Queenborough STC

Odour Management Plan

790101_ERA_OdourMP_QUE

August 2024

V6

Contents

Issue and Revision Record

Revision	Date	Originator	Checker	Approver	Description
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Document reference: 790101_ERA_OdourMP_QUE August 2024

1. Odour Management Plan

1.1. Introduction

The Odour Management Plan (OMP) for Queenborough Sludge Treatment Centre (STC) ('the Site') has been developed by Mott MacDonald on behalf of Southern Water Services ('Southern Water' or 'the Operator'). The OMP remains the responsibility of Southern Water Services as the OMP may assume a legal status if it forms part of the planning conditions or other legal agreements with local authorities or other third parties.

The OMP has been designed to be a live working document that forms part of the operational management system of the Site. It is a mitigation and control measure document that operations shall comply with. It demonstrates how odours shall be managed and controlled to prevent odour impacts from activities during normal operation and during abnormal events.

The OMP has been produced in accordance with the Environment Agency's H4 Odour Management guidance[1], Best Available Techniques (BAT) Reference Document for Waste Treatment[2] and Appropriate measures for the biological treatment of waste[3].

1.2. Objectives

The OMP identifies potential odour emissions from site operations and identifies procedures to manage, control and minimise odour impacts. It is based on a plan prepared by Southern Water and provides information about the measures currently implemented to control odour emissions from the Site. It provides sufficient detail to allow operators and maintenance teams to understand the operational procedures for both normal and abnormal operational 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;
- The Site's individual process operation descriptions in order to minimise, manage and control odour;
- Characterisation of odours at different points in the treatment process and assessment of risk, particularly during abnormal operating conditions;
- Southern Water Operation and Management (O&M) procedures for the Site, including housekeeping measures to minimise odour generation and release;

[1] Environment Agency (2011), *Environmental permitting: H4 odour management.* Available online at: https://www.gov.uk/government/publications/environmental-permitting-h4-odour-management

[2] Joint Research Centre (2018) Best Available Techniques (BAT) Reference Document for Waste Treatment. Available online at: https://eippcb.jrc.ec.europa.eu/sites/default/files/2019-11/JRC113018_WT_Bref.pdf

[3] Environment Agency (2020) Appropriate measures for the biological treatment of waste- Consultation draft July 2020 Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/898966/Appropriate_measures_for_the_biological_treatment_of_waste_-_consultation_document.pdf

- 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 odour risk assessment identifying any odorous or potentially odorous areas of the works and immediate and longer-term actions required to eliminate odour complaints;
- Containment, enclosure, ventilation, abatement of odours and emission standards;
- Monitoring of odorous emissions and action plans for investigation, remedial measures and procedural changes in the event of abnormal emissions;
- Management of the sludge reception, dewatering and treatment processes;.
- Odour control and management procedures during emergencies and maintenance;
- Routine care and maintenance of critical equipment (extraction and odour abatement plant);
- Monitoring, recording and reporting arrangements;
- The management and operator training requirements and records with respect to odour;
- Staffing, responsibilities, training and procedures;
- Communication strategy and complaint management/resolution procedures;
- OMP updating, review and development procedures; and
- An action procedure for complaints.

The primary responsibility for implementation of the OMP lies with the operational site management. Other business functions support the implementation of the OMP across their areas of responsibility.

The OMP outlines the sources of odours and the risks to receptors. It outlines the measures Southern Water will employ on a daily basis and how Southern Water will respond to prevent or minimise odour releases and impacts. The routine assessment of odour and the monitoring and maintenance of plant and equipment at the Site will be carried out according to the schedules given in the Operation & Maintenance (O&M) manual and Environmental Management System (EMS) to ensure that performance is optimised.

The OMP will be reviewed, and amended where necessary, following changes in infrastructure or changes in operation that have an impact on odour at the Site. Otherwise, the OMP will be reviewed annually as a minimum, or as requested by the Environment Agency. The OMP is incorporated into the Site's Environmental Management System.

1.3. Site location

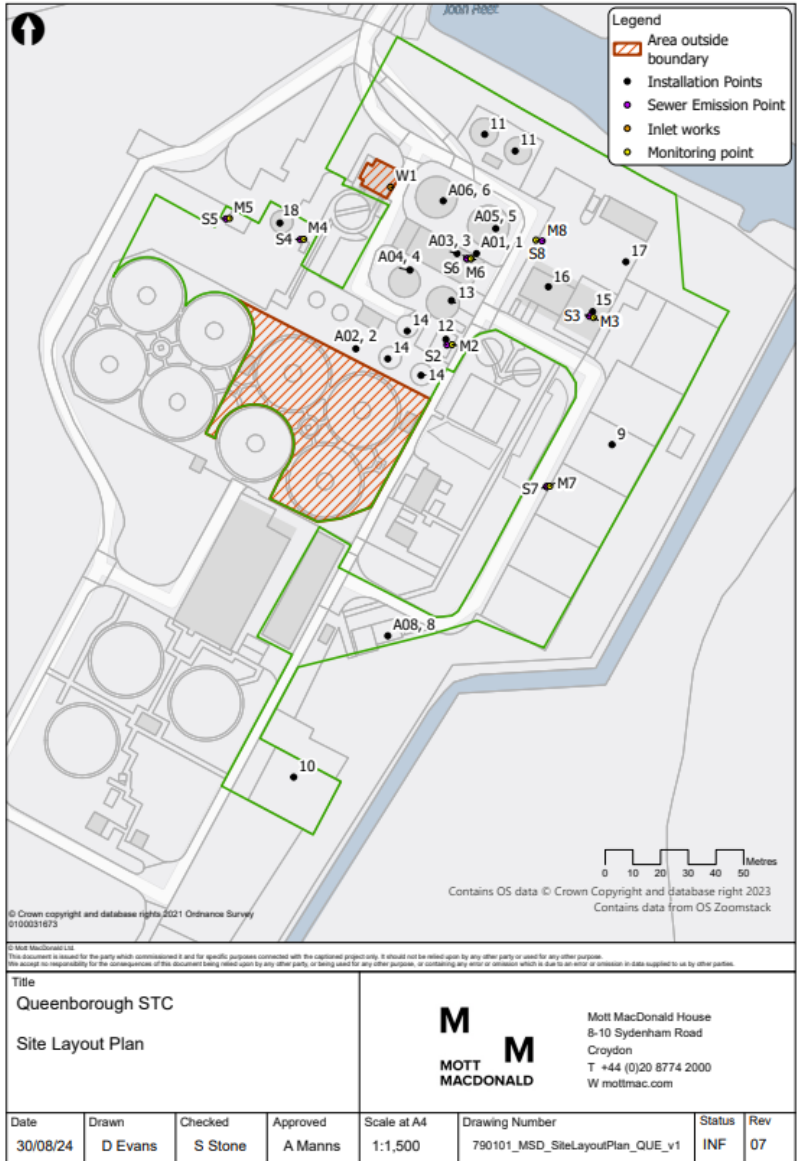
The Site has been in the current location since the 1980s. It is located on the southern marshes below Queenborough (approximately 1.7km north-east of the Site), on the western side of the Isle of Sheppey, Kent. The Queenborough catchment covers the towns of Sheerness, Queenborough, Halfway and Minster.

Activity address: Argent Road, Queenborough, Kent, ME11 5DZ

National grid reference: TQ 90914 70575

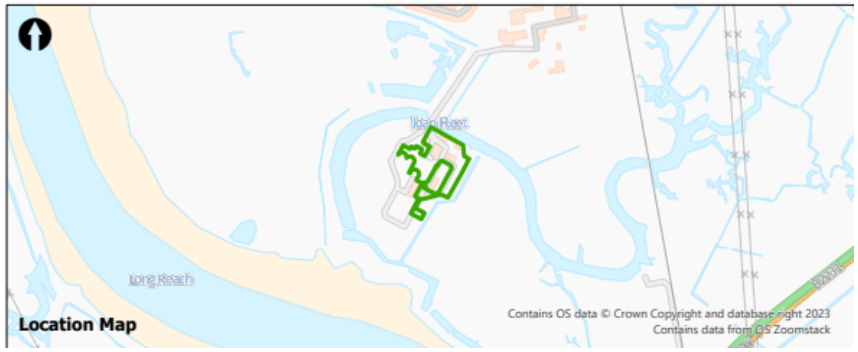
The site location and layout are shown in Figure 1.

Figure 1: Location and layout of the Site



Emissions Ref	Emissions Points	Assets Ref	Assets	X	Y
A01	CHP unit	1	CHP	590937	170589
A02	Flare stack	2	Flare	590893	170555
A03	Duty/standby boiler 1 & 2	3	Duty/standby boiler 1 , 2 and 3	590930	170589
A04	Whessoe relief valve 1	4	Gas holder	590913	170583
A05	Whessoe relief valve 2	5	Digester 1	590944	170598
A06	Whessoe relief valve 3	6	Digester 2	590925	170608
A08	Odour control units	8	Odour control units x2	590905	170451
S2	GBT Liquors			590926	170556
M2	GBT Liquors			590928	170556
S3	Centrifuge Liquors			590978	170566
M3	Centrifuge Liquors			590979	170566
S4	Sludge Reception			590873	170594
M4	Reception			590875	170594
S5	Surface water drainage			590847	170602
M5	Surface water drainage			590848	170602
S6	Gas condensate			590934	170587
M6	Gas condensate			590935	170587
S7	Surface water			590962	170505
M7	Surface water			590963	170505
S8	Surface water (future bund)			590959	170594
M8	Surface water (future bund)			590961	170594
W1	Inlet works (context only)			590906	170613
		9	Cake bays (6 main bays)	590986	170520
		10	Back-up cake bay	590871	170400
		11	Post digestion storage tanks x2	590940	170632
		11	Post digestion storage tanks x2	590951	170626
		12	Gravity belt thickeners x2	590926	170558
		13	Thickened sludge storage tank	590928	170572
		14	Sludge storage tank 1	590912	170561
		14	Sludge storage tank 2	590917	170545
		14	Sludge storage tank 3	590905	170551
		15	Centrifuges x2	590979	170568
		16	Polymer storage	590963	170577
		17	Waste management area on hardstanding	590991	170586
		18	Sludge Reception	590866	170600

AX: Air emissions SX: Sewer emission points MX: Monitoring Points



1.4. Best Available Techniques

The OMP addresses the following BAT:

- BAT 1: Environmental Management System to include the Odour Management Plan.
- Bat 10: periodically monitor odour emissions.
  - Section 5 addresses monitoring.
- BAT 12: implement and regularly review an OMP, as part of the EMS, including protocols for:
  - Actions and timelines (addressed in Section 4.2 and 5).
  - Conduction monitoring (Section 5).
  - Response to identified odour incidents (Section 7.4 and Appendix A).
  - Odour prevention and reduction (Section 4, 5, and 6).
- BAT 13: reducing odour emissions through the use of techniques (addressed in Section 4).
- BAT 14: reducing diffuse emissions to air (addressed in Section 4.2).
- BAT 33: control of odour emissions though pre-acceptance, acceptance, and sorting the waste addressed in document reference 790101_MSD_DutyofCare_QUE January 2024
- BAT 34: reduce channelled emissions (addressed in Section 4.1).
- BAT 53: Reducing emission of hydrochloric acid (HCl), ammonia (NH_3) and organic compounds to air in Section 4.1.

This OMP is applicable to the STC operations only and any mention of the wider WTW is for context only.

2. Site Operation

2.1. Overview of site operations

The Wastewater Treatment Works (WTW) is operated under the Urban Wastewater Treatment Regulations and has a standalone Water Discharge Activity Environmental Permit, this will remain an independent permitted activity.

The waste activity comprises imports, physio-chemical and anaerobic digestion (AD) treatment and the storage of waste, all for recovery purposes. The STC handles waste derived from the wastewater treatment process, either indigenously produced on-site or imported from other Southern Water owned assets.

The primary permitted installation activity will be the AD treatment facility. The AD facility will treat indigenously produced and imported sludges. Permitted Directly Associated Activities will be the import of waste from other WTW assets; the physio-chemical treatment of imported and indigenously produced sludges; the storage of indigenously produced sludges, imported sludges and the sludge cake from the AD facility; the storage of biogas derived from the AD treatment of waste and the combustion of biogas in an on-site Combined Heat and Power plant (CHP). In the event the CHP cannot run in an emergency or due to operational issues, biogas will be combusted via an on-site flare stack and/or back-up boiler system. Intersite transfers of post digested liquid sludge are also accepted at the site which enter the STC process after anaerobic digestion (post digestion).

2.2. Summary of the STC components

Currently the Site accepts indigenous sludge, imported liquid sludge and cess. Cake is imported on rare occasions, but is not treated, only stored in the cake bays. On average the site accepts six tankers of imported sludge per day. All waste is delivered to the Site in covered and sealed skips. The site does not accept tankered trade waste.

Below is a brief summary of the components for the Site.

2.2.1. Sludge treatment at the STC

The Site contains an STC which has liquid sludge reception facilities.

Reception and Screening of Imported Liquid Sludge and Cess

Imported sludge goes into an enclosed sludge reception tank. Liquid sludge is imported into the Site using tankers. The tankers are sealed to prevent any escape of malodours. Liquid sludge is imported on average of 220 m^3/day, mainly from Sittingbourne and Eastchurch, but also from other places, if required. Imported sludge makes up around 2/3 of the total dry solids treated. Liquid sludge is transferred from tankers into one sludge reception tank (270m^3).

Sludge Storage

Sludge storage is provided between each of the main sludge processing stages by means of cylindrical storage tanks. Sludge is first stored in 1 No. sludge reception tank (270m^3) and then is transferred to 2 No. post screened sludge tank (237m^3 each) after being produced by the primary settlement stage. It is then stored in 1 No. thickened sludge storage tank (518m^3 each) after being thickened. After the digestion

process, it is stored in 2 No. post-digestion sludge storage tanks (271m^3 each). All of these tanks are enclosed to capture odorous air for treatment.

Air is extracted from each tank by odour extraction fans. The sludge storage tanks are mixed using enclosed macerator pumps located outside the digesters. Therefore, there are no mechanical parts inside the tanks requiring access at regular intervals for maintenance purposes. Routine maintenance of the tanks and external mixing pumps would be subject to the Site odour risk assessment.

Thickening of Liquid Sludges

Sludge thickening is undertaken to increase the solids content of the sludge. This is achieved by means of mechanical equipment that is housed within a building to contain odorous air for extraction.

Liquor from the thickening process is returned to the WTW for further treatment.

The sludge is thickened in two duty/standby gravity belt thickeners. The belt thickeners are designed to give 150% capacity at average loads when operating 24 hours a day, seven days a week, and receive sludge at approximately 3% dry solids and raise it to 7%. The thickeners are covered and extracted to an odour control system.

Thickened sludge is stored in 1 No. thickened sludge storage tank (518m^3) before being fed to the anaerobic digesters.

Digesters

There are two large sealed, conventional mesophilic anaerobic digesters (3,696m^3 total volume) operating at around 36^{o}C. The anaerobic digestion process provides a controlled environment where micro-organisms (including bacteria and fungi) can grow, multiply and break-down organic material, releasing water, carbon dioxide and methane (biogas). Gas production, gas pressure and digester temperature are monitored and logged on the SCADA system. The produced gas is stored in one biogas holder, which is a double skinned, expandable, hemispherical container. A biogas flare is provided for periods when, for example, the CHP are unavailable during maintenance or downtime, to control and manage excess gas during these periods.

In instances where the gas pressure is too high the pressure relief valve system de-pressurises the system. These pressure relief valves are located at the connection point with the biogas distribution system pipework at the top of each digester. Opening of the pressure relief valves is an emergency response of the system to maintain safety and would be rare, short-lived events. Pressure levels are monitored in the gas system and linked to the SCADA system. This is provided with an alarm which can alert operators to increased pressure. The performance of the digesters is monitored daily, through the sampling of inlet and outlet sludge quality.

Combined Heat and Power (CHP)

A CHP plant is installed at the Site, designed to use biogas. The biogas produced in the digestion process is fed to the CHP unit and two standby boilers (powered by biogas/light oil) to generate electricity and heat. The electricity is used to partially power the Site and heat is to be recovered and used to heat the digesters. There is also a back-up flare for use when the CHP engine is on downtime for maintenance.

Post Digestion

Digested sludge is stored in two post digestion sludge storage tanks (271m^3 each) to allow the material to cool down, prior to being fed into a dewatering plant employing 2 No. centrifuges. These tanks are required to provide buffer storage between the continuous digestion process and the dewatering processes which will

run intermittently. The odour emissions from this tank are greatly reduced by the fact that the sludge is digested and has had ferric sulphate addition, which converts soluble sulphide to insoluble iron sulphide and greatly reduces any emission of H_2S.

Dewatering

Dewatering takes place in two centrifuges (one standby, one duty) to further reduce the volume of sludge.

Liquor from the dewatering plant is returned to the WTW for further treatment.

The centrifuges are housed within the centrifuge building, which is connected to odour extraction. The centrifuges are maintained as part of the framework maintenance contract which also provides an emergency response.

The dewatered digested cake is stored in cake storage bays, before being transported off-site for storage prior to spreading onto agricultural land.

Cake storage

Dried sludge is stored in the form of a cake in one of seven open cake bays, six in the east of the Site and one back-up bay in the south. Cake maturation takes approximately 61 days.

Odour control equipment

All sludge treatment processes and sludge storage tanks are covered or enclosed except for the cake bays.

Two odour control units (OCUs) are present on site (a wet chemical scrubber system). Odorous air is extracted by 2 No. duty, standby fans and dispersed via the stack, as shown by A08 in Figure 1.

Leak detection (methane gas analyser) is also installed on biogas holder/s to ensure any leaks from the inner bag are detected. Any leaks detected on the biogas system would always be fixed immediately by Southern Water due to the process safety risk of posed by biogas. Other odour mitigation measures implemented on-site include placing covers on containers and limiting the height of rising sludge.

The use of odour atomisers during unloading of waste into the system is to be considered. The removal of biosolids off-site will be undertaken as soon as practically possible whilst considering prevailing weather conditions.

A schematic for the odour control units can be found in Appendix B.

Other relevant STC components

The IED permit will include:

- Sludge reception tank 1 No. (270m^3)
- Strain presses 2 No.
- Post screened sludge storage tank 2 No. (237m^3 each)
- Gravity belt thickeners (duty/standby) 2 No.
- Thickened sludge storage tank 1 No. (518m^3)
- Digesters 2 No. (3,696m^3 total volume)
- Post digestion storage tank 2 No. (271m^3 each)
- Centrifuges (duty/standby) 2 No.

- Gas bag holder 1 No. (570m^3)
- Auxiliary boilers 3 No. powered by biogas/gas oil
  - Boiler 1: 0.88MWth dual fuel (biogas/gas oil)
  - Boiler 2: 0.82MWth dual fuel (biogas/gas oil)
- CHP engine 1 No. (1.1MWth thermal rated input)
- Biogas burner (flare stack) 1 No.
- Cake storage bays 7 No. including one back-up bay (total volume 3920m^3), wall height is approximately 6ft
- Odour control units (OCU) 2 No.
- Odorous air is extracted by 2 No. duty, standby fans

The following are outputs from the process:

- Cake (dewatered post digestion sludge) - stored in cake bays before being transported off-site for agricultural use;
- Bio-gas - stored in an existing gas holder, then either:
  - Burnt in the CHP or back-up boilers to generate electricity;
  - Flared in the waste biogas burner.
- Grit and screenings (small amount) – deposited in skips before being taken off-site.

A schematic for the odour control units can be found in Appendix B.

3. Potential Odour Sources

3.1. Overview of the mechanisms for odour generation

The generation of odour from the processing of sewage is primarily associated with the release of odorous Volatile Organic Compounds (VOCs) that are generated as a result of the anaerobic breakdown of organic matter by micro-organisms.

Since the main source of odour and VOCs is the solid organic matter, the most intense and offensive odours tend to be generated from the operations involving the handling of sludge i.e. the processes applied to dewater, treat and store raw sludge. These processes are generally considered to present the greatest risk of odour impact off-site unless adequate controls are put in place. Depending on the quality of the sewage presented to the works, aspects of the treatment process involved in the handling of raw sewage (e.g. preliminary and primary treatment stages) may also contribute to offensive odours.

Odours generated from the sewage treatment processes downstream of the primary sludge removal stage (e.g. the activated sludge processes and final settlement) present a significantly reduced risk of odour impact. This is due to the fact that the majority of odorous biogenic material has been removed from the flow at this point, and the treatment processes applied to remove any remaining contaminants in the sewage are aerobic, which inhibits the formation of the majority of the reduced sulphur compounds which are responsible for offensive sewage odours.

The rate of odour release from sewage and sludge sources is primarily dependent on the temperature of the material, and the surface area exposed to the atmosphere. As a result, odorous emissions from sewage treatment operations tend to be highest during the summer months. Furthermore, activities that lead to increases in the surface area of odorous material exposed to the atmosphere (e.g. due to turbulence generated by sewage handling processes and agitation of sludge) will inevitably lead to an increase in the magnitude of odour released.

Southern Water acknowledges that high levels of odour arising from wastewater and sludge treatment are not acceptable and that reasonable and practicable measures must be taken to minimise any nuisance caused to the general public. Southern Water does not operate under a single defined odour exposure standard. Each site is considered individually taking into account the relevant legislation and the 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 Site are also taken into consideration.

3.2. Potential odour sources

Table 1 identifies the plant, equipment and activities which have the potential to generate odours under normal operational conditions. Odour sources under emergencies and abnormal operating conditions are addressed in section 4.3.3 Abnormal conditions.

Wastes accepted to the STC, under the Environmental Permit, are listed in Appendix C.

Due to the nature of the Site's activities, the hedonic tone of odours is neutral at best, whereas most odours generated on site will have a negative hedonic score (therefore deemed offensive). As the local population has already become sensitised to this, it is prudent to reduce the benchmark of the rating associated with

sludge treatment. The hedonic score of the material will improve through the sludge treatment process as organic material is digested.

Table 1: Identified odour sources

Process or activity	Plant or equipment	Potential source of odour	Odour controls in place	Potential for odour emissions during normal conditions
Sludge reception	Sludge reception building TQ 90909 70618	Liquor	Imported liquid sludge is delivered to the Site by tanker and stored in a sludge reception tank. The reception tank is enclosed and air is extracted from under the covers and treated by the odour control plant. Maximum storage: 300 m^3/day	Low
Sludge treatment	Sludge treatment buildings TQ 90944 70597 TQ 90928 70609	Sewage sludge	Where sludge treatment processes are in a building, air is extracted from inside the building to the odour control plant. Building doors are kept closed, except when access is required. Sludge is mixed and regular throughput is maintained.	Low
	Anaerobic digesters pressure release valve TQ 90944 70597 TQ 90928 70609	Biogas	Digesters covered, process monitored and regularly maintained. Planned preventative maintenance undertaken on equipment Maximum storage: 3,696m^3 total	Low
	Sludge storage tanks TQ 90943 70633 TQ 90955 70627	Liquid sludge	The screened sludge storage tank and post digestion sludge storage tank are covered, process monitored and regularly maintained. Maximum storage: 237m^3 each	Low
	Sludge thickener tank TQ 90928 70570	Liquid sludge	The thickened sludge storage tank is covered, odour controlled, process monitored and regularly maintained Maximum storage: 518m^3	Low
	Centrifuges TQ 90982 70566	Sludge cake	Centrifuges are enclosed and odour controlled and planned preventative maintenance is undertaken on equipment	Low
	Odour control units TQ 90903 70452	Untreated air	Odour control units treat air to remove odorous compounds. They are process monitored and planned preventative maintenance is regularly undertaken on equipment	Low

	Cake bays TQ 90987 70519 TQ 90873 70393	Sludge cake	While uncovered, cake is moved by low loader from a conveyor along the road into the receiving bay at the end of the treatment process so odour emissions are minimised. No disturbance of cake while in bays except for removal. Daily movement of cake into the bays is undertaken as required. Maximum storage: 6,200tonnes Retention time: 2-3 months	Medium
Biogas combustion	Gas holder TQ 90912 70587	Biogas	This is a sealed system. Maximum storage: 570m^3	Very low
	Combined Heat and Power (CHP) unit TQ 90942 70587	Biogas	Planned preventative maintenance undertaken on equipment. If CHP unit is down, gas is burnt in flare	Low
	Boilers TQ 90876 70458	Biogas	Planned preventative maintenance undertaken on equipment	Low
	Flare TQ 90893 70555	Biogas	Planned preventative maintenance undertaken on equipment	Low
Cake export	Cake export	Sludge cake	Lorries/trailers are covered before leaving or sealed skips are used. Covers only removed when inside building.	Low

3.3. Odour impact

3.3.1. Adjoining land use

The area surrounding the Site largely comprises marshland, and is bounded to the south (approximately 300m) by The Swale, a tidal channel of the Thames Estuary. Immediately surrounding the site (north, west and south) is a smaller channel named Joan Fleet (approximately 20m north of the site, at its closest), which is fed by a small drain that runs along the western boundary of the site. There are further drains, streams and small surface water features surrounding the Site.

3.3.2. Sensitive receptors

Receptors sensitive to odour include users of the adjacent land, which may vary in their sensitivity to odour. The level of sensitivity will be defined using the Institute of Air Quality Management guidance[4].

- High sensitivity receptors e.g. residential dwellings, hospitals, schools/education and tourist/cultural.
  - users can reasonably expect enjoyment of a high level of amenity; and
  - people would reasonably be expected to be present here continuously, or at least regularly for extended periods, as part of the normal pattern of use of the land.
- Medium sensitivity receptor e.g. places of work, commercial/retail premises and playing/recreation fields.
  - users would expect to enjoy a reasonable level of amenity, but wouldn't reasonably expect to enjoy the same level of amenity as in their home; or
  - people wouldn't reasonably be expected to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land.
- Low sensitivity receptor e.g. industrial use, farms, footpaths and roads.
  - the enjoyment of amenity would not reasonably be expected; or
  - there is transient exposure, where the people would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land.

The magnitude of risk relates to[4]:

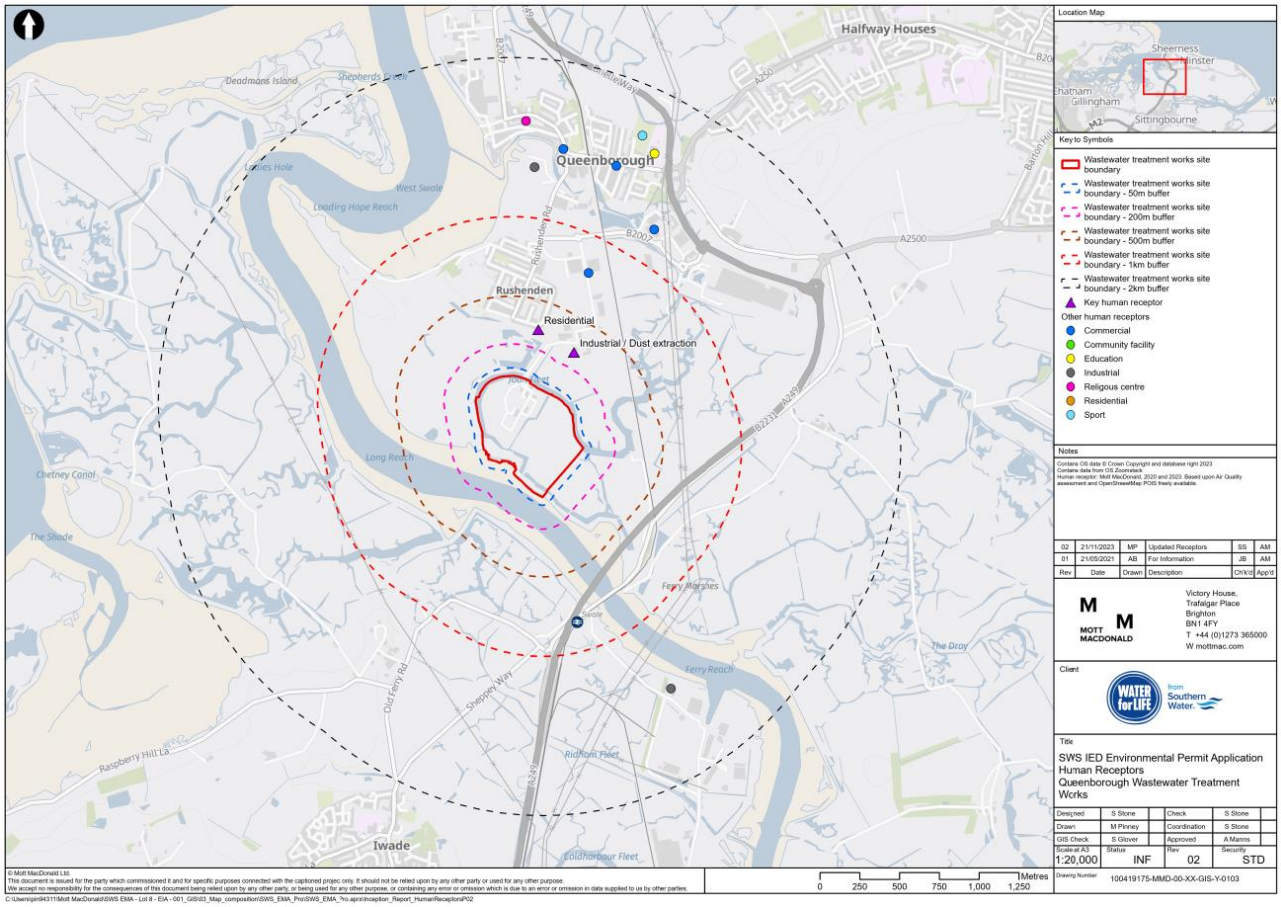
- Frequency: How often an individual is exposed to odour
- Intensity: The individual's perception of the strength of the odour
- Duration: The overall duration that individuals are exposed to an odour over time
- Odour unpleasantness: Odour unpleasantness describes the character of an odour as it relates to the 'hedonic tone' (which may be pleasant, neutral or unpleasant) at a given odour concentration/ intensity. This can be measured in the laboratory as the hedonic tone, and when measured by the standard method and expressed on a standard nine-point scale it is termed the hedonic score.
- Location/Receptor sensitivity: The type of land use and nature of human activities in the vicinity of an odour source. Tolerance and expectation of the receptor. The 'Location' factor can be considered to encompass the receptor characteristics, receptor sensitivity, and socio-economic factors.

No sensitive human receptors lie within 250m of the Site. An industrial site/depot/works (Elmley Industrial Estate) lies within 400m northeast of the Site, with two car depots mapped 1km north and northeast of the site. A residential area lies within 400m northwest of the Site at the nearest point.

Figure 2 identifies the sensitive receptors within 2km of the Site and Table 2 identifies sensitive receptors within 500m of the Site, as these will be the most likely affected receptors.

[4] Institute of Air Quality Management (2018) Guidance on the assessment of odour for planning V1.1. Available online at: https://iaqm.co.uk/text/guidance/odour-guidance-2014.pdf

Figure 2: Sensitive receptors within 2km of the Site



Source: Mott MacDonald (2021),

Table 2: Receptors within 500m of potential emission sources at the Site

Receptor	Nearest potential emission source to receptor	Process	Distance (m) from nearest potential emission source	Direction of receptor from closest emission source
Industrial estate	Sludge reception inlet	Sludge reception and distribution	370	North east
	Sludge reception tank	Sludge reception and distribution	390	North east
	Primary sludge storage tanks	Sludge treatment	395	North east
	Gravity belt thickener/thickened sludge storage tanks	Sludge treatment	380	North east
	Anaerobic digester	Sludge treatment	350	North east

Receptor	Nearest potential emission source to receptor	Process	Distance (m) from nearest potential emission source	Direction of receptor from closest emission source
	Post digestion storage tank	Sludge treatment	320	North east
	Centrifuge and press house	Sludge treatment	355	North east
	Cake Bays	Sludge treatment	340	North east
	Biogas storage	Biogas combustion	380	North east
	CHP	Biogas combustion	365	North east
	Flare	Biogas combustion	420	North east
Residential properties	Sludge reception inlet	Sludge reception and distribution	390	North
	Sludge reception tank	Sludge reception and distribution	405	North
	Primary sludge storage tanks	Sludge treatment	430	North
	Gravity belt thickener/thickened sludge storage tanks	Sludge treatment	415	North
	Anaerobic digester	Sludge treatment	380	North
	Post digestion storage tank	Sludge treatment	355	North
	Centrifuge and press house	Sludge treatment	410	North
	Cake Bays	Sludge treatment	410	North
	Biogas storage	Biogas combustion	410	North
	CHP	Biogas combustion	395	North
	Flare	Biogas combustion	445	North

Note: (a) Distance from source to receptor is rounded to the nearest 5m
(b) Sludge storage tank includes sludge reception tank, screened sludge storage tanks, thickening sludge storage tanks, thickened sludge storage tanks and post digestion storage tanks
Value in **bold** represents the nearest potential emission source for each process which is closest to a sensitive receptor

3.4. Odour modelling

The effectiveness of the pathway for odour impacts associated with the Queenborough Wastewater Treatment Works has been assessed using wind data and the locations of the nearest sensitive receptors relative to the Site. Modelled wind data for the years 2019-2022 were derived for the Site from an atmospheric hindcast model (Vortex).

The nearest high sensitivity receptors to the site were residential receptors between Manor Road and River View which is approximately 340m to the north and one area of medium sensitivity industrial receptors on Argent Road which is approximately 350m to the northeast. During 2019-2022, the mentioned receptors were downwind from the site approximately 29% (industrial receptor) and 18% (residential receptor) of the time, respectively. Based on the distance between these receptors and the Site and the frequencies of winds to disperse odours towards these receptors, the pathway for odour impacts from the Site to the residential and commercial receptors are considered to be slightly effective to moderately effective. Therefore, the potential for odour impacts from the Site cannot be scoped out on the basis of this simple assessment.

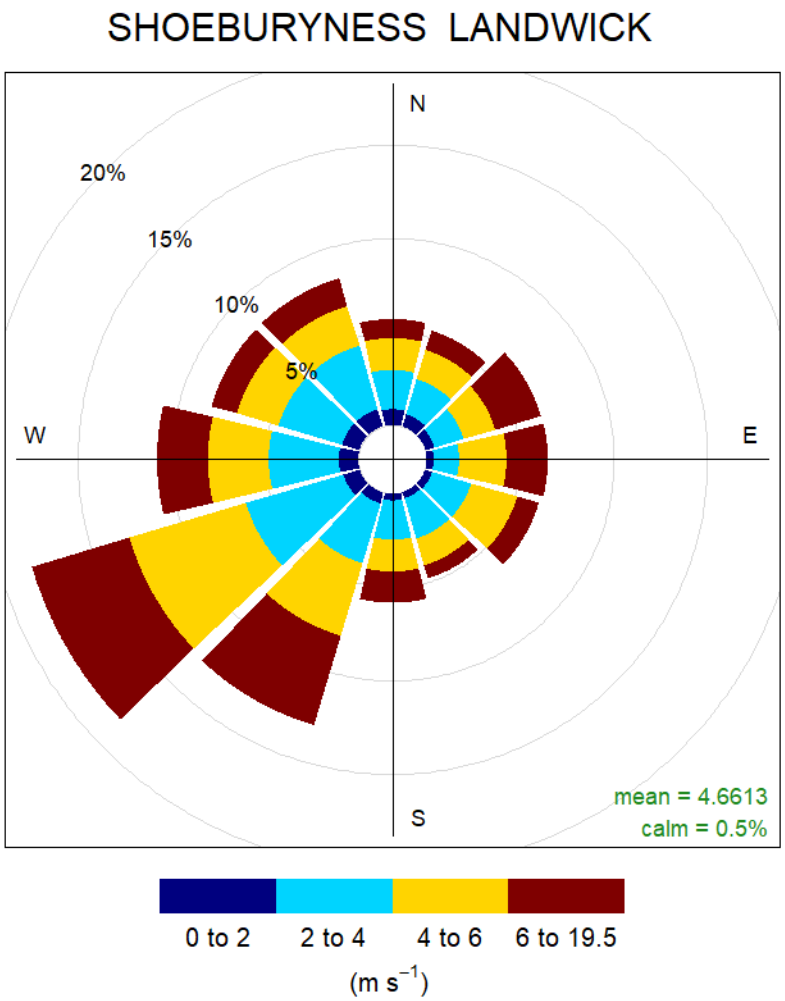
No specific odour modelling has been commissioned for this site and modelling has not been undertaken prior to the application for a bespoke installation permit because the OMP consolidates existing odour control measures and will form part of the Operational Techniques. The Site does not meet the criteria for the listed suggestions for odour modelling according to the Environment Agency H4 guidance:

- to predict the impact of a new proposal: The Site is an existing site and structural changes are not proposed as part of the variation application. The sources of odour and their controls are already known;
- to assist in the investigation of the cause of odour complaints Causes of odour are identified and resolved with requirement for further investigation established;
- compare the cost effectiveness of odour mitigation options: Southern Water are not seeking at the time of the Bespoke Installation Permit application to implement additional odour mitigation measures that require capital investment;
- work out emission limits for point source emissions: The Site presents a low odour risk to sensitive receptors and an Odour Control System is in operation, which will be compliant with design standards or as specified in the Environmental Permit, see Section 5.7;
- indicate how much improvement is needed or size abatement equipment: improvements to odour control is implemented through the OMP. No odour complaints have been received from 2018 to 2023, according to the CSM system. The Site had no complaints received, which suggests capital investment and improvement on existing abatement equipment is not necessary at present; and,
- calculate a suitable chimney height to provide an acceptable exposure at receptors: the chimney heights are fixed structures, since the Site is low risk of odour it is not justified to alter existing odour control structures.

The 2018--2022 wind rose for the meteorological site at Shoeburyness Landwick, the nearest representative meteorological site to the Site (located approximately 18km north of the Site), is shown in Figure 3. The Shoeburyness Landwick meteorological site experiences frequent mild and strong winds from the southwest, with fairly frequent and occasional strong winds from the west. This suggests that sensitive receptors located to the north east of the Site would be at the greatest risk from odour emissions from the Site as they would be downwind of the prevailing wind direction.

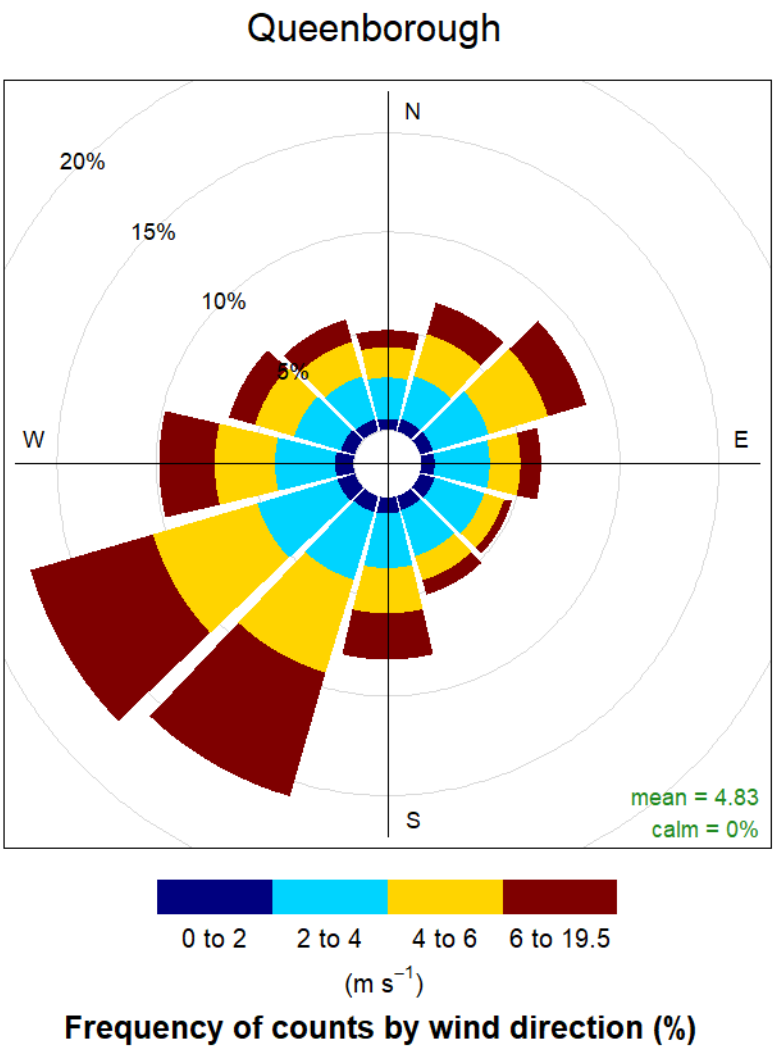
Given the distance between Shoeburyness Landwick and the Site, an atmospheric hindcast model (Vortex) has also been used to assess the wind conditions at the Site. Figure 4 presents the wind rose generated for the Site from the Vortex model for the period from 2018-2022. The wind rose demonstrates that historically this location also experiences strong prevailing winds from the south west. Overall, the two datasets show general agreement with both the monitored and modelled data indicating the prevailing winds originate from the south west. Therefore, sensitive receptors located to the north east of the site would be at the greatest risk from odour emissions from the Site, as they would downwind of the prevailing wind direction.

Figure 3: Average wind rose for Shoeburyness Landwick meteorological site, 2018-2022



Source: NOAA Integrated Surface Database (ISD) (2023)

Figure 4: Average wind rose for the Site from the Vortex model, 2018- 2022



Source: NOAA Integrated Surface Database (ISD) (2023)

4. Odour Management and Control

4.1. Odour control system

Sewage, sewage sludges and returned liquors can all contribute to odour on a STC. All potential sources of odour identified at the Site have been either covered or enclosed within buildings and the air is extracted continuously.

All sludge treatment processes and sludge storage tanks are covered or enclosed. Two odour control units (OCUs) are present at the STC.

Odorous air is extracted by 2 No. duty, standby fans with air dispersed via the stack. When the OCUs are in operation, the odorous gases from tanks and treatment areas will be channelled to the odour control treatment units.

In-line with BAT 34 and 53, the Site has a wet chemical scrubber, and when in operation it will treat and reduce channelled emissions to air. Details of the monitoring to be carried out on the OCU when in operation is outlined within this section and in Section 5.

Leak detection (methane gas analyser) is installed on biogas holder/s to ensure any leaks from the inner bag are detected. Any leaks detected on the biogas system would always be fixed immediately by Southern Water due to the process safety risk posed by biogas.

The use of odour atomisers during unloading of waste into the system is to be considered. The removal of biosolids off-site will be undertaken as soon a practically possible whilst considering prevailing weather conditions.

A process flow diagram showing which assets are covered by the OCU can be found in Appendix B.

Odour control checklists can be found in Appendix D.

4.2. Odour control in normal and abnormal conditions

All operating practices must be compliant with the Site's O&M manuals, Southern Water company practices and management systems and the OMP.

In order to achieve overall odour containment and thus to minimise unplanned releases of odour to atmosphere, it is essential that:

- The integrity of all covers over process units is maintained continuously, other than during periods of essential maintenance.
- All doors in buildings ventilated to the odour control system remain closed except when access is required and that the integrity of the buildings fabric is ensured.
- Imports of pre-digested cake are to be offloaded within buildings with closed doors and Odour Control Unit and/or odour extraction operating.
- Any imports to the head of works to be undertaken as quickly as possible to limit odour emissions. Additional imports to head of works would be an emergency basis, for example if a pumping station goes down or there is a burst rising main, the waste would be transferred via tanker to the head of works and only from assets that would already discharge to the Site (indigenous).

Where routine, planned and emergency maintenance of plant items has to be carried out and there is a high risk of odour being released to atmosphere in quantities sufficient to result in detection off-site, a detailed risk assessment of the activity is conducted, as part of which issues of odour generation, release and control are considered. Where the risk of an off-site odour event occurring is judged to be high, the Southern Water Customer Services call centre will be informed, together with the Environment Agency.

4.2.1. Normal conditions

There will be regular occasions throughout the year when routine, planned and reactive maintenance are carried out in order to ensure continued optimum operation of wastewater treatment and sludge recycling. Routine and planned maintenance tasks are divided into different classifications according to the level of complexity, speciality and frequency. The classifications are:

- Routine Operations: the daily and weekly routine operations are schedule regionally through weekly and quarterly programmes of work. Site operators are responsible for carrying out the tasks and the Field Performance Manager (FPM) for checking completion and quality.
- Planned Maintenance (Ellipse): the programmes for planned maintenance are generated regionally. Jobs are sent direct to qualified mechanical or electrical technicians via electronic communication. Start and completion of tasks, including work done, are logged direct to Ellipse, which produces records of plant performance. Site and regional mechanical and electrical staff, in conjunction with specialist contractors, are responsible for carrying out the tasks and the FPM for checking completion and quality.
- Contractor Maintenance (CM): the programmes for planned maintenance of some categories of specialist equipment (centrifuges, odour control equipment, odour control monitoring equipment, etc.) are generated regionally. Paper records of work carried out, completion and approval are kept on-site and by the Supply Agreement Leader.
- Local Plant Monitoring (LPS): Specific monitoring (for example, hydrogen sulphide at some sites) is carried out by online instrumentation. Information is recorded on SCADA. The plant records (daily plant spreadsheet) are created by site operators and process scientists. Site operations staff are responsible for carrying out the tasks and FPMs for checking completion and quality.
- Contractors Records (CR): Records of sludge deliveries are recorded in real time on-site via an electronic logging system and reported monthly. Records are available via online database.
- Material Delivery and Removal: Records of sludge deliveries are recorded electronically in real time. Chemical delivery records are maintained on site logs. Bulk chemical deliveries and consumption are also recorded on SCADA in real time.

Minor repairs and routine maintenance work are carried out continuously throughout the year during the working day, avoiding evenings and weekends, except in emergencies. Where possible, more major maintenance tasks are carried out in a planned manner according to priority and resources. Odour sensitive major maintenance tasks will be aimed to be undertaken during the winter period (between October and April), where appropriate. The emphasis in planning this maintenance is to minimise the time required to carry out the work, ensuring as far as possible, that odours are contained or abated during the work and to deploy alternative odour suppression systems, if required.

Where a maintenance operation is likely to release quantities of odour likely to be detectable off-site, the relevant authorities and the Southern Water Regional Call Centre would be informed in advance.

Table 4 highlights the typical maintenance activities for the wastewater and sludge treatment processes.

Table 4: Typical maintenance for wastewater and sludge treatment activities

Process	Period	Typical maintenance activities
Preliminary treatment	Daily	Checks on plant and equipment as per operating plan
	2-3 times/week	Removal of grit/screening skips
	Weekly	Operational checks on screens, compactors and associated equipment as per operating plan
	Monthly	Checks by mechanical/electrical (M&E) engineers as per regional maintenance schedules.
	Annually	Maintenance of plant and equipment
Primary Treatment	Annually	Drain-down of and repairs to the tanks
Secondary Treatment	Daily	SCADA and Visual checks by operations personnel, checks of dissolved oxygen and bubble pattern along with daily sampling.
	Weekly	Clean and check dissolved oxygen probes.
	Dictated by operational performance	Drain and clean lane, replace failed diffuser membranes.
Sludge Import	Ad-hoc	Regular checks on deliveries and operation of exhaust extraction and ventilation, removal of skips from sludge and cess screens.
	Weekly	Routine checks on equipment. Tasks carried out and records maintained under the Site operating and monitoring plan.
	Monthly	Checks by M&E. Tasks carried out and records maintained under regional maintenance schedules.
	Annually	Checks by M&E. Tasks carried out and records maintained under regional maintenance schedules.
Sludge Storage	Daily	Monitoring of levels. Tasks carried out and records maintained under the Site operating and monitoring plan.
	Weekly	Visual inspection of plant & equipment. Tasks carried out and records maintained under the Site operating and monitoring plan.
	Dictated by operational performance	As required drain down and clean tank, inspect structure. Tasks carried out and records maintained under regional maintenance schedules.
Sludge Thickening	Daily	Routine daily checks.
	Weekly	Routine weekly checks and maintenance.
	Monthly	Maintain and adjust plant to maintain efficiency.
	Annually	Checks by M&E as per regional maintenance schedules.
Digester and degassing tanks	Daily	Feed Volume, Temperature, Dry solids Test, and Visual Inspections (levels and Equipment) monitoring.
	Monthly	Checks of pressure relief valves and plant. Routine maintenance of systems.
	Annually	Checks and service of gas systems.

Centrifuge	Daily	Centrifuge check routine as advised by supplier.
	Weekly	Centrifuge check routine as advised by supplier.
	Monthly	Checked in line with routine service agreement by appointed service provider.
	Annually	Checked/Serviced every six months by appointed service provider.
Odour control units (when in operation)	Daily	Routine daily checks
	Weekly	Inspection and maintenance routines in accordance with both the frequency and task specified in the regional maintenance schedules.
	Monthly	Inspection and maintenance routines in accordance with both the frequency and task specified in the regional maintenance schedules.
	Annually	Annual service by the Odour control service provider in line with contracted maintenance requirements

Diffuse emissions from open storage areas (such as cake bays, aeration lines), are minimised by ensuring optimization of the digestion process to limit bioaerosol potential of post-digested sludge.

To minimise odour nuisance, it is important to ensure that the Site is operating as designed. Covers and hatches are replaced to maintain the integrity of enclosures provided to collect odours air.

4.2.2. Odour risk assessment

Unless it is in an emergency situation, an odour risk assessment will be undertaken before carrying out maintenance tasks with high odour risk and high odour sensitivity. Examples of such activities are:

- Shutdown of odour control systems for an extended period for maintenance;
- Non-routine draining down of large open process tanks with potential to generate odour;
- Lifting of odour control covers, opening of hatches or keeping doors of odour-controlled building open for an extended period;
- Commissioning of new odour sensitive processes or equipment where odour risk may not be adequately mitigated; and
- Significant flow diversion outside odour-controlled processes for an extended period

A flowchart to identify when an activity requires a separate odour risk assessment is provided in Appendix E.

An odour risk assessment matrix will be used to determine the odour risk for planned and unplanned maintenance work commonly performed. Where an unusual activity not contained in the matrix is planned, a site-specific risk assessment will be carried out according to a standard procedure. The matrix also includes foreseeable situations for emergency breakdown and situations arising as a result of dealing with an emergency where the ability to improve control of or minimise odorous release is compromised. The advice given by the odour risk assessment matrix will be followed, as appropriate, taking into account site conditions.

Table 5 provides an example of a risk assessment for routine maintenance operations, which are reviewed and updated at least annually. The key contact group (the Environment Agency and Southern Water

Customer Services) will be informed for high risk activities, in relation to odour, at least 3 days before work is due to commence.

The Regional Control Centre (RCC) will be informed in advance of the nature and duration of maintenance work and measures to be undertaken when a significant odour risk is identified from the Odour Risk Assessment.

Table 5: Example of risk assessment for routine maintenance operations

Event	Implications	Odour Risk (High, Medium, Low)	Proactive Actions	Responsive Actions
Maintenance of processes within WTW	Opening of hatches, and exposure of process units to building.	Low	Processes contained within the WTW which itself is odour controlled.	Minimise number of hatches open at any one time.
Maintenance on sludge treatment process (not biogas system)	Potential for odour release if any sludge exposed to atmosphere.	High	Divert or minimise sludge throughput in process area.	Carry out during winter months where possible, if required during summer use portable odour reduction sprays.
Maintenance of odour control system	Reduced capacity for period of maintenance risk of odour release if input peaks received	Medium	Control processes to minimise risk of high peaks of H_2S reaching odour control unit.	Carry out during winter months where possible, if required during summer assess need to use portable odour reduction sprays

4.2.3. Abnormal conditions

There will also be unanticipated breakdowns of equipment which require unplanned and emergency maintenance. During periods of abnormal conditions, the normal odour standard and emission standards may not be able to be fully complied with, and/or there may be fugitive emissions of odour from parts of the Site where there are normally none. Exemption would be required for these operations.

In the event of plant failures or emergency situations, this would raise an alarm on the Site's SCADA or telemetry systems, which will be reacted to by on-site or regional control room operators and FPM.

Depending upon the nature of the fault or emergency, a mechanical or electrical technician, both of whom are on-call 24-hours, would be contacted and will attend the Site as soon as practicable if required. Where the on-call technicians are already engaged upon other response work, there is the facility to access staff from other Southern Water geographic divisions, coordinated by the FPM. All faults, breakdowns and emergencies are logged electronically together with records of the action taken and the solutions reached.

If any waste arrives on-site that fails to provide correctly completed paperwork this is immediately reported to the Industrial Waste Services Team, who will decide if it can be accepted or rejected. Waste arriving at Site is quarantined in any of the following circumstances:

- Hazard Analysis Critical Control Point (HACCP) critical limit breach
- Maximum Acceptable Concentration (MAC) sample failure
- Measured cake DS% on-site has dropped below 20% (the 20% has to be confirmed by 2nd sample)

If any of these take place, then material will need to be quarantined in line with the Southern Water – Quarantine procedure for non-compliant or low cake DS% biosolids procedure. If quarantining is required, then the quarantined digested material is placed in an empty bay on site if available. If a storage bay is not available, then the Biosolids Compliance Team should be contacted to arrange alternative storage.

When the breach is HACCP or MAC failure related the cake will be held at the quarantine location until compliant results are received from the lab provider. After bacti compliance is confirmed the relevant stakeholders will be notified by a certificate of compliance that cake from the site in question can be recycled to land.

When the breach is related to DS% content of the cake being below 20% then the affected cake will be held in quarantine until alternative treatment or disposal can be arranged by Southern Water .

If, on sampling and testing, the waste does not meet the specific pH limits in the Environmental Permit, then further advice is sought from the Industrial Waste Services Team, who will decide if it can be accepted or rejected. If rejected, then the Waste Rejection and Incident Note is completed, and the load is turned away.

Table 6 provides an example of a risk assessment for abnormal and emergency operations, which are reviewed and updated as required. The key contact group (the Environment Agency and Southern Water Customer Services) is informed, for high-risk activities, relating to odour, as soon as event occurs.

Table 6: Risk Assessment for Emergencies and Abnormal Operating Conditions

Event	Potential source of odour	Potential impacts	Odour **risk**	Measures to prevent or minimise risk	Actions to be taken
Breach of odour-controlled area (excluding sludge containing structures)	Untreated air	Effectiveness of foul air extraction system compromised, risk of odour release until repairs completed	Medium	Minimise odour generating activities in area	Temporary containment pending full repair Ensure any interconnecting doors etc secure Minimise odour generating activities in area Assess odour impact with local survey, use portable odour reduction sprays if requirement identified
Breach of odour-controlled area sludge containing structure	Untreated air	Effectiveness of foul air extract system compromised, risk of odour release until repairs completed	High	Review sludge handling operations divert or minimise for duration of breach	Minimise area exposed to atmosphere and surround with portable odour sprays as appropriate
Breach of biogas system/ loss of biogas containment	Leaks from membrane	Uncontrolled release of biogas, risk of odour release until repairs completed Double membrane system with gas pressure between the membranes regulated and monitored. Methane detectors operated with alarms to alert operators of any leakage.	High	Minimise activities for duration of containment loss	Minimise sludge processing, divert to controlled release point via the combined vacuum and pressure release valve Surround with portable odour sprays as appropriate Diversion of biogas to CHP plant or Gas Burner Inspection maintenance and repairs as appropriate Record details and actions taken in site diary Report to the Environment Agency Emergency response from gas maintenance contractor
Failure of odour control plant	Untreated air	High risk of release of abnormal operational	High	Routine maintenance. Regular monitoring of equipment performance.	Assess need to use portable odour reduction sprays Investigate and repair

		odours direct to atmosphere until repaired		Duty standby functionality. Standby capacity in the media beds. Emergency call to odour system maintenance contractor. Control processes to minimise risk of high peaks of H2S reaching odour control unit. Design provides for degree of redundancy.	
Spillage of sludge on site	Liquid sludge	High risk of odour until cleaned up. Low volume spillage likely to go directly to drain which returns to the WTW for treatment.	High	Regular site inspections and monitoring the system through SCADA to detect any spills. Priority to clean up as and when detected. Pipe work and tanks undergo regular inspections. Planned maintenance on equipment	Stop source of spill and immediately wash down area Repair or bypass if possible. If incident prolonged use portable odour sprays until cleared. Record spillage and actions taken in site diary
Sludge thickeners	Sewage sludge	Thickeners are enclosed and air extracted to OCU (when in operation)	Medium	Sludge dosed with polymer as required	
High pressure conditions in digesters	Release from Pressure Relief Valve	Biogas would be vented at high pressure to aid dispersion	Medium	Gas pressure is regulated and monitored	Diversion of biogas to Gas Burner Record details and actions taken in site diary
High pressure conditions in biogas holder	Release from Pressure Relief Valve	Biogas would be vented at high pressure to aid dispersion	Medium	Gas pressure is regulated and monitored.	Diversion of biogas to Gas Burner Record details and actions taken in site diary
Sludge reception unit roller shutter door failure	Release from behind the shutter door in sludge reception	Effectiveness of odour control measures compromised, risk of odour release until repairs completed	Medium	Minimise sludge reception activities until repairs have been completed	Record details and actions taken in site diary

Failure of treatment process	Release from untreated sludge	Risk of odour from incomplete biological treatment until plant recovery achieved	Medium	Process monitoring and having closed covers. Immediate involvement of process support team to identify cause of process failure and aid recovery	Assess need to use portable odour sprays spread around process unit
Prolonged hot and dry period	High strength / septic sludge	Potential for septicity to develop throughout the works. Issues with temperature sensitive components	High	Increased monitoring. Planned maintenance on equipment	Record details and actions taken in site diary
Very high rainfall	Flooding causing failure of odour control equipment	Flooding on site causing failure of equipment	Low	Increased monitoring. Installing new equipment above water levels, if known to be an issue on site Planned maintenance on equipment	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)

5. Monitoring

5.1. Routine site observation monitoring

As part of the general operation of the Site, control room operators monitor the SCADA outputs on a routine basis in order to ensure that individual process units on and off the Site are performing within specification. In the event of an out-of-specification plant item is operating beyond normal operating ranges, the process parameters are outside optimum, or an any other alarm being initiated, appropriate remedial actions would be instigated. Operatives will follow the Awareness Raising Instruction in Appendix A, and further measures are dealt with in subsequent sub-sections.

Any odour detected on-site during normal operation will be rectified using measures described in Table 7 to implement actions and prevention protocol. Routine sniff tests at the potential odour sources listed in Table 1 are in place to proactively mitigate odour reaching and exceeding the site boundary. If detected, investigation into odour source is undertaken and contingency measures listed in Table 7 are implemented.

Site personnel periodically assess the performance of odour containment and extraction systems utilising specialist equipment (such as but not limited to Optical Gas Imaging) to compare actual vs. designed air changes per hour, or to identify leakage points on systems. Any issues identified will be addressed and then a re-assessment performed to confirm issue resolution.

5.1.1. General duties

Operators shall carry out routine duties according to the relevant operational and maintenance schedules and procedures to ensure effective operation of plants. Specific tasks include:

- Perform daily, weekly and monthly maintenance tasks as scheduled;
- Make regular observation of critical processes and equipment including odour sensitive and odour control systems;
- Carry out routine performance tests and recording;
- Order and take deliveries of chemicals and other consumables; and
- Report performance issues or equipment problems promptly to Process Scientists, Mechanical & Electrical (M&E) technicians, Instrumentation, Control & Automation (ICA) technicians or Specialist Contractors as appropriate.

5.1.2. Duties for odour control

Operators shall carry out the following tasks:

- Undertake and record any inspections in the site diary, along with any actions undertaken.
- Investigate odour complaints following the Complaints Procedure as shown in Appendix F.
- Record actions taken in respect of odour investigations.
- Conduct weekly sniff tests.
- Record and report incidents that caused significant odorous emission, and follow the Awareness Raising Instruction in Appendix A.
- Produce other records as required by the OMP.
- Undertake the Site odour monitoring and controls listed in Table 7.

Drivers delivering odours loads shall carry put the following tasks:

- Ensure loads are sealed and covered when arriving the Site and approaching the sludge reception.
- Covers to only be removed within the sludge reception building with the doors closed.

- Follow the spillage management procedures set out in Section 5.1.6 if odour materials are spilled.
- Any wastes that are not authorised to be accepted must not enter the Site (as referred to in the Duty of Care).

Table 7: Site odour monitoring and detection processes

Potential Odour Source	Routine Actions Required	Risk pre-control measures	Monitoring Frequency	Attention Level	Action level	Preventative Action	Risk post-control measures
Raw sludge reception	Avoid excessive turbulence (open tanks) Ensure doors are closed before discharging or unloading Connect foul air exhaust to hose before loading Ensure vehicles cleaned after loading/unloading. Hose down any spillage after each load/unload Clean contaminated wheels before leaving site. Doors closed after unloading/discharging	Medium	Every site visit	Investigate unusual and/or excessive odours	Follow the Awareness Raising Instruction, Appendix A.	Stringent loading and unloading procedures. Extracted air from the tanker loading area is treated by odour control unit. If necessary, implement special odour mitigation measures to reduce the risk of odour nuisance. Make contractor aware of requirements in OMP.	Low
Transportation	Ensure only sealed or covered skips/trailers used. No removal of covers whilst parked waiting to load/unload Monitor odours during cake loading	Medium	Daily	Investigate unusual odours	Follow the Awareness Raising Instruction, Appendix A.	If necessary, implement special odour mitigation measures to reduce the risk of odour nuisance. Make contractor aware of requirements in OMP	Low
Sludge holding tanks	Minimising retention time Monitor odour levels around tank		Every site visit	Increased odour from tank	Noticeable odour from tank Follow the Awareness Raising	Increase sludge treatment rate to reduce retention Hose spillage's Increase de-sludge ops up stream	

Potential Odour Source	Routine Actions Required	Risk pre-control measures	Monitoring Frequency	Attention Level	Action level	Preventative Action	Risk post-control measures
					Instruction, Appendix A.	Run odour masking system (Short term)	
Sludge thickening/ blending	Minimise retention prior to thickening, dewatering or digestion. Discharge sludges and liquors, including imported sludges, to covered tanks, with displaced air passed through stack via extraction fans, and/or the Odour Control Units. Prevention of sludge accumulation in off-line tanks; and Proactive identification of potential problems and tankering of sludges to other sites with odour abatement.	Medium	Daily	Increased odours from area	Noticeable odour from area and/or complaint received. Follow the Awareness Raising Instruction, Appendix A.	Process is undertaken in an enclosed building with appropriate odour abatement	Low
Secondary digesters	Check for strong and uncharacteristic odours	Low	Daily	Investigate unusual odours	Investigate and report strong/unusual odours to FPM and Scientist. Follow the Awareness Raising Instruction, Appendix A.	Planned preventative maintenance undertaken on equipment. If necessary, implement special odour mitigation measures to reduce the risk of odour nuisance.	Low
Centrifuges	Check for strong and uncharacteristic odours	Low	Every site visit	Investigate unusual odours	Investigate and report strong/unusual odours to FPM and Scientist	Regular checks and investigative action	Low

Potential Odour Source	Routine Actions Required	Risk pre-control measures	Monitoring Frequency	Attention Level	Action level	Preventative Action	Risk post-control measures
					Follow the Awareness Raising Instruction, Appendix A.		
	Check polymer dosing	Low	Weekly	Polymer dosing rates exceeds set limits	Polymer dosing exceeds upper or lower threshold limits Follow the Awareness Raising Instruction, Appendix A.	Take remedial action to return polymer dosing to correct rate	Low
Gas flare stacks	Complete biogas combustion should give clean emissions with blue or non-visible flame	Low	Weekly	Occasional orange flame or black smoke visible	Constant orange flame or black smoke visible Follow the Awareness Raising Instruction, Appendix A.	Routine M&E checks or maintenance to clean nozzles of carbon build-up	Low
Skip conveyer feed gates	Visual check to ensure skips not over filling	Low	Every visit		Follow the Awareness Raising Instruction, Appendix A.	Engage M&E to rectify if malfunctioning	Low
Whessoe valves on digesters	Check they are clear from foam residue	Low	Daily	Investigate unusual odours and gas detection	Not seating correctly Follow the Awareness Raising Instruction, Appendix A.	Engage service contractor to resolve any problems	Very low

Potential Odour Source	Routine Actions Required	Risk pre-control measures	Monitoring Frequency	Attention Level	Action level	Preventative Action	Risk post-control measures
OCU	Check pH Check media condition	Medium	Daily	pH>3 Sudden drop in performance	pH >3 Sudden drop in performance Follow the Awareness Raising Instruction, Appendix A.	Ensure media is damp. Change media as per schedule. These are process monitored and planned preventative maintenance is regularly undertaken on equipment.	Low
Whole site	Doors to operational buildings will remain closed and hatches will be latch closed.	Medium	Daily	Increased odours	Noticeable odour from area and/or complaint received. Follow the Awareness Raising Instruction, Appendix A.	Doors and hatches will only be opened for minimum periods while access is required for planned operational and maintenance activities.	Low

5.1.3. Visual and olfactory inspections

There will be a daily walkover survey incorporating a “sniff test”. Sniff testing will be undertaken at the security fence boundary, starting at an upwind location. Where possible, the sniff testing will be carried out by a person who is not accustomed to the odour generated by on site activities i.e. a person who has recently entered the Site boundary such as an FPM.

During each walkover, the person undertaking the “sniff test” must stand nearby to each potential source of odour identified in Table 1 and at least one location for the north, south, east and west of the site boundary (as close to the perimeter as practicable) and note on a map the location of the perimeter checks. Checks in each location should be undertaken for at least 20 seconds and the monitoring form completed, see Appendix G.

During this walkover, over a period of approximately 30 minutes, perceptive “sniff testing” of the ambient atmosphere is conducted and observations are recorded on a daily check sheet. If odour is likely to exceed the site boundary and, therefore, has potential to cause a complaint, the procedure in Appendix A will be followed.

The results of the sniff test will be recorded in the site diary or an appropriate form. Sniff testing is designed to detect any abnormal plant odour emissions. In addition, it is important to document any potential contribution from other off-site sources of potential odour nuisance located outside of the facility boundary.

In the event that abnormal plant odour is detected, the source of the odour will be investigated, as appropriate, and remedial action taken, as necessary, following measures addressed in the OMP. The approximate extent of the downwind odour will be established to determine whether this reaches the downwind post and rail fence boundary. During maintenance and/or emergency conditions which are likely to result in release of odours, the frequency of “sniff testing” will be increased to twice daily, or more frequently as appropriate.

Actions for remediation will be assigned by the FPM following the issue of an odour record. Once actions are completed, additional sniff tests at least once a day for minimum three days at the source of the odour will be carried out to determine whether further actions are required. Whereby odour is no longer detected the record will be closed. If odour remains the OMP and maintenance records will be reviewed to determine alternative actions to be taken, this process will continue until the odour issue is no longer on-going.

5.1.4. House keeping

Good housekeeping improves efficiency, creates a pleasant environment to work within and makes the Site less likely to cause odour nuisance. Operators have a responsibility to keep sites clean and tidy. The “Top 10 Tips to Minimise Odour Impact” will be communicated to the Site.

- Ensure that your odour control plants are fully operational and maintained
- Keep all doors and hatches latch closed at all times to contain odour
- Clean up debris / spillages as soon as practicable
- Monitor sludge levels within Primary Treatment to avoid septicity
- Hose down and clean process tanks / channels after draining
- Monitor digesters / Whessoe valves and gas flares
- Report any odour activity caused by Contractors to your Senior Manager
- Where possible, don’t undertake odour sensitive work if it cannot be completed before or continued during the weekend
- Follow business procedures and respond to all odour complaints

- If you See it, Smell it, do something about it (Don't Ignore It)

Additional reminder signs will be displayed in prominent positions at the Site where open doors, covers and skips present an odour risk and include:

- Keep all doors shut
- Keep all covers / lids latch closed
- Clean up spills immediately using disinfectant if required
- Monitor odour control systems
- All rubbish / waste to be disposed of immediately to relevant skip

5.1.5. Meteorological observations

Southern Water will record daily in the site diary the following meteorological data:

- Air temperature
- Relative Humidity
- Wind Direction
- Wind Speed
- Rainfall

Meteorological data will be reviewed in advance of activities that may present an odour concern, such as movement of sludge cake, to consider suitable measure to limit odour. For example, time such activities when wind speed is low.

Meteorological data will also be available to complete odour records to establish potential trends.

5.1.6. Spillage management

All staff on-site have a responsibility to maintain good housekeeping and clear spillages at the earliest opportunity to prevent odour. If a spillage occurs from a process, operators will carry out clean up as soon as possible (using disinfectant, where necessary). If a spillage is caused by a lorry or tanker, the driver is responsible to clean up before leaving the Site. If a lorry or tanker left a spillage behind, operators will log and report any incident observed. The driver or company involved will be asked to return to the Site immediately to clean up. Significant spillage incidents will be recorded in the site diary.

Key areas at risk from spillage (and the control measures):

Sludge reception area

- Tanker drivers are responsible for cleaning up spillages after every load. Hose is supplied.

Cake bay area

- Drivers are responsible for cleaning up spillages after every load.

Inlet works

- Spillages around the inlet area must be cleaned up immediately.

Digester

- Anti-foam used to suppress foaming of sludge within the digester or dewatering process.

Entire site

- Routine site inspections by FPM and site manager – a minimum of once per month.

5.1.7. Accident management

The site-specific Accident Management Plan (AMP) includes a description of nominated key personnel and their responsibilities, emergency response procedures, contact details of internal contacts (Works Manager, Team Leader, Process Technician, Regional Control staff and key H&S staff), national and regional (where appropriate) contact details of emergency services and environmental regulators.

Other key procedures relating to environmental accident and incident management are set out in Southern Water's ISO14001 accredited Environmental Management System (EMS).

The relevant procedures in the EMS relating to environmental accident and incident management includes:

- EMS234 – Chemical and oil storage
- EMS240 – Nuisance management
- EMS260 – Pollution prevention
- EMS275 – Emissions to air
- EMS308 – Site housekeeping checklist
- EMS340 – Nuisance management procedure
- EMS341 – Air quality/odour management procedure
- EMS360 – Pollution prevention procedure
- EMS363 – Procedure for managing oil spills on sites
- EMS364 – Lime spill management
- EMS381 – Operational waste procedure
- EMS387 – Procedure for the acceptance of tankered commercial waste
- EMS388 – Waste permit breaches and near miss reporting procedure

5.2. Monitoring of the odour abatement system

Table 8 identifies the parameters and monitoring requirements in relation to the odour control system that needs to be undertaken at the Site.

Table 8: Parameters and monitoring requirements in relation to the odour control system to be undertaken at the Site

Emission point type	Parameter	Monitoring frequency	Monitoring standard or method
Channelled emissions to air (extraction fans and scrubbing system)	Hydrogen chloride	Once every 6 months	Southern Water are to initially undertake characterisation of emissions from the odour control units, in line with BAT 3, to demonstrate if TVOC and HCI are present in the waste gas stream. If TVOC and HCI are identified as relevant in the waste gas streams Southern Water will monitor these emissions in line with BAT requirements and the Environmental Permit.
	TVOC	Once every 6 months	
	Ammonia	Once every 6 months	As per design and manufacturer's specifications
	H_2S	Once every 6 months	Maintenance undertaken by service provider, or otherwise as specified in the Environmental Permit
	Efficiency checks	Annual	Maintenance undertaken by service provider, or otherwise as specified in the Environmental Permit
	Gas stream flow	Continuous	As per design and manufacturer's specifications and SCADA, or otherwise as specified in the Environmental Permit
	Overall operation, including air circulation	Daily	Visual assessment or otherwise as specified in the Environmental Permit

Service visits are to be undertaken for OCU's by a contractor (currently ERG), when in operation. A service visit report is issued after each visit which identifies priority actions required, other faults and comments as well as condition monitoring and observations.

6. Training

6.1. Staff training

Southern Water provides a comprehensive programme of Health and Safety and operational awareness training which is carried out for new starters and as an ongoing programme of refresher courses.

All new starters receive a comprehensive programme of health and safety training and on-going refresher courses. All staff receive training to cover operations at the Site. On the job training is provided to all staff through a rolling training programme.

Southern Water has developed its own Competency Management System (CMS), which identifies the training required for different roles on site.

Training on the following technical subjects relevant to odour control will be provided to operational staff according to needs and site requirements:

- Wastewater treatment processes.
- Sludge treatment processes.
- Checks for odour control equipment.
- Risk assessment of odour sensitive maintenance activities.
- Deployment of temporary odour control measures, for sites where these are present.
- Site requirements in relation to the Odour Management Plan.

The training needs of each individual are assessed during personal performance appraisal and reviews.

Formalised training for all grades of staff on the Site is undertaken relevant to job role. All staff are made fully aware of the need to be constantly vigilant with regard to site odour control and management procedures.

Records for training received by all staff are held electronically. Records of environmental training are kept in the Southern Water EMS.

Relevant components of the OMP should form part of the induction process for all site staff and contractors, to ensure they are aware of the procedures and responsibilities in relation to odour.

7. Communication

The objective of communication in odour management is to raise the profile and awareness of the importance of odour control and to keep stakeholders informed of odour incidents, and management practices. Appendix A provides an example of an awareness raising instruction.

7.1. Internal communication

Odour control will be regularly included by FPMs as an agenda item for team meetings.

Statistics of odour complaints and progress of actions to address odour issues will be updated monthly and communicated to Wastewater and Network Area Managers and other key personnel with odour management responsibilities.

7.2. External communication

Southern Water is committed to working closely with stakeholders to achieve sustainable reduction of odour nuisance. Southern Water is committed to making available relevant records and information to regulatory and local stakeholders, where appropriate, and communicating and engaging, in advance, with stakeholders where appropriate, any relevant activities that may generate odours.

7.3. Reporting

Southern Water will send all reports and notifications required by the Environmental Permit, or upon request by the Environment Agency, within the given timescales.

7.4. Complaints management and resolution procedure

All customer complaints about odour are entered on the Southern Water Customer Services Management System (CSMS), the details of which are detailed in Appendix F.

8. Reviews and Auditing

8.1. Reviews

8.1.1. Periodic reviews

A review of this OMP will be carried out by the FPM annually, unless agreed otherwise, and in accordance with the Environment Agency's H4 guidance (or current existing guidance should this change).

8.1.2. Ad-hoc reviews

This OMP will be reviewed when any significant changes in operational practice are made and on completion of any significant capital scheme which could impact the OMP.

8.2. Auditing

The regulatory authorities, where required, will be provided with reasonable access, in order to audit the implementation of the OMP upon request.

8.3. Records

The following records will be maintained:

- Record of complaints are stored on CSMS.
- Reports of investigations are held electronically.
- Odour issues which require a capital scheme to be raised to resolve them.

A. Awareness Raising Instruction

Activities that may result in an odour nuisance

All Process Operations staff must ensure that if a failure of plant, equipment or a system occurs, which may lead to complaints from customers, that the RCC/Customer Services are informed in a timely manner.

Listed below (but not limited to) are some examples of the type of incident that are to be reported.

- Odour control plant failure;
- Spillage of wastewater/sewage;
- Spillage of sludge or sludge cake;
- Failure of chemical dosing systems;
- Odour monitoring equipment failure;
- STC flare stack ignition failure.

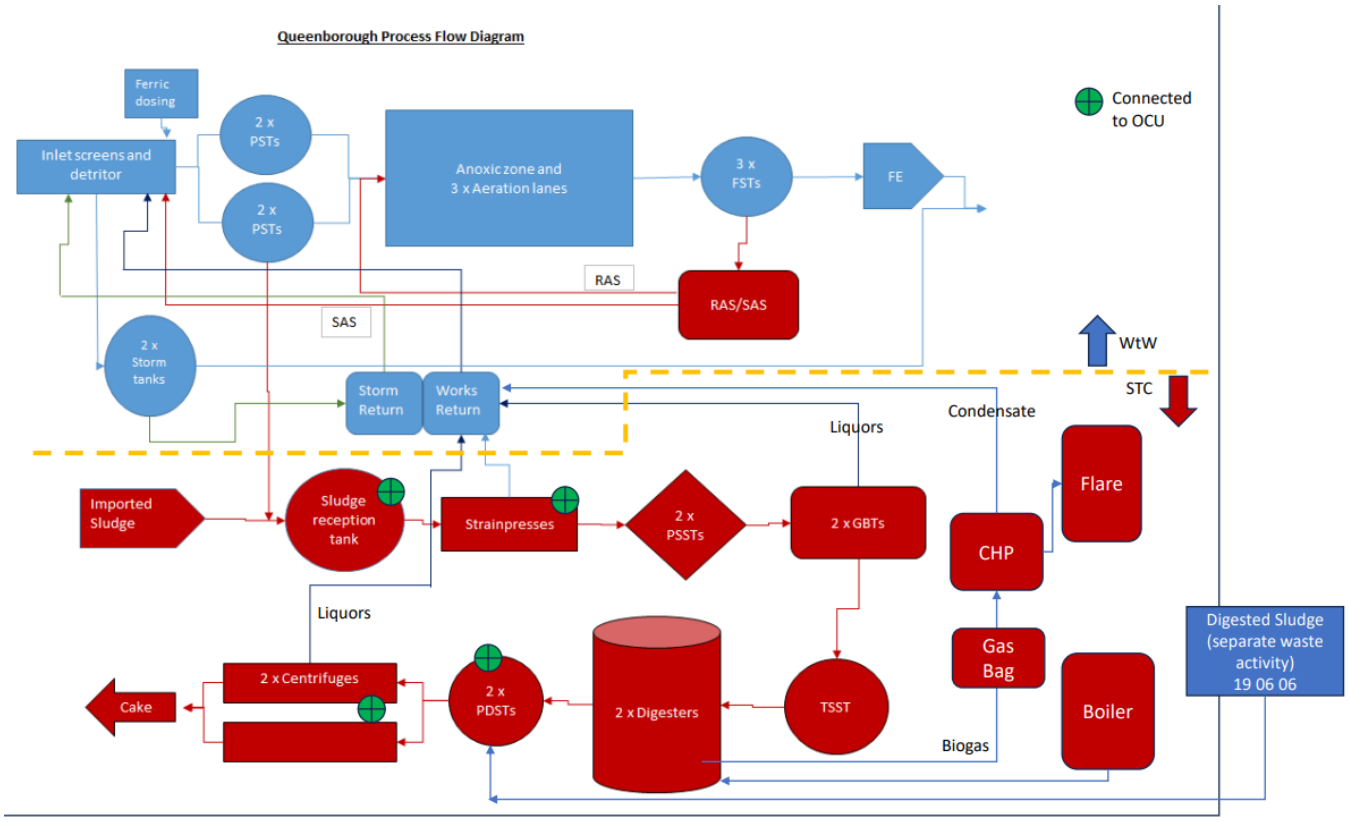
If the RCC or Customer Services are made aware of the problem, it means that they give a more constructive response to the person making the enquiry/complaint.

- In normal working hours contact Customer Services on 01903 272685;
- Outside normal working hours contact the RCC and request information is added to the 24-hour report.

Every effort must be made to carry out the above request, a short phone call to share information with colleagues dealing directly with the Customer will greatly help them deliver a more valid and informed response.

Be proactive, not reactive!

B. Odour Control Process Flow



C. Waste Codes

C.1 Wastes featuring in the permit

Wastes imported for Anaerobic Digestion

EWC Code	Description	Where accepted	Indigenous or imported	Justification for use
19 02	**wastes from physico/chemical treatments of waste (including dechromatation, decyanidation, neutralisation)**			
19 02 06	sludges from physico/chemical treatment other than those mentioned in 19 02 05 (sewage sludge only)	Pre-digestion AD	Raw – imported	
19 08	**wastes from waste water treatment plants not otherwise specified**			
19 08 05	sludges from treating urban wastewater	AD	Indigenous/Imported	

Wastes to import under a waste activity permit

EWC Code	Description	Where accepted	Indigenous or imported	Justification for use
19 02	**wastes from physico/chemical treatments of waste (including dechromatation, decyanidation, neutralisation)**			
19 02 06	sludges from physico/chemical treatment other than those mentioned in 19 02 05 (sewage sludge only)	Post-digestion for blending/dewatering or Cake Bay	Digested cake – imported	
19 06	**wastes from anaerobic treatment of waste**			
19 06 06	digestate from anaerobic treatment of animal and vegetable waste - digested cake	Post digestion	Imported	Used for intersite transfers of post digested liquid sludge as per EMS480. Common example of this is if centrifuges are offline which necessitates exports of digested liquid. Definition is with reference to RPS231. https://www.gov.uk/government/publications/waste-codes-for-sewage-sludge-and-sludge-containing-other-materials-rps-231/waste-codes-for-sewage-sludge-and-sludge

C.2 Other wastes

Wastes received under the Controlled Waste Regulations 2012*

*Southern Water acknowledge these waste codes will not be included in a permit

EWC Code	Description	Where accepted	Indigenous or imported	Justification for use
20 03	**Other municipal wastes**			
20 03 04	septic tank sludge	Head of works	Imported	
20 03 06	waste from sewage cleaning	Head of works	Imported	

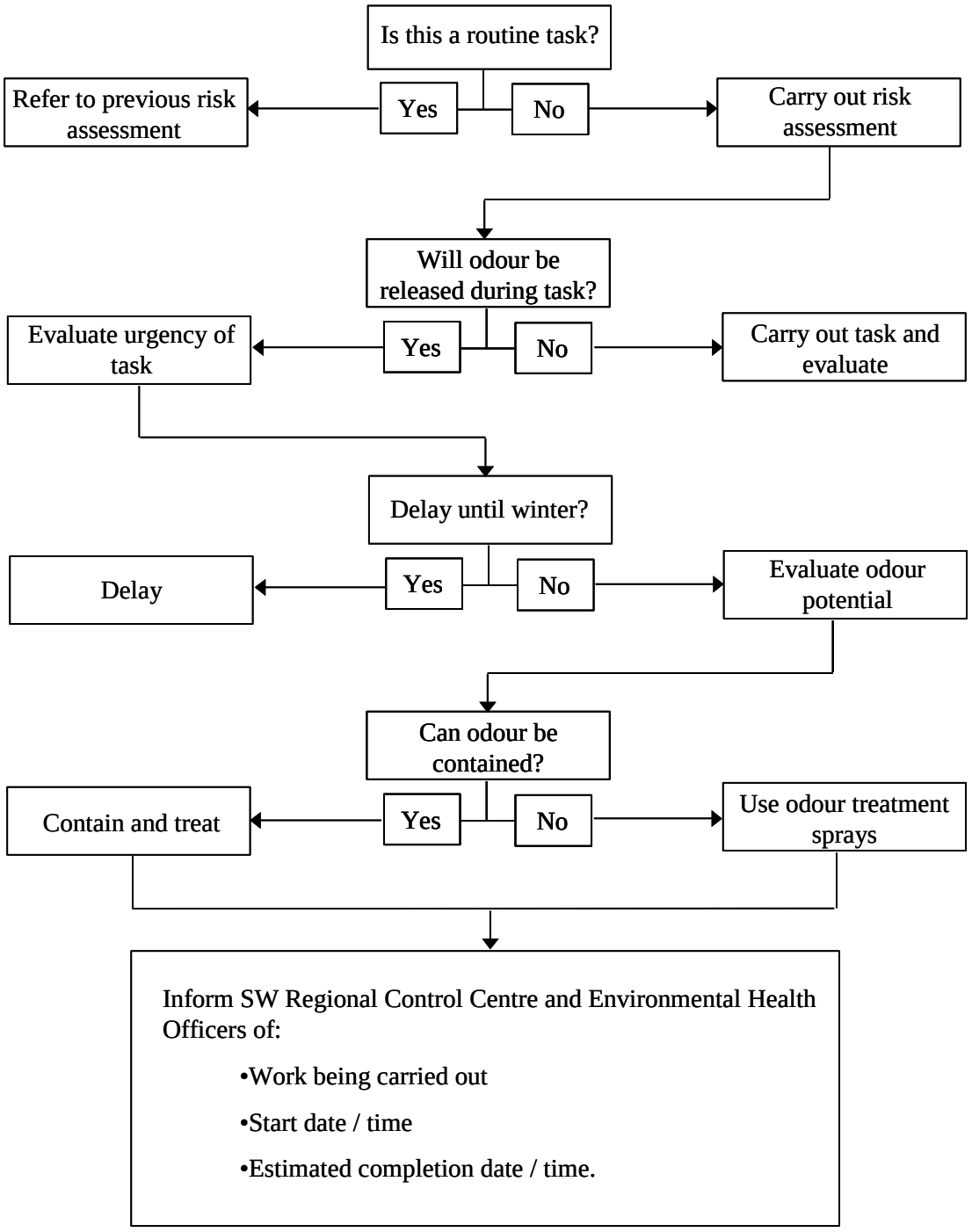
D. Odour Checklist

This is a generic checklist applicable to all sites and aspects that are not applicable to a particular site should be ignored.

Area of works	Potential issue		Follow up action
Odour management plan (OMP)	Is the Site 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	Put back 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	Check incoming sewage for septicity (in communication with Operations Support Team)
			Check for potential septic discharges
Screening	Are there any spilled screenings?	YES / NO	Clean up spills
	Are the compacted screenings clean	YES / NO	Optimise operation of screenings hand ling equipment
Grit removal	Is there any spilled grit?	YES / NO	Clean up spills
	Is the grit clean	YES / NO	Optimise operation of grit handling equipment
Screening and Grit Skips	Do the screening skips smell?	YES / NO	Check that screenings are clean and free from organic material;
	Do the grit skips smell?	YES / NO	Check that grit is clean and free from organic material; optimise grit cleaning system if needed
	Are the screenings skips too full?	YES / NO	Empty skip(s)
	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	Check inlet for septicity
	Are the tanks gassing?	YES / NO	Check levels of sludge in the tank and increase de-sludge rate if needed.

Area of works	Potential issue		Follow up action
	Is there excess scum on the surface	YES / NO	Remove excess scum
Biological filtration	Are the aeration vents blocked?	YES / NO	Unblock aeration vents
	Is there any 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 requ ired
	Do the MLSS fall within the timelines for the Site?	YES / NO	Increase / decrease RAS rate as needed
Final settlement tanks	Are the tanks black and/or smelly	YES / NO	Check inlet of tanks for septicity
	Are the tanks gassing?	YES / NO	Check levels of sludge in the tank and increase de-sludge rate if needed
	Is there excess scum on the surface	YES / NO	Remove excess scum
Tertiary treatment	Any there any site-specific issues?	YES / NO	Investigate and rectify
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	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 in place?	YES / NO	Put back 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	Contact contractor to investigate
	Is flare stack ignition immediate and reliable?	YES / NO	
	Are the Whessoe valves / pressure relief valves operating prematurely?	YES / NO	
	Are the seals on the condensate trap s intact?	YES / NO	
Odour abatement	Is there 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	Are there any outstanding actions fro m a previous investigation?	YES / NO	Complete actions

E. Risk Assessment Flowchart



F. Complaints Management

F.1 Management of odour complaints

F.1.1 System overview

Southern Water operates an integrated process to receive and record odour complaints by members of the public. It is designed to ensure complaints are dealt with promptly and consistently and a comprehensive record is kept. The following system ensures these objectives are achieved:

- A unique and recognised point of contact for members of public and Southern Water staff to report odour incidents and issues
- A straightforward process for operational staff to investigate and mitigate odour issues after a complaint is received.
- A recognised point to provide feedback to customers
- A mechanism to review recent odour complaints and actions
- A database to capture trends and potentially serious problems to guide future improvement

The following sections describe how odour complaints are received and handled. This procedure may be augmented by local arrangement to provide a tailored service to meet local council requirements.

F.1.2 Receipt of odour complaints

The Customer Services is the first point of contact for members of the public to report odour incidents during normal working hours.

The Regional Control Centre can deal with odour complaints out of hours.

When a member of the public phones in to report odour from a Southern Water site, relevant information will be taken from the caller, including name, phone number, address, time, duration, the characteristics of the odour experienced and whether the customer would like to receive a feedback by phone. Each call is assigned a unique CSMS number. The information is entered into the CSMS Database under a designated sort code.

Verification of the complaint is made through identification of the caller's property and the Southern Water site in question on electronic GIS maps. Following verification, a CSMS summary sheet is generated and transmitted immediately to the relevant FPM or the Regional Controller.

Where odour complaints are received directly by other Southern Water staff, the receiver of the call will contact Customer Services to log the call on behalf of the caller. The caller will be provided with the telephone number for Customer Service for future use.

All CSMS records of odour complaints are stored in the Corporate Information System to ensure transparency, visibility and consistency of the information.

F.1.3 Follow up actions

Initial action by Field Performance Manager

The FPM or Regional Controller upon receiving a CSMS summary of odour complaint will investigate the issue as soon as practicable. Based on the sensitivity of the Site, the investigation may range from remotely checking the Site alarms to the assignment of an operator to conduct a site investigation. Site investigation will be guided by and recorded on a site odour incident form if available or on a generic Odour Risk Checklist. Where possible, actions will be undertaken by the operator to improve control of odour emission.

Following the investigation, the FPM or the investigator will forward the findings to the Customer Liaison Officer during normal working hours at other times. If required in the site specific OMP, FPM will also produce reports to the regulator within an agreed time period.

Feedback to the customer from Customer Liaison Officer

Unless the customer had indicated that they would not wish to receive a feedback, a feedback will be provided at the earliest opportunity by the Customer Liaison Officer. The Customer Liaison Officer will then close the CSMS call.

Action by Process Scientist

If requested by a FPM, a process scientist will carry out a further investigation where a site has received reoccurring odour complaints. Process scientists will advise FPMs of available options to mitigate odour, e.g., re-adjusting sludge disposal activities or process parameters. Process scientists will provide technical support if such measures are adopted. Process scientists will produce a written report for each investigation and follow up any further actions.

Action by Southern Water Managers

Managers will carry out regular reviews of odour complaints to all Southern Water sites and inform relevant FPMs where a trend is developing. Southern Water Managers will deploy additional monitoring resources where necessary to support the resolution of significant odour issues.

G. Odour Monitoring Form

Date:	
Name:	**Visitor or staff:**

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

Receptor Sensitivity
Low (e.g. footpath, road)
Medium (e.g. Industrial or place of work)
High (e.g. housing)

Location	Time	Weather conditions (dry, rain, snow etc)	Temperature (very warm, mild) *Use degrees when known*	Wind strength (light, strong) *Use Beaufort scale if known*	Wind direction (e.g. SE)	Intensity *(See above)*	Duration	Constant or intermittent in this period or persistence	Receptor sensitivity *(See above)*	Is source evident?	Any other comments or observations