer Focal Lead • Area Engineering Manager • Area Deployed Team- Process Engineering or Odour Technical Specialist

	Tier 1 On site risk - no external communications	Tier 2 Neighbourhood risk – external communications
External Contact		All odour compliant investigation findings to be reported back to the complainant within ten working days (the customer charter response time). Wherever possible, the initial investigation findings should be reported back to the complainant in a shorter timescale than 10 days. ICC to detail the reason behind the issue to the complainant (if substantiated) and the actions taken to resolve the matter. Following internal consultation, the Production Manager may determine that external communication with all of some of these stakeholders is required: • The Environment Agency • The Local Environmental Health Officer • Customers in the impacted area • The Parish Council • The local Councilor and/or MP (within area impacted) Where required, and instructed to do so by the Production Manager, the ERA will complete and submit the permit Schedule 5 Part A notification to the Environment Agency.

5.3 Community Engagement

In accordance with the Escalation Procedure detailed in Section 5.2, if the Production Manager deems it appropriate, external engagement will be initiated. The level of external engagement will be dependent upon the number of complaints received, the nature of the complaints received and findings of the investigation. For example, if the complaints are substantiated and there is an ongoing source of odour due to a plant failure the level of engagement will be greater than a transient source where the issue has been resolved. The site typically receives very few odour complaints and there are currently no on-going odour issues with neighbours or local residents groups.

5.4 Pro-active Odour Monitoring

Site inspection tours are carried out daily by site-based staff and monthly by the site's ERA. If any abnormal operating conditions or odours are identified during the tour, these are reported to the Production Manager who would raise a Tier 1 or 2 escalation as appropriate (see Table 5.2.1). Any issues raised will be logged on the corporate action tracker and assigned to the relevant colleague for completion.

A hydrogen sulphide monitor is fitted on the OCU emissions stack. The stack outlet monitor continuously records hydrogen sulphide emissions in the range 0-1.5ppm. Hydrogen sulphide for the stack emissions is trended in the HMI and is set to alarm at 0.05ppm. Activation of the alarm will trigger diagnostic checks, as detailed in Appendix D.

Pressure monitoring of the digesters and gas holder will also be used to identify biogas leaks, i.e. pressures recorded above the set PVRV operation value would indicate PVRV operation. If releases from PVRVs are observed, they will be recorded in the site diary along with any escalations or remedial actions taken.

Site infrastructure and equipment are subject to a regular schedule of site inspections, which includes a leak detection program and incorporates requirements set out in the IGEM standard, IGEM/UP/1. This comprises non-intrusive testing and inspection of gas related assets for leaks of volatile organic compounds (VOCs) using a thermal infrared gas camera and is carried out by a specialist team within the business. Inspections are carried out annually and will also be arranged on a reactive basis if required. On detection of a possible leak, an escalation procedure will be followed, and repairs or maintenance will be actioned promptly.

5.5 Reactive Odour Monitoring

Odour concerns and complaints will be substantiated by on-site and off-site 'sniff testing' carried out by an employee, as detailed in Section 5.1.3 on odour investigation.

6 Abnormal Events

6.1 Abnormal Events Potentially Leading to Odorous Emissions

In the event of failure of one or more of the existing fixed assets within the sludge treatment process the site will bring emergency contingency temporary/mobile equipment onto the installation. These units shall be operated until such time that the fixed units are repaired and can be brought back into the process stream.

Temporary/mobile equipment will be utilised for the task required and will be positioned within the installation boundary whenever feasible. The units will be positioned on impermeable hardstanding when required. The sludge will be transferred between fixed and temporary/mobile assets through suitable flexible hosing where appropriate. Any accidental spillages shall be washed down into the sealed installation drainage system, to be returned to the head of the on-site, off-installation drainage system, downstream of the storm overflow, for treatment. Any process effluent discharges, such as liquor will be discharged into site drainage and returned to the head of the works. Centrate is pumped to the Liquor Treatment Plant (LTP) for treatment, before returning it back into the WwTW flow to full treatment by a pumped automated system.

Abnormal operating events are considered in detail in the site Accident Management Plan. Table 6.1.1 summarises abnormal event scenarios which may lead to odorous emissions.

Table 6.1.1: Abnormal Events

Abnormal Event	Control Measures	Recovery Steps
Damage to tank roofs	Routine inspection regime of digester and tank roofs Gas pressures monitored Gas pressure alarms	Conduct investigation of damage Rectification of fault Temporary/mobile equipment utilised if required until permanent asset can be repaired or replaced
Damage to fabrication of sludge buildings	Visual inspection of the sludge building fabrication	Conduct investigation of damage and rectify cause, if possible Commission and undertake repair work Temporary repair may be required until permanent repairs can be undertaken
PVRVs activate	Calibrated to the safe working limit of the digester Gas pressures monitored Gas pressure alarms Digester feed and volumes controlled to maintain safe biogas level.	Investigate cause of high pressure, check for foaming and blockages Check sizing of valve is correct against design Reset and recalibrate PVRVs if required

Abnormal Event	Control Measures	Recovery Steps
Loss of sludge from Digester PVRV or overflow due to foaming	Daily visual monitoring of foam level in digester through sight glass as part of the EO+M Tour Pressure and operating levels monitored via telemetry Routine process monitoring of digester health Dosing with anti-foam if required	Monitor pressure until foaming subsides Cease digester feed during foaming incident. Temporarily cease mixing to reduce foaming Purge plan in place Longer term - investigate reasons for, and ways to mitigate foaming
Leakage of biogas from seals, flanges, valves, pumps, pipework and tanks	Assets are scheduled for routine proactive inspection by thermal imaging camera on a 6-monthly basis Asset list is based on the potential for biogas leakage Planned maintenance assessment work is scheduling using the MARS system at the appropriate time and frequency Any detection of leakage is escalated for action.	Reactive monitoring for biogas emissions by thermal imaging camera Route cause analysis of leakage Rectification of fault Temporary /mobile equipment utilised if required until permanent asset can be repaired or replaced
High high pressure in the digesters (>23mb) leading to potential odorous emissions	Regular calibration of pressure monitors Pressure monitors display locally on SCADA with telemetry back to the ICC Immediate response alarm generated to alert site operators	Reduce digester sludge feed therefore reducing gas production Immediate investigation of the issue to prevent reoccurrence
Normal route for cake off-take is not available leading to excess storage on cake pad	Contingency arrangements for alternative off-take	Cake to be removed off site to a suitably licensed waste disposal facility Cake to be reduced to normal storage levels within 48 hours
Valves, pipes or pumps damaged or malfunctioning	Selection of correct pipework for pressure and flow loads. Frequent on-site checks	Temporary/mobile equipment utilised for the task required until permanent asset can be repaired or replaced Clean any spills promptly
OCU damaged or malfunctioning	OCU designed in accordance with UU asset standards Monitoring and maintenance in accordance with relevant SOP for OCU	Conduct checks set out in relevant SOP for OCU equipment, for example: Check when media was last changed

Abnormal Event	Control Measures	Recovery Steps
	equipment and Site-Specific Instruction (SSIs)	Check load against design Check airflow rate in ductwork against design Check and adjust set points
Processing equipment damaged or malfunctioning	All EP assets are flagged as a priority and scheduled on inspection tours. All work completed is held on the asset inventory and work planning system, MARS. The MARS work order system schedules the frequency of inspection tours and the preventative maintenance tasks carried out as part of these tours.	Check loading against design Conduct route cause analysis of damage/malfunction Rectification of fault Temporary/mobile equipment utilised if required until permanent asset can be repaired or replaced
Loss of containment from tanks or digester	Selection of correct pipework for pressure and flow loads Frequent on-site checks Maintenance in accordance with pressure vessel regulations, where appropriate	Follow spill response plan Investigate route cause of loss of containment Rectification of fault Temporary/mobile equipment utilised if required until permanent asset can be repaired or replaced
Fire and/or explosion	Staff training and supervision DSEAR zones identified on plan with appropriate signage on site Fire extinguishers placed for quick access and checked regularly Fire hydrants positioned at key locations Emergency isolation valves available Incident management planning and training No smoking or other sources of ignition. No mobile phones	Follow the Digestion and Biogas Emergency Plan Ref. WwP/I/3033/01/16 This procedure includes site evacuation details, site checks to be undertaken, a list of emergency equipment, plant exclusion areas and plans detailing purge points and location of fire hydrants
Failure of electricity supply	Backup generators Ensure sufficient fuel stocks and manpower to facilitate operation of the generators	Follow the Process Loss Contingency Plan Ref. WwP/I/3033/30/01 Establish estimated time for return of electrical supply

Abnormal Event	Control Measures	Recovery Steps
	Process Loss Contingency Plan in place	Remote Monitoring Control Centre to be contacted to update them on the status of the incident and to inform EA of power outage Request adequate presence of Field Service Engineers for connection and operation of the generators Arrange for sufficient operations personnel to be present during the power outage to assist the FSE's and to monitor the plant and processes
Flood	Relocate key equipment where possible Power down electrical units Protect sensitive areas with sandbags Secure objects that could float in floodwater e.g. skips, gas bottles Check surface water drains to ensure they are clear if debris Shutdown and drain flammable liquid piping Isolate gas supplies. Refer to the Flood and Spill Plan (Ref. WwP/I/3033/30/03)	Hire pumps to remove standing water from site areas Clean and dry equipment, prioritising vital or susceptible equipment Check, clean and test all electrical distribution equipment and components exposed to flooding or humidity Remove flood debris Implement plan to resurrect process/part of process impacted by flood

6.2 Responsibility

Any operational problem that cannot be dealt with by normal operational procedures shall be classed as an INCIDENT and the current issue of UU Incident Management Procedure shall be referred to and SOP (WP/S/001/30/01 Incident Response).

All Standard Operating Procedures, Instructions and other documented operational procedures and activities are to be carried out by the Process Controller or other trained person designated by the Production Manager.

If in carrying the instruction it is not possible to rectify any problem encountered within a reasonable timescale the Production Manager or senior equivalent person must be contacted. Timescales for rectification will be dependent on the nature of the problem and guided by the relevant Standard Operating Procedure/Instruction.

All actions and communications carried out while applying any Standard Operating Procedure, Instruction or other documented operational procedure or activity shall be recorded using form WwP/F/001/31/08 Site Diary Log.

Refer to WP/S/001/30/01 Incident Response for incident escalation and communication procedures.

6.3 Notification

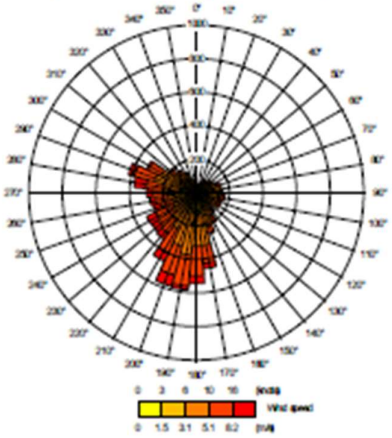
The Environment Agency must be notified without delay of any accident which has caused, is causing or has the potential to cause significant pollution, as required by the Environmental Permit. The following procedure shall be followed for EA notification:

- Site Operations/Production Manager to notify ERA of the incident, the ERA will assess if a Part A notification is required. If required, the Part A notification form is to be agreed with the Production Manager and Waste Compliance Manager and submitted to the EA within 24 hours.
- During out of hours, Site operations to contact EA hotline then inform the ERA as soon as possible.
- E-mail the Part A notification form to the local EA Officer and the EA Installations mailbox (email: Incident_Communication_Service@environment-agency.gov.uk).
- Provide a copy of the completed form to the Waste Compliance mailbox and EA correspondence and Regulatory Services mailbox (email addresses: WasteCompliance@uuplc.co.uk; EACorrespondence@uuplc.co.uk).
- ERA to complete the Part B notification form within 21 days or provide an update to the EA on progress.
- Follow the SOP for EPR Waste & Installations Incident Notification and Reporting (WwP/S/001/01/14).

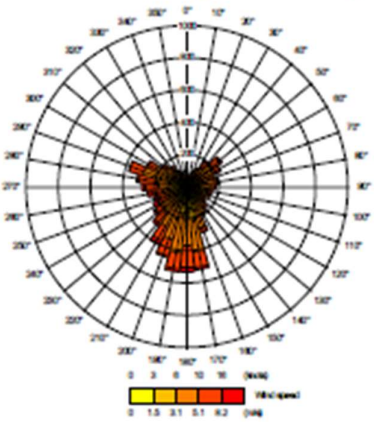
If considered necessary following an incident or application of a contingency measure, this OMP will be reviewed.

Appendix A: Wind Rose Data

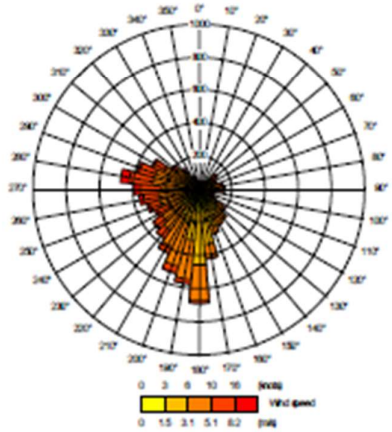
Manchester Airport meteorological station, 2015



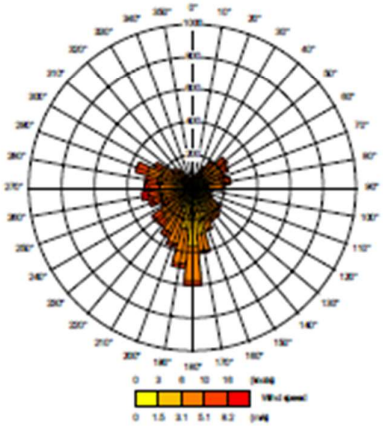
Manchester Airport meteorological station, 2016



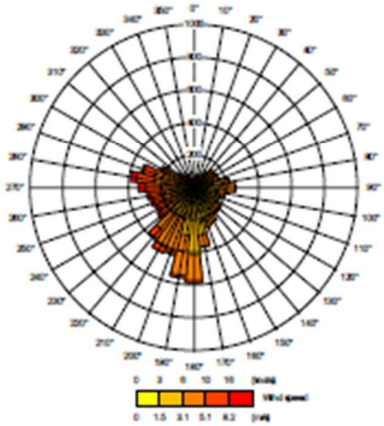
Manchester Airport meteorological station, 2017



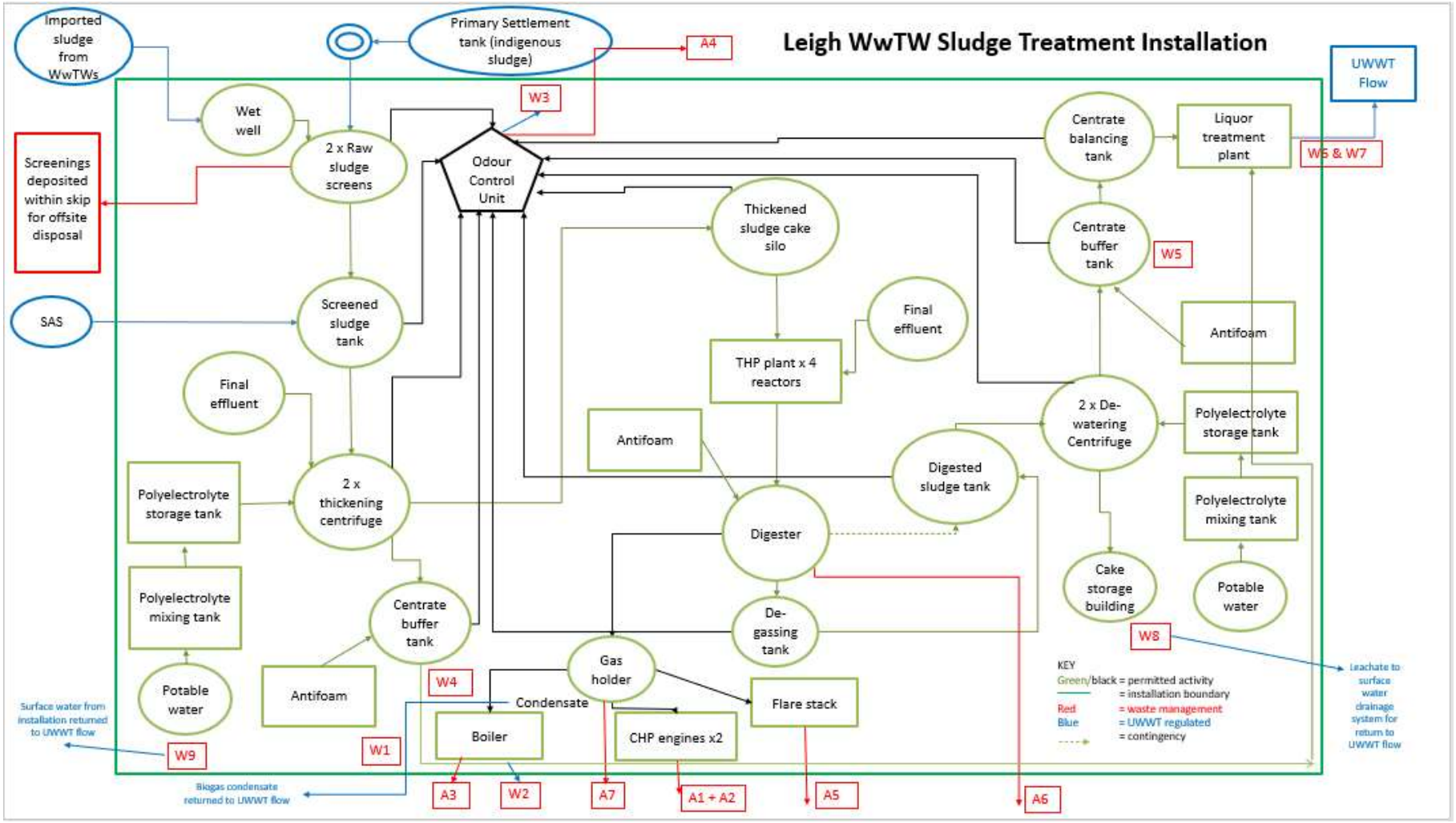
Manchester Airport meteorological station, 2018



Manchester Airport meteorological station, 2019



Appendix B: Process Flow Diagram



Appendix C: Design Operating Parameters for Odour Control Unit

Sludge OCU - Emission Point A4			
Parameter	Units		
Airflow OCU	m^3/hr	6,857	
Temp	°C	UK ambient Average 15°C	
Contaminants	Ammonia	10/15	Ave/Max
	H_2S	35/95	Ave/Max
	RSH	5/15	Ave/Max
	DMS	0.3/0.75	Ave/Max
	Misc VOCs	18/35	Ave/Max
Parameter	Units		
Outlet odour biological	OU_e/m^3	Expected >95% removal	
Hydrogen Sulphide	% Rem	>98	
Mercaptans	% Rem	minimum 50%	
DMS	% Rem	minimum 50%	
VOCs	% Rem	minimum 50%	
Outlet odour Carbon	OU_e/m^3	<1,000 >98% Removal	
H_2S, RSH, DMS, VOCs		>98% Removal	
Airflow	m^3/hr	+/- 10% of design acceptable Changes of >20% Diff pressure should be investigated	
pH	pH	based on design load design is pH 3-3.5. Identifying a significant change is important <2.0 irrigation rate /load check /adjustment	
Irrigation flow minimum flow 1,700 l/hr	l/hr	4618 same for both beds. Minimum 1700 Pumice - constant flow Coir 30-60sec /15mins	
-		Failure of the irrigation system to be instigated immediately and should be reinstated as soon as possible. Loss of irrigation for 24hrs will compromise performance and shall be escalated.	
Differential pressure	Pa	226 Pumice layer/ 93 Coir Low trigger 100 High Trigger 300. Carbon Bed 940 Pa 400Pa low trigger 900 Pa high trigger	

Appendix D: General Inspection and Maintenance Activities for Operational OCU

BIOLOGICAL ODOUR CONTROL FILTER SYSTEMS – INSPECTION & MAINTENANCE ACTIVITIES										
Sub Task	Activity	Ops/Main	Daily	Week	Month	Quarter	6 Month	Annual	Greater	Comment
-	**Biological Odour Control**									
1	Visual inspection of extraction system – ductwork & covers	Ops		✓						Check integrity of ductwork, flexible connectors and covers for damage/failure. Dampers in open position. Check air inlets are functional and clear of debris, access hatches closed, condensate lines/drain functioning and drained.
2	Fire Dampers							✓		Check condition and operation of fire dampers.
3	Measurement of system air flows	Ops				✓				Record airflow from all extract points, entering, exiting OCU. Compare against design/previous records. Identify and investigate any deviation. Check operation condition of volume control dampers. Non routine measurement instigated based on increase/decrease OCU differential pressure/repeated fan low flow alarms.
4	Inlet, Outlet and inter-stage contaminant concentration H_2S (Could also be Ammonia, Mercaptans, Dimethyl Sulphide, Misc volatile compounds (VOCs	Ops			✓					Confirm performance of each process stage and that inlet is within max. design range - investigate and identify source/cause if Max exceeded. Could be continuous H_2S measurement if online instrumentation is provided.
5	Continuous H_2S monitoring (OCU inlet/Stack (if fitted)	Ops	✓		✓		✓			Daily check to confirm operation of instrument check against inlet design parameters and check correct sample gas flow rates. Replacement of paper tapes – as required (monthly). Calibration/replacement of electro chem sensor annual basis (3rd party).
6	Liquid drain operation/quality	Ops	✓							Visual observation of drain operation. Clear liquor with some floc present is quality standard.

BIOLOGICAL ODOUR CONTROL FILTER SYSTEMS – INSPECTION & MAINTENANCE ACTIVITIES										
Sub Task	Activity	Ops/Main	Daily	Week	Month	Quarter	6 Month	Annual	Greater	Comment
7	Irrigation/recirculation system functionality	Ops	✓							Basic functionality check, log and adjust irrigation water feed pressure/flow. Check availability of recirc. pumps (if fitted/Bio scrubber). Could be continuous measurement if online (flow pressure instrumentation is provided).
8	Irrigation supply Strainer	Ops		✓						Check condition of strainer and clean (if fitted). Damaged strainer to be replaced. Interval maybe increased dependant on rate of fouling/increase if frequent low irrigation flow encountered.
9	High Level Overflow (if fitted)	Ops	✓							Check overflow not operating - investigate cause if it is. Check water trap is charged/Air not being discharged/drawn in. Charge lute if necessary
10	Media Bed Spray coverage	Ops		✓						Checked if OCU performance is observed to decrease below trigger level
11	Effluent pH and/or conductivity	Ops		✓						Manual check frequency may be extended if pH/conductivity remains stable. Manual check dependant on whether on-line instrumentation provided- periodic calibration check of on-line instruments required.
12	OCU pressure drop across bed media bed and Pre-filter (if fitted)	Ops		✓						Information logged to identify performance trends.
13	Visual inspection of OCU Vessel	Ops		✓						Operational and asset condition check. Check for operation. Check vessel integrity (deformation/gas and liquid leaks – air infiltration/fugitive release, corrosion.
14	Vessel Internal inspection	Ops						✓		Media replaced based on reaching performance trigger level value. Use opportunity to inspect vessel internals for corrosion/damage. Potential recertification of vessels if appropriate.

BIOLOGICAL ODOUR CONTROL FILTER SYSTEMS – INSPECTION & MAINTENANCE ACTIVITIES										
Sub Task	Activity	Ops/Main	Daily	Week	Month	Quarter	6 Month	Annual	Greater	Comment
15	Media Replacement	Ops							✓	Media replacement interval should 1-5yrs for organic media, >10yrs for pumice/inert media. However, if unit becomes fouled by solids from irrigation water media will require removal for cleaning/replacement.
16	OCU Fan & isolation/NRD damper operation/vibration	Ops	✓							Check for operation/function. Log hours run and fan availability. AMPs drawn Check for vibration/noise. Check integrity of any flexible connector between ductwork and fans

Leigh WwTW Sludge Treatment Facility
Odour Management Plan

BIOLOGICAL ODOUR CONTROL FILTER SYSTEMS - TROUBLE DIAGNOSTIC TABLE					
OBSERVATION	PROBABLE CAUSE	NECESSARY CHECK	CORRECTIVE ACTION	ROLE RESPONSIBLE FOR ACTION	INDICATIVE TIMESCALE FOR COMPLETION
High H_2S value at OCU outlet	Liquid irrigation rate too low	Check irrigation rate Supply pressure Spray coverage	• Reconnect/realign spray bars • clear blockages from irrigation supply and nozzles • Clean Strainer • Increase irrigation rate	• Process Controller to complete checks- should be resolved during check	• PC will attempt to resolve issue in first instance as part of routine check. If unable to resolve will raise job for FSE or engineering support
	Inlet hydrogen sulphide concentration exceeds design range	Check inlet hydrogen sulphide concentration	• Complete site investigation to reduce sulphide loading onto OCU	• Process Controller to complete checks on site check – escalate to ADT if source of high load cannot be identified	• Could be resolved immediately depending on root cause • Up to 7 days if airflow rebalancing required • Potential for >7-14days if process issue is root cause
	Bypassing of gas around stages	Check position of dampers	• Close any bypass damper found to open	• Process Controller to complete checks should be resolved during check	• PC will attempt to resolve issue in first instance as part of routine check. If unable to resolve will raise job for FSE or engineering support
	Gas loading rate too high through scrubber	Check gas flow rate	• Adjust volume control damper local to OCU • Reduce fan speed(VSD)	• Process Controller to complete checks should be resolved during check	• PC will attempt to resolve issue in first instance as part of routine check. If unable to resolve will raise job for FSE or engineering support
	Recirculating liquor conductivity too high	Check conductivity in recirculating liquor effluent/drain	• Increase blowdown rate	• Process Controller to complete checks should be resolved during check	• 24hrs
	No nutrient for microorganism growth	Check for change in source of irrigation water. Check nutrient tank	• Provide/Reorder nutrient soln • Source high qual sec effluent is possible	• 3rd party/Engineering Only identified through engineering support	• 2-4weeks upon identifying Nutrient deficiency

BIOLOGICAL ODOUR CONTROL FILTER SYSTEMS - TROUBLE DIAGNOSTIC TABLE					
OBSERVATION	PROBABLE CAUSE	NECESSARY CHECK	CORRECTIVE ACTION	ROLE RESPONSIBLE FOR ACTION	INDICATIVE TIMESCALE FOR COMPLETION
High outlet odour concentration (not H_2S)	pH too low	Check pH in OCU effluent/drain	• Increase/decrease blowdown or irrigation rate	• Process Controller to complete checks should be resolved during check	• 24hrs
	Non-degradable VOCs in foul air stream	Use portable Photo ionisation detector (PID) to determine if high levels of VOCs are in the air stream. GC-MS analysis if required to identify compounds	• Undertake process investigation to identify source and reduce emissions • Provide additional stage of treatment if required	• Process Controller to complete initial check on site check – escalate to ADT and Trade Effluent to investigate root cause possible	• Could be resolved immediately depending on root cause- could be one off trade issue • Potential for >7-14days if process issue is root cause
	Degradable VOCs in foul air stream	Determine if VOCs are in the air stream. GC-MS analysis if required to identify compounds Check pH in OCU effluent/drain Check pH profile through across media bed if possible	• Increase blowdown or irrigation rate to achieve pH >6 • Provide additional stage of treatment if required	• Process Controller to complete checks on site check – escalate to ADT if source of VOC load cannot be identified	• Could be resolved immediately depending on root cause • Up to 7 days if airflow rebalancing required • Potential for 7-28 days if process issue is root cause time form OCU to adapt to VOC/adjusted irrigation rate. • If VOC load not treatable due to OCU limitations may require additional treatment min 4 weeks

BIOLOGICAL ODOUR CONTROL FILTER SYSTEMS - TROUBLE DIAGNOSTIC TABLE					
OBSERVATION	PROBABLE CAUSE	NECESSARY CHECK	CORRECTIVE ACTION	ROLE RESPONSIBLE FOR ACTION	INDICATIVE TIMESCALE FOR COMPLETION
Insufficient airflow through the OCU	Fans out of service	Check the fan operation Check isolation Damper positions Check none return damper is preventing recirculation through standby fan	• Check fans are in working order/start fan • Replace belts/motor • Open dampers • Repair/replace none return damper	• Process Controller to complete checks	• Could be resolved immediately depending on root cause • Replacements belts/Fan motor/flexi replacement within 5-7 days
	System pressure drop greater than design	• Measure airflow in ductwork headers • Check pressure drop across media bed any pre-filters and mist eliminators • Check position of dampers	• Ensure required damper are in the fully open position • Open field ductwork dampers to achieve design air flow • Clean -filters	• Process Controller to complete checks • Process Controller to raise work order for FSE to assess repair	• PC will attempt to resolve issue in first instance as part of routine check. If unable to resolve will raise job for FSE or engineering support • Equipment repair/rectification dependent upon nature of repair and supply chain logistics
	Damage to Fan	• Foreign object within the unit • Belt slip • Faults with the motor	• Clean rotors or unit • Re-adjust belt tension or change belts • Check motor and power source	• Process Controller to complete checks • Process Controller to raise work order for FSE to assess repair	• PC will attempt to resolve issue in first instance as part of routine check. If unable to resolve will raise job for FSE or engineering support • Fan motor replacement within 5-7 days
	Leakage-	Check for leaks in ductwork	• Repair ductwork	• Process Controller to complete checks • Process Controller to raise work order for FSE to assess repair	• Equipment repair/rectification dependent upon nature of repair and supply chain logistics

ACTIVATED/DRY MEDIA ODOUR CONTROL UNITS – INSPECTION & MAINTENANCE ACTIVITIES										
Sub Task	Activity	Ops/Main	Daily	Week	Month	Quarter	6 Month	Annual	Greater	Comment
-	**Dry Media/Activated Carbon**									
1	Visual inspection of extraction system – ductwork & covers	Ops		✓						Check integrity of ductwork, flexible connects and covers for damage/failure. Dampers in open position. Check air inlets are functional and clear of debris, access hatches closed, condensate lines/drain functioning and drained.
2	Fire Dampers							✓		Check condition and operation of fire dampers
3	Measurement of system air flows	Ops				✓		✓		Record airflow from all extract points, entering, exiting OCU. Compare against design/previous records. Identify and investigate any deviation. Check operation condition of volume control dampers. Non routine measurement instigated based on increase/decrease OCU differential pressure/repeated fan low flow alarms.
4	Inlet, Outlet and inter-stage contaminant concentration H_2S (Could also be Ammonia, Mercaptans, Dimethyl Sulphide, Misc. volatile compounds (VOCs	Ops			✓					Confirm performance of each process stage and that inlet is within max design range. Could be continuous H_2S measurement if online instrumentation is provided. Daily check to confirm operation of instrument check against inlet design parameters and check correct sample gas flow rates. Replacement of paper tapes – as required (monthly). Calibration/Replacement of electro chem sensor 6 monthly-annual basis (3rd party).
6	Pre-heater functionality (if installed)	Ops	✓							Check heater is operational, AMPs drawn. Check external housing for corrosion. Check

ACTIVATED/DRY MEDIA ODOUR CONTROL UNITS – INSPECTION & MAINTENANCE ACTIVITIES										
Sub Task	Activity	Ops/Main	Daily	Week	Month	Quarter	6 Month	Annual	Greater	Comment
										flow and temperature instruments functionality/alarms. Could be triggered by differential pressure deviation.
8	OCU pressure drop across bed media bed and Pre-filter (if fitted)	Ops		✓						Information logged to identify performance trends. Operational and asset condition check. Check for operation. Check vessel integrity (deformation/gas and liquid leaks – air infiltration/fugitive release, corrosion.
10	Vessel Condensate drain	Ops		✓						More applicable to vessel held under negative pressure. Fans switched off and any drain valves opened. Any condensate allowed to drain. Media replaced based on reaching performance trigger level value. Use opportunity to inspect vessel internals for corrosion/damage. Potential recertification of vessels if appropriate.
12	Media sampling	Ops							✓	Media sampled and sent for external lab analysis to determine remaining media life/adsorption capacity Check for activity, dependent on size of unit, length of time in service Vs performance. Check for operation/function. Log hours run and fan availability. AMPs drawn Check for vibration/noise. Check integrity of any flexible connector between ductwork and fans.
13	OCU Fan & isolation/NRD damper operation/vibration	Ops	✓							Check for operation/function. Log hours run and fan availability. AMPs drawn Check for vibration/noise. Check integrity of any flexible connector between ductwork and fans.

Leigh WwTW Sludge Treatment Facility
Odour Management Plan

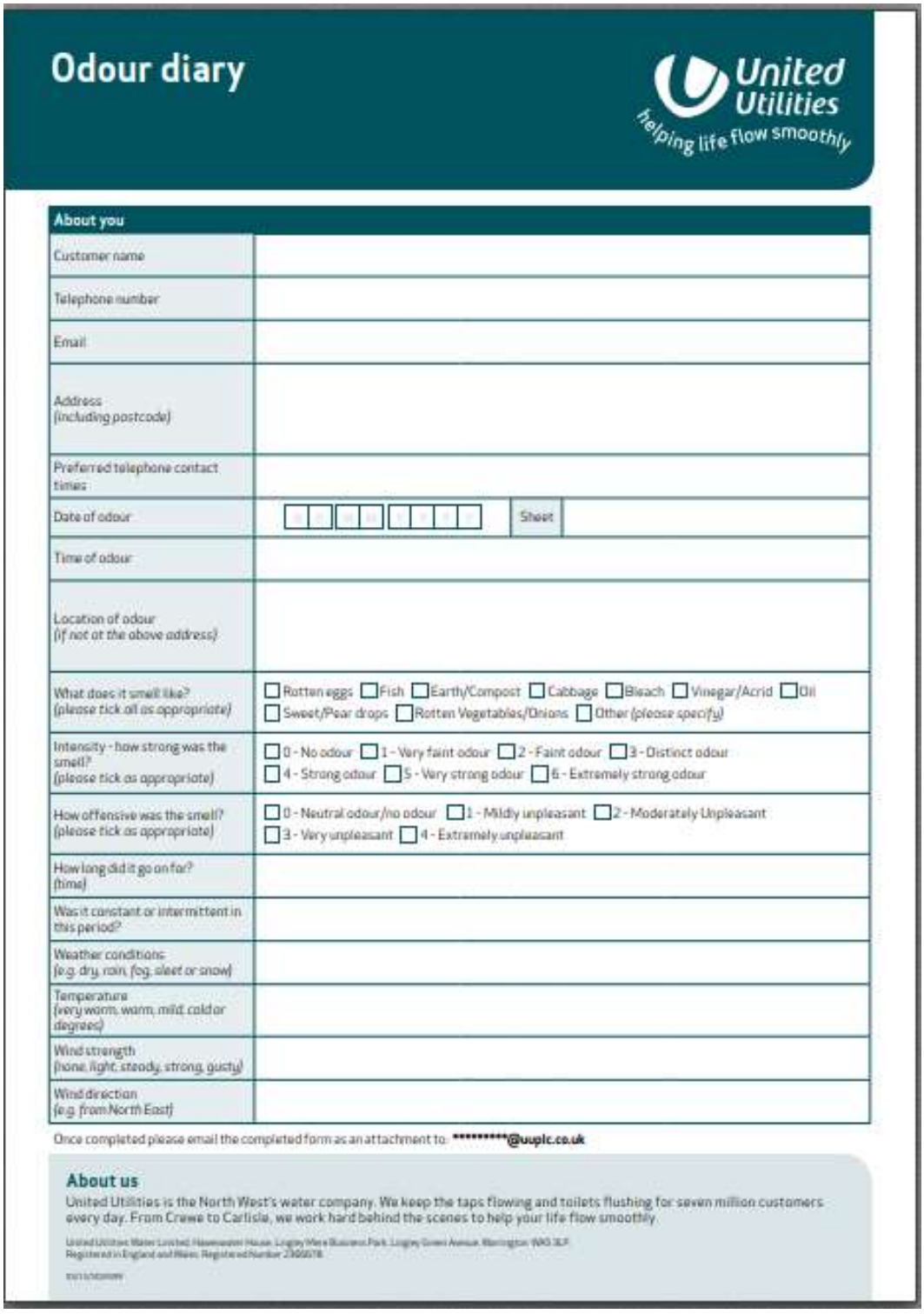
ACTIVATED/DRY MEDIA ODOUR CONTROL UNITS - TROUBLE DIAGNOSTIC TABLE					
OBSERVATION	PROBABLE CAUSE	NECESSARY CHECK	CORRECTIVE ACTION	ROLE RESPONSIBLE FOR ACTION	INDICATIVE TIMESCALE FOR COMPLETION
High NH_3 value at OCU outlet (>15 mg/Nm^3)	Media depleted	• Check when media was last changed • Check load against design • Consider testing media to determine the remaining media life/adsorption capacity	• Replace media where required • Change type/blend of media	• Process Controller to complete checks • Technical officer/Production Engineers to arrangement media replacement	• 7 -14 days for media replacement subject to supply chain
High H_2S value at OCU outlet	Media depleted	• Check when media was last changed • Check load against design • Check odour type i.e. H_2S Vs VOC against carbon type • Consider testing media to determine the remaining media life/adsorption capacity	• Replace media where required • Change type/blend of media	• Process Controller to complete checks • Technical officer/Production Engineers to arrangement media replacement	• 7 -14 days for media replacement subject to supply chain
	Excessive gas flow through unit	• Measure airflow in ductwork headers Check position of bypass dampers Check fan control: - Auto/manual etc. • Check fans speed Vs commissioning spec/datasheets	• If airflow rate exceeds design close dampers to achieve design air flow • Close damper(s) • Place fan into Auto • Reduce fan speed	• Process Controller to complete checks	• PC will attempt to resolve issue in first instance as part of routine check. If unable to resolve will raise job for FSE or engineering support
High outlet odour concentration (not H_2S)	VOCs in foul air stream	• Check operation or for installation of Pre heater • Use portable Photo ionisation detector (PID) to determine if high levels of VOCs are in the air stream. GC-MS analysis if required to identify compounds. • Check inlet relative humidity is within range recommend by media suppliers • Check type of media installed and suitability to treat VOCs	• Repair pre-heater if necessary • Undertake process investigation to identify source and reduce emission • Change media or provide additional stage of treatment if required	• Process Controller to complete checks • Process Controller to raise work order for FSE to assess repair • Technical officer/Production Engineers to arrangement media replacement	• PC will attempt to resolve issue in first instance as part of routine check. If unable to resolve will raise job for FSE or engineering support • 7 -14 days for media replacement subject to supply chain • Equipment repair/ rectification dependent upon nature

ACTIVATED/DRY MEDIA ODOUR CONTROL UNITS - TROUBLE DIAGNOSTIC TABLE					
OBSERVATION	PROBABLE CAUSE	NECESSARY CHECK	CORRECTIVE ACTION	ROLE RESPONSIBLE FOR ACTION	INDICATIVE TIMESCALE FOR COMPLETION
	Media depleted	• Check when media was last changed • Check load against design • Check odour type against carbon type • Consider testing media to determine the remaining media life/adsorption capacity	• Replace media where required • Change type/blend of media	• Process Controller to complete checks • Technical officer/Production Engineers to arrangement media replacement	• 7 -14 days for media replacement subject to supply chain
	Excessive gas flow through unit	• Measure airflow in ductwork headers • Check position of bypass dampers	• If airflow rate exceeds design close dampers to achieve design air	• Process Controller to complete checks	• PC will attempt to resolve issue in first instance as part of routine check. If unable to resolve will raise job for FSE or engineering support
Insufficient airflow through the OCU	Fans out of service	• Check the fans operation	• Check fans are in working order. • Start-up fan	• Process Controller to complete checks • Process Controller to raise work order for FSE to assess repair	• PC will attempt to resolve issue in first instance as part of routine check. If unable to resolve will raise job for FSE or engineering support • Failure of both duty and stand by fan will result in same day response from FSE (subject to higher priority alarms needing to be resolved). • Fan motor replacement within 5-7 days

ACTIVATED/DRY MEDIA ODOUR CONTROL UNITS - TROUBLE DIAGNOSTIC TABLE					
OBSERVATION	PROBABLE CAUSE	NECESSARY CHECK	CORRECTIVE ACTION	ROLE RESPONSIBLE FOR ACTION	INDICATIVE TIMESCALE FOR COMPLETION
	Bed collapse	• Check pressure drop across all beds. • Perform visual inspection.	• Place unit out of service. • Contact OCU supplier	• Process Controller to complete checks • Process Controller to raise work order for FSE to assess repair	• Equipment repair/rectification dependent upon nature of repair and supply chain logistics
	Duct broken/cracked	• Visual inspection.	• Organise repair.	• Process Controller to complete checks • Process Controller to raise work order for FSE to assess repair	• Equipment repair/rectification dependent upon nature of repair and supply chain logistics
Insufficient airflow through the OCU	System pressure drop greater than design	• Measure airflow in ductwork headers • Check pressure drop across scrubbers and pre-filters and mist eliminators • Check position of dampers	• Ensure required damper are in the fully open position • Open field ductwork dampers to achieve design air flow • Clean -pre-filters	• Process Controller to complete checks • Process Controller to raise work order for FSE to assess repair	• PC will attempt to resolve issue in first instance as part of routine check. If unable to resolve will raise job for FSE or engineering support • Equipment repair/rectification dependent upon nature of repair and supply chain logistics
	Damage to Fan	• Foreign object within the unit • Belt slip • Faults with the motor	• Clean rotors or unit • Re-adjust belt tension or change belts • Check motor and power source	• Process Controller to complete checks • Process Controller to raise work order for FSE to assess repair	• PC will attempt to resolve issue in first instance as part of routine check. If unable to resolve will raise job for FSE or engineering support • Fan motor replacement within 5-7 days

ACTIVATED/DRY MEDIA ODOUR CONTROL UNITS - TROUBLE DIAGNOSTIC TABLE					
OBSERVATION	PROBABLE CAUSE	NECESSARY CHECK	CORRECTIVE ACTION	ROLE RESPONSIBLE FOR ACTION	INDICATIVE TIMESCALE FOR COMPLETION
	Leakage	• Check for leaks in ductwork	• Repair ductwork	• Process Controller to complete checks • Process Controller to raise work order for FSE to assess repair	• Equipment repair/rectification dependent upon nature of repair and supply chain logistics
Airflow exceeds design rate	Installed system pressure drop less than design	• Measure airflow in ductwork headers.	• If airflow rate exceeds design close dampers to • achieve design air flow	• Process Controller to complete checks • Process Controller to raise work order for FSE to assess repair	• PC will attempt to resolve issue in first instance as part of routine check. If unable to resolve will raise job for FSE or engineering support • Equipment repair/rectification dependent upon nature of repair and supply chain logistics
	Bypass damper in open position	• Check position of bypass dampers	• Close damper(s)	• Process Controller to complete checks	• PC will attempt to resolve issue in first instance as part of routine check. If unable to resolve will raise job for FSE or engineering support
	Fan operating at higher than normal speed	• Check fan control:- Auto/manual • Check fans speed Vs comm spec/datasheets	• Place fan into Auto • Reduce fan speed	• Process Controller to complete checks	• PC will attempt to resolve issue in first instance as part of routine check. If unable to resolve will raise job for FSE or engineering support

Appendix E: Odour Diary Form



Odour diary

United Utilities
helping life flow smoothly

About you	
Customer name	
Telephone number	
Email	
Address (including postcode)	
Preferred telephone contact times	
Date of odour	☐☐☐☐☐☐☐☐ Sheet
Time of odour	
Location of odour (if not at the above address)	
What does it smell like? (please tick all as appropriate)	☐ Rotten eggs ☐ Fish ☐ Earthy/Compost ☐ Cabbage ☐ Bleach ☐ Vinegar/Acrid ☐ Oil ☐ Sweet/Pear drops ☐ Rotten Vegetables/Onions ☐ Other (please specify)
Intensity - how strong was the smell? (please tick as appropriate)	☐ 0 - No odour ☐ 1 - Very faint odour ☐ 2 - Faint odour ☐ 3 - Distinct odour ☐ 4 - Strong odour ☐ 5 - Very strong odour ☐ 6 - Extremely strong odour
How offensive was the smell? (please tick as appropriate)	☐ 0 - Neutral odour/no odour ☐ 1 - Mildly unpleasant ☐ 2 - Moderately Unpleasant ☐ 3 - Very unpleasant ☐ 4 - Extremely unpleasant
How long did it go on for? (time)	
Was it constant or intermittent in this period?	
Weather conditions (e.g. dry, rain, fog, sleet or snow)	
Temperature (very warm, warm, mild, cold or degrees)	
Wind strength (none, light, steady, strong, gusty)	
Wind direction (e.g. from North East)	

Once completed please email the completed form as an attachment to: **********@uuplc.co.uk

About us

United Utilities is the North West's water company. We keep the taps flowing and toilets flushing for seven million customers every day. From Crewe to Carlisle, we work hard behind the scenes to help your life flow smoothly.

United Utilities Water Limited, Haweswater House, Lingley Mere Business Park, Lingley Green Avenue, Warrington WA5 3LP.
Registered in England and Wales. Registered Number 2366678.

Appendix F: Odour Investigation Form

United Utilities Water for the North West	Wastewater Treatment	Reference: WwP/F/001/30/16
	Site Specific Form (SSF)	Version: 1 Issue date: 04/03/2021 Expiry date: 04/03/2024
	Site Odour Investigation Form	

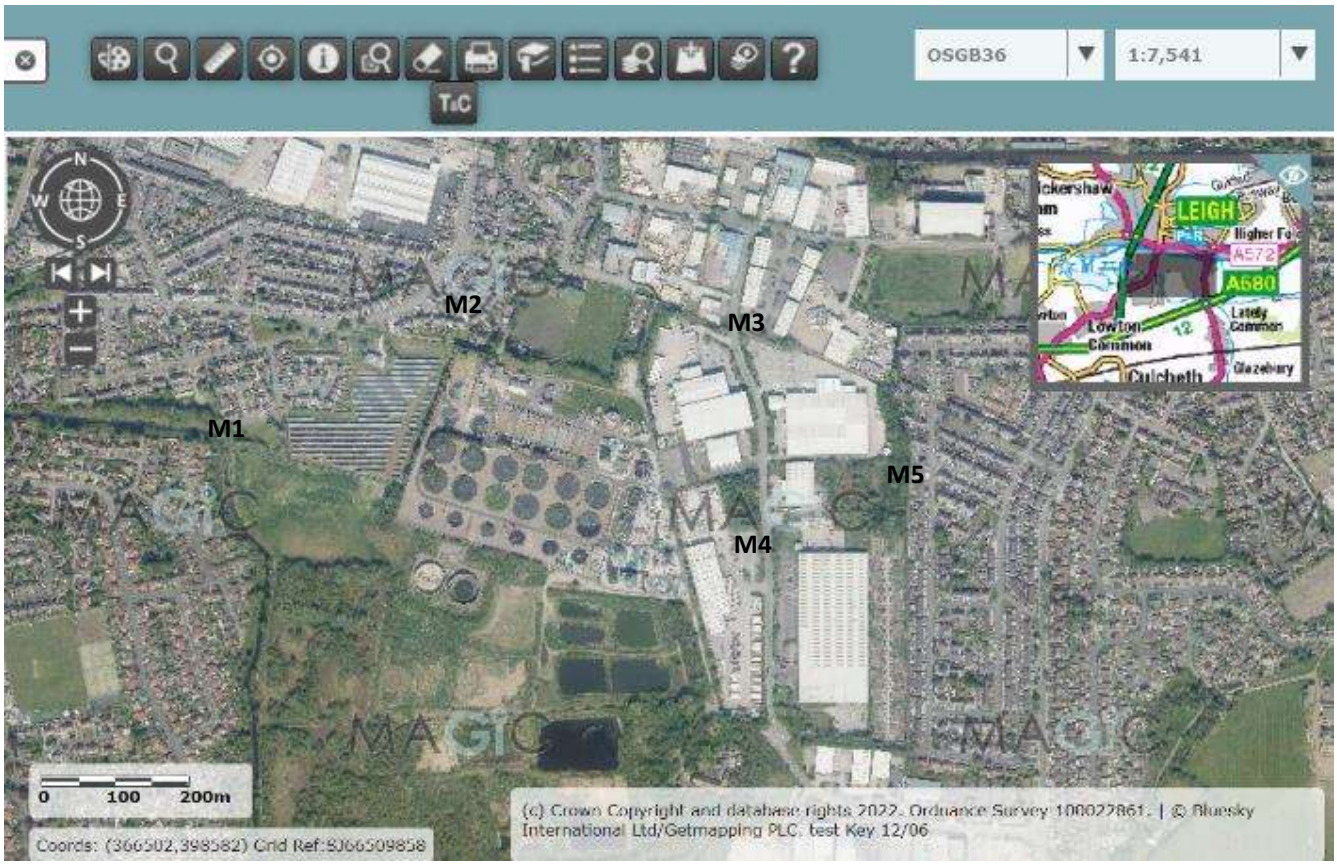
Site Odour Investigation Form	
Site:	
Name and Address of Complainant:	
Telephone number of complainant: N/A	
Date of odour:	
Time of odour:	
Location of odour, if not at above address:	
Weather conditions (i.e., dry, rain, fog, snow):	
Temperature (very warm, warm, mild, cold or degrees if known):	
Wind strength (none, light, steady, strong, gusting):	
Wind direction	
Complainant's description of odour: Prompts : Rotten eggs, Fish, Earth/Compost, Cabbage, Bleach Vinegar/Acrid, Oily, Sweet/Pear drops, Rotten Vegetables/Onions, Other (please specify)	
Intensity 0 - No odour 1 - Very faint odour 2 - Faint odour 3 - Distinct odour 4 - Strong odour 5 - Very strong odour 6 - Extremely strong odour	
Duration (time):	
Constant or intermittent in this period:	
Any other comments about the odour?	
Are there any other complaints relating to the installation, or to that location? (either previously or relating to the same exposure):	
Any other relevant information:	
Do you believe that the odour is likely to be from site activities?	
What was happening on site at the time the odour occurred? (Any potential cause of odour?)	
Operating conditions at time the odour occurred (e.g. OCU working ok? Sludge mixing, spillage, maintenance on PST/ST/Sludge tank?):	

Site Odour Investigation Form		
Actions taken: Investigation completed and checked site area.		
Form completed by:	Date	

Appendix G: Sniff Test Monitoring Locations

On Site Monitoring Locations

Off-site Monitoring Locations



Appendix H: Site Layout and Permit Boundary Plan