Blackburn WwTW Sludge Treatment Facility

Permit Number EPR/XP3638LJ

Odour Management Plan

May 2025

Contents

Site Details

Site name:	Blackburn WwTW Sludge Treatment Facility
Site address:	Cuerdale Lane, Samlesbury, Lancashire, PR5 0UY
Operator name:	United Utilities Water Limited
Application number:	EPR/XP3638LJ
National Grid Reference	SD 60150 29950

Document Owner

Document author: Production Manager

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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:

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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 regard to practices that will minimise the risk of odour emissions being discharged from the Blackburn 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 and appropriate control measures to reduce or minimise of 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

Blackburn Wastewater Treatment Works (WwTW) is located approximately 7 kilometres east of Preston town centre and approximately 8 kilometres west of Blackburn town centre. 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 indigenous sewage sludge arising from the wastewater treatment process at Blackburn comprises:

- unthickened sludge storage
- enhanced enzymic hydrolysis (EEH)
- digestion of sludge
- sludge dewatering by gravity belt thickeners (2), drum thickeners (3) and centrifuges (2)
- addition of polyelectrolyte
- settlement of solids from dewatering liquors using a Lamella tank
- storage and combustion of biogas in CHP and dual fuel boilers
- flaring of excess gas
- siloxane removal from the biogas
- disposal of process liquors
- raw material handling and storage
- odour abatement
- sludge cake storage
- sludge cake re-liquification
- sludge cake liming.

In addition to indigenous sludge, the facility receives imported sludge from other wastewater treatment works by road tanker. The facility can treat up to 2,628,000m^3 of wet tonnes per year. The hydrolysis process is undertaken within six vessels and there are four operational digesters utilised to treat the sludge. Biogas is combusted in two on-site combined heat and power (CHP) engines, generating heat and electricity for the process.

The treatment process is automated and operates 24 hours per day, 365 days per year. Imported sludge is received by road tanker 24 hours per day, 365 days per year.

The WwTW is situated in an agricultural area with the River Darwen flowing approximately 160m to the south and the Hole Brook 85m to the east of the installation boundary. There are a few isolated farms and a hotel within 500m of the installation. The nearest property is Darwen Side Farm which is approximately 160m south east of the installation boundary.

1.3. Maintenance and Review of the OMP

The OMP is held electronically on the company's Quality Assurance system.

The WwTW Production Manager (PM) is responsible for compliance and review of the OMP, with support from the Process Controllers (PC) and site Environmental Regulatory Advisor (ERA).

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 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 OCUs 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 2021).

2. Receptors

2.1. Receptor List

The WwTW is situated in an agricultural area with the River Darwen flowing approximately 160m to the south and the Hole Brook 85m to the east of the installation boundary. There are a number of isolated farms and residential properties, a brewery, a restaurant and a hotel within 1km of the installation boundary. High and medium sensitivity receptors (housing, pubs, hotels, industrial/commercial workplaces) within 500m of the sludge treatment activities (any odorous emissions are considered likely to have sufficiently dispersed beyond this distance) are shown on Figure 2.1. Receptors within 2km of the site are detailed in Table 2.1 and shown in Figure 2.2.

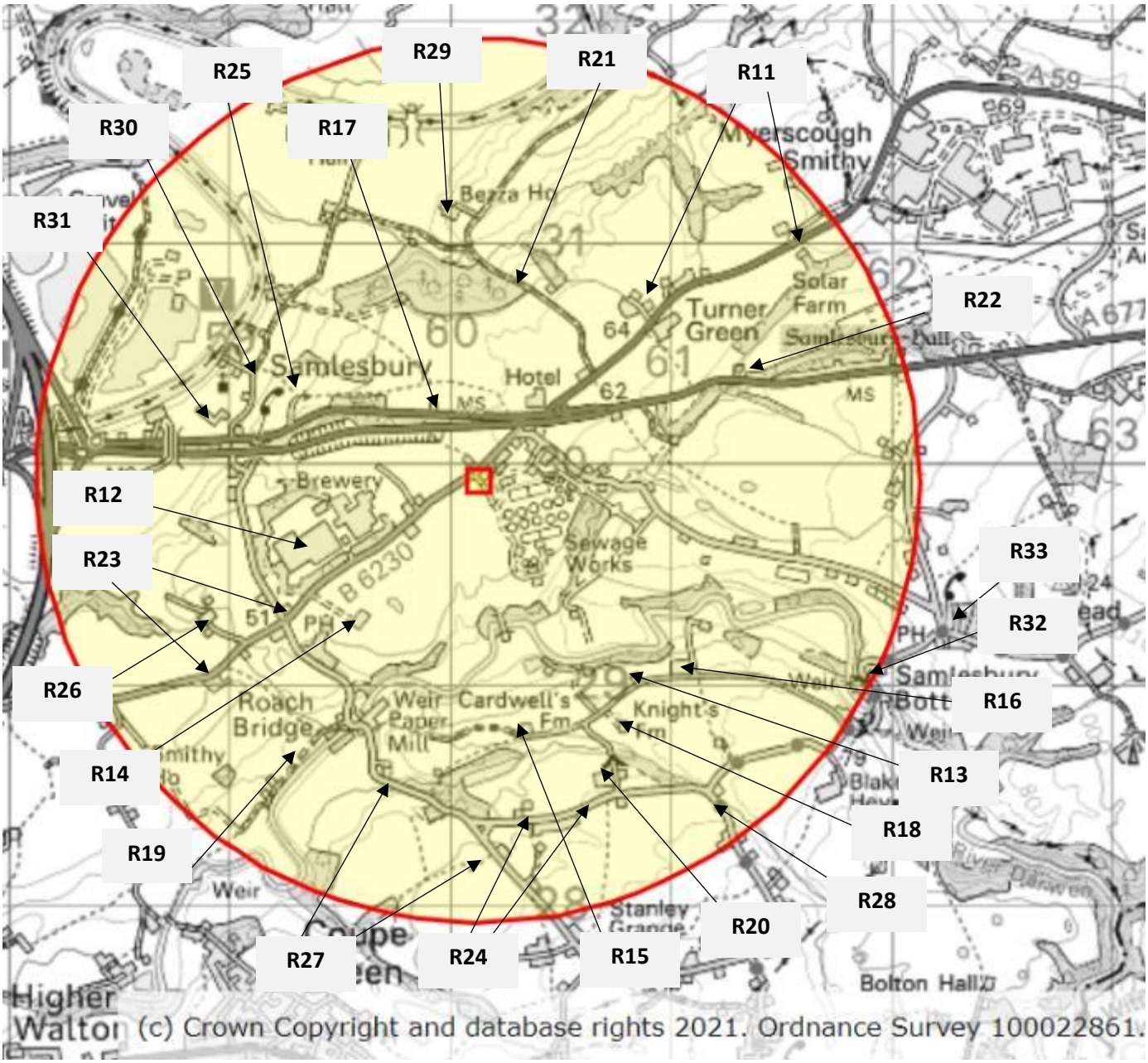
Table 2.1. Receptor List

Receptor	Description	Closest distance from Installation boundary (m)	Direction from the site	Sensitivity to odour
R1	Commercial property (petrol station), Preston New Road	460	N	Medium
R2	Samlesbury Hotel, Preston New Road	530	N	High
R3	Residential and commercial properties at Upland Farm, Spring Lane	395	NE	Medium/High
R4	Residential properties (The Hermitage) at Preston New Road	700	NE	High
R5	Residential property at Hole Bottom Cottage, Spring Lane	500	ENE	High
R6	Residential properties at Spring Lane	560	ENE	High
R7	Residential and commercial properties at Darwen Side Farm	160	SSE	Medium/High
R8	Residential properties at Knight Bottoms, off Green Lane	350	S	High
R9A	Residential property at Cowells Farm, Cuerdale Lane	320	WNW	High
R9B	Agricultural building at Cowells Farm, Cuerdale Lane	260	WNW	Medium/Low
R10	Samlesbury War Memorial Hall, Cuerdale Lane	360	NNW	Medium
R11	Mix of commercial and residential properties along Whalley Road	520	NNE	Medium/High
R12	Commercial property (brewery) on Cuerdale Lane	560	WWN	Medium
R13	Residential property at Oak Cottage, Green Lane	585	SSE	High
R14	Commercial properties at Roacher Hall	620	W	Medium
R15	Mix of commercial and residential properties at Cardwell's Farm	630	S	Medium/High

Receptor	Description	Closest distance from Installation boundary (m)	Direction from the site	Sensitivity to odour
R16	Mix of commercial and residential properties at Green Lane Farm	685	SE	Medium/High
R17	Commercial property on Preston New Road	700	SW	Medium
R18	Mix of commercial and residential properties at Knights Farm, off Green Lane	750	SSE	Medium/High
R19	Mix of residential and commercial properties at Roach Bridge	820	SW	Medium/High
R20	Commercial properties at Dark Wood Lane (Simpson's Farm)	860	SSE	Medium
R21	Residential properties along Dean Lane	910	N	High
R22	Residential properties along Preston New Road	930	NW	High
R23	Mix of residential and commercial properties along Cuerdale Lane	1,000	W	Medium/High
R24	Mix of residential and commercial properties along Firwood Lane	1,080	S to SSE	Medium/High
R25	St. Mary's & St John Southworths RC Church	1,170	NW	Medium
R26	Commercial properties at Walmsley Fold Farm	1,290	W	Medium
R27	Mix of residential and commercial properties along Roach Road	1,080	SSW to S	Medium/High
R28	Mix of residential and commercial properties along Goosefoot Lane	1,250	SE	Medium/High
R29	Mix of residential and commercial properties along Bezza Lane	1,330	NNE	Medium/High
R30	Residential properties (including school and church) along Potter Lane	1,380	NW	High
R31	Commercial property on Potter Lane	1,460	NW	Medium
R32	Residential area at Samlesbury Bottoms	1,530	ESE	High
R33	Residential area at Nab's Head	1,780	E	High

Figure 2.1 Map of site location and receptors within 500m

Figure 2.2 Map of site location and receptors within 500m to 2km radius



2.2. Wind Rose and Source of Weather Data

Wind rose data from 2016-2020 for the Burnley area is provided in Appendix A, as it is considered to be the most representative data available for Blackburn. The wind rose data shows that the site experiences strong prevailing west-south-westerly winds, predominantly in excess of 6 knots, meaning any odorous emissions released from site are likely to be dispersed to the east/north east of the works.

The Blackburn Sludge Treatment Facility and surrounding area has a relatively flat topography with few natural barriers to wind movement. However, there is a line of mature trees that provide some screening along the western boundary of the site, and thicker lines of mature trees/woods along the east and south of the site, adjacent to the closest residential property.

Live data on wind speed and direction can be obtained from numerous websites, including the Windfinder website which provides information for two local weather stations at New Longton to south west and Lea Town to the west and one forecast spot at Rishton Reservoir to the east:

- New Longton: https://www.windfinder.com/#10/53.7292/-2.7438
- Lea Town: https://www.windfinder.com/#10/53.7844/-2.7919
- Rishton Reservoir: https://www.windfinder.com/#10/53.7649/-2.4348

Past data on wind speed and direction can be obtained from the following website for Manchester Airport and Bingley. 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 – indigenous and imported sludges), 19 02 06 (sewage sludges from physico/chemical treatment) and 19 06 06 (imported liquid digestate and digested cake from other UUW sludge treatment sites) may be accepted at the facility.

Waste accepted at the facility is limited to sewage sludges; indigenous sludges produced from Blackburn WwTW and imported sludge and cake from other UUW sites. The process has been designed to treat sewage sludges generated within the UU 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 Blackburn'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) and assessed in advance in accordance with a Biosolids Assurance Scheme (BAS) source material risk assessment. 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 automatically from the Nereda system into two sludge reception tanks (these tanks do not form part of the installation). From here it is fed via an underground pipe to three enclosed drum thickeners, from which point it joins the imported sludges in the hydrolysis plant and thus there is limited potential for diffuse emissions to atmosphere.

Following the digestion processes, the dewatered digestate cake is carried by an enclosed conveyor and deposited in a concrete surfaced and walled external cake storage area adjacent to the Press House. The treated cake is transferred onto covered trucks using an excavator and loading shovel and removed off site for agricultural land spreading. The typical storage retention time in the cake storage area is 5 days. Any non-conforming digested sludge cake will be quarantined within an isolated area of the cake storage area.

Imported cake transported from other WwTWs by truck/trailer comprises digested, thickened sludge. Cake is off-loaded into segregated bays within the northern cake pad. This area is concrete surfaced with concrete. A proportion of the imported digested cake is treated with lime to produce an enhanced product for land spreading under the Biosolids Assurance Scheme (BAS). The mobile liming plant mixes cake with powdered lime to achieve the required pathogen kill. 'A' frame panels are used to separate lime treated (enhanced) cake from untreated (conventional) digested cake.

Indigenous cake would only be moved to the northern cake pad for lime treatment if there was a prolonged HACCP failure whereby special arrangements would be made to clean and prepare a segregated area.

Raw sludge imports from other wastewater treatment works are delivered to site in enclosed road tankers. Following off-loading, the sludge discharges through a screen into a below ground chamber. The sludge reception chamber is open; however, it only has a small surface area and thus limited potential for diffuse emissions to atmosphere.

Raw sewage sludge cake is imported to site in covered wagons from other UUW sites and is reliquefied. It is stored in a designated raw cake storage area in accordance with the relevant work instruction. From the cake storage area, the cake is loaded into the hopper of the re-liquification unit. Liquid sludge from the mixing and balancing tanks is pumped into the hopper, where it reliquefies the raw cake via mixing within an inclined conveyor. The reliquefied sludge discharges into a pump station and is then pumped into the EEH feed tank. The cake is treated within 24 to 48 hours of delivery and thus there is limited potential for diffuse emissions to atmosphere. Any non-conforming raw sludge cake will be quarantined within an isolated area of the cake storage area.

3.2. Overview of Odorous Processes and Emissions

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

Imported sludge is discharged through a screening unit into the sludge reception chamber. The sludge reception chamber is open; however, it only has a small surface area and thus limited potential for diffuse emissions to atmosphere. From the chamber, sludge is pumped into an enclosed above ground storage tank (unthickened sludge tank). The unthickened sludge tank is connected to an odour control unit.

The unthickened sludge is passed through a second screen into four mixing and balancing tanks. Sludge screenings are collected in open skips that are partially enclosed in a steel-clad unit. The mixing and balancing tanks are open, uncovered tanks. Sludges are continually mixed and pumped through this part of the process, which will prevent anaerobic conditions and hence minimise odours.

From the mixing and balancing tanks, the blended sludge is pumped into two gravity belt thickeners (GBTs), which are located within an enclosed building. The thickened sludge drops into a sludge storage tank below the GBTs (within the building) and is pumped to the EEH feed tank.

Indigenous sludge from the WwTW is fed automatically from the Nereda system into two sludge reception tanks (these tanks do not form part of the installation), before undergoing thickening in the drum thickeners. Thickened sludge is pumped into the enclosed EEH feed tank where it joins the imported sludges and reliquefied imported sludges. The EEH feed tank is connected to an odour control unit.

From the EEH feed tank, the thickened sludge is pumped to the enclosed EEH plant for pre-digestion sludge treatment. From the EEH vessels the sludge is batch fed into four enclosed digesters.

Biogas generated in the digesters and the EEH is drawn off and directed to the gas bag. The gas is then directed to the CHP engines for combustion. There are pressure vacuum relief valves (PVRVs) on each of the digester tanks, gas bag and on the EEH plant which will operate automatically if a set pressure is exceeded.

From the digesters, the digested sludge is passed into one of three enclosed post digestion tanks via positive displacement by incoming hydrolysed sludge from the EEH plant. Following storage in these tanks, the sludge is pumped to a sludge feed tank before being fed through a final de-watering process. This tank is enclosed within the building housing the dewatering centrifuges and polyelectrolyte make up system.

Centrate from the centrifuges passes through a small enclosed buffer tank before being pumped to an open tank where it is combined with the GBT filtrate. The centrate buffer tank is connected to an odour control unit. The combined centrate/ filtrate stream is passed through an enclosed lamella tank for solids reduction prior to discharge into a pumping chamber (the liquor return well). From the Liquor Return

Pump Well the liquor is pumped to a second pump station where it is mixed with wastewater from the tertiary backwash filter before being pumped to the Nereda inlet channel for biological treatment.

De-watered digestate cake from the centrifuges is carried by a conveyor and deposited in a concrete surfaced and walled external cake storage area.

Imported digested cake is storage on the northern cake pad. The lime/ digestate mixing drum hopper and discharge conveyor are not enclosed and thus a potential source of fugitive emissions. During the liming process fugitive releases of ammonia will occur giving rise to some localised odours.

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 – imported	Hydrogen Sulphide Mercaptans Dimethyl Sulphide	Rotten eggs Decayed cabbage Decayed vegetables	Medium to High
Surplus Nereda sludge	Hydrogen Sulphide	Surplus Nereda sludge	Medium
Sludge screening and thickening	Hydrogen Sulphide Mercaptans Dimethyl Sulphide	Rotten eggs Decayed cabbage Decayed vegetables	Medium to High
Digested sludge (indigenous and imported)	Ammonia	Ammoniacal/ fishy	Low to Medium
Filtrate and 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 to Medium
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.

A site plan showing point source emissions to air and tank locations is provided as Figure 3.1.

Table 3.3.2 Potential Sources of Odours

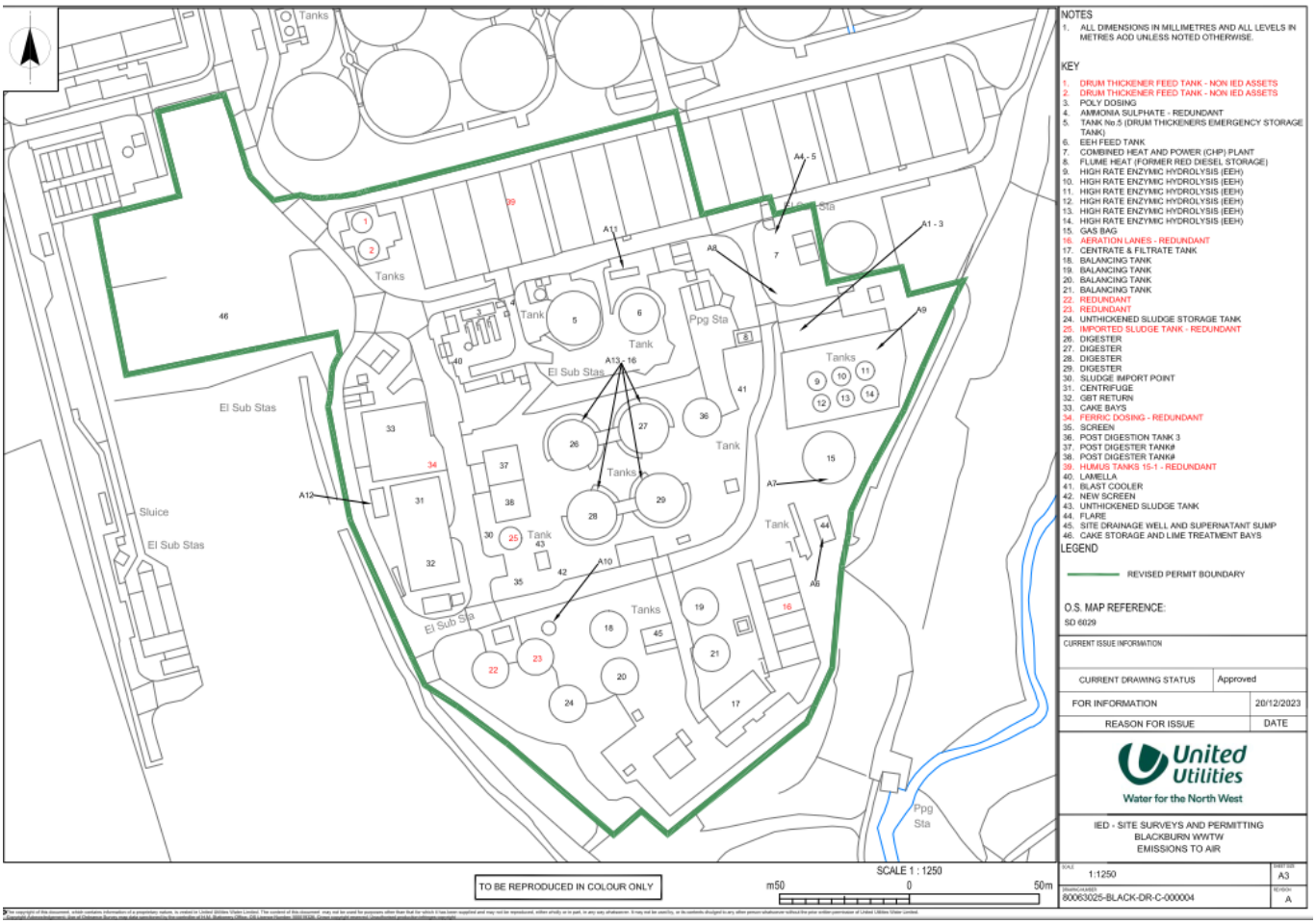
Source Area	Source Material	Quantity Stored on Site	Odour Potential	Probability of Release	Additional comments
Imported sludge tanker off-load	Untreated sludge	N/A	High	Medium	Fugitive emissions
Unthickened sludge chamber	Untreated sludge	10m^3	High	High	Open tank – fugitive emissions
Unthickened sludge tank	Untreated sludge	1,800m^3	High	Low	Connected to OCU – point source emissions
Sludge screening	Untreated sludge	N/A	High	Medium	Enclosed units situated externally - fugitive emissions
Separated solids storage	Solids screened from sludge	9.2m^3 skips	High	High	Fugitive emissions
Mixing and balancing tanks x 4	Screened, undigested sludge	2,000m^3	High	High	Open tank - fugitive emissions
Site drainage sump	Site drainage	Approx. 200m^3	Low	Low	Open sump - fugitive emissions
Drum thickeners	Undigested sludge	200m^3/hr max throughput	High	Low	Enclosed unit situated externally - fugitive emissions
Drum thickeners emergency storage tank	Undigested, thickened sludge	700m^3	High	High	Open tank - fugitive emissions but only for emergency usage
EEH feed tank	Screened/ thickened sludge	1,400m^3	High	Low	Connected to OCU – point source emissions
Post digestion tanks	Digested sludge	2 x 900m^3 1 x 1,200m^3	Medium	Low	Enclosed tanks – fugitive emissions
Centrifuge sludge feed tank	Digested sludge	600m^3	Medium	Low	Enclosed tank housed within building
Centrifuges & GBTs	GBT - undigested sludge Centrifuge - digested sludge	GBT (combined total) – 100m^3/hr max throughput Centrifuges (combined total) - 90m^3/hr max throughput	Medium	Low	GBTs and centrifuges housed within building - fugitive emissions
Centrate buffer tank	Liquid centrate	2m^3	High	Low	Connected to OCU – point source emissions
Centrate and filtrate tank	Liquid centrate and filtrate	1,200m^3 each	High	High	Open tank - fugitive emissions
Lamella tank	Liquors from GBTs and centrifuges	19m^3	High	Low	Enclosed unit situated externally - fugitive emissions

Source Area	Source Material	Quantity Stored on Site	Odour Potential	Probability of Release	Additional comments
Gas Holder PVRV (A7)	Biogas	N/A	Medium	Low	Point source emissions
EEH Plant PVRV (A9)	Biogas	N/A	Medium	Low	Point source emissions
Digester PVRVs (A13 to A16)	Biogas	N/A	Medium	Low	Point source emissions
CHP stacks (A4 & A5)	Combustion of biogas	N/A	Very low	High	Point source emissions
Boiler stacks (A1 to A3)	Combustion of biogas	N/A	Very low	High	Point source emissions
Flare (A6)	Combustion of biogas	N/A	Very low	Medium	Point source emissions
Leaks in gas pipework e.g. around flanges	Biogas	N/A	Medium	Low	Fugitive emissions
Digestate cake conveyor	Digested sludge cake	N/A	Low	Low	Fugitive emissions
Indigenous digested cake storage pad	Digested sludge	Approximately 1,000m^3	Low	High	Open storage - fugitive emissions
Imported digested cake storage pad	Digested sludge	Maximum 6,000m^3	Low	High	Open storage - fugitive emissions
Digestate cake liming equipment	Digested sludge	Processes up to 20 tonnes of cake per hour	Low	High	Open mixing - fugitive emissions
Raw sludge cake storage area and reliquification auger/hopper	Raw sludge cake	6m^3 hopper Up to 90m^3 cake storage*	High	High	Fugitive emissions
Tank cleaning	Grit	N/A	High	High	Fugitive emissions
Leaks/spills of sludge from process	Digested or Undigested Sludge	N/A	Medium	Low	Fugitive emissions
* Maximum quantity that could be stored, however significantly less is actually stored					

The open tanks represent a potential source of fugitive emissions of volatile organic compounds, hydrogen sulphide and ammonia to the atmosphere. Permit Improvement Condition IC 2 requires UUW to submit a plan to enclose and abate emissions from these tanks and to obtain the Environment Agency's written approval to it.

Control measures for other sources identified in Table 3.3.2 are detailed in Section 4.

Figure 3.3.1: Site Layout Plan and Emissions to Air



3.4. Odour Exposure Pathways

The following section details 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.

The majority of storage tanks, treatment tanks and associated pipework are enclosed, with the exception of the unthickened sludge reception chamber, mixing and balancing tanks and the centrate and filtrate storage tank. Permit Improvement Condition IC 2 requires UUW to submit a plan to enclose and abatement these tanks and to obtain the Environment Agency's written approval to it.

The enclosed unthickened sludge tank, EEH feed tank and centrate break tank are all connected to odour control units.

Tanks that are connected to the gas management system only vent to atmosphere under abnormal operating conditions. Pressure vacuum relief valves (PVRVs) on the digesters, EEH and gas bag 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.

Digestate cake and raw sludge cake are stored in the open. Raw sludge cake is treated within 24 to 48 hours of delivery. De-watered digestate cake is stored in concrete surfaced and walled storage areas. The imported digested cake may be mixed with lime in a dedicated bay and segregated from un-limed cake. The cake is transferred onto covered trucks using an excavator and loading shovel and removed off site for agricultural land spreading. The typical storage retention time in the cake storage areas is 5 days.

A significant spill or leak of sludge or digestate from the tanks, associated pumps or pipework could result in fugitive odour emissions. 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. Process monitoring controls are set out in the Wastewater Services Mesophilic Digestion SOP (WwP/S/001/02), Blackburn Primary Digestion (SOP WwP/I/3006/18/04) and the site HACCP (WwP/I/3006/18/39).

The HACCP contains critical control limits to maintain digester health and digestate quality, as set out in Table 4.1.1.

Table 4.2.1: HACCP Critical Control Points

Critical Control Point (CCP)	Description	Critical Limit	Frequency of monitoring
CCP1	EEH Plant Reactor No.1 Temperature	>30 degrees C	Daily, Continuous and Automatic
CCP2 * (Not required for conventional end product)	EEH Plant Digester Sludge Feed Temperature	>35 degrees C	Daily, Continuous, Automatic Only required when operating plant to produce an enhanced product
CCP3 – CCP6	Digesters No.1 -4 Temperature	>28 degrees C	Daily, Continuous, Automatic
CCP7	EEH Maximum Daily Feed	835 m^3	Daily, Automatic
CCP8	Primary Digester Maximum Daily Feed	260 m^3 per Digester	Daily, Automatic

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

- pH – 5 to 8
- temperature 35 +/- 3ºC
- VFA in digested sludge - <200mg/l
- VFA/alkalinity ratio <0.2
- Alkalinity in digested sludge - 3,000 - 5,000mg/l
- Biogas quality - 60-70% CH_4

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 (sludge)	Weekly	Sample taken (digester feed)	Lab analysis
Alkalinity (sludge)	Weekly	Sample taken (digester feed)	Lab analysis
Temperature	Continuous	Temperature probe within digesters and EEH vessels	SCADA
Volatile fatty acids concentration (sludge)	Weekly	Sample taken (digesters)	Lab analysis

Parameter	Frequency of measurement	Point of measurement	System of measurement
Ammonia (sludge)	Weekly	Sample taken (digesters)	Lab analysis
Sludge flow	Continuous	Flow meter	SCADA
Biogas Flow	Continuous	Flow meter	SCADA
Methane (biogas)	Continuous	Gas meter	SCADA
CO_2 (biogas)	Fortnightly	Gas meter	SCADA
O_2 (biogas)	Fortnightly	Gas meter	Engine HMI
Hydrogen Sulphide (biogas)	Continuous	H_2S analyser	PLC/ HMI boiler plant room
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.

The digested cake liming process is controlled by a dedicated HACCP. Mixing the cake with lime raises the pH to 12 which virtually eliminates any remaining pathogens which may be present in the sludge when held for a period of two hours. The HACCP sets out critical control points (CCPs) and the process to be taken in the event of a breach of a CCP. Examples of site specific corrective actions are provided in Table 5.18.3.

Table 4.2.3: Corrective Actions in the event of a Critical Control Point Breach – Liming Process

CCP	Name	Critical Limit (CL)	Corrective Actions Approaching CL	Corrective Actions when CL breached
L1	Retention time	2 hours	Increase monitoring process and if possible reduce sludge being limed.	Stop the process, quarantine the cake and take samples to be sent to the labs for testing.
L2	Weight of sludge vs % lime	4 %	Increase monitoring process and if possible reduce sludge being limed.	Stop the process, quarantine the cake and take samples to be sent to the labs for testing.

4.3. Odour Abatement

The facility was designed with the containment and odour control of certain process units. There are three odour control units that have fallen into disrepair and are not currently operational. The design of these units is detailed in Section 4.3.1. Remedial actions to reinstate these units are detailed in Section 4.3.2.

4.3.1. Odour Control Units

The facility has three odour control units, each with its own emission stack.

1. Unthickened Sludge Tank OCU - Emission Point A10 (NGR SD 6035 2948)

   The unthickened sludge tank is connected to an OCU, which is designed to continuously remove odours from the air expelled from the tank. The OCU has two stages of treatment, comprising catalytic iron filtration (CIF) and an activated carbon unit (dry media adsorption process). The CIF comprises rusting iron Pall rings for bulk hydrogen sulphide removal. The first adsorption stage uses a proprietary media for hydrogen sulphide and mercaptans removal, followed by a second stage which contains dry media selected to remove other odorous wastewater compounds, including VOCs, that maybe present. The odour control extraction fans are used to extract air out of the odour control unit and push it up the stack (emission point A10). In the event that the CIF stage is out of service, the second stage is designed to treat the 'full' design load into the plant.

2. EEH Feed Tank OCU - Emission Point A11 (NGR SD 6037 2962)

   The OCU serving the EEH buffer tank comprises catalytic iron filtration (CIF) and an activated carbon adsorption odour control unit, which is designed to continuously remove odours from the air expelled from the tank. The CIF operates as two separate columns operating on a duty/standby basis, followed by two carbon vessels operating in parallel. The adsorption stage uses an alkali impregnated carbon media for enhanced hydrogen sulphide and mercaptans removal. The odour control extraction fans are used to extract air out of the odour control unit and push it up the stack (emission point A11). In the event that the CIF stage is out of service, the second stage is designed to treat the 'full' design load into the plant.

3. Centrate Buffer Tank OCU - Emission Point A12 (NGR SD 6028 2953)

   The centrate buffer tank is connected to an OCU. The OCU has one stage of treatment (adsorption), comprising an activated carbon unit (alkali impregnated carbon media) for enhanced hydrogen sulphide and mercaptans removal.

The process flow diagram in Appendix B shows the process connections to the odour control units and the emission points.

The odour control technologies were designed in accordance with UUW's Asset Standard for Odour Control and Removal[1].

A combination of catalytic iron filtration and activated carbon/dry media (adsorption) technologies were chosen for this facility. The use of adsorption techniques complies with BAT.

The design operating parameters and odour removal efficiencies for the OCUs at Blackburn are detailed in Appendix C, as are the units design performance levels, principle operating parameters and associated trigger points. 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 OCUs were assessed against an odour benchmark level of 1.5 ouE/m^3 at nearby sensitive receptors, which is the H4 odour benchmark for the

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

most offensive odours and the UU Odour Control and Removal Asset Standard (for high sensitivity receptors).

The results indicate that the maximum predicted 1-hour mean (98th percentile) odour concentration at the assessed sensitive receptors is less than 0.1 ouE/m^3, which is significantly below the 1.5 ouE/m^3 benchmark.

Table 4.3.1: OCU operating parameters and emission rates

Emission point	Source	Stack height (m)	Effective stack diameter (m)[1]	Efflux velocity (m/s)	Design air flow rate (m^3/s)	Odour conc. (ou_E/m^3)	Odour release rate (ou_E/s)
A10	Unthickened Sludge Tank OCU	3.50	0.21	15.0	0.528	1,000	527.78
A11	EEH Feed Tank OCU	6.00	0.23	15.0	0.611	1,000	611.11
A12	Centrate Buffer Tank OCU	14.40	0.06	15.0	0.037	1,000	36.94

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

The design of the odour control technologies is considered to comply with BAT for the treatment process.

The OCUs have recently been refurbished and six-monthly emissions monitoring in line with the permit conditions is being initiated.

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. The OCUs are listed as Environmental Permitted assets and flagged as a priority for scheduled inspection tours. All work completed is held on United Utilities' asset inventory and work planning system, MARS.

The MARS work order system will be utilised to schedule 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.

Site-Specific Instructions (SSIs) will be developed for the operation of the OCUs. These will document local set points and operating parameters and provide advice on trouble shooting and corrective actions for abnormal operating conditions.

A general list of tasks and activities to monitor and maintain the performance of CIF and carbon absorption systems is provided in Appendix D. This is intended to give a guide to the range of activities that will be included in the SSIs.

4.4.2 Monitoring

The following emissions monitoring is to be undertaken for each odour control unit stack once every 6 months, in line with the permit conditions:

Hydrogen sulphide
Ammonia
Odour Concentration
Total volatile organic compounds (TVOC)
Hydrogen chloride

Suitable measurement ports will be provided to allow access and monitoring of the OCU stacks. Emissions monitoring will be carried out by an MCERTS accredited third party laboratory.

Olfactory monitoring ('sniff' testing) is undertaken on a daily basis at the boundary of the sludge treatment facility. Operators are required to complete a daily chart noting any odour and odour strength at the installation boundary.

The open tanks represent a potential source of fugitive emissions to the atmosphere. Permit Improvement Condition IC 2 requires UUW to submit a plan to enclose and abatement these tanks and to obtain the Environment Agency's written approval to it.

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 – 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 OCU.

Odour control measures are detailed in Table 4.4 below.

Table 4.4. Odour Control Measures

Source	Nature	Odour Potential	Probability of Release	Control Measures	Residual Risk
Sludge reception chamber	Untreated sludge	High	High	• Reception chamber is below ground, but open. The capacity of the chamber is relatively small (approximately 10m^3). • Site inspection tours are carried out daily by site-based staff and monthly by the site's Environmental Regulatory Advisor (ERA). • Provision of masking sprays around area will be considered if required.	Medium
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 sludge reception chamber via a screening unit. • In the event of any spillage, clean up measures are implemented in accordance with the Flood and Spill Plan.	Low
Unthickened sludge tank	Untreated sludge	High	Low	• Hatches are kept shut except for inspections or maintenance.	Low

Source	Nature	Odour Potential	Probability of Release	Control Measures	Residual Risk
				• Tank is enclosed and connected to an OCU (A10) comprising a CIF and activated carbon unit. • Routine operation checks and maintenance to ensure the tanks and OCU are functioning as per design. • Six monthly monitoring of the OCU emissions. • Raw sludge storage times are minimised to avoid septicity and odour.	
Screenings and separated solids storage	Untreated sludge	High	High	• Separated solids are stored in skips within a steel-clad enclosure with walls around three sides. • Skips are sheeted when full and emptied frequently. • 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 Environmental Regulatory Advisor (ERA). Any leaks or spillages identified are investigated and actioned promptly. • Provision of masking sprays around area will be considered if required.	Medium
Mixing and balancing tanks (x4) Tank No.'s 18-21	Screened sludge	High	High	• These tanks are below ground but are open to the atmosphere. The capacity of the tanks is 500m^3 each. These tanks are subject to Permit Improvement Condition IC2. • Raw sludge storage times are minimised to avoid septicity and odours. • Routine operation checks and maintenance ensure the tank mixers are functioning as per design. • Site inspection tours are carried out daily by site-based staff and monthly by the site's Environmental Regulatory Advisor (ERA). Any leaks or spillages identified are investigated and actioned promptly. • Provision of masking sprays around area will be considered if required.	Medium

Source	Nature	Odour Potential	Probability of Release	Control Measures	Residual Risk
Drum thickeners	Undigested indigenous sludge	Medium	Low	• Fully enclosed units and pipework. • Maintenance in accordance with MAMS schedule to minimise risk of blockages. • Hatches kept shut except for inspections or maintenance. • 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 Environmental Regulatory Advisor (ERA). Any leaks or spillages identified are investigated and actioned promptly. • Provision of masking sprays around area will be considered if required.	Low
Drum thickeners emergency storage tank (Tank No.5)	Undigested, thickened sludge	High	High	• This tank is below ground but open to the atmosphere. The capacity of the tank is 700m^3. The tank is subject to Permit Improvement Condition IC2. • Sludge storage time is typically 2-3 days. • Site inspection tours are carried out daily by site-based staff and monthly by the site's Environmental Regulatory Advisor (ERA). Any leaks or spillages identified are investigated and actioned promptly. • Provision of masking sprays around area will be considered if required.	Medium
EEH feed tank	Undigested sludge	High	Low	• Hatches are kept shut except for inspections or maintenance. • Tank is enclosed and connected to an OCU (A11) comprising a CIF and activated carbon unit. • Routine operation checks and maintenance to ensure the tank and OCU are functioning as per design. • Six monthly monitoring of the OCU emissions. • Raw sludge storage times are minimised to avoid septicity and odour.	Low

Source	Nature	Odour Potential	Probability of Release	Control Measures	Residual Risk
Raw sludge cake storage area and reliquification auger/hopper	Untreated sludge	High	High	• Cake storage area and hopper are open and therefore have the potential to produce odorous emissions. • Raw sludge storage times are minimised to avoid septicity and odour. Cake is treated within 24 to 48 hours of delivery. • Site inspection tours are carried out daily by site-based staff and monthly by the site's Environmental Regulatory Advisor (ERA). Any leaks, odour or spillages identified are investigated and actioned promptly. • Provision of masking sprays around area will be considered if required.	Medium
EEH PVRV (A9)	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 EEH. • PVRV set points calibrated every 2 years by a specialist contractor to ensure safe and effective operation within design parameters. • PVRVs at Blackburn are set to operate at 28.5 mb, as per the design criteria. • 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 EEH and controlling the feed rate 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.	Low

Source	Nature	Odour Potential	Probability of Release	Control Measures	Residual Risk
Digester PVRVs (A13 to A16)	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 digesters. • PVRV set points calibrated every 2 years by a specialist contractor to ensure safe and effective operation within design parameters. • PVRVs at Blackburn are set to operate at 22.5 mb, as per the design criteria. • 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 High Pressure in Digesters; Procedure SSI (doc ref. WwP-I-3006-15-13).	Low
Centrifuge sludge feed tank	Digested sludge	Medium	Low	• Enclosed tank housed within an enclosed building. • Doors are kept closed to prevent fugitive emissions escaping. • Site inspection tours are carried out daily by site-based staff and monthly by the site's Environmental Regulatory Advisor (ERA). Any leaks or spillages identified are investigated and actioned promptly.	Low
Centrifuge/GBT building	GBT - undigested sludge	Medium	Low	• Centrifuges and GBT units housed within an enclosed building.	Low

Source	Nature	Odour Potential	Probability of Release	Control Measures	Residual Risk
	Centrifuge - digested sludge			• Doors are kept closed to prevent fugitive emissions escaping. • Site inspection tours are carried out daily by site-based staff and monthly by the site's Environmental Regulatory Advisor (ERA). Any leaks or spillages identified are investigated and actioned promptly.	
Post digestion sludge storage tanks	Digested sludge	Medium	Medium	• Tanks enclosed. Hatches are kept shut except for inspections or maintenance. • .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 Environmental Regulatory Advisor (ERA). Any leaks or spillages identified are investigated and actioned promptly.	Low
Centrate buffer tank	Centrate	High	Low	• Tank enclosed. • Hatches are kept shut except for inspections or maintenance. • Tank is connected to an OCU (A12) comprising an activated carbon unit. • Routine operation checks and maintenance to ensure the tank and OCU are functioning as per design. • Six monthly monitoring of the OCU emissions.	Low
Centrate/filtrate tank (Tank No.17)	Centrate/filtrate	High	High	• This tank is partially below ground but is open to the atmosphere and therefore prone to odour emissions. The capacity of the tank is 1,200m^3. The tank is subject to Permit Improvement Condition IC2. • Site inspection tours are carried out daily by site-based staff and monthly by the site's Environmental Regulatory Advisor (ERA). Any leaks, odours or spillages identified are investigated and actioned promptly.	Medium

Source	Nature	Odour Potential	Probability of Release	Control Measures	Residual Risk
				• Provision of masking sprays around area will be considered if required.	
Lamella Tank	Centrate/filtrate	High	Low	• Enclosed unit situated externally. • Routine operation checks and maintenance to ensure the tank is functioning as per design. • Site inspection tours are carried out daily by site-based staff and monthly by the site's Environmental Regulatory Advisor (ERA). Any leaks, odours or spillages identified are investigated and actioned promptly.	Low
Gas Holder PVRV (A7)	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 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.	Low
CHP stacks (A4 & A5)	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.	Low

Source	Nature	Odour Potential	Probability of Release	Control Measures	Residual Risk
				• CHP maintained in accordance with the manufacturer's maintenance schedule for the engine. Additional maintenance scheduled based on UUW's experience of running such plant.	
Boiler stacks (A1 to A3)	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. • Boilers are maintained in accordance with the manufacturer's maintenance schedule.	Low
Flare (A6)	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.	Negligible
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
Digested 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 Environmental Regulatory Advisor (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
Open indigenous digestate cake storage bay	Digested sludge	Low	High	• The Press House cake bay is bounded by concrete walls approximately 4m in height that provide some protection from wind dispersion. A sensor on the cake conveyor ensures the height of the cake pile does not exceed the height of the walls. • The typical storage retention time in the cake storage area is 5 days. • Site inspection tours are carried out daily by site-based staff and monthly by the site's Environmental Regulatory Advisor (ERA). Any odours identified are investigated and actioned promptly. • Provision of masking sprays around area will be considered if required.	Low
Open imported digestated cake storage bay	Digested sludge	Low	High	• The cake pad and segregated bays are bounded by concrete walls. The cake piles do not exceed the height of the walls. The height of the cake at the walls is up to 1.75m while the wall height is 2.4m. • Site inspection tours are carried out daily by site-based staff and monthly by the site's Environmental Regulatory Advisor (ERA). Any odours identified are investigated and actioned promptly. • Provision of masking sprays around area will be considered if required.	Low
Liming process	Digested sludge	Low to Medium	High	• The Liming area cake bays are bounded by concrete A frame panels. Stockpiles of cake are managed such that the height of the pile does not exceed the height of the panels. • Site inspection tours are carried out daily by site-based staff and monthly by the site's Environmental Regulatory Advisor (ERA). Any odours identified are investigated and actioned promptly. • Provision of masking sprays around area will be considered if required.	Medium

Source	Nature	Odour Potential	Probability of Release	Control Measures	Residual Risk
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 around area 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 Environmental Regulatory Advisor (ERA). Any leaks or spillages identified are investigated and actioned promptly.	Low
Site drainage sump	Surface water run off and process emissions (condensate, boiler blow down and cake bay run off)	Low	Low	• During normal operations there is a low risk of odour emissions. In the event of a spill there is potential for odours to be emitted from this open sump. • 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 Environmental Regulatory Advisor (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 24 hours.

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

Table 5.1. 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 E 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 Environmental Regulatory Advisor (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 both 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, taking 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 Environmental Regulatory Advisor (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 back 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 Area impacted);
- Area Production Manager (within Area impacted);
- Area Business Manager (within impacted area);
- Asset Manager (within area impacted);
- Customer Focal Lead (Production Manager within area impacted);
- 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;
- The local Councilor and/or MP (within area impacted).

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 5.1.

Table 5.1: 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 – ideally this would be confirmed via an on-site reading and operator Sniff tests (Jerome)	Knowledge of at least 5 no. of telephone odour complaints/ contacts received within 24hr period. 10 telephone odour complaints/ contacts received within 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 centrate 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, centrate or filtrate spillage on site
Internal Contact	• Central Area HUB • Maintenance 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
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 investigation findings should be reported back to the

	Tier 1 On site risk - no external communications	Tier 2 Neighbourhood risk – external communications
		complainant in a shorter timescale than 10 working 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 Councillor 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 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.

Olfactory monitoring ('sniff' testing) is undertaken by operators on a daily basis as part of the EO&M (Effective Operations & Maintenance) site checks. This is typically at the locations shown in Appendix G.

Weather conditions and any 'abnormal' site operating conditions are recorded. Observations are recorded on a daily monitoring record form (see Appendix E).

Operational staff undertaking the olfactory monitoring shall rotate so that a range of staff are engaged in the monitoring and the time of day that the monitoring is undertaken shall also be varied.

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)
- 6 - Extremely strong odour (likely to causes immediate physical symptoms such as nausea, sore throat and headaches)

The Production Manager shall be notified in the following circumstances:

- following human senses detection of any odour of intensity 3 (distinct odour) or above at any of the monitoring points
- if a reading of >20ppb (0.02 ppm) hydrogen sulphide is recorded at a boundary location
- if a reading of >2.5 ppm hydrogen sulphide is recorded on site.

Plant operations shall be reviewed to investigate the source of the odour and ensure wastewater treatment processes are operating normally. The Production Manager will raise a Tier 1 or 2 escalation as appropriate (see Table 5.1). Any issues raised will be logged on the corporate action tracker and assigned to the relevant colleague for completion.

Pressure monitoring of the digesters and gas holder will also be used to identify 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 programme 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 centrate, will be discharged into site drainage and returned to the Nereda plant inlet channel.

Abnormal operating events are considered in detail in the site Accident Management Plan. Table 6.1 summarises abnormal event scenarios which may lead to odorous emissions.

Table 6.1: Abnormal Events

Abnormal event	Control Measures	Recovery Steps
Damage to tank roofs	Routine inspection regime of digesters 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 digesters 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 PVRVs or overflow due to foaming	Daily visual monitoring of foam level in digesters 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 MAMS 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 (>22.5mb) leading to potential odorous emissions	Regular calibration of pressure monitors Pressure monitors display locally on the 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
OCUs damaged or malfunctioning	OCUs designed in accordance with UU asset standards	Conduct checks set out in relevant SOP for OCU equipment, for example:

Abnormal event	Control Measures	Recovery Steps
	Monitoring and maintenance in accordance with relevant SOP for OCU equipment and Site-Specific Instruction (SSIs)	Check when media was last changed 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, MAMS The MAMS 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 digesters	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
Open storage of undigested sludge cake for longer than usual, due to reliquification plant breakdown, resulting in increased odour being detected	Regular site odour checks	Imports of undigested cake will be ceased so as not to exceed the storage capacity of the bay. If cake storage is going to exceed 5 days, then it will be removed from site within 48 hours to an alternative sludge treatment facility on a first in first out basis.
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	Follow the Emergency Fire Response Plan and Digestion and Biogas Emergency Plan (Ref. WWP-1-3006-01-16) 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

Abnormal event	Control Measures	Recovery Steps
	Incident management planning and training No smoking or other sources of ignition. No mobile phones	
Failure of electricity supply	Backup generators Ensure sufficient fuel stocks and manpower to facilitate operation of the generators Process Loss Contingency Plan in place (WWP-1-3006-30-01)	Follow the Process Loss Contingency Plan Establish estimated time for return of electrical supply Integrated 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/3006/30/03)	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

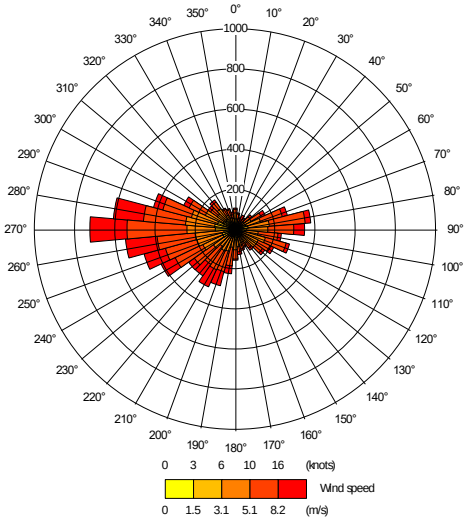
The Environment Agency must be notified without delay of any accident which has caused, is causing or has the potential to cause significant pollution, as required by the Environmental Permit. The following procedure shall be followed for EA notification:

- 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.
- 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 (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 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).

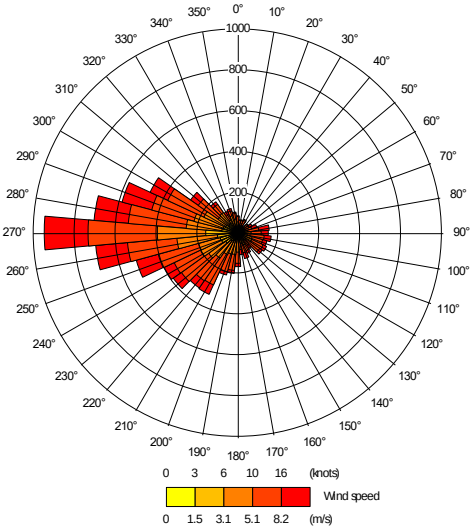
If considered necessary following an incident or application of a contingency measure, this OMP will be reviewed.

Appendix A: Wind Rose Data

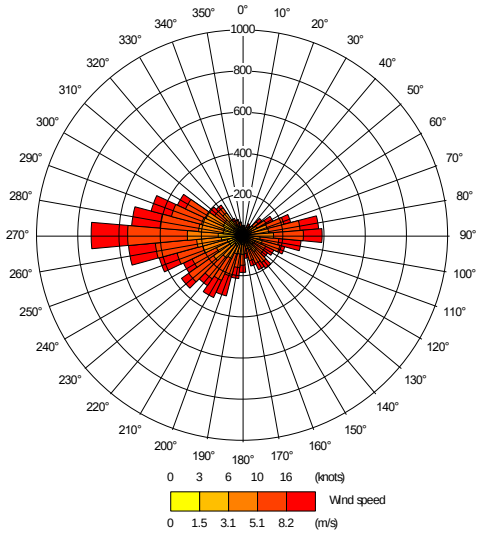
Numerical Weather Prediction (NWP) data was sourced from ADM Ltd. for the Burnley WwTW site (NGR E 382723 N 435292) as it is considered the most representative meteorological data for the Blackburn site. The closest alternative meteorological stations to the site are Manchester airport (approximately 50 km from the site), which is not representative due to the distance from the site, and Bingley, which is also not representative due to distance (approximately 50 km from the site) and an elevation difference.



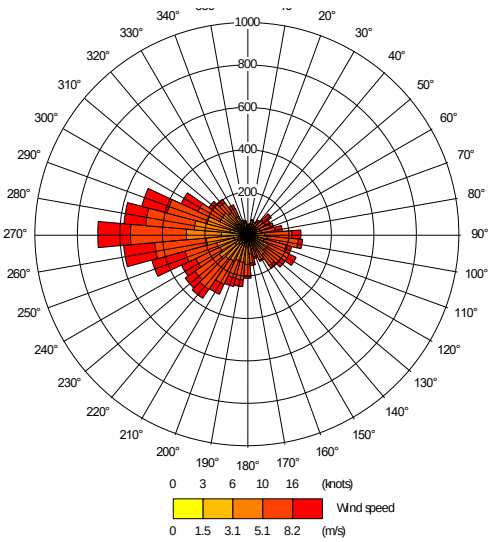
NWP data, 2016



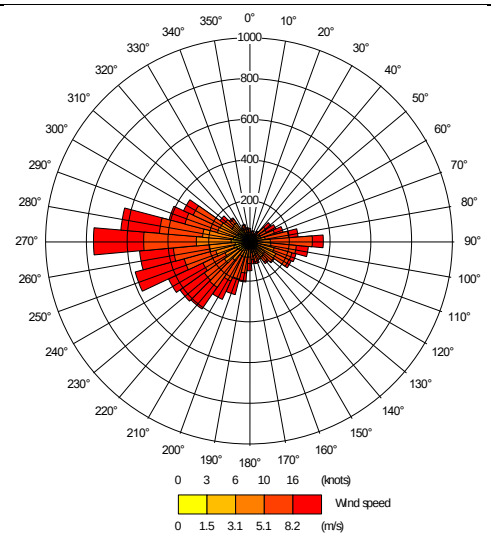
NWP data, 2017



NWP data, 2018

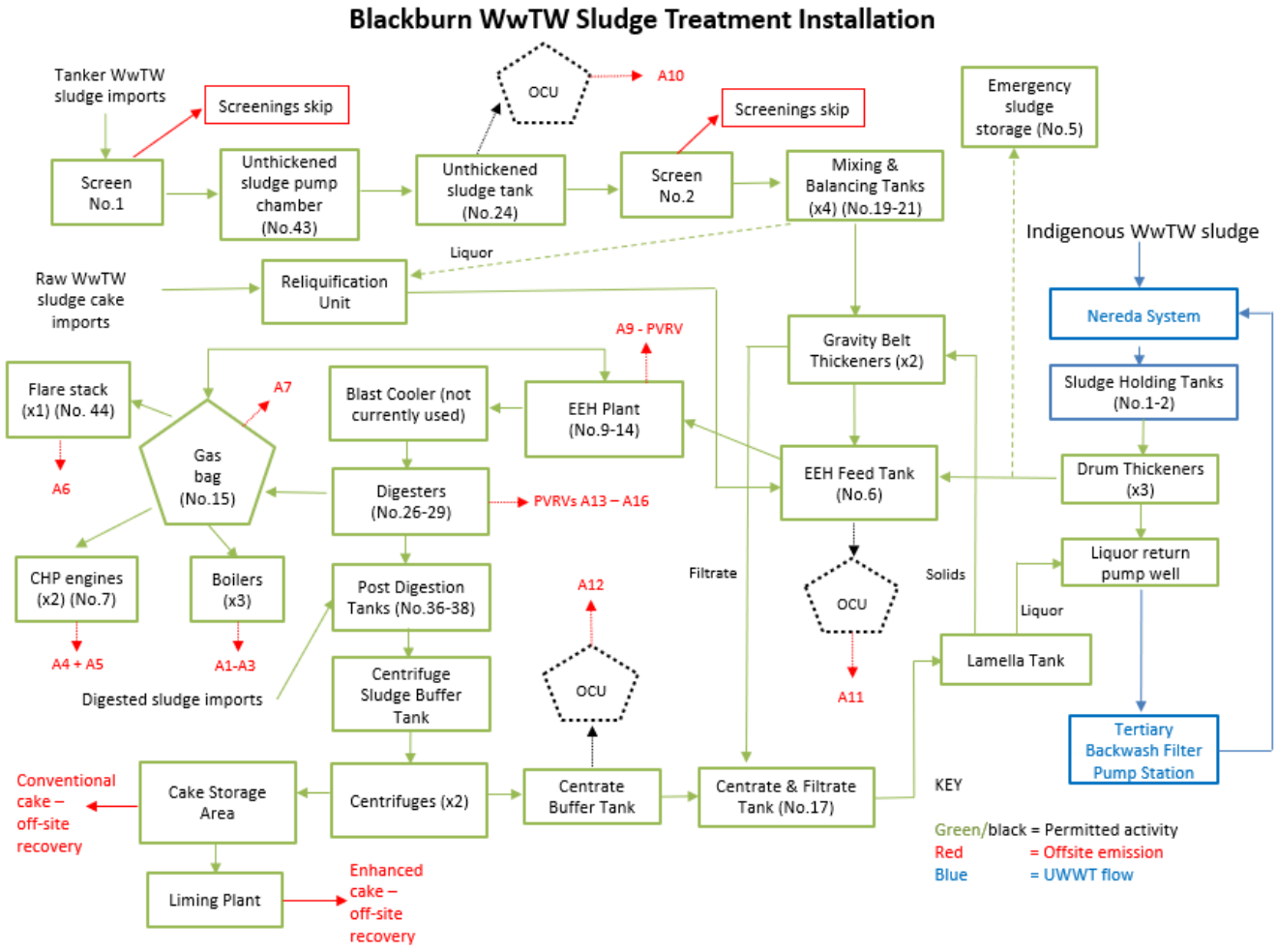


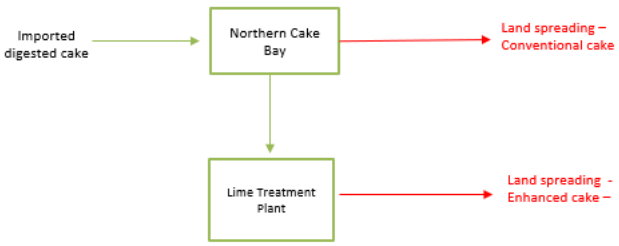
NWP data, 2019



NWP data, 2020

Appendix B: Process Flow Diagram





Appendix C: Design Operating Parameters for Odour Control Units

Unthickened Sludge Tank OCU - Emission Point A10			
Treats foul air from unthickened sludge tank (No.24)			
Parameter	Units		
Airflow OCU	m^3/hr	1,900	
Temp	°C	UK ambient Average 14°C	
Contaminants	Ammo	1/1	Ave/Max
	H_2S	100/1000	Ave/Max
	RSH	20/40	Ave/Max
	DMS	N/A	Ave/Max
	Misc VOCs	N/A	Ave/Max
Parameter	Units		
Outlet odour CIF	OU_e/m^3	N/A	
Hydrogen Sulphide	% Rem	>85	
Mercaptans	% Rem	>50	
DMS	% Rem	N/A	
VOCs	% Rem	N/A	
Outlet odour Carbon	OU_e/m^3	<1,000 Typical >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	
CIF Humidification flow	l/hr l/s	50 calculated to maintain 80% rh 0.01	
CIF drain pH	pH	6.5-7.5	
-		Failure of the irrigation system to be instigated immediately and should be reinstated as soon as possible.	
Carbon inlet rh	%	<80%	
Differential pressure	Pa	300	CIF stage
		150	Prefilter (estimated)
		2000	2nd carbon stage
EEH Feed Tank OCU - Emission Point A11			

Treats foul air from EEH feed tank (No.6)			
Parameter	Units		
Airflow OCU	m^3/hr	2,200	
Temp	°C	UK ambient Average 14°C	
Contaminants	Ammo	1/2	Ave/Max
	H_2S	100/500	Ave/Max
	RSH	10/30	Ave/Max
	DMS	N/A	Ave/Max
	Misc VOCs	10/35	Ave/Max
Parameter	Units		
Outlet odour CIF	OU_e/m^3	N/A	
Hydrogen Sulphide	% Rem	>70	
Mercaptans	% Rem	>50	
DMS	% Rem	N/A	
VOCs	% Rem	N/A	
Outlet odour Carbon	OU_e/m^3	<1,000 Typical >98% Removal	
H_2S, RSH, DMS, VOCs		>99.7 Removal	
Airflow	m^3/hr	+/- 10% of design acceptable Changes of >20% Diff pressure should be investigated	
CIF Humidification flow	l/hr l/s	200 0.06	
CIF drain pH	pH		
-		Failure of the irrigation system to be instigated immediately and should be reinstated as soon as possible.	
Carbon inlet rh	%	≥80	
Differential pressure	Pa	650	CIF stage- Calculated
		120	Demister (estimated)
		250	2nd carbon stage estimated

Centrate Buffer Tank OCU - Emission Point A12			
Treats foul air from Centrate Buffer Tank			
Parameter	Units		
Airflow OCU	m^3/hr	133	
Temp	^oC	UK ambient Average 14^oC	
Contaminants	Ammo	9.5/12	Ave/Max
	H_2S	5/30	Ave/Max
	RSH	0.1/0.5	Ave/Max
	DMS	5/5	Ave/Max
	Misc VOCs	2.7/7	Ave/Max
Parameter	Units		
Outlet odour Carbon	OU_e/m^3	<500 >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	
Carbon inlet rh	%	<60-80%	
		Dependant on Operator selection of pre heater	
Differential pressure	Pa	350	Carbon bed (calculated)

Appendix D: General Inspection and Maintenance Activities for Operational OCUs

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 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

ACTIVATED/DRY MEDIA ODOUR CONTROL UNITS – INSPECTION & MAINTENANCE ACTIVITIES										
Sub Task	Activity	Ops/Main	Daily	Week	Month	Quarter	6 Month	Annual	Greater	Comment
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

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	• If airflow rate exceeds design close dampers to achieve design air flow • Close damper(s) • Place fan into Auto	• 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

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 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 • of repair and supply chain logistics
	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

ACTIVATED/DRY MEDIA ODOUR CONTROL UNITS - 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 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
	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

CATALYTIC ODOUR CONTROL UNITS – INSPECTION & MAINTENANCE ACTIVITIES										
Sub Task	Activity	Ops/Main	Daily	Week	Month	Quarter	6 Month	Annual	Greater	Comment
-	**Catalytic Iron Filtration**									
1	Visual inspection of extraction system – ductwork & covers	Ops		**P**						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							**P**		check operation condition of fire dampers
3	Measurement of system air flows	Ops				**P**		**P**		monthly check air flow around OCU Annual 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			**P**					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.
5	Continuous H_2S monitoring (OCU inlet/Stack (if fitted)	Ops	**P**		**P**		**P**			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	Humidification system functionality	Ops	**P**							Basic functionality check, log and adjust humidification water feed, pressure/flow.
7	Duty CIF Liquid drain operation/quality	Ops	**P**							Visual observation of drain operation. No flow indicates humidification flow failure fouling by biomass/degraded CIF media
8	Humidifier High Level Overflow	Ops	**P**							Check overflow not operating - investigate cause if it is. Check water trap is charged/Air not being discharged/drawn in. Charge lute if necessary
9	Active CIF unit High Level Overflow	Ops	**P**							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	Regen Cycle switch over	Ops				**P**				Confirm regeneration cycle is optimised i.e. Switch over timed to ensure H2S

CATALYTIC ODOUR CONTROL UNITS – INSPECTION & MAINTENANCE ACTIVITIES										
Sub Task	Activity	Ops/Main	Daily	Week	Month	Quarter	6 Month	Annual	Greater	Comment
										breakthrough is not occurring with high loads being passed on to downstream process:
11	Regen Fresh air feed valves/Dampers	Ops		**P**						Confirm functionality/Availability of actuated valves and regen airflow is active on standby unit
12	OCU pressure drop across duty bed media bed	Ops		**P**						Information logged to identify performance trends
13	OCU pressure drop across post CIF filter/Cleaning of filter	Ops				**P**				Information logged to identify performance trends. Blinding indicated media degradation.
14	Visual inspection of OCU Vessel	Ops		**P**						Operational and asset condition check. Check for operation. Check vessel integrity (deformation/gas and liquid leaks – air infiltration/fugitive release, corrosion
15	Vessel Internal inspection	Ops						**P**		Use opportunity to inspect vessel internals for corrosion/damage. Check condition of media at top of vessel (if down flow), check for degraded media in vessel base (if up or down flow). Potential recertification of vessels if appropriate.
16	Media Replacement	Ops							**P**	Media replacement interval should be 3-5yrs. However over time media will degrade.

Appendix E: Odour Diary Form

Odour diary

helping life flow smoothly

About you	
Customer name	
Telephone number	
Email	
Address (including postcode)	
Preferred telephone contact times	
Date of odour	D D M M Y Y Y Y — 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 ☐ Earth/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.

Appendix F: Odour Investigation Form

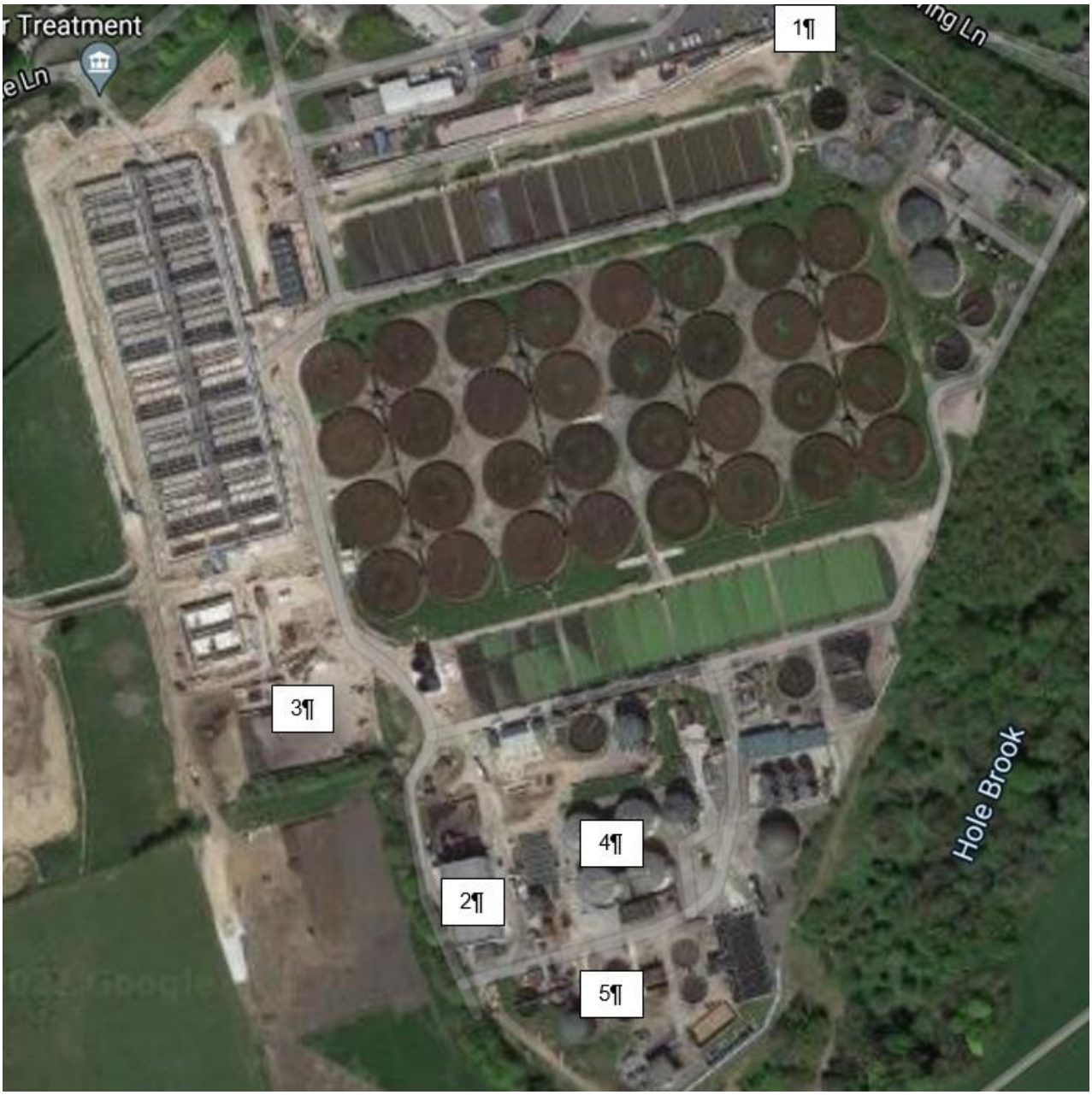
United Utilities Water for the North West	Wastewater Treatment	Reference: WwP/F/001/30/16
	Site Specific Form (SSF)	Version: 1 Issue date: 04/03/2021 Expiry date: 04/03/2024
	Site Odour Investigation Form	

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?):	
Actions taken: Investigation completed and checked site area.	

Form completed by:	Date	

Appendix G: Odour Sniff Monitoring Locations

On Site Monitoring Locations



Number¤	Description¤	Number¤	Description¤
1¤	Nereda·Channel·¤	4¤	Digesters·¤
2¤	Sludge·Press·House·and·treated·cake·bay¤	5¤	Sludge·Mixing·tanks¤
3¤	Raw·Cake·Bay¤	¤	¤

Off-site Monitoring Locations

ID¤	Description¤
A¤	Residential¤
B¤	Industrial/Commercial¤
C¤	Farmland¤