



Odour Management Plan

Blackburn WwTW

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Version: 4

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AMENDMENT SUMMARY

Version no.	Date	Brief description of amending action	Prepared by:	Reviewed/ authorised by:
1	September 2014	N/A	Alan Evenson/Peter Towne	Barbara Argent
2	December 2015	Update names	Graham Bibby/Ian Smith	Martin Gilday
3	January 2017	Review	Alan Evenson/Peter Towne	Martin Gilday
4	March 2019	Review	Alan Evenson/Peter Towne	Dan Jones
5	October 2019	Review	Alan Evenson/Peter Towne	Dan Jones

March 2021 - Continued operation of all the installed Odour Control Units has not found to be necessary to this point. We intend to conduct a review of the existing odour control assets over the next 12 months with regard to their necessity and performance. We will issue details of proposed operation and monitoring requirements or changes to operation to the Environment Agency as part of a 12 month review of this OMP.

ABBREVIATIONS

BPM	Best Practicable Means
BTEC	Business and Technology Education Council
CoP	Code of Practice
Defra	Department for Farming and Rural Affairs
FTFT	Flow to Full Treatment
GBT	Gravity Belt Thickener
MARS	Mobile Asset and Resource Scheduling
OCU	Odour Control Unit
OMP	Odour Management Plan
PPC	Pollution Prevention and Control
SBC	Submerged Biological Contractor
UKWIR	United Kingdom Water Industry Research
UU	United Utilities
WwTW	Wastewater Treatment Works
BAT	Best Available Technique
ORP	Oxidation reduction potential
PID	Photo ionisation detector
SCADA	Supervisory Control & Data acquisition
STOC	Sludge Treatment & Odour Control (Building)

SCOPE OF BLACKBURN ODOUR MANAGEMENT PLAN

The objective of this odour management plan (OMP) is to provide guidance to all Operations and Maintenance staff with regard to practices that will minimise the risk of odour emissions being discharged from the Blackburn site. This document describes the odour management practices that have been considered as part of the design of the works and those that must be adhered to during the operation of the treatment plant.

Adherence to the practices indicated below is vital to ensure that the plant complies with the relevant permit conditions within the (PPC) EP Installation boundary and also the wider site boundary in terms of the statutory nuisance provisions outlined in the DEFRA code of practice on odour nuisance from sewage treatment works.

As part of the odour management plan the application of best available techniques (BAT) has been used in the design process in the selection of odour treatment technology to minimise the risk of odour nuisance being caused to the local community.

In effect United Utilities is working with dual regulation in terms of its odour obligations.

This is a “live” document and will be subject to further review and updating over the operational life of the site as part of the on-going monitoring and review programme focused upon improved performance, via input from all stakeholders this includes, but is not limited to, Site Operations, regulatory bodies and the local community.

This Odour Management Plan (OMP) is an operational document that is developed following the identification and review of risk areas for odour release. It details operational and control measures appropriate to the reduction or elimination of the impact of odours from a wastewater treatment works (WwTW) site. It provides detail to allow operators and maintenance staff to understand the operational procedures for both normal and abnormal conditions.

It considers a range of issues including:

- A summary of the sites odour sources and the location of receptors
- Formation, transfer and dispersal of odour from source to receptor
- Suitable monitoring for odours
- Contingencies and responsibilities when problems arise
- Identifying maintenance needs, replenishing consumables
- Odour-critical plant operation and management procedures (e.g. correct use of plant, process, materials; checks on plant performance, maintenance and inspection)
- Staff training
- Anticipated performance of installed odour control units
- Spillage and incident procedures
- Record keeping – format to be used, responsibility for completion and location of records
 - Odour complaint investigation, recording and reporting

The above issues are discussed regularly as part of the sites team brief agenda and individually at Process Controllers and Operators monthly 1 to 1's.

INTRODUCTION TO UNITED UTILITIES

United Utilities (UU) is the UK's largest operator of wastewater systems. In the Northwest UU owns, maintains and operates a 39,000 km network of sewers and 600 WwTW to collect and treat 2,200 million litres of wastewater from homes, commerce and industry every day, before returning it safely to the environment.

WASTEWATER ASSET STRATEGY AND PLANNING AND WASTEWATER OPERATIONS AND MAINTENANCE

UU is structured such that the Wastewater Asset Strategy and Planning division, under Asset Management and Regulation is responsible for the management of the wastewater asset base, producing and delivering regional investment and operational strategies. The Water Operations and Maintenance Division, under United Utilities Utility Solutions is responsible for operating and maintaining the water and wastewater asset base. The organisation applies

a structured and co-ordinated approach to systems and procedures that prioritise and monitor wastewater operations, asset management and both capital and operational investment.

Wastewater Asset Strategy and Planning manages the asset base through its relationship with Wastewater Operations and Maintenance, ensuring that all operational tasks are undertaken in accordance with best practice. It is also responsible for the development of standards and policies covering the design and operation of wastewater assets.

SUMMARY OF BLACKBURN WWTW'S LOCATION AND TREATMENT PROCESSES

Blackburn WwTW is located to the northwest of Blackburn and treats wastewater from a population equivalent of 235,000. The WwTW treats a flow to full treatment (FTFT) of 168 MI/d, with average flows of 75 MI/d. The treatment process as detailed in the process flow diagram (see Figure 3) comprises preliminary treatment, which provides screening and grit removal; conventional primary treatment; secondary biological treatment; and tertiary treatment utilising Biological Aerated flooded filter (BAFF) and UV Treatment to complete. In addition, storm flows over and above the consented FTFT receive settlement in storm tanks before discharge to river or returning to full treatment following cessation of a storm.

There is housing and industrial areas to the south and west of the WwTW at an approximate distance of 2000m (see Figure 2), however there are no records of complaints from receptors in these areas. In the past, odour has caused a nuisance for the property that is a direct neighbour of Blackburn WwTW. The OMP will serve to minimise odours originating from Blackburn WwTW in order to minimise or eliminate the impact of odours upon these receptors.

Figure 1: Blackburn WwTW location plan

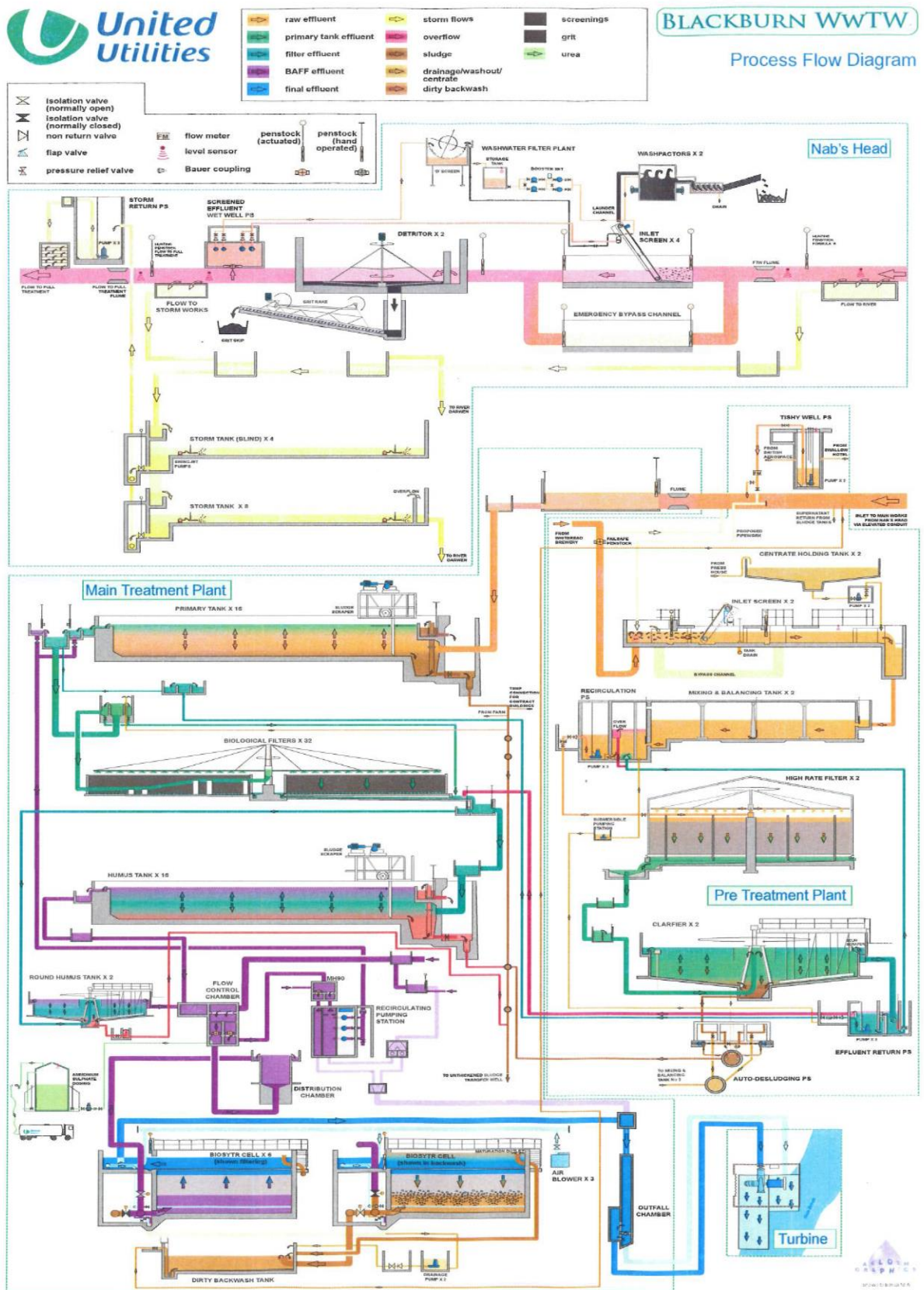
Blackburn WwTW
Cuerdale Lane,
Samlesbury,
Nr Preston,
Lancs
PR5 0UY



Figure 2 – installation boundary



A process flow diagram for the works is provided (see figure 3).



- Preliminary Treatment consisting of:
 - 1 C.S.O. Screen.
 - 4 X Escalator screens & associated screenings dewatering, and storage
 - Grit removal comprising of 2 detritors complete with grit storage.
- Primary Treatment consisting of:
 - 16 X Rectangular Primary Tanks
 - Auto-desludge facilities

12 X Storm Tanks with associated scrapers and emptying equipment+ U.I.D. Tank

- Biological Secondary Treatment consisting of
- 32 X Rotating Trickling Filters

16 X Rectangular Humus Tanks + 2 Round Tanks

1 X BAFF Plant

1 X UV Plant

Sludge treatment consisting of:

- 15 X Digested sludge holding tanks (Nabs Head)
- 2 X Sludge Import Tanks
- 2 X Sludge Screens with associated pumps and screening storage
- 4 X Mixing & Balancing Tanks with associated pumps and mixing
- 2 x Thickened Sludge Tanks with associated pumps and mixing
- 6 x EEH Vessels with associated pumps and mixing
- 4 X Mesophilic Anaerobic Digesters with associated pumps and mixing
- 1 X Gas bag
- 1 X 625kWh and 1 x 526kWh CHP Engine with associated pumps and mixing
- 3 X Dual Fuel Boilers
- 1 X Gas Oil Storage tank with associated pumps and mixing
- 1 X Bio Gas Flare Stack
- 3 X Odour Control Unit with associated equipment
- 2 X Sludge Storage
- 2 X Centrifuge and associated Conveyors /Pumps

KEY CONTACTS

1.1 United Utilities Key Personnel and Contact list

Production Manager	Dan Jones	07717 538972
Technical Officer	Martin Gilday	07713 322798
Environmental Regulatory Advisor	Peter Towne	07766136902
Process Controllers	Stephen Gilday	07717200766
	Alan Evenson	07826539391
Asset Manager	Claire Mallard	07795241473
Integrated Control Centre	0345 072 0837	

FORMATION OF ODOUR NUISANCE PATHWAYS

In order for an odour nuisance to occur the following conditions must be achieved

1. The formation of odorous compounds in the wastewater
2. Transfer of compounds from the wastewater to the atmosphere
3. Transport of compounds from source to receptor, and the degree of dispersion/dilution achieved during the transport process

1.2 Odour Generation in Wastewater Treatment Systems.

The presence of odorous compounds in a predominantly domestic wastewater is as a result of anaerobic conditions within the system which occurs whenever all dissolved oxygen has been utilised by bacterial respiration. Under such conditions sulphate is reduced to sulphide by the sulphate reducing bacteria (SRB).

Anaerobic fermentation in wastewater also produces other odorous compounds such as organo-sulphide compounds which includes mercaptans, and dimethyl sulphide. In addition both domestic and industrial discharges will result in the release of a variety of odorous compounds collectively termed volatile organic compounds (VOCs).

The release of odours into the atmosphere is controlled by the conditions within the wastewater treatment system, which are:

- Solubility of the dissolved gas
- Odour compound concentration in both gas and liquid phases
- Turbulence within the system (highest odour emission rates usually occur under high turbulent conditions)
- Wastewater temperature
- Wastewater pH

1.3 Transfer and Dispersion of odour from source to receptor

In general the transfer and dispersion of odour from source to receptor is governed by meteorological conditions (wind speed and direction), and geographical conditions (hilly/complex terrain and the physical distance separating the receptor from the source).

Odour released under windy conditions will disperse quickly and in some cases may have no effect on the local residences while under calm conditions less dispersion of the odour plume occurs before reaching the receptor.

With regard to the distance between source and receptor, in general the greater the distance between source and receptor the greater the probability of the odour plume being subject to mixing and dispersion with the atmosphere, and hence a greater degree of dilution is achieved.

Identification of Site Odour Sources and Source Materials at Blackburn WwTW

Table 1 Summary of site odour source materials

Source Material	Source Area	Odourous Compound	Most Common Cause	Odour Characteristics
Wastewater Raw biosolids (liquid sludge & sludge cake)	Preliminary Treatment Area Primary Treatment Area Biosolids Processing Areas	Hydrogen Sulphide	Anaerobic Conditions within wastewater/biosolids Industrial discharge	Rotten eggs
Wastewater Raw Biosolids (liquid sludge & sludge cake)	Preliminary Treatment Area Primary Treatment Area Biosolids Processing Areas	Mercaptans	Anaerobic Conditions within wastewater/ biosolids	Decayed cabbage
Wastewater Raw Biosolids (liquid sludge & sludge cake)	Preliminary Treatment Area Primary Treatment Area Biosolids Processing Areas	Dimethyl Sulphide	Anaerobic Conditions within wastewater/biosolids	Decayed vegetables
Wastewater Raw Biosolids (liquid sludge & sludge cake) Unwashed Screenings Unwashed Grit	Preliminary Treatment Area Primary Treatment Area Biosolids Processing Areas	Miscellaneous VOCs	Industrial discharge	Varies
Odour neutralising/masking agent	All areas	Chemical product	Site Operation	Varies

SITE ODOUR MITIGATION AND CONTROL MEASURES

1.3.2 Selection of Odour control Technologies at Blackburn WwTW

Where required and when plant design alone cannot prevent the formation or release of odour, treatment can be provided. Methods of treatment can take a variety of forms and can be broadly characterised into:

Liquid phase treatment: - where the wastewater or biosolids are subject to chemical addition to either prevent the in-situ formation of odours compounds, or to prevent their release into the atmosphere.

Gas phase treatment: - where compounds released into the air/gas phase as a result of liquid or biosolids processing are removed prior to the treated gas being discharged into the atmosphere. A variety of gas phase treatment methods are generally classified into one of the following: - chemical, biological or thermal treatment.

In many instances liquid and gas phase treatment are used in conjunction with each other, and a variety of gas phase treatments may be used in combination to achieve the desired level of odour removal.

Table 2 summarises the technologies used at Blackburn WwTW and their dedicated purpose

Table 2 Summary of odour control technologies used at Blackburn WwTW

Technology Type	Purpose
Activated carbon/Impregnated Media	Adsorption of sulphide based odours and sparingly soluble/non soluble VOCs within the foul air stream

1.3.3 Description of Gas Phase Odour Control Technologies

Sludge Treatment Area OCU

The Odour control system is designed to continuously remove odours from the air expelled from the sludge storage area. This is achieved by the gas flowing through dry carbon to allow natural absorption to take place.

Non soluble VOCs and other odorous compounds are adsorbed onto the Carbon, and are thus removed from the gaseous phase. The main odour control extraction fans are used to extract air out of the odour control units and push it up the stack.

Liquor Return Area Odour Control

The Odour control system is designed to continuously remove odours from the air expelled from the liquor return area. This is achieved by the gas flowing through dry carbon to allow natural absorption to take place.

Non soluble VOCs and other odorous compounds are adsorbed onto the Carbon, and are thus removed from the gaseous phase. The main odour control extraction fans are used to extract air out of the odour control units and push it up the stack.

The main odour control extraction fans are used to extract air out of the odour control units and push it up the stack.

1.3.4 Provision of Operational Security and Contingency as part of odour control plant design

As the provision of containment and odour treatment is the primary measure used to minimise the risk of odour nuisance/pollution at Blackburn WwTW, a variety of methods have been employed to provide operational security, these include, but are not limited to : -

- Standby equipment
- Bypass ductwork

Equipment critical to the operation of the odour control plant have standby units built in to the design which will automatically start in the event of plant failure

Standby equipment is provided for the following items

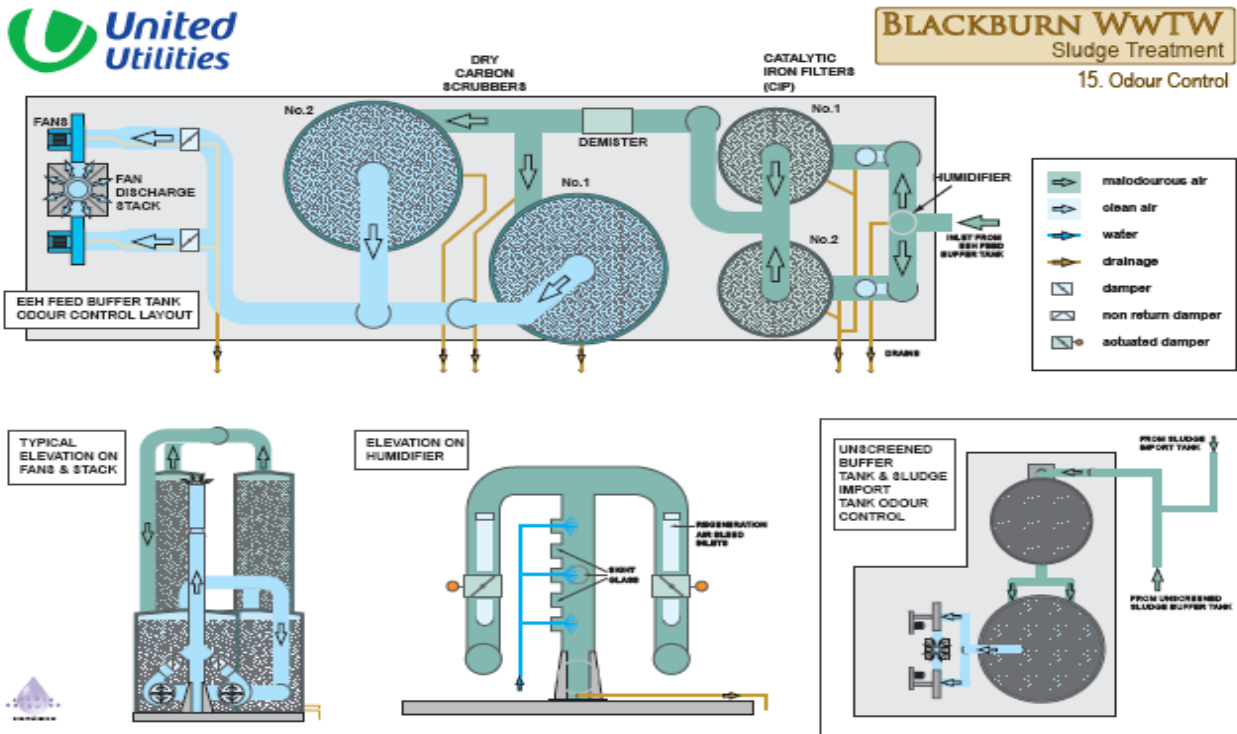
- Odour control fans

All odour control technologies require down-time at some point, be it for maintenance, media replacement or unplanned work. To ensure that odour treatment is provided during such times on the primary and sludge control units bypass ductwork is installed around each stage to enable any stage to be taken out of service whilst still allowing ventilation of the covered/enclosed process units and also providing some odour treatment.

All odour control units installed on site consist of multiple treatment stages or are used in combination with each other, so that in the event that a single stage is out of service, some degree of odour treatment is provided.

With regard to the sludge plant odour control units, in the event that the venturi stage is out of service, the second stage is designed to treat the 'full' design load onto the plant.

Typical Odour Control Fan at the Blackburn Sludge Treatment Facility



1.4 Operational Management of Odour

1.4.1 Overview

As untreated wastewater and associated biosolids is inherently odourous, good operational practice focuses upon effectively treating and then discharging/disposing of the wastewater and biosolids as effectively and as rapidly as possible.

As wastewater is received on a continuous basis, and extensive odour containment and treatment is employed it is not advantageous to store biosolids on site, as this may result in increases in the 'odour load' on the associated odour control units and may exceed their design capacity- resulting in odour complaints/pollution.

As the provision of containment and odour treatment is the primary measure used to minimise the risk of odour nuisance/pollution at Blackburn WwTW and as odour containment is maximised through the mechanical extraction of air from the covered process units, airflow must be maintained to ensure air is directed to treated and then discharged via the OCU's stack to ensure maximum treatment and dispersion, even under 'calm' atmospheric conditions.

If mechanical ventilation is not maintained this can lead to the escape untreated odours, the release of potentially explosive gases/atmospheres in addition to the development of corrosive environments within the covered process units.

1.5 Odour Risk Assessment Procedure

1.5.1 Stage 1 Risk Assessment

United Utilities has implemented a staged approach to assessing odour risk at WwTW.

This is a desktop exercise using a series of 30 questions on an Excel spreadsheet. The questions assess the potential for septicity and odorous emissions potentially generated from normal and intermittent operations. It also assesses risk in terms of customer involvement i.e. customer complaints, media interest.

This assessment generates an odour risk score and the following action limits apply: -

Table 3 Stage 1 odour risk scores

SCORE	COMMENT
0 – 6	Low odour risk, no further action required
7 – 14	Medium odour risk, collate data and monitor site performance
> 14 (Warrington North scored 17)	High odour risk, move onto stage 2 site audit for OMP
'Y' to any of the questions related to customer involvement	Customer involvement significant. Carry out stage 2 site audit for OMP.

The results for Blackburn WwTW are contained in Appendix B.

1.5.2 Stage 2 Assessment

The need for a Stage 2 audit and an odour management plan over and above the baseline measures is triggered by the Stage 1 risk assessment in Table 4. It involves a detailed site audit that reviews and identifies potential odour risks. The whole WwTW process stream is reviewed in-terms of operation and potential for odour release. The detailed risk assessment is contained within Appendix B.

1.6 Site Housekeeping

A lack of good housekeeping can result in elevated levels of residual odour, and at times more serious sources of odour. The majority of housekeeping is good working practice and this approach should be implemented regardless of whether complaints are received or not.

The following section identifies areas where particular focus should be made with respect to house keeping

1.6.1. Preliminary Treatment Area Screenings and Grit Handling

Detritors ensure grit and screenings are washed to remove organic matter, and skips containing them should be removed from site as soon as is practicable. At Blackburn WwTW screenings are washed and compressed, then stored outside the building. Grit is also washed and stored in skips outside of the buildings.

The skips which collect grit and screenings are removed in a timely manner, the agreement being next day removal where required.

1.6.2 Primary settlement tanks

The build-up of scum and fats on primary settlement tank surfaces can/may lead to odour and should generally be avoided. Odour generation from the primary settlement tanks is minimised at Blackburn WwTW by monitoring sludge blanket levels and aiming to remove sludge from the hopper within 12 hours of it entering.

Final settlement tanks

The build-up of scum or foam on final settlement tank surfaces can at times lead to odour and should generally be avoided. (However, a stable scum layer can reduce odour in some instances, e.g. sludge storage). Odour generation from the final settlement tanks is minimised at Blackburn WwTW by monitoring sludge blanket levels and aiming to remove sludge from the hopper within 24 hours of it entering.

1.6.3 Sludge handling

The sludge handling facilities at Blackburn WwTW are operated as follows:

Raw Sludge – Raw sludge is stored in 1 large Import Sludge Storage Tank with a Total volume of 1800m³. The tank is used for imported tankered sludge and also site sludge produced from the Primary Tanks. A second Thickened Import Sludge Tank is present but out of service for some years. This tank in the future could be returned for extra storage capacity used for both Blackburn (approx. 400 m³). Both sludge tanks are covered. Hatches on tanks or other possible sources of odour are closed at all times other than for maintenance and access. Air is extracted from these tanks to the odour control unit (OCU).

Sludge Treatment – Prior to transfer into the digester feed tank, the Raw sludge is pumped through a sludge screen. There are 2 screens in a Duty/Standby arrangement, The sludge screenings fall into an open skip. Sludge now screening free is then pumped to 4 off Mixing and Balancing Tanks to pass through the Thickening Process Before being pumped to the EEH Buffer Tank prior to Digestion. The EEH buffer tank is covered with a volume of 15,00m³. Hatches on tanks or other possible sources of odour are closed at all times other than for maintenance and access. Air is extracted from these tanks to the odour control unit (OCU). Sludge is then passed through the first EEH / Digestion Process before being Centrifuged and applied to land.

1.6.4 Spillages

Spillages at Blackburn WwTW are usually due to the blinding of the screens and the overloading of the screenings dewatering system. Sources of possible spillage should be considered and avoided at the design stage where possible.

Often, spillages involve sludge: an interruption to continuous sludge processing could lead to spillage from a storage tank or cause sludge levels to build up in settlement tanks, one of the known risk factors for odour at WwTW's.

At Blackburn WwTW the site is monitored for spillages as part of routine inspections. If a spillage occurs, it is washed into site drainage as soon as possible, where it's returned to the head of the WwTW for full treatment.

If spillages are a recurring incident, investigations in to the cause of such occurrences will be undertaken, and action taken to minimise these occurrences.

The following table summarises the identifies potential odour sources at Blackburn WwTW, the primary mitigation methods employed, and contingencies measures are provided, in addition to the roles and responsibilities of key personnel.

Table 1: Risk assessment of potential odour sources

Process Unit Description/Area	Potential Source material of Odour	Identify cause of potential odour releases or abnormal situations	Primary Control Measures	Contingency Measure	What actions are taken and who is responsible
Preliminary treatment Inlet flow	Septic wastewater	Process units covers left open/damaged Seasonal effects-elevate temperature/low rainfall Illegal trader discharge on network	Enclosed with air extraction and odour control. Regular monitoring at WwTW inlet for unusual sewage conditions Trade effluent control on network. Routine operation checks and maintenance to ensure plant is functioning as per design-ventilation being achieved , access hatches closed, cover in good condition	Odour monitor the network based on hot spots of odour reported to Warrington North. Consider provision of masking sprays around area Consider provision of chemical dosing into network	Production Manager to request network monitoring as required. Process Controller will be responsible for the monitoring of inlet flow. If a problem is identified that has no obvious appropriate actions then a meeting between interested parties including PM, TO, FSE's PC's instigated by the PC will take place ASAP. The ultimate responsibility for resolving the issue falls to PM
Preliminary treatment Bendy Channel Grit Removal	Septic wastewater Residual Organic material retained within grit	Obstructions in channel causing excessive turbulence of flow Grit stored of site for prolonged periods	Routine operation checks and maintenance to ensure plant is functioning as per design Channels inspected and kept clear of obstruction	Arrange for more frequent removal of grit skips Consider provision of masking sprays around area	Process Controller will be responsible for the monitoring of odours. If a problem is identified that has no obvious appropriate actions then a meeting between interested parties including PM, TO, FSE's & PC's instigated by the PC will take place ASAP. The ultimate responsibility for resolving the issue falls to PM
Preliminary treatment Inlet screens screenings handling	Septic wastewater Residual organic material retained within screens and conveyance system	Process units covers left open/damaged Unwashed screenings containing organic matter. can turn odorous Screenings stored of site for prolonged periods	The screenings are washed and inspected, and any malfunction in washing facility will be rapidly repaired. Identified spares will be stored on site to enable rapid repairs	Arrange for more frequent removal of screenings skips Consider provision of masking sprays around area	Process controller will be responsible for monitoring screenings; initiating maintenance; and requesting their removal. If a problem is identified that has no obvious appropriate

			<p>Enclosed with air extraction and odour control</p> <p>Routine operation checks and maintenance to ensure plant is functioning as per design</p> <p>The service agreement for screening removal is for next day removal.</p> <p>Routine operation checks and maintenance to ensure plant is functioning as per design-ventilation being achieved , access hatches closed, cover in good condition</p>		<p>actions then a meeting between interested parties including DPM, TO, FSE's & PC's instigated by the PC will take place ASAP. The ultimate responsibility for resolving the issue falls to PM</p>
<p>Primary treatment primary settlement tanks and associated structures</p>	<p>Septic wastewater Raw sludge Floating fats oils grease (FOG)</p>	<p>Failure of desludge system resulting in bio solids accumulating with in tank</p> <p>Storm surges resulting in loading of tanks</p> <p>Seasonal Effects- warm conditions and low rainfall resulting in more septic conditions and longer retention times within tanks</p> <p>Excessive scum build up on tank surface</p>	<p>Routine operation checks and maintenance to ensure plant is functioning as per design</p> <p>Provision of scum removal on tanks. Scum directed to sludge treatment via wet well forwarding pumping station</p> <p>Tank desludge is controlled automatically through combination of timer control and sludge density monitoring</p> <p>Regular Desludge of all PST to keep on top of levels</p>	<p>Ferric dosing could potentially provide addition benefit of precipitating sulphide out of the wastewater preventing release to atmosphere</p> <p>Consider provision of masking sprays around area</p>	<p>Process Controller will be responsible for inspections of the tanks; initiating maintenance; arranging cleaning.</p> <p>If a problem is identified that has no obvious appropriate actions then a meeting between interested parties including PM, TO, MM, FSE's & PC's instigated by the PC will take place ASAP. The ultimate responsibility for resolving the issue falls to PM</p>
<p>Primary treatment Primary tank desludge chambers and forwarding pumping station</p>	<p>Raw sludge Floating fats oils grease (FOG)</p>	<p>Failure of forwarding pumps/blockage within pipe work resulting in bio solids accumulating within tank</p> <p>Storm surges resulting in loading of tanks</p> <p>Seasonal Effects- warm conditions and low rainfall</p>	<p>Routine operation checks and maintenance to ensure plant is functioning as per design</p> <p>Level monitoring and automatic control on chamber to prevent sludge spills</p>	<p>Ferric dosing could potentially provide the additional benefit of precipitating sulphide out of the wastewater preventing release to atmosphere</p>	<p>Process Controller will be responsible for inspections of the tanks; initiating maintenance; arranging cleaning.</p> <p>If a problem is identified that has no obvious appropriate actions then a meeting between interested parties</p>

		resulting in more septic conditions and longer retention times within tanks		Consider provision of masking sprays around area	including PM, TO, MM, FSE's & PC's instigated by the PC will take place ASAP. The ultimate responsibility for resolving the issue falls to PM
Sludge Treatment Raw Sludge Reception tanks & transfer wet wells	Raw Sludge's Accumulation of sludge within tanks Spillages	Failure of downstream sludge processing plant will result in prolonged storage period in wells Failure of pump system Process units covers left open/damaged	Hatches are kept shut except for inspections or maintenance. Routine operation checks and maintenance to ensure plant is functioning as per design	Consider provision of masking sprays around area	Process Controller will be responsible for ensuring raw sludge storage times are minimised; the monitoring of storage tank condition; monitoring the odour abatement kit performance; initiating maintenance. If a problem is identified that has no obvious appropriate actions then a meeting between interested parties including PM, TO, MM, FSE's & PC's instigated by the PC will take place ASAP. The ultimate responsibility for resolving the issue falls to PM
Sludge Treatment Raw Sludge Holding Tanks	Raw sludge's (normal condition) Accumulation of sludge within tanks Spillages	Process units covers left open/damaged Failure of downstream sludge processing plant will result in prolonged storage period Failure of tank mixing system Tank Failure or Overtopping	Sludge tanks are enclosed with air extraction and odour controlled. Hatches are kept shut except for inspections or maintenance. Routine operation checks and maintenance to ensure plant is functioning as per design	Consider provision of masking sprays around area	Process Controller will be responsible for ensuring raw sludge storage times are minimised; the monitoring of storage tank condition; monitoring the odour abatement kit performance; initiating maintenance. If a problem is identified that has no obvious appropriate actions then a meeting between interested parties including PM, TO, MM, FSE's & PC's instigated by the PC will take place ASAP. The ultimate responsibility

					for resolving the issue falls to PM
Sludge Treatment Sludge Screens, Screen Handling and associated equipment.	Residual organic material retained within screens and conveyance system. Spillages	Unwashed screenings containing high amounts of organic matter can produce odour. Screenings left standing for prolonged periods in skips. Screenings not disposed of.	The screens and equipment are regularly inspected to ensure correct operation. Malfunction of the washing facility will be repaired quickly once identified. There is the provision of standby equipment. Identified spares will be stored on site to enable rapid repairs The screens are enclosed units. There is a service agreement for the removal of screenings from site.	Arrange for more frequent removal of screenings skips Consider provision of masking sprays around area	Process controller will be responsible for monitoring screenings; initiating maintenance; and requesting their removal. Spares to be ordered and stored as agreed between PC&FSE. If a problem is identified that has no obvious appropriate actions then a meeting between interested parties including PM, TO, FSE's & PC's instigated by the PC will take place ASAP. The ultimate responsibility for resolving the issue falls to PM
Sludge Treatment Area odour control unit	Foul air- arising from covered wastewater process units	Failure of OCU Inlet design load exceeding design Odorous compounds present which cannot be removed by installed technology Poor control of ORP/pH within unit	Routine operation checks and maintenance to ensure plant is functioning as per design Provision Duty/Standby equipment for critical kit such as recirculation pumps, dosing pumps and extract fans- with auto change over in the event of equipment failure Bypasses provided around each process stage to allow individual stages to be maintained, whilst providing at least one stage of treatment and ensuring ventilation/odour containment is maintained Provision of dual validation pH and ORP instrumentation and flow monitoring to	Potential to dose Sodium Chlorite (MPOX 50) to oxidise liquid phase sulphides and other odorous compounds upstream of assets preventing their release into the atmosphere. Consider the provision of bring temporary odour control unit to site in the event all treatment stage OCU are required to be out of service at the same time for prolonged periods (weeks/Months) Consider provision of masking sprays around area	Process Controller will be responsible for inspections of the tanks; initiating maintenance; arranging cleaning. If a problem is identified that has no obvious appropriate actions then a meeting between interested parties including PM, TO, MM, FSE's & PC's instigated by the PC will take place ASAP. The ultimate responsibility for resolving the issue falls to PM

			minimise risk of poor process control within scrubbers- with alarms to SCADA Provision of continuous hydrogen sulphide monitoring on inlet and outlet of the OCU to identify performance issues		

1.7 Contingency Measures and Maintenance Conditions

1.7.1 Temporary / Mobile Contingency Equipment

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

Temporary /Mobile equipment will be utilised for the task required and will be positioned within the installation boundary whenever feasible. The units will be positioned on impermeable hardstanding when required. The sludge will be transferred between fixed and temporary / mobile assets through suitable flexible hosing where appropriate. Any accidental spillages shall be washed down into the sealed installation drainage system, to be returned to the head of the onsite, off-installation drainage system, downstream of the storm overflow, for treatment. Any process effluent discharges, such as centrate will be discharged into site drainage and returned to the head of the works.

The emergency contingency temporary/mobile centrifuge will be located within the designated area stipulated in the permit application when required. Dewatered sludge will be discharged from the centrifuge by a central scroll and then dropped onto a conveyor that transfers the cake directly onto a cake slab ready for transportation offsite for appropriate disposal or recovery. With the mobile centrifuge, any planned or unplanned discharges shall be redirected to the appropriate drainage systems and returned to the head of the works downstream of the storm overflow.

Other mobile equipment that could be required can include.

- Mobile Boiler
- Mobile Heat Exchanger
- Mobile Screening/Gritting Unit
- Mobile Odour Unit

Use of these extra mobile kits would be agreed with the EA prior to use and risk assessments and plans for operation would be agreed beforehand.

MAINTENANCE

Records of maintenance requirements, including prioritisation and consideration of criticality for individual assets form part of the maintenance strategy within United Utilities. All EP assets are flagged as a priority as are scheduled inspection tours. All work completed are held on United Utilities' asset inventory and work planning system, MAMS. The MAMS work order system schedules the frequency of inspection tours and the preventative maintenance tasks carried out as part of these tours, this schedule is agreed between the Resource Coordinators and the Production Manager, it is reviewed and amended as deemed necessary. Further maintenance and control parameters of the processes at Blackburn WwTW are kept within the site "Odour Control Unit" SOP as part of the sites Quality Works System. Best endeavours will be used to maintain suitable critical spares and consumables as indicated below

Odour abatement kit – critical spares and consumables

Table 5: critical spares and consumables

Equipment	Re-order level	Time remaining at re-order	Responsibility
Odour control unit	Essential spares to be held on site		Process Controllers to liaise with FSE

MONITORING

1.8 Site Supervisory, Control, and Data Acquisition (SCADA) system

The site makes extensive use of telemetry, which allows plant operations personnel to monitor, control and record the status and performance of key equipment in the various plant areas. The system also provides alarms in the event of an equipment failure.

This includes but is not limited to:

- Odour control unit ventilation fans
- Hydrogen Sulphide concentration at the outlet of the OCUs

Levels of chemical stored on site

A review of the information held on the SCADA system can be used in identifying/preventing potential odour nuisance/pollution occurring

1.9 Monitoring site hydrogen sulphide emissions

Hydrogen sulphide (H₂S) is the most commonly monitored odour component, and is often used as a surrogate or indicator of “odour” because it is almost always present under septic conditions.

For the purpose of monitoring site odour, as opposed to those installed for Health and Safety purposes H₂S analysers are installed at key locations within the plant.

These are:

- **Within The Main Sludge Treatment building**
- **Sludge Treatment Area OCU (Centrifuge Centrate) outlet – measures the off gas H₂S concentration and will provide an indication of OCU performance**

Under normal operation it is expected that The H₂S concentrations recorded by these analysers should always remain below the maximum/peak design levels. Should they record higher concentrations, the cause of the higher concentrations should be promptly investigated to ensure that an odour nuisance is not caused. Likewise extended periods of values being above design average conditions (excluding seasonal effects) should also be investigated to identify if an operational issue or plant failure has led to an increase in sulphide emissions.

During service and maintenance of the online H₂S monitors, Blackburn WwTW has use of a hand held Jerome Mobile H₂S monitor that can be used to cover any downtime experienced.

Monitoring Odour Control Critical Operating parameters

Table 6 Summary of routine odour control monitoring activities and frequencies

Site	Equipment / Activity	Daily ^{\$}	Week	Month	Quarter	6 Month	Annual	Greater	Expected Range	Comment
Blackburn	Site extraction testing									
	Visual inspection of extraction system		✓							Site walk-around to report of anything unusual
	Functional testing							✓		Basic functionality check
	Check for leaks		✓							General visual inspection
	Carbon sampling							✓		Check for activity
	Replace media							✓		Manufacturers recommendations

Notes

Future Alarm settings

Alarms	Alarm Set Point	Response Time	Impact on OCU
Recirculation pumps	Failure of both pumps	Engineer Response (P0) Less than 2 hours. One Pump (P2) Next Working day	Will inhibit OCU operation and possibly cause odour omissions through exhaust stack
Extract Fan Motor Failure	Failure of Extract Fan	Engineer Response Less than 2 hours (P0)	Will inhibit OCU operation and possibly cause fugitive odour omissions

ODOUR MONITORING AND COMPLAINT INVESTIGATION PROCEDURES

1.10 Odour status investigation (sniff testing)

Blackburn staff priority will be to deal with the potential ongoing performance of the relevant OCU and bring it back to efficient odour reduction. When resources' allow, staff will then complete an odour mapping exercise, as per site specific instructions, to determine whether or not Blackburn is complying with the Sites permit in the event that site sludge OCUs reach the outlet hydrogen concentrations stated below:

Sludge Area OCU – >90 ppb for a continuous period greater than 60mins

Blackburn staff will investigate the OCU, to determine the remaining treatment capacity within the bed, to ensure that the OCU media is replaced prior to becoming completely exhausted.

As part of the required response to an odour complaint Blackburn staff will carry out an odour investigation using the template below, along with site specific information such as performance of the odour control unit, the containment of any potential odours in terms of closed doors, appropriate fans operating, cake wagons located inside building, spills etc. (Odour complaints report form)

If the Production Manager deems it appropriate he will liaise with the local community via the local forum and council meetings and request a representative number of the community complete the details requested in an Odour diary.

This approach taken by United Utilities can be very valuable with regard to collating useful data based on staff proactively odour monitoring around the Sites receptors and neighbourhood. Positive information is also collated due to staff complaint investigations and engaging with the community in terms of their assistance to fill in odour diaries.

The site uses these reactive assessments to build up a picture of the impact the odour has on the surrounding environment over time.

Staff normally exposed to the odours may not be able to detect or reasonably judge the intensity of odours off-site. Whenever possible Blackburn uses non site based staff (i.e. network staff) and also the local neighbours and receptors in terms of Odour diaries.

The location where staff carries out the required monitoring will depend on whether they are responding to a complaint, wind direction, or whether the staff are proactively checking the sites state of compliance as a result of the above trigger levels.

The assessment may involve staff walking along an agreed route that the site has determined takes in the nearest or most common receptors. Another option is to choose specific fixed points as opposed to a route this enables staff to evaluate the changing situation over several weeks or months.

Staff record and report any external activities that could be either be the source of the odour, or contribute to the odour.

See Odour complaint report form in Appendix A

STAFF TRAINING

Competence assessments are carried out as part of the UU appointments procedure and all staff receives bi-annual performance reviews. Process Controllers receive externally accredited training to gain competence on treatment process units. In addition all staff receives general training in the maintenance and operation of the OCUs and any additional training as identified through personal development plans.

Odour complaint training that includes monitoring, investigating and reporting of odour issues is also provided to all staff. This training details the legislative background to odour pollution including the relevant H4 and DEFRA guidance. The role and importance of the Sites odour management plan is covered in briefing and training that all staff receives.

OMP REVIEW AND UPDATE

The OMP is to be reviewed every year or sooner if any of the following occur:

- There is an increase in public interest e.g. Local Authority /EA requests an update or a local action group is set up and/or requests an update
- Regulations or guidelines are updated
- If the internal audit dictates an update

If there are significant changes on site e.g. due to capital spend

This update is to be led by the Wastewater Operations Technical Team in conjunction with WwTW operations staff.

Production Manager Sign-off:

Date:

Process Controller sign-off: A

Date:25.09.14

Catchment Manager sign-off

Date:

APPENDIX A

Odour Compliant Form Pro-forma

Odour Report Form

Odour Diary Pro-forma

Odour Complaint Report Form		
Reference number OMP 1		
Issue date 01.04.2013		
Version number 1		
Odour Complaint Report Form		
Time and date of complaint:	Name and address of complainant:	
Telephone number of complainant:		
Date of odour:		
Time of odour:		
Location of odour, if not at above address:		
Weather conditions (i.e., dry, rain, fog, snow):		
Temperature (very warm, warm, mild, cold or degrees if known):		
Wind strength (none, light, steady, strong, gusting):		
Wind direction (e.g. from NE):		
Complainant's description of odour:		
• What does it smell like?		
• Intensity (see below):	•	
• Duration (time):	•	
• Constant or intermittent in this period:	•	
• Does the complainant have any other comments about the odour?	•	
Are there any other complaints relating to the installation, or to that location? (either previously or relating to the same exposure):		
Any other relevant information:		
Do you accept that odour likely to be from your activities?		
What was happening on site at the time the odour occurred?		
Operating conditions at time the odour occurred (e.g. flow rate, pressure at inlet and pressure at outlet):		
Actions taken:		
Form completed by:	Date	Signed

Intensity (Detect ability)

- 1 No detectable odour
- 2 Faint odour (barely detectable, need to stand still and inhale facing into the wind)
- 3 Moderate odour (odour easily detected while walking & breathing normally)
- 4 Strong odour
- 5 Very strong odour (possibly causing nausea depending on the type of odour)

Odour Diary	Reference number						
	Issue date						
	Version number						
Name:	Address:						
Telephone Number:							
Date of odour:							
Time of odour:							
Location of odour, if not at above address:							
Weather conditions (dry, rain, fog, snow etc.):							
Temperature (very warm, warm, mild, cold or degrees if known):							
Wind strength (none, light, steady, strong, gusting):							
Wind direction (e.g. from NE):							
What does it smell like? How unpleasant is it? Do you consider this smell offensive?							
Intensity – How strong was it? (see below 1-5):							
How long did go on for? (time):							
Was it constant or intermittent in this period:							
What do believe the source/cause to be?							
Any actions taken or other comments:							

APPENDIX B

Blackburn WwTW

Odour Risk Assessment

Blackburn WwTW Odour Risk Assessment Odour Management Plan

Category 1 - Odour Risk Assessment

GUIDANCE:

- Complete the general site information below
- Answer all the questions on the following worksheets within the yellow shaded boxes. Please answer using one of the options given in the brackets. If the question is not applicable put N/A.
- This will generate an odour risk given below and next steps to be taken

General Site Information

SITE NAME: Blackburn WwTW

Domestic Population	
Population equivalent	235,000
Consented flow (FTFT, FTW etc.)	168
Average daily flow	75
Design biological loading rates	
Actual biological loading rates	

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CUSTOMER INVOLEMENT SIGNIFICANT. CARRY OUT STAGE 2

SEPTICITY RISK ASSESSMENT

Blackburn WwTW

SEWAGE

Q1.How does crude sewage arrive at works (Gravity/Pumped/Both?)	Both
Gravity	
Q2.High proportion of TE or imported wastes (Y/N)?	Y
N	
Q3.If yes to Q2 is there septicity control (Y/N)?	Y

0

SLUDGE

Q1. Desludging of PSTs - (Auto or manual)?	A
Both	Both
Q2. Principle sludge origin - (Primary or cosettled)?	P
Cosettled	1
Q3.Tankered imports to works (Y/N)?	Y
y	

RISK OF EMISSIONS FROM NORMAL OPERATION

Blackburn WwTW

SEWAGE

Q1.Is secondary treatment (under or over loaded)?	
Yes	
Q2.Hydraulic loading (under or over loaded)?	
???	
Q3.Are key processes covered and air treated (Y/N)?	
N	1
Q4.If yes, are performance tests done on the OCU (Y/N)?	
No	
Q5.Is the OCU in working order (Y/N)?	
Yes	
Q6.Is the WwTW a coastal site (Y/N)?	
N	
Q7.If yes to the above question, is ingress an issue (Y/N)?	
Q8.Are there areas of high turbulence on site (Y/N)? I.e. drops of greater then 20cm are considered to increase risk.	
???	1

2

SLUDGE

Q1. Are sludge processes covered (Y/N/Part)?	
Part	
Q2.Are sludge processes odour controlled (Y/N)?	
Part	
Q3.If yes, are performance tests done on the OCU (Y/N)?	
N	
Q4.Is the OCU in working order (Y/N)?	
Y	
Q5.Sludge processes air mixed or evidence of other sources of excessive turbulence (Y/N)?	
Y	1
Q6.Is tanker unloading/loading odour controlled (Y/N)?	
N	1

2

RISK OF INTERMITTENT EMISSIONS

Blackburn WwTW

SEWAGE

Q1.Are PST sludge blankets regularly over 0.5m (Y/N)?	
N	
Q2.Are storm tanks emptied in a timely effective manner (Y/N)?	
Yes	1
Q3.Are there any outstanding maintenance issues that may have an impact on odour production (Y/N)?	
Y	

2

SLUDGE

Q1.Do maintenance activities require opening of enclosed processes (Y/N)?	
N	
Q2.Are there any outstanding maintenance issues that may have an impact on odour production (Y/N)?	
Y	1

1

PERCEPTION OF ODOUR RISK

Blackburn WwTW

Q1.Media interest (Y/N)?	
N	
Q2.Political interest (Y/N)?	
N	
Q3.Local action group (Y/N)?	
N	
Q4.Is there encroachment from housing or commercial development (Y/N)?	
N	
Q5.Number of complaints in last 12 months	
Yes	1

Category 2 Odour Risk Proforma - Blackburn WwTW

Category 2 Risk reduction assessment - Inlet works

	Y/N	Evidence/records/Comments	Action required
Is septicity an issue?	N		
Is there evidence of screenings or scum build up?	N		Visual checks to be carried out on a routine basis.
Are grit and screenings removed in a timely manner?	Y	The screening skip is removed in a timely manner, service is for next working day removal.	No action
Is the inlet channel/pipework designed to minimise turbulence?	Y	The bell mouth has a drop of approximately 50cm, which creates some turbulence	The release of odour from this point is to be monitored. If a problem is identified appropriate actions will be taken, however this is now covered.
Is the sludge return spread over the day?	N	Storm flows are returned to the inlet. This occurs intermittently during low FTFT flows. Centrate is returned gradually over the course of a day.	
Are imported sludge's taken direct to holding tanks?	Y	Diagram of sludge routes held on site	

Category 2 Risk reduction assessment - Primary Tanks

Is septicity an issue?	N		
Are sludge levels over 0.5m (sludge depth measured at sidewall)?	N	0.5m is the trigger level for action. See site QA	Tank dips are taken every working day to monitor sludge depths
Are distribution chamber and outlet weirs designed to minimise turbulence?	N	Medium risk from overflow weirs	The release of odour from this point is to be monitored. If a problem is identified appropriate actions will be taken.
Is there evidence of scum build up on the PST surface?	Y	Inefficient scum removal system leading to occasional build up.	Scum is monitored every working day and action taken as issues arise. If and when scum becomes a problem a local jetting firm is employed to clean PSTs.

Category 2 Risk reduction assessment - Secondary Treatment

Is the plant overloaded?	YES	Design biological loading is 21.32Kg/m ³ /d and the actual loading is 14.62Kg/m ³ /d	Amp 6 Refurb
Activated Sludge			
Are there any areas prone to anaerobic conditions?	N		No action
Are aerosols an issue?	N		No action
Filter Plant			
Is there evidence of ponding or dry areas on filters?	N/A		
Are aeration vents clear?	NO		Clean out channels
Is the media in good condition?	NO		Amp 6 Refurb

Category 2 Risk reduction assessment - Storm Water

Are tanks emptied within 72 hours of the end of a storm event?	Y	This is flow dependent	No action
Are tanks desludged and cleaned as soon as practicable after emptying?	Y	Swing jets installed	
Category 2 Risk reduction assessment - Sludge handling			
Are imported sludge's transferred to areas that are odour controlled	N		Monitoring on-going to ascertain if this is an area of risk.
Are sludge's processed as soon as possible after generation	Y		No action
Is unstabilised sludge storage and processing covered and odour controlled	N		Monitoring on-going to ascertain if this is an area of risk.
Is the sludge treated with lime	N		
If sludge is dosed with lime is it controlled to prevent ammonia release	N/A		
Is stored sludge mixed with slow speed mixer	N	Air mixed	Monitoring on-going to ascertain if this is an area of risk.
Is the sludge kept aerobic	Y	Air mixing keeps sludge aerobic.	No action

Category 2 Risk reduction assessment - Anaerobic Digestion

Are condensation traps drained regularly	Y	Task referenced on MAMS	No action
Are measures in place to keep the digester pressure balanced	Y		
Is the standby flare checked to ensure it flares	Y	Records in site diary	No action
Is there excessive turbulence of sludge post digestion	N		
are secondary digesters uncovered	Y	No odour issues as sludge is digested.	No action
Are secondary digesters a source of odour	N		No action

Category 2 Risk reduction assessment - Odour Control Units

Can inlet and outlet air samples be taken	N		Treatment Manager and Process Controller to review the operation.
Are odour removal rates calculated	N		Treatment Manager and Process Controller to review the operation.
Are H2S removal rates greater than 95%	N/A		
Have site staff been trained in the use and maintenance of odour control equipment	Y	Handover training on the OCU received. FSE carries out routine and reactive maintenance.	
Is the odour control equipment routinely maintained	N		Review maintenance activities
In an emergency can maintenance/supplier respond in 24hrs	Y		No action
If chemicals/reagents are required by OCU, are sufficient supplies on site or can supplier respond	Y	Carbon at inlet	No action