Lundwood Sludge Treatment Facility Odour Management Plan

August 2024

YorkshireWater

Stantec

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Contents

1 Introduction

This Odour Management Plan (OMP) for Lundwood sludge treatment facility (STF) has been developed by Stantec on behalf of Yorkshire Water Services Ltd (YW). YW have developed this OMP as a live working document that forms part of the operational management system of the site. The OMP demonstrates how odours shall be managed and controlled to prevent odour impacts from activities during normal operation and also during abnormal events.

The OMP has been developed to meet the Environment Agency's (EA) H4 Odour Management Guidance.

The OMP has been prepared in support of the permit variation for Lundwood STF.

These activities fall under Environmental Permit reference VP3392ZB.

The OMP provides sufficient detail to allow operators and maintenance staff to understand clearly the operational procedures for both normal and abnormal conditions. It is intended to be used as a reference document by operational staff on a day-to-day basis. The OMP includes the following:

- A description of the site and catchment, including sources of odour on the site, and location of sensitive receptors;
- A brief history of received complaints and measures taken to date;
- YW Operation and Management (O and M) procedures for the site, including good housekeeping measures to minimise odour generation and release;
- The mitigation procedures which should be implemented when foreseeable situations that may compromise the ability to prevent and minimise odorous releases occur. These can include both breakdowns and external conditions such as extreme weather;
- An Action Procedure for complaints;
- An odour risk assessment identifying any odorous or potentially odorous areas of the works and immediate and longer-term actions required to eliminate odour complaints; and
- The management and operator training requirements and records with respect to odour.

1.1 Yorkshire Water Odour Management

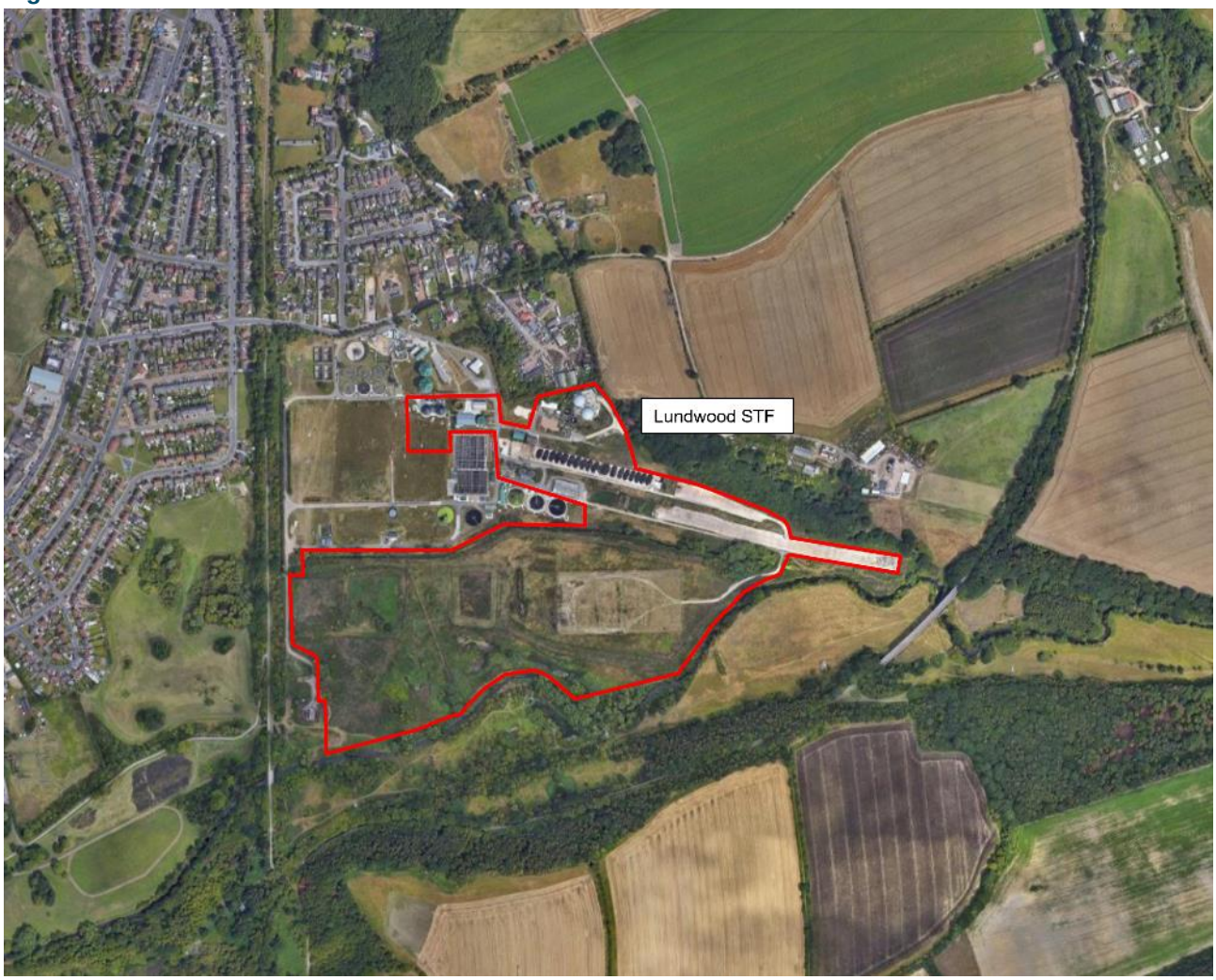
YW acknowledges that high levels of odour arising from wastewater and sludge treatment are not acceptable and that reasonable measures must be taken to minimise any inconvenience to the general public. YW does not operate under a single defined odour exposure standard. Each site is considered individually taking into account the relevant legislation and local authority's conditions. Site specific factors such as site history with regard to odour complaints, potential future encroachment by residential or business developments, and the presence of particularly odour sensitive receptors within the vicinity of the works / facility are also taken into consideration.

2 Site Information

2.1 Site Location

Lundwood STF is located adjacent to Lundwood WwTW. The site is located to the east of Lundwood village and to the north of the River Dearne. This site is located approximately 3.5 km east of Barnsley. The site is bordered grassland and farmland to the east and south, and residential and industrial areas to the north and west. The works location is highlighted in Figure 1.

Figure 1 Lundwood STF Site Location



2.2 Site Receptors

Lundwood STF is located adjacent to Lundwood WwTW. The site is bordered to the north and west by industrial and residential areas. Towards the east and south are open grassland and farms with residential and industrial receptors beyond this initial boundary area.

The YW Lundwood site (which includes both the STF and the WwTW) has received 5 odour complaints in the last 5 years. The complaints are of an infrequent nature and relate to the site as a whole; it is not known whether these complaints are attributed to the STF or to the WwTW operations.

A summary of the areas of interest and receptors local to the site are highlighted in Figures 2-4, complete with receptor description and sensitivity in Table 1.

Figure 2 Location of Sensitive Receptors (Residential)

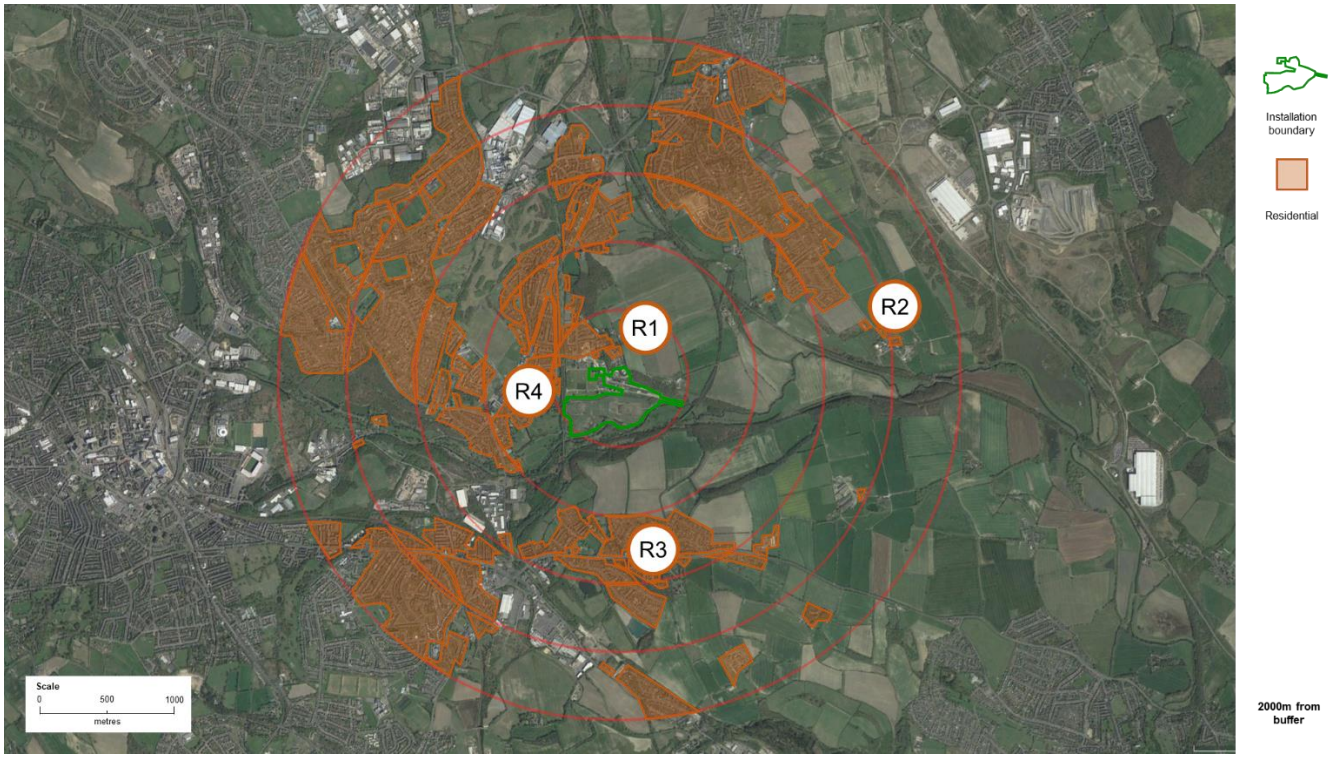


Figure 3 Location of Sensitive Receptors (Commercial / Industrial)

Figure 4 Location of Sensitive Receptors (Education / Leisure)

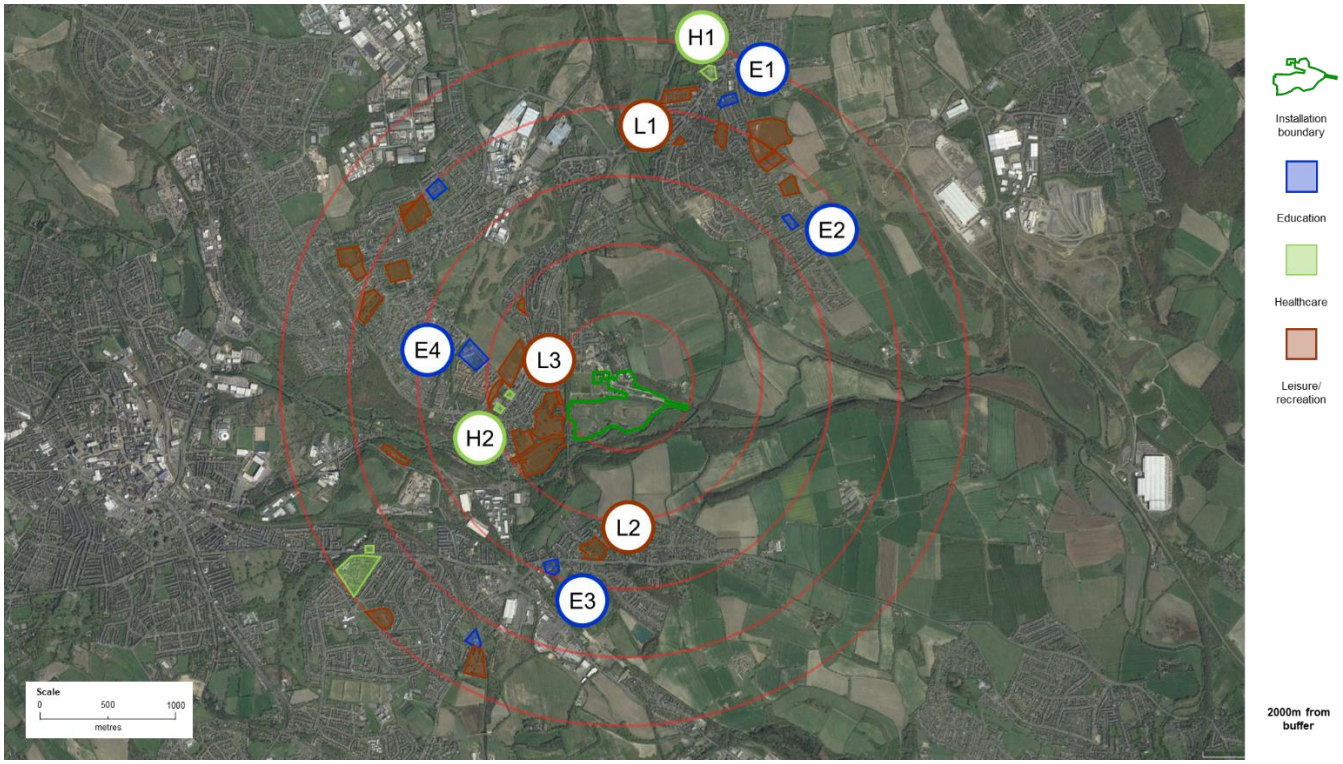


Table 1 Lundwood Receptor sensitivities

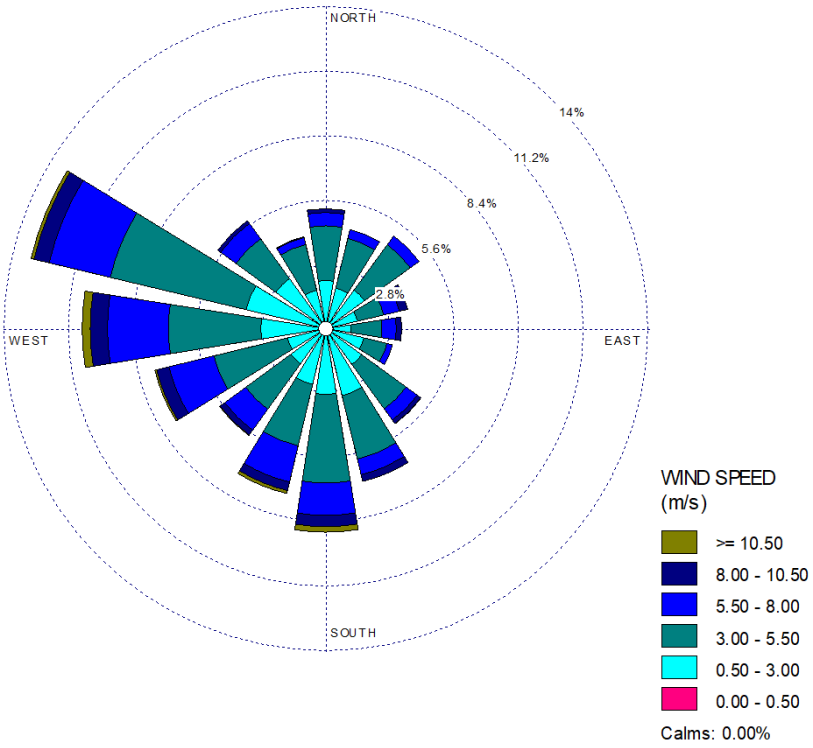
Receptor Name	Receptor Map Reference	Distance from STF operational area (m)	Receptor Type	Receptor Sensitivity
Residential properties to north	R1	100	Residential	High
Residential properties to east	R2	1,420	Residential	High
Residential properties to south	R3	800	Residential	High
Residential properties to west	R4	210	Residential	High
Commercial businesses to north	C1	1,760	Commercial	Medium
Commercial businesses to south	C2	1,150	Commercial	Medium
Commercial businesses to west	C3	415	Commercial	Medium
Industry to north	I1	0	Industrial	Low
Industry to east	I2	1,220	Industrial	Low
Industry to south	I3	910	Industrial	Low
Industry to west	I4	340	Industrial	Low
Schools to the north	E1	2,040	Education	High
Schools to the east	E2	1,450	Education	High
Schools to the south	E3	1,310	Education	High
Schools to the west	E4	800	Education	High
Leisure/recreation to the north	L1	1,800	Leisure/recreation	Medium
Leisure/recreation to the south	L2	1,080	Leisure/recreation	Medium
Leisure/recreation to the west	L3	250	Leisure/recreation	Medium
Healthcare to the north	H1	2,220	Healthcare	Medium
Healthcare to the west	H2	580	Healthcare	Medium

2.3 Meteorological Conditions

In the UK, the prevailing wind directions are commonly from the west and south-west. The wind direction and speed will impact the dispersion of odour emissions from site. There is currently no wind station on site to measure meteorological conditions.

As there are no representative meteorological stations for Lundwood STF, numerical weather predicted (NWP) meteorological data for Lundwood STF has been used to predict the wind direction frequency for Lundwood STF. NWP meteorological data has been adopted for this assessment due to the complexity of the topography on site and is likely to give more accurate wind directions and frequencies. The wind rose plot for Lundwood STF is included in Figure 5.

Figure 5 Lundwood STF NWP Windrose Plot



2.4 Process Description

Lundwood STF treats the following sewage sludges:

- Indigenous primary sludges and surplus activated sludge (SAS) arising from sewage treatment processes operating within the wider Lundwood WwTW that are piped directly to the STF.
- Liquid sludges generated by other YW Wastewater Treatment Works (WwTW) (with lower capacity or capability for treating sludges on-site) that are imported to Lundwood STF for additional treatment.

Imported liquid sludge is delivered to site by tanker. The tanker unloads at the dedicated sludge import area and sludge is pumped (using vehicle mounted pumps) into the sludge screen feed tank (150 m^3 covered steel tank). The maximum load is typically 28 tonnes with unloading taking up to 30 minutes. Only appropriately authorised vehicles can discharge at the site. This is controlled using a 'WaSP' logger; valves on the discharge pipework will only open when a driver presents appropriate authentication to the system. The WaSP logger records the source of the sludge, the time and date of delivery, the total volume discharged and average percentage dry solids of the load.

There are waste acceptance procedures that deal with the trade waste that is being treated through the WwTW. Some traders may also be subject to trade effluent consents. With regard to the potential for septic sludge imports to be received into the STF, a pre-acceptance process is in place to ensure that it is only received at sites that are capable of processing it without impacting the process.

The sludge is then screened using two Huber ROTAMAT enclosed rotating screens. Screenings drop into a skip and are disposed of off-site.

After screening, imported liquid sludge is pumped via a sub-surface concrete sump, in pipework (largely underground) to the thickener feed tanks (2 no. 1,589 m^3 covered steel tanks). These tanks are air mixed and operate in fill / draw mode with tanks changing over every 24 hours. The tanks are covered with headspace air extracted and routed to a two-stage odour control unit (see below for further details of odour control).

Indigenous SAS and primary sludge from the wider Lundwood WwTW is piped directly to the thickener feed tanks and mixed with the imported screened liquid sludge prior to onward transfer to the drum thickener building.

Sludge from the thickener feed tanks is then transferred to the thickener building via above and below ground pipework serving two thickening process streams, which operate on a duty/standby basis. Each sludge stream comprises a dedicated thickener feed pump drawing blended sludge, a polymer dosing pump drawing made-up polymer, a flocculation tank and a pair of drum thickeners (thus there are four thickeners in total). Concentrated liquid polymer is diluted with potable water, then mixed with treated final effluent as a carrier and mixed with the sludge in the flocculation tank. Each flocculation tank feeds two drum thickeners at an equal rate. The polymer encourages separation of water and sludge as the sludge is rotated in the drum to remove excess liquid. The resulting liquor is transferred to a wet well located to the west of the thickener feed tanks and from there is pumped back to the WwTW for full treatment. Each sludge stream has been sized with sufficient capacity to process site daily throughput requirements over a 16 hour period i.e. there is adequate redundant capacity in the event of plant failure.

The drum thickeners are equipped with automatic spray bars which provide continual self-cleaning. In addition, an automatic hot wash system is run periodically in accordance with the planned maintenance regime. The hot wash is designed to break down any fats that would blind the drum filter material. The automatic spray bars operate using treated final effluent and the hot wash system utilises mains potable water.

The liquid polymer delivery point is located in the roadway outside the thickener building; liquid polymer is delivered in 1m^3 IBCs and pumped from these to a 10 m^3 bulk storage tank located within the thickener building. Located above the same concrete sump bund within the thickener building as the bulk storage tank is the 5 m^3 capacity polymer solution storage tank containing the diluted polymer solution.

The thickened sludge is transferred to the 712 m^3 digester feed tank. This tank is of concrete construction, mixed and covered. Sludge is passed forward continually from this tank to the anaerobic digesters (2 no. 2,056 m^3 concrete tanks). The digesters are located on steeply sloping ground and therefore are partly buried below ground on one side. The anaerobic digesters operate as a continuous process with sludge being added and treated sludge extracted. The two digesters have a typical feed rate of around 120 m^3/day combined; the combined maximum feed rate is 308m^3/day (at 6% dry solids) giving a 12-day retention time as required by Hazard Analysis and Critical Control Points (HACCP) controls. The digesters are mixed by gas mixing systems, which utilise biogas from the headspace of each digester; the gas is compressed and then reintroduced using an array of mixing nozzles on the floor of the digester.

A hot water circuit provides heating to ensure optimum conditions for digester microbial activity. Potable water is heated to around 70°C by the CHP and/or boiler. This hot water then heats the digester using tube-in-tube, counter-current heat exchangers. Sludge from the digesters is continually recirculated around the heat exchangers using 2 no. (duty/standby) recirculation pumps per digester. A 3-way modulating valve on the water side moderates the amount of hot water that passes into the heat exchanger, depending on the heat demand of the digesters.

Grit build up within digesters is a normal feature of operation; the digesters are cleaned out (including accumulated grit) every 10 years as part of the planned periodic inspection which also includes an internal and external inspection of tank integrity and replacement of instrumentation and gas mixing equipment as required.

An automatic anti-foam dosing system is in place to control digester foaming. This system uses a radar level probe in the digester headspace and compares this to the pressure level sensor at the bottom of the digester to determine the depth of foam. Upon detection of foam, treated final effluent is sprayed into the digester head space through nozzles in the digester roof. If this is not effective in breaking up the foam, a chemical anti-foam is mixed with treated final effluent and dosed into the headspace of the digester via the same spray nozzles. This system includes operator-adjustable dosing setpoints and failsafe systems; if the foam level continues to increase mixing systems are inhibited and if this continues the digester feed will be inhibited. Antifoam is stored in 20 litre plastic containers on a drip tray located within the digester compound prior to transfer to the integrally bunded antifoam dosing tank (approximate capacity of 0.5m^3).

Biogas generated by the digestion process is collected and stored within the digesters. Each of the digester tanks is equipped with a membrane gas holder (700 m^3 capacity each) located over the tank providing biogas storage continuous with the tank headspace. The gas holders allow capacity to store and balance the biogas produced from the digestion process. Each roof gas holder is kept inflated by duty/standby air blowers, blowing into the inter-membrane air space, in conjunction with a pressure sustaining valve. Biogas is withdrawn, conveyed by a pipeline through the tank wall, from the gas space of each tank. Pressure relief valves (PRVs) are fitted to each pipeline. The pipelines combine into a manifold which branches to the CHP/boiler and to the flare. Condensate removal pots are installed at low points in the gas pipelines. The collected condensate is drained to Lundwood WwTW for treatment.

Biogas is used as the sole fuel source for the site CHP. The CHP facility comprises a single reciprocating engine generator set with a thermal input of approximately 413 kW and generates electricity which is used to power essential site processes. Heat from the combustion process is used to maintain the required temperature in the anaerobic digesters, with any excess being discharged using air cooled radiators.

The CHP set is located within a building with engine combustion products discharged via a 3m high (approximately) stack located to the rear of the building.

A boiler is available for use as an alternative heat source for the digesters. The boiler can be fired by either biogas or fuel oil and has a thermal input of approximately 833 kW. This is located within the same building as the CHP (in an adjacent room) and combustion products are discharged via a 3.5m high (approximately) stack located to the rear of the building. In normal operations boiler use is limited as heat recovery from the CHP engine meets the digester heat demand.

Fuel oil used as back up supply for the boiler is stored within a 35,000 litre integrally bunded steel tank.

In periods where the CHP engines and boiler are unavailable or biogas generation exceeds combustion capacity, biogas is directed to the waste gas burner (575 m3/hr capacity). This burner, although a purpose-built closed flare system, is not capable of achieving a minimum of 1,000°C with 0.3 seconds retention time at this temperature. The flare facility is located at a safe distance from the digesters and other biogas handling and treatment activities. Flare stack operation is automated based on gas level within the biogas holder. If the gas level is high then the flare will operate, however utilisation of the gas is preferred over flaring.

Digested sludge is gravity fed from the digesters to the adjacent digested sludge balance tanks (2 no. concrete open topped tank with capacity of 880m^3). These tanks are periodically mixed to prevent settlement and anoxic conditions. Powdered polymer stored in 750kg bags is dispensed via a hopper dosing system which feeds a polymer ‘ageing’ tank where the powdered polymer is mixed with potable water and transferred to a stock tank (approximate capacities of 6m^3). The polymer solution is injected into the sludge stream and taken to the digested sludge dewatering centrifuge where the sludge coagulates and supernatant liquor is removed by centrifugal forces. Dewatering liquor is transferred to two liquor balancing tanks (covered steel tanks, each with a capacity of 250 m^3) prior to transfer to the WwTW for full treatment.

The final digested and dewatered sludge cake is transferred via a conveyer from the centrifuge up over a push-wall and onto the cake pad. The area under the conveyer and adjacent sludge cake pads are an engineered impermeable surface, with water runoff collected in drains running along the bottom edge of the pad. These liquids are pumped back to the WwTW for full treatment.

Once on the cake pad, sludge cake is moved by mechanical loaders into storage rows. There is no lime addition at Lundwood STF; instead, cake is stored in piles according to age and is left to mature for a minimum of six weeks in accordance with HACCP requirements. Approximately 3,000 tonnes sludge cake will normally be held on site at any one time. However, the maximum storage capacity of the cake pad is significantly greater than this, up to 12,750 tonnes; greater volumes may be stored on site in emergency/abnormal conditions such as following processing problems at other YW sites or in extreme weather conditions when landspreading operations are temporarily paused. Once maturation is complete, sludge cake is removed from site and landspread in accordance with legislative requirements. Samples of digested, matured cake are taken every 3 months, or whenever a Critical Control Point (CCP) (e.g. digestion retention time or temperature) is not within specification, and analysed for metals and pathogens to ensure HACCP standards are being met.

The cake pad is for storage of digested cake only.

There is 1 no. odour control unit (OCU) present on site. The OCU is a two-stage biotrickling filter and activated carbon polishing OCU that extracts and treats odours from the following sources and discharges to atmosphere via a 15m tall stack:

- Thickener Feed Tanks
- Drum Thickeners

Air from the thickener building is extracted directly to the second stage of the OCU (the carbon polishing unit) where it is treated prior to discharge via the stack. The process flow diagram for the site is highlighted in Figure 6. The location of key site activities are shown in Figure 7.

Figure 6 Lundwood STF Process Flow Diagram

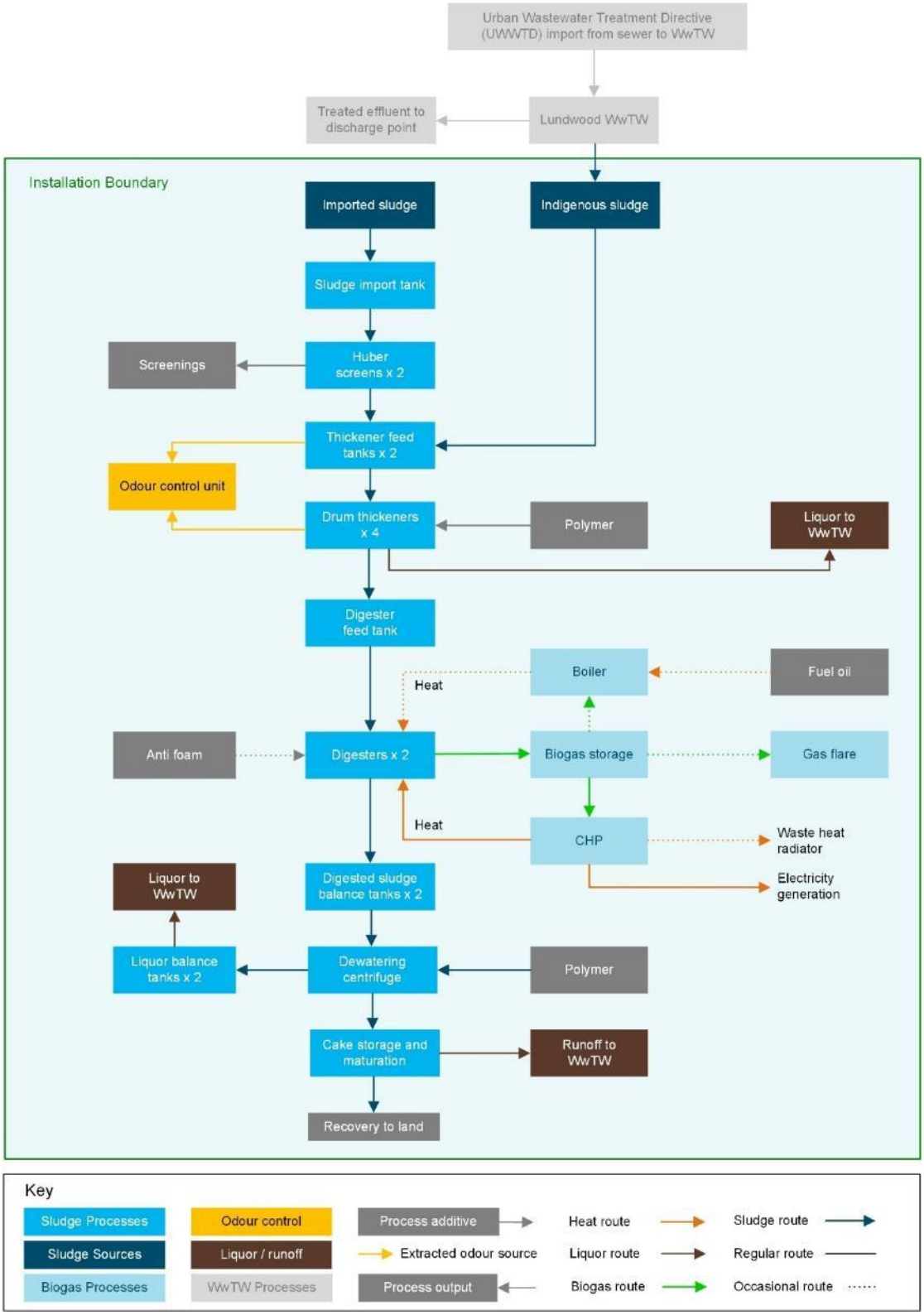
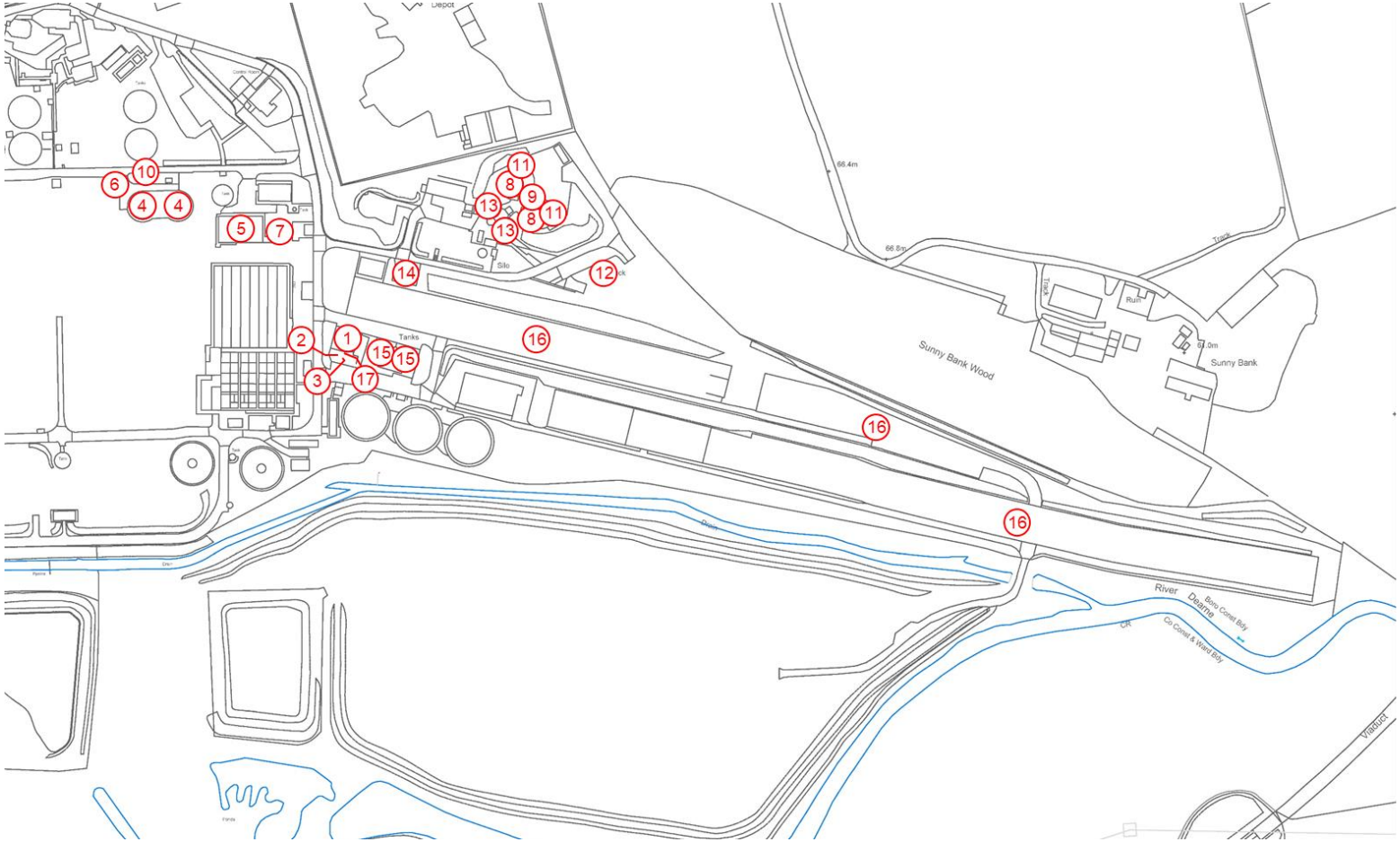


Figure 7 Lundwood STF Source Locations



Odour sources	
Sludge Import Tank	1
Sludge screens	2
Screenings Skip	3
Thickener Feed Tanks	4
Drum Thickeners	5
Thickener Liquor Wet Well	6
Digester Feed Tanks	7
Digesters	8
Biogas Relief Valves	9
OCU stack	10
Biogas Holder	11
Flare	12
Digested Sludge Balance Tanks	13
Dewatering Centrifuges	14
Liquor Balance Tanks	15
Cake Storage Pad	16
Screened sludge PS	17

Type of waste accepted at Lundwood STF are provided in the environmental permit.

2.5 Process Odour Sources

The odour potential of a source can be broken down into three key considerations:

- How inherently odorous the compounds present are.
- The unpleasantness of the odour.
- The magnitude of the odour release.

When trying to determine the offensiveness of an odour source, site-specific odour sampling should be considered in the first instance. In the absence of source odour emission data, the assessment criteria will consider the Environment Agency's Horizontal Guidance Note (H4). H4 looks to categorise how offensive odours are with sources/processes/activities that are considered 'most offensive' odours include septic effluent or sludge and biological landfill odours. All raw sludge treatment processes would be considered to have a high odour offensiveness unless source-specific odour sampling is undertaken demonstrating a low level of odorous compounds. Processes containing the below material are considered to represent a high odour offensiveness:

- Indigenous sludge
- Sludge imports (liquid and solid)
- Sludge liquors

Processes containing the below material are considered to represent a medium odour offensiveness:

- Rags and screenings
- Digested sludge
- Digested sludge liquors
- Digested sludge cake (stored)

No processes on an STF are considered to store material that represents a low odour offensiveness unless supported by source-specific odour sampling.

The unpleasantness of an odour can be used in defining the source odour offensiveness. This is typically achieved through source material hedonic tone assessments, however; these types of assessments are not typically available for a site without source-specific sampling.

The risk source odour potential critical risk scoring for odour offensiveness and mitigation / control adopted is summarised in Table 2.

Table 2 Source Odour Potential Risk Scoring

Source	Risk Rating		
	High	Medium	Low
Odour Offensiveness	Very odorous compounds (H2S, Mercaptans) with low odour threshold. Unpleasant odour - "Most Offensive". Unpleasant hedonic tone. Large, permitted process / Surface Area.	Compounds involved are moderately odorous. Unpleasantness - process classed in H4 as "Moderately Offensive" or where odours have neutral or slightly unpleasant hedonic tone. Smaller permitted process / Surface Area.	Compounds involved are only mildly offensive. Unpleasantness - process classed in H4 as "Less Offensive". Neutral to positive hedonic tone.
Mitigation / Control	Open air operation with no containment. Reliance solely on good management techniques and best practice.	Some mitigation measures in place but significant residual odour remains.	Effective mitigation measures in place (e.g. BAT, BPM) leading to little or no residual odour.

Table 3 displays the site sludge odour sources, with an inventory of material, quality, and storage capacity, and goes on to explore the odour offensiveness and emission risk. The location of each odour source (asset ID) is shown in Figure 7 above.

Table 3 Lundwood STF Sludge Inventory of odorous materials

Source	Asset ID	Source Type	Storage Capacity (m^3)	Average retention time	Frequency of Operation	Odour Description	Hedonic Tone	Odour Offensiveness	Mitigation Measures	Emission Release Type	Emission Risk
Sludge Import Tank	1	Indigenous, Imports	150	30 minutes	Continuous	Septic sludge, sulphide	Unpleasant	High	Covered	Fugitive	Medium
Sludge screens	2	Indigenous, Imports	N/A	N/A	Continuous	Septic sludge, sulphide	Unpleasant	High	Covered	Fugitive	Medium
Screenings Skip	3	Sludge Screenings	N/A	N/A	Continuous	Septic sludge, sulphide	Unpleasant	Medium	Open to atmosphere	Diffuse	Medium
Thickener Feed Tanks	4	Indigenous, Imports	2 x 1,589	24 hours per tank	Continuous	Septic sludge, sulphide	Unpleasant	High	Covered and extracted to OCU	Abnormal - fugitive only as off-gases ducted to OCU in normal operation	Low
Drum Thickeners	5	Indigenous, Imports	N/A	N/A	Intermittent Daily	Septic sludge, sulphide	Unpleasant	High	Covered and extracted to OCU	Abnormal - fugitive only as off-gases ducted to OCU in normal operation	Low
Thickener Liquor Wet Well	6	Indigenous Liquors	N/A	N/A	Intermittent Daily	Septic sludge, sulphide	Unpleasant	High	Open to atmosphere	Diffuse	High
Digester Feed Tanks	7	Indigenous, Imports	712	24 hours	Continuous	Septic sludge, sulphide	Unpleasant	High	Covered	Fugitive	Medium
Digesters	8	Indigenous, Imports	2 x 2,056	12 days	Continuous	Biogas, Methane/ sulphide	Unpleasant	High	Covered and extracted to biogas storage Full containment of biogas is a critical safety consideration	Abnormal - fugitive only as biogas is collected for use on site.	Low

Source	Asset ID	Source Type	Storage Capacity (m^3)	Average retention time	Frequency of Operation	Odour Description	Hedonic Tone	Odour Offensiveness	Mitigation Measures	Emission Release Type	Emission Risk
Biogas Relief Valves	9	Digested Sludge	N/A	N/A	Emergency operation	Biogas, Methane/ sulphide	Unpleasant	High	Critical process safety requirement. Operates only as required under abnormal process conditions	Point	Low
OCU stack	10	Treated gases	N/A	N/A	Continuous	Treated off gases	Acceptable	Low	Enclosed system with 2-stage treatment	Point	Low
Biogas Holder	11	Biogas	1,580	2 days	Continuous	Biogas	Unpleasant	High	Enclosed vessel. Full containment of biogas is a critical safety consideration	Abnormal - fugitive only as biogas is collected for use on site.	Low
Flare	12	Combusted biogas	N/A	N/A	Emergency Operation	Combustion	Acceptable	Low	Biogas is combusted	Point	Low
Digested Sludge Balance Tanks	13	Digested	2 x 880	36 hours per tank	Continuous	Digested sludge / Earthy	Acceptable	Medium	Open to atmosphere	Diffuse	High
Dewatering Centrifuges	14	Digested	N/A	N/A	Intermittent Daily	Digested sludge / Earthy	Acceptable	Medium	Covered and within a building	Diffuse	Medium
Liquor Balance Tanks	15	Digested Liquors	2 x 250	24 hours	Continuous	Digested sludge / Earthy	Acceptable	Medium	Covered	Diffuse	Medium
Cake Storage Pad	16	Digested	12,750 tonnes	6 weeks minimum	Continuous	Digested sludge / Earthy	Acceptable	Medium	Open to atmosphere	Diffuse	High
Screened sludge pumping station	17	Indigenous, Imports	N/A	N/A	Intermittent Daily	Septic sludge, sulphide	Unpleasant	High	Open to atmosphere	Diffuse	High

2.6 Odour Control Units

There is 1 no. odour control unit (OCU) present on site. The OCU is a two-stage biotrickling filter and activated carbon polishing OCU that extracts and treats odours from the following sources and discharges to atmosphere via a 15m tall stack:

- Thickener Feed Tanks
- Drum Thickeners

Air from the thickener building is extracted directly to the second stage of the OCU (the carbon polishing unit) where it is treated prior to discharge via the stack.

The key OCU performance parameters are summarised in Table 4 below. OCU emissions monitoring is provided in Section 5.1 and OCU performance checklist is provided in Appendix 3:

Table 4 Lundwood STF OCU Performance Parameters

Parameter	Biological Filter	Carbon Filter
Media Type	Pumice	Activated Carbon
Media Life (Yrs)	Variable – replace media once saturated	1 year approximately, depending on inlet loading
Inlet Parameters		
Airflow (m^3/hr)	9,156	
Hydrogen Sulphide	34.75**	
Stack Outlet Performance		
Stack Height	15m	
Stack Efflux Velocity (m/s)	15	
Permitted Odour Concentration (ou_E/m^3)	1,000	
Measured Odour Concentration (ou_E/m^3)	339*	
Measured Hydrogen Sulphide (ppm)	0.020**	

*Direct air samples were collected by lung method in accordance with BS EN 13725:2003

** Sampling methodology using Jerome Hydrogen Sulphide analyser

3 Odour Critical Plant Operation

3.1 Odour Critical Sources

Given the control measures that are in place during operation of the facility, these contributions (if any) are unlikely to increase the odour impact on the receptors outside of the site boundary.

Management of releases includes reducing turbulence, containment and abatement. Where odorous gasses are finally released, controlling the height of release through a stack or the timing of releases through management of activities can influence dispersion before there is an impact on people. Potential on site odour releases associated with Lundwood STF are given in Table 5 below.

Table 5 Lundwood STF Odour Critical Sources (operational controls)

Asset	Asset ID	Potential Odour Source	Odour Control Measures	Odour Risk	Mitigation Trigger	Mitigation Measures	Timescale	Responsible Person
Sludge Import Tank	1	Liquid sludge	Tank covered without extraction. Inspection hatches kept closed. Sludge is mixed and regular throughput is maintained	Unlikely given control measures in place	Increase in complaint frequency / odour sniff test identifies sludge odours off-site	Dose sludge with odour control chemical	Within 5 working days of incident	Product and Process Engineer
Sludge Screens	2	Liquid sludge	Sludge screen is contained asset	Unlikely given control measures in place	Screenings spill local to skip. Increase in complaint frequency / odour sniff test identifies sludge screenings off-site.	Early removal / replacement of skip	Within 5 working days of incident	Product and Process Engineer
Screenings Skip	3	Sludge screenings	Minimal handling and stockpiling of screenings.	Unlikely given control measures in place	Screenings spill local to skip. Increase in complaint frequency / odour sniff test identifies sludge screenings off-site.	Early removal / replacement of skip	Within 5 working days of incident	Product and Process Engineer
Thickener Feed Tanks	4	Liquid sludge	Tank covered and odour controlled. Inspection hatches kept closed. Sludge is mixed and regular throughput is maintained	Unlikely given control measures in place	Failure of extraction fans & increase in complaint frequency / odour sniff test identifies sludge odours off-site.	Dose sludge with odour control chemical	Within 5 working days of incident	Product and Process Engineer
Drum Thickeners	5	Liquid sludge	Sludge thickeners are enclosed, and air extracted to OCU. Building doors are kept closed, except when access is required.	Unlikely given the control measures in place	Failure of OCU extraction fans & increase in complaint frequency / odour sniff test identifies sludge odours off-site.	Dose sludge with odour control chemical	Within 5 working days of incident	Product and Process Engineer
Thickener Liquor Wet Well	6	Sludge liquors	Wet well is uncovered.	Likely given lack of control measures in place	Increase in complaint frequency / odour sniff test identifies sludge liquor odours off-site	Investigate thickener performance and schedule reactive maintenance	Same day as incident	Product and Process Engineer

Asset	Asset ID	Potential Odour Source	Odour Control Measures	Odour Risk	Mitigation Trigger	Mitigation Measures	Timescale	Responsible Person
						Dose sludge with odour control chemical	Within 5 working days of incident	Product and Process Engineer
Digester Feed Tanks	7	Liquid sludge	Tank covered without extraction. Inspection hatches kept closed. Sludge is mixed and regular throughput is maintained	Unlikely given control measures in place	Increase in complaint frequency / odour sniff test identifies sludge odours off-site	Dose sludge with odour control chemical	Within 5 working days of incident	Product and Process Engineer
Digesters	8	Liquid sludge / biogas	Tank is covered and biogas extracted. Risk assessment and odour plan in place before cleaning of any tank.	Unlikely given control measures in place	Loss of digester performance (see table 14 for monitoring parameters)	Investigate digester performance and schedule reactive maintenance.	Same day as incident	Product and Process Engineer
Biogas Relief Valves	9	Biogas	Planned maintenance on equipment. Monitoring of digester pressures. Flare available to burn excess gas.	Unlikely given the control measures in place. Critical safety system.	Prolonged / frequent use of safety valve.	Failures are investigated and reactive maintenance undertaken.	Same day as incident	Product and Process Engineer
OCU stack (mechanical extraction)	10	Liquid sludge	Duty / Standby extraction fan to be available. Prevent increase of fugitive emissions risk from covered processes.	Unlikely given control measures in place	Standby Fan Failure	Standby extraction fan to be in service. Investigate cause of limited extraction.	Support from OCU supplier to be arranged next availability	Product and Process Engineer
OCU stack (media)	10	Liquid sludge	2-stage process to prevent early exhaustion of carbon media. OCU performance is monitored.	Unlikely given control measures in place emissions from OCU outlet	0.5 ppm Hydrogen Sulphide at outlet	Performance monitoring of OCU. Investigate cause of reduced performance	Support from OCU supplier to be arranged next availability	Product and Process Engineer
Biogas Holder	11	Biogas	Planned maintenance on equipment. Monitoring of digester pressures. Flare available to burn excess gas.	Unlikely given the control measures in place. Critical safety system.	Prolonged / frequent use of safety valves.	Failures are investigated and reactive maintenance undertaken.	Same day as incident	Product and Process Engineer

Asset	Asset ID	Potential Odour Source	Odour Control Measures	Odour Risk	Mitigation Trigger	Mitigation Measures	Timescale	Responsible Person
Flare	12	Biogas	Planned maintenance on equipment.	Unlikely given the control measures in place. Critical safety system.	Prolonged / frequent use of flare.	Failures are investigated and reactive	Same day as incident	Product and Process Engineer
Digested Sludge Balance Tanks	13	Liquid digested sludge	Risk assessment and odour plan in place before cleaning of any tank.	Reduced risk due to lower odour potential from digested sludge	Increase in complaint frequency / odour sniff test identifies digested sludge odours off-site.	Review the digester performance	Same week as incident	Product and Process Manager / Process Engineer
Dewatering centrifuge	14	Digested sludge cake	Centrifuge is contained asset	Unlikely given control measures in place	Increase in complaint frequency / odour sniff test identifies sludge cake storage odours off-site.	Review the digester performance	Same week as incident	Product and Process Engineer
Liquor Balance Tanks	15	Digested sludge liquors	Tank covered without extraction. Inspection hatches kept closed. Liquors are mixed and regular throughput is maintained	Unlikely given control measures in place	Increase in complaint frequency / odour sniff test identifies digested sludge liquor odours off-site.	Review the digester performance	Same week as incident	Product and Process Engineer
Sludge cake storage	16	Digested sludge cake	Cake to be handled by the loader only twice (once to move from conveyor to pad, and once to load into the export wagon) to minimise disturbance and odour release.	Unlikely given control measures in place	Increase in complaint frequency / odour sniff test identifies sludge cake storage odours off-site.	Restrict process and reduce storage volumes.	Same week as incident	Centrifuge unit operator
						Ensure cake is removed from site for disposal at the earliest opportunity.	Arrange for compliant cake to be removed from site same week	Centrifuge unit operator
						Root cause analysis and resolution.	Immediately	Product and Process Engineer
Sludge cake export	16	Digested sludge cake	Cover the wagon before leaving site.	Unlikely given control measures in place	Wagon uncovered when leaving site	Ensure wagon is covered before leaving site	Immediately	Centrifuge unit operator
Screened sludge pumping station	17	Liquid sludge	Wet well is uncovered.	Likely given lack of control measures in place	Increase in complaint frequency / odour sniff test identifies sludge liquor odours off-site	Dose sludge with odour control chemical	Within 5 working days of incident	Product and Process Engineer

3.2 OCU Performance Investigation

OCUs installed on site shall be monitored and maintained by site operations and the product and process engineer. Whereby there is an issue with an OCU's operability or treatability that cannot be resolved by site operations, a 3rd party specialist shall be engaged as a priority to arrange for support. In the event that the 3rd party specialist cannot directly mobilise to site, the product and process engineer shall manage the OCU's operation to reduce the risk of compromised performance.

The 3rd party specialist shall be commissioned to undertake an asset condition and performance assessment. The assessment shall include as a minimum the tasks outlined in Appendix 3 but shall extended to any additional tasks to include the highlighted issues by operations.

As part of the assessment, the 3rd party specialist with support from YW operational staff shall work to resolve any issues to ensure the OCU is returned to normal operating conditions. Any issues that cannot be resolved on the day or requires additional parts shall be raised as an action to be manged by the product and process engineer.

At the end of the asset condition and performance assessment the 3rd party specialist shall provide a summary report that documents findings and associated actions / recommendations to return the OCU to normal operating conditions.

3.3 Protocol for Dosing Odour Control Chemical

In the event that there is failure of process mitigation measures that could lead to increased risk of elevated odours, chemical can be dosed directly into the sludge to mitigate this risk.

4 Odour Impact

4.1 Odour Dispersion Model

An odour dispersion model has not been developed for Lundwood STF as part of this OMP due to infrequent odour complaints associated with the WwTW / STF.

Odour dispersion modelling including site specific olfactometric surveys shall be undertaken in the event of increased frequency of odour complaints or operational changes with a perceived increase in odour impact risk.

Any odour sampling shall be undertaken in accordance with EN standards (e.g. dynamic olfactometry according to EN 13725 in order to determine the odour concentration or EN 16841-1 or -2 in order to determine the odour exposure).

4.2 Odour Survey Results

Table 6 An odour survey has been undertaken on selected processes as part of the qualitative odour risk assessment. The odour survey was undertaken during July 2021 to assess the odour emissions from the uncovered and treated emission source. Table 6 includes a summary of the survey results.Lundwood STF Odour Survey Results

Source	Odour Concentration	Odour Emission Rate	Hydrogen Sulphide	Ammonia
	(ou_E/m^3)	($ou_E/m^2/s$)	(ppm)	(ppm)
Fresh Digested Cake	551	5.7	0.006	18.0
Stored Digested Cake	89	0.9	0.005	3.3
Imported Sludge Tank	4,168	43.3	0.440	< 0.1
Sludge Screen Skip	301	3.1	0.020	< 0.1
Thickener Liquor Wet Well	63,404	658.7	10.5	< 0.1
Digested Sludge Balance Tanks	105	1.1	0.005	3.0

As part of the odour survey, monitoring and sniff tests have been undertaken local to the STF operational area. The STF operational area monitoring has identified that one location on the STF detected hydrogen sulphide (the main compound in sludge odours) above the detection threshold (0.009 ppm hydrogen sulphide, north of imported cake storage). The odour description for the majority of the samples range between no odour or faint, with only one location (north of the imported cake storage) observing “strong” odours. It is understood that the strong odour detected at this location was due to the temporary storage of limed raw cake on the cake pad at the time of the survey. This cake had been produced at another YW site; storage of limed raw cake is not part of normal operation at Lundwood STF and is used as a contingency only.

4.3 Qualitative Odour Risk Assessment

A qualitative odour risk assessment of Lundwood STF has been undertaken by Stantec to determine the odour impact risk at sensitive receptors local to the works. The assessment relies on subjective professional judgement but uses the generic guidance methodologies provided and referenced in documents such as the Institute of Air Quality Managements (IAQM) Guidance on the Assessment of Odour for Planning, the Scottish Environmental Protection Agency (SEPA) Odour Guidance 2010, the Environment Agency's Horizontal Guidance Note H1 Environmental Risk Assessments for Permits, and Annex A of H1 – Amenity & accident risk from installations and waste activities.

These guidelines use the Source-Pathway-Receptor concept in which it evaluates the relationship between source(s) of odour, the pathway or transmission route by which exposure may occur at a given receptor(s) who may be affected/impacted.

How well a qualitative odour risk assessment predicts the odour impact for a scenario is dependent on how well the Source-Pathway-Receptor approach can be assessed and scored. This type of assessment is based on subjective judgement and therefore, robust assessment criteria are required. Where subjective judgement for a criterion could be considered broad, sub-criteria have been determined to provide a more detailed judgement.

The odour offensiveness of the have adopted the risk ratings included in Table 4. The pathway from source to receptor considers the distance, local terrain and meteorological conditions, as highlighted in Section 2.3.

The sensitive receptors considered in the assessment are documented in Figure 8 and Table 7.

Figure 8 Lundwood STF Odour Risk Assessment Sensitive Receptor Locations

Table 7 Lundwood STF Odour Risk Assessment Sensitive Receptors

Receptor ID	Receptor Type	Distance from STF operational area (m)	Receptor Sensitivity
D01	Industry	15	Low
D02	Residential	107	High
D03	Residential	103	High
D04	Residential	159	High
D05	Residential	182	High
D06	Residential	276	High
D07	Residential	208	High
D08	Residential	226	High
D09	Residential	332	High
D10	Residential	253	High
D11	Residential	264	High
D12	Residential	449	High
D13	Residential	638	High
D14	Residential	683	High
D15	Residential	420	High
D16	Residential	612	High
D17	Residential	599	High
D18	Residential	959	High
D19	Residential	1070	High
D20	Residential	1369	High
D21	Farm	91	Low
D22	Farm	729	Low

4.4 Results

The results of the qualitative odour risk assessment are summarised in Table 8.

Table 8 Lundwood STF Odour Risk Assessment Results

Receptor ID	Receptor Type	Source Odour Potential	Pathway Effectiveness	Odour Exposure	Receptor Sensitivity	Likely Odour Effect
D01	Industry	Medium	Highly Effective Pathway	Medium Risk	Low	Negligible Effect
D02	Residential	Medium	Moderately Effective Pathway	Low Risk	High	Slight Adverse Effect
D03	Residential	Medium	Moderately Effective Pathway	Low Risk	High	Slight Adverse Effect
D04	Residential	Medium	Moderately Effective Pathway	Low Risk	High	Slight Adverse Effect

Receptor ID	Receptor Type	Source Odour Potential	Pathway Effectiveness	Odour Exposure	Receptor Sensitivity	Likely Odour Effect
D05	Residential	Medium	Moderately Effective Pathway	Low Risk	High	Slight Adverse Effect
D06	Residential	Medium	Moderately Effective Pathway	Low Risk	High	Slight Adverse Effect
D07	Residential	Medium	Moderately Effective Pathway	Low Risk	High	Slight Adverse Effect
D08	Residential	Medium	Moderately Effective Pathway	Low Risk	High	Slight Adverse Effect
D09	Residential	Medium	Ineffective Pathway	Negligible Risk	High	Negligible Effect
D10	Residential	Medium	Moderately Effective Pathway	Low Risk	High	Slight Adverse Effect
D11	Residential	Medium	Moderately Effective Pathway	Low Risk	High	Slight Adverse Effect
D12	Residential	Medium	Ineffective Pathway	Negligible Risk	High	Negligible Effect
D13	Residential	Medium	Ineffective Pathway	Negligible Risk	High	Negligible Effect
D14	Residential	Medium	Ineffective Pathway	Negligible Risk	High	Negligible Effect
D15	Residential	Medium	Ineffective Pathway	Negligible Risk	High	Negligible Effect
D16	Residential	Medium	Ineffective Pathway	Negligible Risk	High	Negligible Effect
D17	Residential	Medium	Ineffective Pathway	Negligible Risk	High	Negligible Effect
D18	Residential	Medium	Ineffective Pathway	Negligible Risk	High	Negligible Effect
D19	Residential	Medium	Ineffective Pathway	Negligible Risk	High	Negligible Effect
D20	Residential	Medium	Ineffective Pathway	Negligible Risk	High	Negligible Effect
D21	Farm	Medium	Highly Effective Pathway	Medium Risk	Low	Negligible Effect
D22	Farm	Medium	Ineffective Pathway	Negligible Risk	Low	Negligible Effect

The qualitative odour risk assessment for Lundwood STF has indicated that all considered sensitive receptors are exposed to either a negligible or slight adverse odour effect indicating no receptors are exposed to a moderately adverse odour effect or worse.

The YW complaints log recorded only five complaints over the last five years for the site as a whole (i.e. the YW Lundwood WwTW and STF). The odour complaints are reported to be from receptors located to the north and west of the site. The inconsistent and infrequent nature of these complaints coupled with irregularity of timing throughout the year, suggests the complaints are likely to be attributed to ad hoc events and are not associated with “normal” operation of the site.

Of the considered BAT Conclusions associated with emissions to air, specifically 14d and 34, a number of sources have been identified as not complying with certain BAT conclusions. The OCU (biotrickling and carbon OCU) has been assessed to be achieving the stack outlet odour concentration of 1,000 ouE/m3.

Some of the processes are open to atmosphere, such as the digested sludge balance tanks and the cake pad. Whilst these processes do not utilise the techniques specifically described in the BAT conclusions; the assessment has not identified a significant risk of odour impact at surrounding receptors from the works. This is supported by the infrequent nature of odour complaints and no “strong” or “unpleasant” odours associated with the uncovered processes detectable at the STF operational area during the odour survey sniff testing.

For the overall site, it is considered that Lundwood STF does not have an adverse odour effect on its surrounding receptors. As such, no additional odour mitigation is required above the existing measures already observed on site.

4.5 BAT Conclusions

BAT Conclusion 14 describes specific measures which may be appropriate for the prevention or reduction of diffuse emissions to air. BAT Section 14d is associated with the “containment, collection and treatment of diffuse emissions” and includes techniques such as:

- Storing, treating, and handling waste and materials that may generate diffuse emissions in enclosed buildings and/or enclosed equipment (e.g., conveyor belts);
- Maintaining the enclosed equipment or buildings under adequate negative pressure;
- Collecting and directing emissions to an appropriate abatement system via an air extraction system and/or air suction systems close to the emission sources.

In terms of the applicability of this technique it is noted that: “The use of enclosed equipment or buildings may be restricted by safety considerations such as the risk of explosion or oxygen depletion. The use of enclosed equipment or buildings may also be constrained by the volume of waste.”

An assessment of STF processes carried out at Lundwood has been undertaken against BAT 14d. Table 9 provides a summary of compliance for site odour sources.

Table 9 BAT Compliance / Alternative Techniques

Source	Source ID	BAT Compliance Review	Alternative Techniques	Compliance Restrictions
Sludge import tank	1	Tank is covered without foul air extraction. Tank will not hold a negative pressure.	BAT partially in place. YW commits to improvements – refer to proposed improvement programme for further details.	None
Sludge screens	2	Sludge screens contained process without foul air extraction. Sludge screens, although of a proprietary enclosed design, do not facilitate creating a negative pressure environment.	Enclosed process, but without extraction and abatement of process air. Small size of source, intermittent use. No sensitive receptors in close proximity. Skip will be covered.	None
Screenings skip	3	Skips open to atmosphere with no containment or treatment of emissions.	BAT not in place – YW commits to cover screenings skip.	None
Thickener feed tanks	4	Tank is covered and headspace air is extracted and treated.	BAT in place	N/A
Drum thickeners	5	Thickener units are enclosed and located within a building. Air from thickener units is extracted and treated in OCU.	BAT in place	N/A
Thickener liquor wet well	6	Sump open to atmosphere with no containment or treatment of emissions.	Small source footprint. No sensitive receptors in close proximity. YW commits to improvements – refer to proposed improvement programme for further details.	None
Digester feed tank	7	Tank is covered without foul air extraction. Tank will not hold a negative pressure.	Odour management techniques in use rather than specific BAT containment measures. YW commits to improvements – refer to proposed improvement programme for further details.	None
Digesters	8	Tank is covered and biogas captured and utilised. LDAR in place.	BAT in place	N/A
Biogas relief valves	9	N/A – emergency use only	N/A	N/A
OCU stack	10	OCU treats headspace air from tanks and thickener. OCU is operated in accordance with this OMP.	BAT in place	N/A

Source	Source ID	BAT Compliance Review	Alternative Techniques	Compliance Restrictions
Biogas holder	11	Biogas is fully contained. LDAR in place.	N/A	N/A
Flare	12	Used only as required. Biogas is combusted.	N/A	N/A
Digested sludge balance tanks	13	Tank open to atmosphere with no containment or treatment of emissions.	Tank contains digested sludge only which is inherently less odorous. No sensitive receptors in close proximity. YW commits to improvements – refer to proposed improvement programme for further details.	None
Dewatering centrifuge	14	Centrifuges, although of a proprietary enclosed design, do not facilitate creating a negative pressure environment.	Source is enclosed. Area subject to regular inspection and management, source not considered to contribute to off-site odour nuisance potential. No sensitive receptors in close proximity. Adequate measures considered to be in operation.	None
Liquor balance tank	15	Tanks are covered with no containment or treatment of emissions.	BAT partially in place. Odour management techniques in use rather than specific BAT containment measures Liquors arise from digested sludge only which is inherently less odorous. No sensitive receptors in close proximity.	None
Cake Pad	16	Cake Pad open to atmosphere with no containment or treatment of emissions.	Odour management techniques in use rather than specific BAT containment measures. Digested sludge only, which is inherently less odorous, during normal operating conditions. Adequate measures considered to be in operation, as supported by odour measurements and impact assessment.	The use of enclosed equipment or buildings is constrained by the volume of cake stored.
Screened sludge pumping station	17	Sump open to atmosphere with no containment or treatment of emissions.	Small source footprint. No sensitive receptors in close proximity. YW commits to improvements – refer to proposed improvement programme for further details.	None

A number of sources on site do not adopt the specific conclusions outlined in BAT 14d. The sludge import tank, sludge screens, digester feed tank, dewatering centrifuge and liquor balance tanks would be considered to be partially compliant due to being contained processes. Whilst these processes are only partially compliant, the sludge screens, screenings skips and dewatering centrifuge occupy a small source footprint and are not likely to contribute to significant odour emissions or impact on surrounding receptors.

The cake pad is currently uncovered and does not utilise specific measures outlined in BAT 14d. The cake pad odour emissions are more akin to secondary treated wastewater than indigenous sludge emissions. Covering the cake pad would require a large building with air extraction / ventilation, odour treatment and dispersion to atmosphere. The ongoing operation of this building would be associated with significant electrical consumption and use of consumable carbon media. Given that the risk assessment showed that cake storage is low risk and the large volume of waste being handled, it is considered reasonable that the applicability guidance previously mentioned justifies the uncovered storage of cake.

As part of the odour survey, the OCU was sampled and identified to be treating odours and meeting BAT 34 odour concentration.

5 Monitoring and Control of Odours

All monitoring should clearly relate to the assessment of odour control and complete records must be kept in an auditable format. The only way to determine whether the processes on site are under control, and to keep them under control, is to do appropriate monitoring.

As far as possible, Lundwood STF is operated to minimise odour generation and release. As long as the treatment process satisfies the normal design criteria, odour should be minimal. To minimise odour nuisance, it is important to ensure that Lundwood STF is operating at its optimum. Covers and hatches should always be replaced to maintain the integrity of enclosures provided to collect odorous air.

5.1 Sniff Testing

Sniff testing is recognised by Yorkshire Water as a useful technique to build up a picture of the impact the odour has on the surrounding environment over time. Sniff testing shall be used to support profiling site odour impact, investigate odour complaints and to introduce temporary odour mitigation measures.

Sniff testing shall be undertaken on site on a weekly basis by site operational staff. It is accepted that operational staff may not be ideal for sniff testing of site odours as they have adapted to odours from the site. However, this will provide a baseline for routine observations. The weekly operator sniff tests shall assess the site boundary and focus on the detection of any odours that could potentially be leaving site.

Monthly sniff tests shall be carried out by non-site-based staff (Technically Competent Manager) who are not adapted to site odours. The monthly sniff test shall be carried out at additional test locations local to source to profile the location of any fugitive emission sources. For Lundwood STF, due to a low frequency of odour complaints and the majority of assets having odour mitigation, the routine sniff-testing shall be site based only.

In the event of odour complaints being received, site operators shall undertake a sniff test including off-site sniff testing local to the complaint location(s). In the occurrence of a significant odour event or repeated complaints, a third-party shall be engaged for an additional odour investigation including on and off-site sniff testing.

A third-party odour sniff test is scheduled to be undertaken twice a year for comparison with Yorkshire Water (operator and monthly tester) observations. The third-party sniff test shall include both on and off-site locations based on surrounding sensitive receptors and complaint locations. The off-site locations shall be reviewed prior to any third-party testing to ensure any recent changes to sensitive receptors are considered.

The location of weekly and monthly on-site sniff testing locations has been included in Figures 9 and 10, respectively. Routine off-site locations have not been included due to a lack of odour contacts. In the event that odour complaint frequency increase, off-site locations shall be incorporated into the routine sniff testing.

Figure 9 Lundwood STF Weekly On-Site Sniff Testing Locations

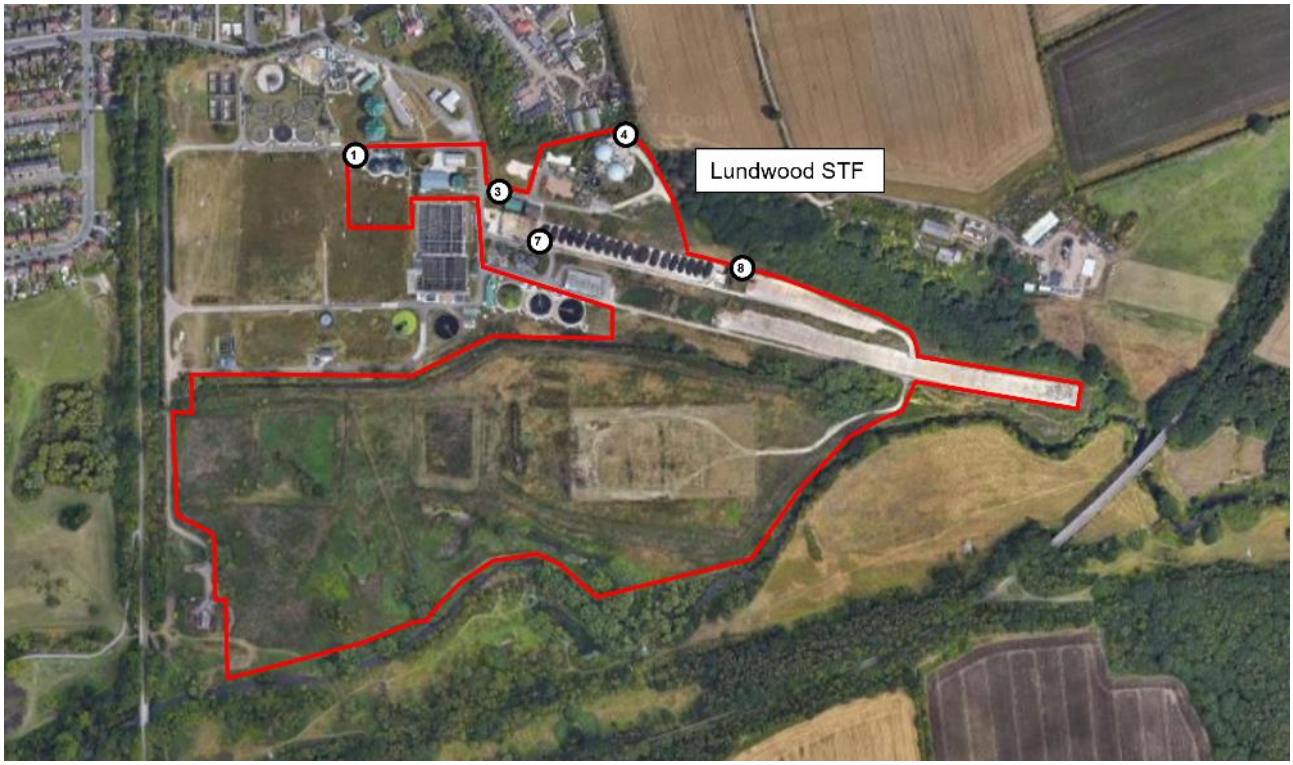
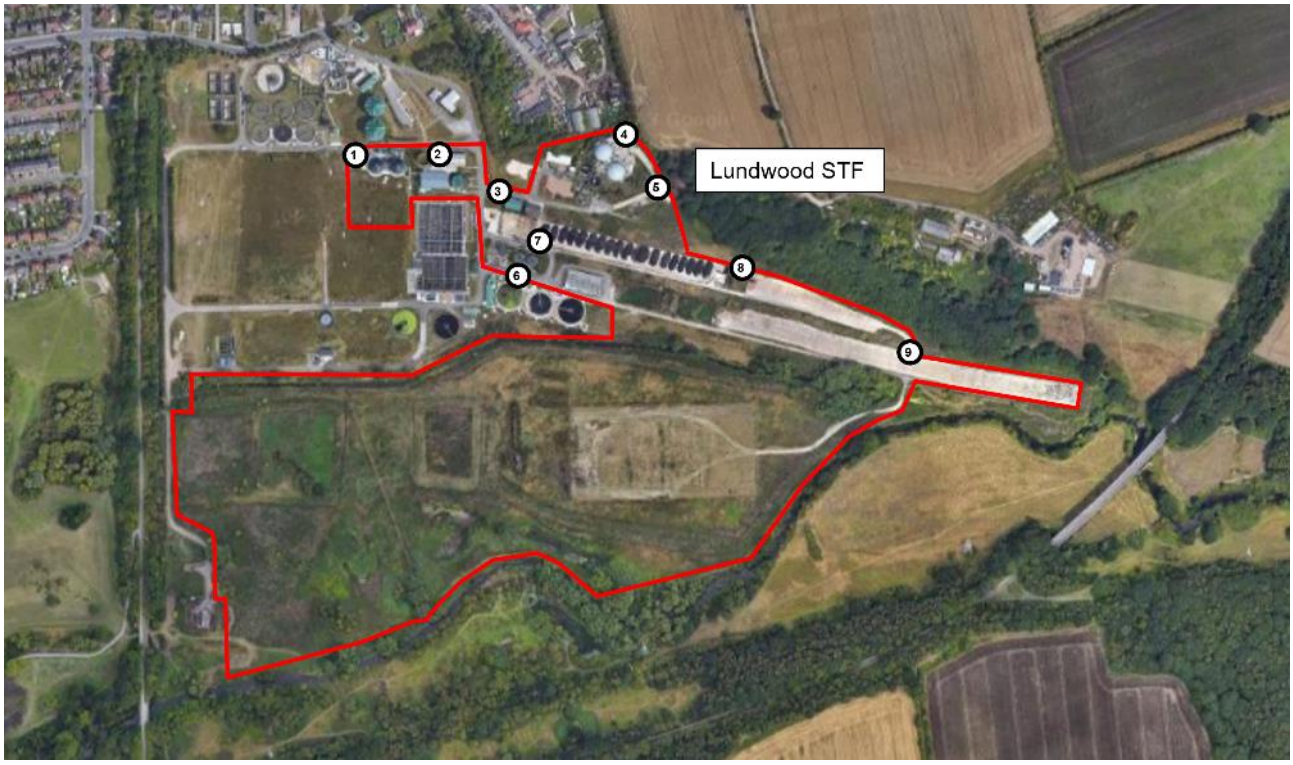


Figure 10 Lundwood STF Monthly On-Site Sniff Testing Locations



5.2 Channelled Emissions

The odour control unit outlet emissions shall be monitored once every six months for H_2S and NH_3. The sampling shall be undertaken by a third-party Assessor. OCU performance shall be monitored in accordance with the OCU performance checklist provided in Appendix 3.

5.3 Imports/Exports

The Site Operating Procedures include instructions on how sludge must be imported. The YW Safe Loading & Discharging of Sludge Road Tankers is available in Appendix 6. Tankers shall be filled and emptied in a way that minimises odour discharge.

5.4 Sludge Treatment and Disposal

Raw or co-settled sludges always smell objectionable, but the odour becomes stronger during storage, as anaerobic decomposition occurs, leading to high concentrations of malodorous compounds in sludges and sludge liquors. Digested sludges are less odorous, particularly after they have cooled. To minimise the generation of odours, where possible, fresh sludge shall be processed and sent to digestion as quickly as possible before further treatment and removal from site. Raw sludges stored upstream of digestion would never be stored for more than 2 days in normal plant operation.

5.5 Sludge Thickening and Storage

Accumulation of sludge in the system can cause increased odour release in storage tanks, as well as from sludges and liquors when thickening takes place. To minimise odours from the Lundwood STF, the works should be operated as follows:

- Minimise retention prior to thickening, dewatering or digestion;
- Prevention of sludge accumulation in off-line tanks; and
- Proactive identification of potential problems and tankering of sludges to other sites with odour abatement.

5.6 Anaerobic Digestion

The digestion process breaks down a wide range of odorous compounds, which may be released if care is not taken to avoid turbulence of the sludge after digestion. Odour problems may be caused by:

- Saline intrusion (or industrial wastes) leading to elevated sulphate concentrations of raw sludge, giving a greater sulphide potential;
- Emissions of biogas resulting in significant odour problems; and
- Incomplete digestion leading to odour release from secondary digestion tanks.

Suggested remedial measures include:

- Check seals and valves to prevent the release of biogas;
- Ensure gas handling system is balanced and that pressure relief valves do not operate prematurely;
- Ensure all excess gas is flared and that flare stack ignition is immediate and reliable;
- Addition of iron salts or other chemicals to precipitate or inhibit the formation of sulphide.

There are odour checklists for both YW Operators and Team Leaders in Appendix 2.

5.7 Site Operation and Management Procedures

All operating practices should be compliant with the site O&M manuals. The Integrated Management System (IMS) developed by YW to cover Environmental, Health & Safety and Quality elements of all aspects of YW activities will also apply.

The IMS identifies the environmental aspects and impacts of all YW plants, including the facility at Lundwood. The facility will operate under the IMS which shall include:

- Quality management procedures for operational aspects, for example: preventative electrical and mechanical maintenance, safe working procedures, accident / incident response and emergencies;
- Specialist contractors shall be employed by YW to undertake any non-routine or specialised maintenance tasks;
- Use of only YW approved contractors. YW maintain an approved contractors list which is used for appointment of all YW contractors. This requires contractors to achieve a high level of environmental competence / performance. YWS Framework Contractors are required to operate an EMS in accordance with ISO 14001;
- Preparation/issue of risk assessments and method statements by all contractors before starting work. These risk assessments and method statements will include consideration of odour and measures in place to control odour releases. These are prepared as part of the 'hand - over' and 'hand – back' certificate or 'permit to work'; and
- Regular environmental and quality audits to be carried out. These shall include a review of potential odour and identify any additional control measures which may be required.

5.7.1 Procedures for Operation Plant

All operating practices should be compliant with the site O&M manuals, YW company practice and the OMP.

5.7.2 Routine Inspection and Recording

Visual inspection of facility processes will be carried out on regular basis as part of staff duties. In addition, regular checks of the OCU performance as described in Appendix 3 shall be carried out. If abnormal odour is witnessed, YW staff shall record details in the Odour Log Spreadsheet of the observation and immediately investigate. During any such recording carried out as part of this OMP, it is important to document any potential contribution from other off-site sources of potential odour nuisance located outside of the facility boundary. An odour monitoring record sheet to be used in the event of site odours is included in Appendix 4.

5.7.3 Maintenance by Engineering Reliability Staff

Engineering Reliability staff (Mechanical Fitters, Electricians and ICA Technicians) carry out routine maintenance of plant and equipment. There is also proactive maintenance of the OCU. This includes odour abatement equipment.

Routine maintenance requirements are included within YW's Work Management System (WMS) task lists for the site and are forwarded to members of this team via their Toughbook. Feedback on planned maintenance carried out is recorded in WMS by the Engineering Reliability staff member via their Toughbook and transferred to SAP for storage.

5.7.4 Reporting Faults and Identifying Maintenance Needs

For faults requiring immediate attention, the Product and Process Engineer raises a SAP notification and calls it through to the Scheduling & Planning Team. If it meets a high priority according to the Risk Assessment Matrix (RAM), it will be attended as a scheduling buster for the relevant YW Engineer to attend site.

For less urgent faults the Product and Process Engineer raises a SAP notification. It will be converted into a SAP job and picked up by the Scheduling & Planning Team and progressed accordingly. If at any time the situation changes, and the job becomes more urgent, the Product and Process Engineer (PPE) would re-prioritise the SAP job in line with the RAM and call through to the Scheduling & Planning Team.

Routine maintenance requirements are fed to YW's maintenance team via SAP.

5.7.5 Replenishing Chemicals / Consumables

The OCU performs an important function for the overall control of odour across the site. When consumables in the OCU need to be replenished they are ordered via YW's ordering system. An order is set up for each chemical and stocks are replenished via a one-off Order. Delivery notes must be kept in a folder on site.

5.7.6 Initiating OCU Media Replacement

Before 12 months of operation carbon samples from the OCUs are manually taken on a given schedule in the Operator's task list and sent for laboratory analysis to determine the lifespan of the media. Once at around 70% spent an order is raised for replacement of the media.

5.8 Changing Dispersion Conditions

Site activities that could lead to increased site emissions will be avoided when there are poor dispersion conditions or during sensitive periods (hot days, when people are more around). If not possible to be avoided, additional monitoring in the form of sniff testing and monitoring of site performance shall be undertaken. In the event that site activities are resulting in increased off-site odours or customer complaints, the activity shall be rescheduled / undertaken during low-risk times / weather conditions.

Table 10 Lundwood STF Changing Dispersion Risk

Asset	Changing Dispersion Condition	Mitigation Trigger	Mitigation Action	Time scale	Responsible Person
Screening skip	Hot Days, School Holidays (summer)	Temperature - >26°C and significant odour complaints	Increase frequency of skip export from site	Forecast in advance – 5-day weather forecast	Product and Process Engineer
Sludge cake export	Hot Days, School Holidays (summer)	Temperature - >26°C and significant odour complaints	Cake export between 8am to 6pm only	Forecast in advance – 5-day weather forecast	Product and Process Engineer

6 Emergency and Incident Response

This section addresses the issue of appropriate response to odour incidents caused by process failure or equipment breakdown. These emergency procedures include the:

- Foreseeable situation that may compromise the ability to prevent and minimise odorous releases from the process;
- Actions to be taken to minimise the impact; and
- Person responsible for initiating the action.

Where abnormally high odour levels are observed – indicating odour pollution a PPE will be required to take appropriate contingency measures. These measures should include:

- Investigating the odour incident and its cause(s);
- Bringing the process back under control; and
- Minimising exposure or annoyance effects.

Table 11 below summarises incident / emergency control measures in place. The YW odour emergency contact details for Lundwood STF are available in Appendix 1.

Table 11 Lundwood STF Incident/Emergency Control Measures

Failure/Abnormal Situation	Potential Odour Source	Potential Impact	Mitigation Measures	Actions to be Taken	Timescale for Rectification	Responsible Person
Failure of the odour control unit	Untreated air	High – OCUs provide treatment for odorous air from the Permitted site. Failure of OCU would result in release of abnormal operational fugitive odours direct to atmosphere	Routine maintenance. Regular monitoring of equipment performance. Duty standby functionality. Standby capacity in the media beds.	For plant failure - investigate and repair.	Site operator to investigate on same working day. Support from OCU supplier to be arranged for next availability	Site Operator
Liquid sludge import spillage	Liquid sludge	Medium – low volume spillage likely to go directly to drain which returns to the WwTW for treatment.	Pipework and tanks undergo regular inspections. Planned maintenance on equipment	Stop source of spill and immediately wash down area.	Immediate	Tanker Driver
				Arrange repair.	Job to be raised and promoted on same working day or next	Site Operator
				Record spillage and actions taken in site diary.	Same day as incident	Site Operator
Sludge cake spillage	Sludge Cake	Medium to High depending on volume of spill	Regular inspection and planned maintenance	Stop source of spill and immediately wash down area.	Immediate	Tanker Driver
				Arrange repair.	Job to be raised and promoted on same working day or next	Site Operator
				Record spillage and actions taken in site diary.	Same day as incident	Site Operator
				If there is likely to be any offsite impact inform manager and technically competent manager immediately.	Same day as incident	Site Operator
		Medium - Biogas would be vented at high	Gas pressure is regulated and monitored	Diversion of biogas to Waste Gas Burner	Immediate	Site Operator

Failure/Abnormal Situation	Potential Odour Source	Potential Impact	Mitigation Measures	Actions to be Taken	Timescale for Rectification	Responsible Person
High pressure conditions in digesters	Release from Pressure Relief Valve	pressure to aid dispersion		Investigate likely sources of high pressure in the digester and resolve (e.g. blocked outlet)	Immediate	Site Operator
Loss of Biogas containment	Leaks from gas holder membrane	Medium	Double gas holder membrane system with gas pressure between the membranes regulated and monitored. Methane detectors operated with alarms to alert operators of any leakage between membranes.	Diversion of biogas to CHP plant or Waste Gas Burner. Inspection maintenance and repairs of gas holder as appropriate	Immediate	Site Operator
				Record details and Actions taken in site diary	Immediate	Site Operator
Staff unavailability	Risk of increase to site odours due to limited operational resources	Low	Staff replacement	Operator replacement from another site Remote monitoring from Control Room / off-site / another site	Same day / For next working day	Product and Process Engineer / Site Manager
Asset Fire	Risk of increase to site odours due to limited access and inability to operate assets	Medium	Regular inspection and planned maintenance	Remote monitoring from Control Room / off-site / another site	Immediate	Product and Process Engineer
Very high rainfall	Flooding	Low	Increased monitoring of media and sludge storage	Check the performance of the Odour Control Unit when water levels drop and replace media as required (if media has been flooded it may need replacing)	Site operator to investigate on same working day. Support from OCU supplier to be	Product and Process Engineer

Failure/Abnormal Situation	Potential Odour Source	Potential Impact	Mitigation Measures	Actions to be Taken	Timescale for Rectification	Responsible Person
					arranged for next availability	

7 Inspection/Monitoring/Maintenance Schedules and Records

7.1 Inspection/Monitoring/Maintenance Schedules for Odour Abatement Equipment

A list of routine monitoring and maintenance tasks for the odour control units is included in Appendix 2. Reference should also be made to the OCU specific O&M manuals.

Proactive maintenance tasks are included within SAP task lists for each site and are forwarded to the Product and Process Engineer and Operator via their Toughbook for completion.

Monitoring results from the inlet and outlet of the odour control units will be recorded as appropriate. Refer to Appendix 3 monitoring schedule.

Feedback on maintenance of odour abatement equipment and pipework is recorded in SAP by the Product and Process Engineer or Operator via their Toughbook. YW maintenance staff also provide feedback on work carried out by them.

A review of the OCU plant effectiveness, including measurement of inlet and outlet process and emissions parameters. Any improvements required will be identified and timescales for implementation proposed. This odour management plan will be updated with details of this planned improvement work.

7.2 Key Process Monitoring

Records of site deliveries for the odour control system are stored on site.

The site is operated under a full PLC SCADA control with data logging and interrogation of key parameters to maintain safe, efficient, and low emissions operation. Table 12 includes the key process monitoring provisions for processes associated with emissions to air.

Table 12 Key Process Monitoring Provisions

Emission point / description	Parameter	Monitoring approach	Monitoring frequency
Sludge intake	Intake volume	SCADA	Continuous during unloading operations
	% dry solids	SCADA	Continuous during unloading operations
CHP (A1)	Operating hours	SCADA	Continuous data logging
	Electricity generated	SCADA	Continuous data logging
	Load required / actual (%)	SCADA	Continuous data logging
	Biogas flow / pressure to CHP	SCADA	Continuous data logging
	Heat circuit temperatures (deg. C)	SCADA	Continuous data logging
Boiler (A2 and A3)	Load required / actual (%)	SCADA	Continuous data logging
	Biogas / natural gas flow / pressure to boiler	SCADA	Continuous data logging
	Heat circuit temperatures (deg. C)	SCADA	Continuous data logging
	Heat circuit flow	SCADA	Continuous data logging
Flare compound (A4)	Biogas to flare (m^3)	SCADA	Continuous data logging
	Run hours	SCADA	Continuous data logging
Odour control unit stack (A5)	Operational status	SCADA	Indication
Biogas storage	Gas level (%)	SCADA	Continuous data logging
	Gas pressure (mb)	SCADA	Continuous data logging
	Methane %	SCADA	Continuous data logging
Digesters	Volume	SCADA	Continuous data logging
	Volatile Fatty Acids (VFAs)	Manual	Periodic
	Alkalinity	Manual	Periodic
	Process temperature	SCADA	Continuous data logging
	% solids (intake)	SCADA	Continuous data logging
	Retention (hours)	SCADA	Continuous data logging
	Temperature	SCADA	Continuous data logging
	H_2S (ppm)	SCADA	Continuous data logging
	Foam level	SCADA	Continuous data logging
Centrifuges	Dry solids (%)	Manual	Periodic
	Flow	SCADA	Continuous data logging

8 Customer Communications

8.1 External Complaints

External odour complaints are received by Loop, which is the external company YW uses for all customer contacts. The call handler will work with the caller to understand the source of the issue. They will explore where the caller experienced the odour, whether it is a repeat or a singular issue, when and where it's most noticeable, what site the odour may be coming from, a description of the smell and if it's the first time it's been noticed. Loop record all complaints on the ICE system and contact the appropriate site owner, via the YW Control Room, to manage the complaint. The complaint will be passed to the Site Manager within 30 minutes or next working day if out of hours. The issue will be dealt with as a matter of priority. ICE is a computer program used to record and manage customer contact. The complainant may or may not request feedback of the cause and resolution of the issue. The odour contact form is included in Appendix 8.

When a complaint has been received, Site will undertake an investigation using the Site Checklist and record details of the investigation in the Odour Investigation Form (Appendix 9).

Odour complaints will be investigated at this site on the same working day (where practicable) and ideally within 2 working days of being aware of the issue. The investigation must not be carried out any later than 5 working days after being aware of the issue.

The Technical Optimiser should then put a note in the site diary and odour diary to record the complaint and inform the TCM and Site Manager of their findings.

Any actions will be resolved as a matter of priority. If immediate resolution of the odour issue can't be carried out, and where reasonably practicable, mitigation measures will be undertaken. Actions will be recorded on the investigation form. Feedback of the issue and the actions undertaken will be sent to the Customer Case Manager to communicate to the Complainant (if requested).

In the event of multiple complaints, and / or the potential for multiple complaints to occur, the Duty Manager will be informed and an incident response will be instigated.

8.2 Internal Complaints

If the PPE or any YW staff identify an abnormal odour release, the PPE will undertake an investigation using the Operator Site Checklist and complete any actions the investigation suggests. The PPE should then put a note in the site diary and the odour site dairy and inform the Technical Optimiser and Site Manager of their findings.

The odour complaint process is included in Appendix 7.

8.3 Community Engagement

Customers are at the heart of what we do at Yorkshire Water. In the event of an odour issue affecting multiple customers within the community, Yorkshire Water's communication team will decide the level of response that is required. This could include, but not be restricted to, stakeholder liaison (communication through local councillors, MPs and affected businesses), local media liaison and/or community meetings to discuss the issues and actions that will be undertaken to rectify the issue. Customer engagement events would be held if the odour severity dictated this level of response. Customers may be encouraged to keep an odour diary to record when odour is perceived to be a greater issue.

9 Training

9.1 Training Requirement

All staff receive training to cover operation of the site, assessment of odour and monitoring and maintenance of the OCU on the site. The training requirements for key staff at Lundwood STF are displayed in Table 13 below.

Table 13 Lundwood STF Training Requirements

Post	Training Requirement
Product and Process Site Manager	• Awareness of the responsibilities for avoiding odour nuisance. • Monitoring / maintenance of odour abatement equipment. • Odour control procedures during start-up / shut down. • Procedures for abnormal conditions. • Requirements of the OMP and Environmental Permit.
Product and Process Engineer / Operator	• Awareness of the responsibilities for avoiding odour nuisance. • Monitoring / maintenance of odour abatement equipment. • Odour control procedures during start-up / shut down. • Procedures for abnormal conditions. • Requirements of the OMP and Environmental Permit.
Sampler	• Awareness of responsibilities for avoiding odour nuisance and reporting. • Monitoring of odour abatement equipment.

9.2 Training Received

YW maintains processes to ensure that all those working for or on behalf of YW are suitably trained to fulfil their roles efficiently. Assessment of competence and identification of individual training needs is carried out through mutual discussion between the individual and their manager as part of the company performance management process, a fundamental part of which is the competency framework and progression plans which are available for every role in the organisation.

All YW employees receive IMS awareness training, delivered online at induction and periodically thereafter. This includes awareness of the environmental policy and understanding key environmental hazards and risks and the need to comply with IMS requirements.

Staff who work at the Lundwood STF receive specific training in the plant's operation and the potential environmental impact of the process as well as health and safety. Plant operators have a detailed understanding of the operational procedures for the site for both normal and abnormal operation. As part of the training, operators will receive specific instructions relating to those aspects of plant operation that have the potential for a negative impact on the environment. Toolbox talks are used to provide information and training to site staff, including information about environmental requirements/activities and legislative and compliance requirements. Training records for programmes and courses managed centrally are held on the company Learning Management System. Records for specific training managed locally at the Lundwood site is held by individual managers and/or on the Leaning Management System.

Appendix 1 Emergency Contacts

Table 14 Lundwood STF Contacts

Area	Contact
Barnsley Council	01226 787787
Odour Abatement Systems Suppliers	ERG Odour Control
OCU Maintenance Provider	Greenacre Environmental Systems Limited
Lundwood STF Odour related Yorkshire Water Contacts	Site Manager: Mick Flanaghan Site Optimiser: John Bullivant

Appendix 2 Odour Checklist

CHECKLIST FOR SITE ODOUR INVESTIGATION

AREA OF WORKS	POTENTIAL PROBLEM		FOLLOW UP ACTION REQUIRED
ODOUR MANAGEMENT PLAN (OMP)	· Does the site have an OMP?	YES / NO	
	· Is the site operated according to the OMP?	YES / NO	Inform Treatment Team Leader
SITE - GENERAL	· Are all covers in place?	YES / NO	Replace covers and close hatches as required
	· Are all access hatches closed?	YES / NO	
INLET WORKS	· Is the crude sewage black and / or smelly?	YES / NO	Inform Treatment Team Leader
Screening	· Are there any spilled screenings?	YES / NO	Clean up spills
	· Are the compacted screenings clean?	YES / NO	Inform Treatment Team Leader if screenings are not clean
Grit Removal	· Is there any spilled grit?	YES / NO	Clean up spills
	· Is the grit clean?	YES / NO	Inform Treatment Team Leader if grit is not clean
Screening and Grit Skips	· Do the screenings skips smell?	YES / NO	Inform Treatment Team Leader
	· Do the grit skips smell?	YES / NO	Inform Treatment Team Leader
	· Are the screenings skips too full?	YES / NO	Empty skips as needed
	· Are the grit skips too full?	YES / NO	Empty skips as needed
Storm Tanks	· Have the storm tanks been left full following a storm?	YES / NO	Empty and clean out tanks as needed
	· Is there any sludge left in the bottom of the tanks?	YES / NO	
PRIMARY TANKS	· Are the tanks black and / or smelly?	YES / NO	Inform Treatment Team Leader
	· Are the tanks gassing?	YES / NO	
	· Is there excess scum on the surface?	YES / NO	
BIOLOGICAL FILTRATION	· Are the aeration vents blocked?	YES / NO	Inform Treatment Team Leader
	· Is there any ponding?	YES / NO	
ACTIVATED SLUDGE	· Do the dissolved oxygen levels in the aeration lanes match the setpoint(s)?	YES / NO	Adjust dissolved oxygen levels as required
	· Do the MLSS fall within the tramlines for the site?	YES / NO	Increase / decrease RAS rate as needed
FINAL TANKS	· Are the tanks black and / or smelly?	YES / NO	Inform Treatment Team Leader
	· Are the tanks gassing?	YES / NO	
	· Is there excess scum on the surface	YES / NO	
TERTIARY TREATMENT	· Any there any site specific issues?	YES / NO	Inform Treatment Team Leader
SLUDGE TREATMENT	· Are there any sludge spills?	YES / NO	Clean up spills
Imports and Exports	· Does the tanker filling and emptying process cause significant release of odour?	YES / NO	Inform Treatment Team Leader
Sludge Thickening and Storage	· Are all covers are in place?	YES / NO	Replace covers and close hatches as required
	· Are all access hatches closed?	YES / NO	
	· Are the doors to sludge treatment buildings / sludge cake stores kept closed?	YES / NO	Close doors as required
Anaerobic Digestion	· Is all excess gas flared?	YES / NO	Inform Treatment Team Leader
	· Is flare stack ignition immediate and reliable?	YES / NO	
	· Are the whesso valves / PRVs operating prematurely?	YES / NO	
	· Are the seals on the condensate traps intact?	YES / NO	
ODOUR ABATEMENT	· Is there any detectable odour downwind of the stack?	YES / NO	Inform Treatment Team Leader
	· Is the fan(s) working?	YES / NO	Arrange for fan to be repaired
GENERAL	· Are there any outstanding actions from a previous investigation?	YES / NO	Complete actions

NAME: _____ **DATE:** _____

CHECKLIST FOR SITE ODOUR INVESTIGATION
PRODUCT + PROCESS OPTIMISER / TREATMENT TEAM LEADER

AREA OF WORKS	POTENTIAL PROBLEM		FOLLOW UP ACTION REQUIRED
ODOUR MANAGEMENT PLAN (OMP)	· Does the site have an OMP?	YES / NO	
	· If the site is not operated according to the OMP	YES / NO	Make changes to site operation to minimise odour production and release
SITE - GENERAL	· Are all covers in place?	YES / NO	Replace covers and close hatches as required
	· Are all access hatches closed?	YES / NO	
INLET WORKS	· If the crude sewage black and / or smelly	YES / NO	Check incoming sewage for septicity (in conjunction with Operations Support team) Contact Industrial Waste to check for potential septic discharges
Screening	· Are there any spilled screenings?	YES / NO	Clean up spills
	· If the compacted screenings are not clean	YES / NO	Optimise operation of screenings handling equipment
Grit Removal	· Is there any spilled grit?	YES / NO	Clean up spills
	· If the grit is not clean	YES / NO	Optimise operation of grit handling equipment
Screening and Grit Skips	· If the screenings skips smell	YES / NO	Check that screenings are clean and free from organic material; optimise screenings handling equipment if needed Empty skip(s)
	· If the grit skips smell	YES / NO	Check that grit is clean and free from organic material; optimise grit cleaning system if needed Empty skip(s)
	· Are the screenings skips too full?	YES / NO	Empty skips as needed
	· Are the grit skips too full?	YES / NO	Empty skips as needed
Storm Tanks	· Have the storm tanks been left full following a storm?	YES / NO	Empty and clean out tanks as needed
	· Is there any sludge left in the bottom of the tanks?	YES / NO	
PRIMARY TANKS	· If the tanks are black and / or smelly	YES / NO	Check inlet for septicity: Check levels of sludge in the tank and increase desludge rate if needed
	· OR If the tanks are gassing	YES / NO	
	· If there is excess scum on the surface	YES / NO	Remove excess scum
BIOLOGICAL FILTRATION	· If the aeration vents are blocked	YES / NO	Unblock aeration vents
	· If there is ponding	YES / NO	Consider increasing flushing rate and / or forking media
ACTIVATED SLUDGE	· Do the dissolved oxygen levels in the aeration lanes match the setpoint(s)?	YES / NO	Adjust dissolved oxygen levels as required
	· Do the MLSS fall within the tramlines for the site?	YES / NO	Increase / decrease RAS rate as needed
FINAL TANKS	· If the tanks are black and / or smelly	YES / NO	Check inlet of tanks for septicity: Check levels of sludge in the tank and increase desludge rate if needed
	· OR If the tanks are gassing	YES / NO	
	· If there is excess scum on the surface	YES / NO	Remove excess scum
TERTIARY TREATMENT	· If there are any site specific issues	YES / NO	Investigate and rectify
SLUDGE TREATMENT	· Are there any sludge spills?	YES / NO	Clean up spills
Imports and Exports	· If the tanker filling and emptying process causes significant release of odour	YES / NO	Investigate whether the process can be modified to reduce odour emissions Consider changing timing of tanker operations to reduce nuisance potential
Sludge Thickening and Storage	· Are all covers are in place?	YES / NO	Replace covers and close hatches as required
	· Are all access hatches closed?	YES / NO	
	· Are the doors to sludge treatment buildings / sludge cake stores kept closed?	YES / NO	Close doors as required
Anaerobic Digestion	· If all excess gas is not flared	YES / NO	Contact ER to investigate
	· If flare stack ignitionis not immediate and reliable	YES / NO	Contact ER to investigate
	· If the whesso valves / PRVs operate prematurely	YES / NO	Contact ER to investigate
	· If the seals on the condensate traps leak or are damaged	YES / NO	Contact ER to investigate
ODOUR ABATEMENT	· If there is any detectable odour downwind of the stack	YES / NO	Check OCU using additional checklist
	· Is the fan(s) working?	YES / NO	Arrange for fan to be repaired
GENERAL	· If there are any outstanding actions from a previous investigation	YES / NO	Complete actions

NAME: _____ **DATE:** _____

Appendix 3 OCU Performance Check List

Task	Frequency	Performance Indicators	Method	Actions to be Taken	Responsible Person
Odour Abatement Plant – Biofilter					
Gas flow rate	Continuous	+/- 15% design value (21,260 m^3/hr)	Gas flow meter / EN 16911-1 and MID for EN 16911-1	Odour abatement plant shall be regularly checked and maintained to ensure appropriate performance. Odour abatement plant shall be managed in accordance with permit conditions, the odour management plan and manufacturer's recommendations. Carbon filter(s) to be replaced in accordance with manufacturers recommendations. Equipment shall be regularly calibrated.	Operations
Temperature (inlet)	Daily	For information only	Temperature probe /Traceable to national standards		Operations
Thatching / compacting	Weekly	As per O&M	Back pressure		Operations
Hydrogen sulphide	Continuous	Max 172 ppm	Electrochemical monitor		Operations
pH (biofilter drainage effluent)	Continuous	pH 6 – 8	pH metre		Operations
Differential pressure	Continuous	+/- 15% design value (-224 Pa)	Recognised industry method		Operations
Check irrigation rates of biological OCU	As per O&M	As per O&M	Monitor flow on the unit.	Adjust wetting rate as required.	Operations
Check and clean the irrigation nozzles on the biological OCU	As per O&M	As per O&M	As per O&M	Clean as required	Operations
Efficiency assessment	Every 6 months	Hydrogen Sulphide – 98% removal rate Ammonia – 90% removal rate Mercaptans – 95% removal rate Dimethyl Sulphide – 20% removal rate VOCs – 50% removal rate	Media health, air-flow distribution and emission removal efficiency (BS EN 13725 for odour removal)	Third party survey to assess performance of the OCU including contaminant removal rates, media health, channelling of media.	3rd Party Specialist
Odour Abatement Plant – Carbon Filters					
Moisture / humidity	Daily	For information only	Moisture meter	Odour abatement plant shall be managed in accordance with permit conditions, the odour management plan and manufacturer's recommendations. Carbon filter(s) to be replaced in accordance with manufacturers recommendations. Equipment shall be regularly calibrated.	Operations
Differential pressure	Continuous	+/- 15% design value (-1,278 Pa)	Recognised industry method		Operations
Efficiency assessment	Annual	99% removal of contaminants	Emission removal efficiency (BS EN 13725 for odour removal)		3rd Party Specialist

Task	Frequency	Performance Indicators	Method	Actions to be Taken	Responsible Person
Odour Abatement Plant – Outlet Stack					
Temperature	Continuous	For information only	Temperature probe /Traceable to national standards	N/A	Operations
Hydrogen sulphide	Continuous	0.5 ppm	Electrochemical monitor	Investigate OCU performance. Arrange third party specialist support. Replace OCU media	Operations
Hydrogen sulphide	Every 6 months or as agreed in writing by the Environment Agency.	As per BAT 8 / BAT 34	CEN TS 13649 for sampling NIOSH 6013 for analysis	Action levels to be achieved in accordance with permit conditions and the odour management plan.	3rd Party Specialist
Ammonia	Every 6 months or as agreed in writing by the Environment Agency.	As per BAT 8 / BAT 34 (0.3 – 20 mg/Nm^3)	EN ISO 21877	Action levels to be achieved in accordance with permit conditions and the odour management plan.	3rd Party Specialist
Containment and Extraction System					
Extraction fan visual inspection	Monthly	No damage / leakage/ signs of corrosion	Visual inspection	If fans are damaged raise a job with ER	Operations
Extraction fan noise	Monthly	Increase noise or vibration from the fan motor	Listen	If fan is in fault or running noisy raise a job with ER	Operations
Check fan drive belt condition and tension	Annually	As per O&M	As per O&M	Check / Repair. Raise a job with ER	Operations
Check fan motors	Annually	As per O&M	As per O&M	Check / Repair. Raise a job with ER	Operations
Check physical integrity of ducting	Monthly	No signs of degradation or other damage and no holes	Visual Inspection	Raise a job with ER	Operations
Check duct supports	Monthly	No damage or corrosion	Visual Inspection	Raise a job with ER	Operations

Task	Frequency	Performance Indicators	Method	Actions to be Taken	Responsible Person
Process covers visual inspection	Monthly	Good cover integrity. No damage / gaps allowing for fugitive emission leakage.	Visual inspection	If process covers are damaged raise a job with ER	Operations

Appendix 4 Odour Monitoring Record Sheet

Odour Monitoring Record Sheet

				METEROLOGICAL CONDITIONS							ODOUR[1]		SOURCE		SITE STATUS	Sheet No: CORRECTIVE ACTION		
Date	Location	Time	Staff Name	Weather Temp	General air quality	General air stability	Wind Strength	Wind Direction	Bar Pressure	cloud cover	Intensity 0-6	Offensiveness / Nature	Source within facility	External source	Facility Activities	Action required	Action implemented	

[1] *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

Appendix 5 Sniff Testing Record Sheet

Test by		Start Time	
Date		End Time	
Weather Condition		Temperature	
Wind Strength		Wind Direction	

Location No. / Name	Nearest Receptor Sensitivity	Intensity	What does it smell like?	Frequency of odour?	Is the source evident?	Other comments / observations
1. Odour Control Unit	Low / Medium / High	0 No odour 1 Very faint 2 Faint odour 3 Distinct odour 4 Strong odour 5 Very strong odour 6 Extremely strong odour.		Constant / Intermittent	Yes / No Source area / name to be provide. Might be that maintenance work if occurring and you can detect increased odours due to that activity, or call smell cake import wagon etc	Are there odours detected from other sources? Farm / Landfill / other industry etc
2. Drum Thickener building						
3. North of Dewatering Building						
4. Gas Holders						

5. Site Boundary – North-East						
6. Sludge Screens						
7. Cake Pad - Fresh						
8. Cake Pad East						
9. Cake Pad South-East						

Appendix 6 Safe Loading and Discharge of Sludge Road Tankers

Occupational Health & Safety Management System

Safe Working Procedure SWP 007

Safe Loading & Discharging of Sludge Road Tankers

Document Control Ref:	SWP 007
Document Location:	OH&S Database / Safe Working Procedures
Document Custodian:	OH&S Department
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Revision History

Issue	Date	Reviewed By	Amendment Details
1	31/12/2013	D. Ross	New document
2	13/02/2015	D. Ross	Clauses 2.10, 2.21, 2.25, 3.3, 3.4, 3.5, 3.15
3	12/10/2016	S. Ross, C. Birkenshaw, M. Blanchard, J. Pell	Updated to reflect current practice
4	30/10/2018	J. Pell, M Blanchard	Updated gas monitor requirements & reviewed document

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Safe Loading & Discharging of Sludge Road Tankers

The following notes are for your guidance. For further information, or if in doubt, contact your line manager / Safety Advisor who will give further help or advice.

Minimum Number of Persons Required:	**Major Hazards:**
1	• Hydrogen sulphide • Slips, trips and falls • Manual Handling • Stored energy • Pressure systems • Noise • Falls from height
Essential Safety Equipment Required: • Personal gas monitor • Safety footwear • Hand protection • Hi-Vis jacket/vest • Eye protection • Head protection (hard hat) • Hearing protection • First aid kit (Include. Eyewash) • Task lighting	
Training and/or Documentation required: • Please see Section 6 – Further Guidance.	

1. Introduction

1.1 Sludge tanker 'barrels' are classed as pressure vessels and are subject to annual examination by a competent person. Only fully trained YW personnel, or authorised persons who understand how all the controls pressure relief valves etc. function, may operate this equipment.

Note: Do not use pressure vessels that you are not familiar with or have not been trained on and seek advice and support.

1.2 Pressurised vessels are potentially hazardous under working conditions, and daily checks should be made of the satisfactory operation of safety critical devices such as the Pressure Relief Valve. Follow the detailed supplier's instructions regarding operator's daily checks.

1.3 Sewage and sewage sludge are substances that are potentially hazardous to health. Avoid skin contact, ingestion and inhalation of aerosols. Always wear your personal protective equipment and follow good hygiene practices.

1.4 Experience has shown that during the operation of a vacuum tanker, hydrogen sulphide can be vented from the tanker barrel. The use of suitable portable gas monitors is therefore a mandatory requirement at all times whilst on-site.

1.5 Avoid leaving pressure vessels containing sludge parked overnight. (Where this cannot be avoided ensure that the vessels are adequately vented by the means of leaving the vent valve open).

1.6 Follow designated traffic routes, one way systems etc. and comply with site speed restrictions.

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Task

2. Loading the Tanker (Vacuum Transfer)

2.1 On arrival on site, check that your personal gas monitor is turned on – has been calibrated (in a clean air environment) - and is worn on your person at all times whilst on-site (near your breathing zone).

2.2 Complete a 360º check of the tanker/loading area. Consider the environment around you – hazard identification, wind direction, vehicle movements, people in close proximity to the vehicle e.g. operators/contractors etc. Ensure all inlet and outlet valves are closed and then open the vent breaker valve before removing the end-cap.

2.3 Where practicable attach sufficient 'vent bagging' to the compressor exhaust extension pipe to vent any hydrogen sulphide away from the work area to ensure a safe working area is provided. Also consider the positioning or repositioning of your vehicle to reduce the potential of H2S in the working zone.

Note: Ensure that any gases being vented away from the tanker are not creating additional hazards to other people or processes and are not likely to enter a confined space.

2.4 If loading from a hose already connected to sludge holding tank, check hose for weight kick and gently lift (hose may possibly still have liquid left in it). Never assume any hose is sound - check for splits and excessive wear. Also check that couplings are in good condition and the correct sealing ring is in place before using the tanker hose. If the tanker hose is found to have faults, the tanker hose must never be used and be disposed of correctly.

2.5 Connect the hose between the tanker inlet valve and the loading point. Check that all connections are correctly fitted and all air taps are closed.

Note: The use of gloves in couplings is an unacceptable practice – do not use to create a seal in the bauer coupling.

2.6 Ensure that the changeover valves are in the vacuum/suck position.

2.7 Open the travel valve (if not automatic where fitted).

2.8 Once connections to vehicle and sludge tanks are made and vehicle power take off (PTO) is engaged if applicable, the driver should carefully monitor the loading operation. This may be achieved by standing in a safe location outside of the vehicle, observing the loading procedure.

Note: Keep clear of the exhaust area when loading and venting the barrel.

2.9 Yorkshire Water vehicles predominantly use a hydraulic pack. If using a donkey engine, do not engage the PTO as this will damage the hydraulic pack.

2.10 Start the vacuum pump and check that vacuum starts to develop.

2.11 Monitor the dial gauge to ensure the vacuum develops.

2.12 Open inlet valve on tanker.

2.13 If loading from sludge tank open outlet valve on loading point slowly.

2.14 Look and listen for air or product leaks.

2.15 On tankers fitted with sight glass, check isolation valves are open.

2.16 Feel the hose for sludge going through it and check the sight glass when loading for sludge rising in the barrel.

2.17 You may not always get a full load on the first attempt.

2.18 If this happens, vent the barrel and ensure the dump tank is empty and then re-start vacuum pump and check that vacuum starts to develop.

2.19 Monitor the dial gauge to ensure the vacuum develops.

2.20 When tanker is nearly full (sight glass and dial gauge) close the valve on sludge tank and then open the air release valve to enable the tanker hose to be emptied safely on completion of loading.
Note: Sight glasses should be clearly marked to the correct level for vehicle weight.

2.21 Close inlet valve on tanker.

2.22 Turn off vacuum pump and vent tank.

2.23 Disconnect tanker hose and put away in a safe place ensuring site is left in a clean and safe state.

2.24 Connect end cap and ensure relevant valves, such as vent valves, are closed before moving vehicle.

2.25 In addition to the vacuum loading of tankers, barrels may also be loaded by external pumping. Please refer to the pump loading safe working procedure.

2.26 Complete a 360° walk-around check of the vehicle, equipment and immediate work area.

Note: At sites where there are no fixed tanker points, sludge (or sewage), may have to be drawn directly from an asset which is not a sludge holding tank. Ensure that steps are taken to minimise risk by using the correct tools, considerations are made for working at height, avoid confined spaces and other hazards. If in any doubt about the safety of the operation, consult your line manager.

3 Discharging the Tanker (Pressure)

3.1 Yorkshire Water vehicles predominantly use a hydraulic pack. If using a donkey engine, do not engage the PTO as this will damage the hydraulic pack.

3.2 On arrival on site, check that your personal gas monitor is turned on – has been calibrated (in a clean air environment) - and is worn on your person at all times whilst on-site (near your breathing zone).

3.3 Complete a 360º check of the tanker/loading area. Consider the environment around you – hazard identification, wind direction, vehicle movements, people in close proximity to the vehicle e.g. operators/contractors etc. Ensure all inlet and outlet valves are closed and then open the vent breaker valve before removing the end-cap.

3.4 Open air tap on barrel before removing end cap.

3.5 If discharging from a tanker hose already connected to sludge holding tank, check hose for weight, kick and gently lift (it is possible that the hose may still have liquid left in it). Never assume any tanker hose is sound - check for splits and excessive wear. Also check that couplings are in good condition and the correct sealing ring is in place before using the hose.

3.6 Connect hose between the tanker outlet valve and the off-loading point. Check that all connections are correctly fitted and all air taps are closed.

Note 1: Ensure that tanker hoses are securely connected before operating the V5, rotork valves or manual valves at the off-loading point.

Note 2: The use of gloves in couplings is an unacceptable practice – do not use to create a seal in the bauer coupling.

3.7 Ensure that the discharge point rotork or manual operating valve is fully open before opening the tanker rear outlet valve.

3.8 Open the outlet valve on tanker.

3.9 Ensure that the changeover valves are in the pressure/blow position.

3.10 Open travel valve (if fitted and not automatic).

3.11 Start pump.

3.12 Monitor the Dial Gauge for pressure.

3.13 Feel the hose for sludge going through and where possible visually check the V5 machine or sight glass to make certain liquid is discharging (no blockages).

3.14 Where ever possible it's always better to turn the pump off before the last of the sludge is discharged as this helps to reduce odour, prevent the bagging from bouncing and H2S.

3.15 Be aware that when discharging under pressure the load can be "discharged" with significant force and sludge can spray over a wide area, especially in windy conditions.

3.16 If discharging to a level below the barrel outlet, the preferred method is by gravity as it is a safer but possibly slower operation. Ensure that you have left the pipe work clear of the product.

3.17 Close tanker outlet valve (and ensure any manual/rotork valves at the discharge point are left closed).

3.18 Turn off pump and vent tank in a suitable location to prevent H2S exposure to all parties.

3.19 Open air tap and release remaining air pressure within the tanker hose slowly.

3.20 Disconnect tanker hose and replace end cap.

3.21 Store the tanker hose in a safe place.

3.22 Clean out dump tank and clean up any spillages.

3.23 Ensure all valves are in the correct position. Connect end cap and ensure relevant valves, such as vent valves, are closed before moving vehicle.

3.24 Complete a 360° walk-around check of the vehicle, equipment and immediate work area.

4 Action in the Event of a Gas Monitor Alarm

4.1 The gas monitor is designed to alarm at any reading above 10 parts per million of hydrogen sulphide with a pre warning at 5ppm.

4.2 If an alarm is activated, the driver must immediately shut down the load/discharge operation and walk away from the vehicle. This will remove you from the immediate gas hazard as detected by the monitor.

4.4 Advise any person in the local area that there is hydrogen sulphide present and ask them to leave the area until you give the all clear.

4.5 Check your gas monitor – the reading will start to decrease as you move out of the gaseous atmosphere.

4.6 Periodically check the reading of the monitor, when the reading has dropped to a safe level and press the reset button on the monitor. Walk back towards the working area, checking gas levels.

4.7 If the alarm sounds again, repeat the above process.

4.8 Once the alarm indicates it is safe at the vehicle controls – re-start the load/unload process.

4.9 All gas monitor alarms over 10ppm must be reported as 'Near Misses'.

4.10 The alarm will indicate the presence of hydrogen sulphide and you must follow the SWP if the alarm sounds.

4.11 Multiple alarm activations may occur at a site during a load/unload. If this occurs for a prolonged period stop work at this site and seek immediate advice from your line manager.

4.12 Time Weighted Average alarm means that you should inform your line manager and stop working with sludge for the day when using a gas monitor.

5 Incident and Hazard Reporting

5.1 Report all Accidents to your line manager immediately and complete an accident report on Safeguard.

5.2 Report all Near Misses using the YW incident reporting system on Safeguard.

5.3 Report all Hazards using the YW Hazard Reporting System on Safeguard.

5.4 Report any vehicle defects promptly in accordance with the YW Fleet defect reporting procedures.

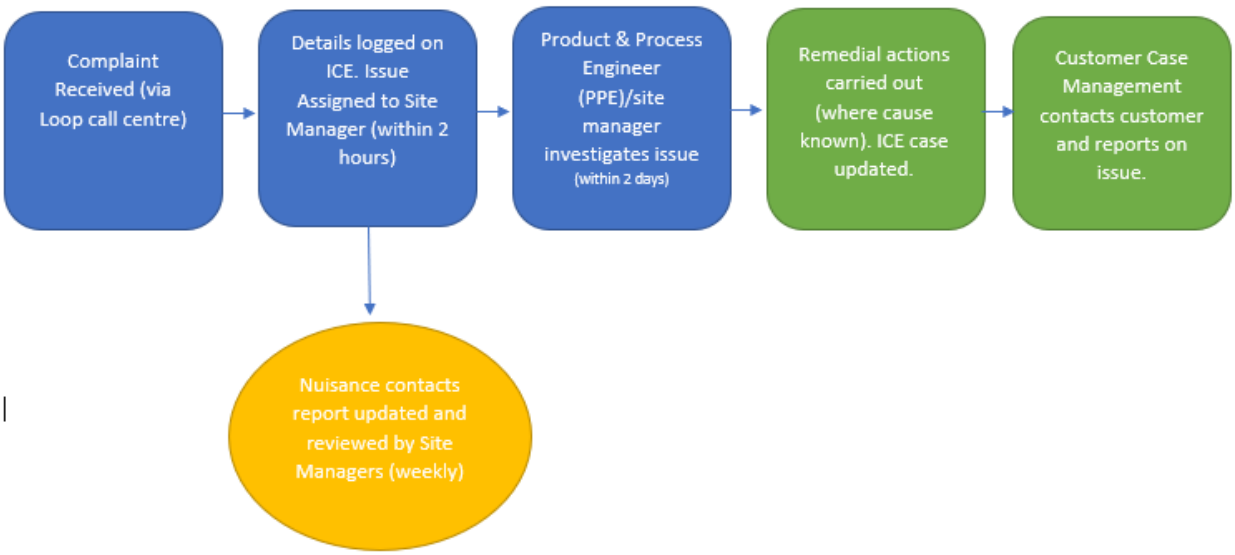
6 Further Guidance

Management Procedures / Safe Working Procedures / Technical Specifications (held on Safeguard) that are also relevant include:

- SWP 053 – Personal Safety & Security
- SWP 078 – Safe Use of Mobile Phones
- MP 05 – Lone Work
- MP 34 – Manual Handling

REMEMBER: IF IN DOUBT - ASK YOUR LINE MANAGER / SAFETY ADVISOR

Appendix 7 Odour Complaint Process



Appendix 8 STF Odour Complaint Form

Loop handle customer complaints being reported to Yorkshire Water. The call Handler will work with the complainant to try and locate the odour. Loop uses a software system called ICE to record the issue. If the issue is believed to be arising from a sewage works, the call handler will work through the following forms to pinpoint the issue.

Customer's details (name and address, if provided)	
When did the odour occur	
Time when the odour occurred	
Where was the location of the odour	
Is the odour happening now or was it in the past	
Does the customer know what is causing the smell	
What is a description of the odour (sewage / drains / eggy / sweet composting)	
Is this the first time the odour has been noticed	
Where is the odour at its worst (inside/outside house/boundary)	
Any other comment	

Appendix 9 Odour Investigation Form

The following investigation form will be used by Operational staff in the event of an odour complaint being received.

Date of odour complaint	
Time of odour (if known)	
Name of YW colleague investigating issue	
Postcode where the issue was identified (if known)	
Weather at the time of odour complaint (including temperature)	
Wind Direction (from onsite wind monitor) and strength (no wind, light, gusty, heavy)	
Description of smell from Complainant (if known)	
Is this linked with other complaints	
Do you know what asset is causing the issue	
Can the asset be identified through sniff testing (follow sniff testing monitoring programme in the odour management plan)	
Can the issue be resolved immediately	
If no, what actions are needed to resolve the issue	
If the issue is going to take >2 days to resolve, can the issue be mitigated to reduce the odour effect	
Does the odour management plan need updating to discuss the cause/action/mitigation	
Date when resolved	