Hunter Water Corporation A.B.N. 46 228 513 446

Standard Technical Specification for:

ODOUR CONTROL UNITS
STS 680

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Tables

Standard Technical Specification – Odour Control Units – STS 680

1 Purpose

This document describes the requirements of Hunter Water for Odour Control Units (OCU) and associated works.

1.1 Scope

This document specifies the design, manufacture, installation and performance testing requirements for activated carbon type, biotrickling type, and biofilter type Odour Control Units in Hunter Water's sewerage network and at wastewater treatment plants. This STS is intended to be incorporated into Tenders/Contracts that Hunter Water administers, but may selectively be applied to other works at Hunter Water's discretion.

2 Interpretation

For the purposes of interpretation of this document, except where the context requires otherwise:

- 'Drawings' means the drawings detailing the work involved in a particular project in hand
- 'Include' means including but not limited to, and is used to provide clarification or examples of the type and nature of items intended
- 'Specification' means a specification detailing the work involved in a particular project
- 'Standards' means applicable industry standards include the Australian Standards (AS), Australian / New Zealand Standards (AS/NZS), American National Standards Institute (ANSI) and ISO Standards (ISO) referenced in Appendix A: Standards and related documents.
- 'Standard Drawings' means Hunter Water Corporation Limited drawings
- 'Standard Technical Specification' (STS) references any of Hunter Water's Standard Technical Specifications, as implied by the text.
- 'Mechanical' work includes work carried out by the core trades: Fitting, Machining, Fabricating, Welding (Fabrication Engineering), Plumbing and the Engineering (Mechanical) Trade

Headings are for the convenience of the reader and must not be used in the interpretation of this Standard Technical Specification.

Unless stated otherwise any expression such as "give notice", "submit", "approval", or "directed" means give notice to, submit to, approval by, or directed by the person nominated by Hunter Water.

Approval does not imply acceptance of responsibility by Hunter Water for compliance with this technical specification. Unless approval has been issued in writing, approval has not been granted.

Failure to comply with the requirements of this Standard Technical Specification or any referred documentation may result in rejection. Where equipment and / or manufacture is rejected, notice will be given by Hunter Water in writing. All associated rectification work must be completed by the contractor at their cost.

2.1 Order of Precedence

Specific requirements, including those in project specifications or standard Drawings take precedence over general mechanical requirements in this Standard Technical Specification.

The order of precedence for this STS are, from highest to lowest are:

- Legislative requirements
- Content in this STS
- Australian Standards
- WSAA standards

2.2 Exception to this Document

Any concession to any requirement in this Standard Technical Specification is valid only when authorised in writing by the Document Owner.

Project specific requirements, including those in project specifications or Drawings, take precedence over requirements in this document and do not need exception approval.

2.3 Referenced documents

In addition to this STS 680, all work must comply with relevant current Australian Standard (AS), Australian/New Zealand Standard (AS/NZS) and Hunter Water reference documents, including:

- Workplace Health and Safety Regulations
- National Codes of Practice (For example, Safe Work Australia Codes of Practice)
- SafeWork NSW Codes of Practice
- Hunter Water's Standard Technical Specifications
- ISO 9001 Quality Management Systems

A list of relevant Australian and International Standards is contained in Appendix A: Standards and related documents, Roles and Responsibilities

2.4 Document Management

The Document Owner of *this STS 680 – Odour Control Units* is Hunter Water's Manager Mechanical Engineering.

2.5 Responsibilities

The nominated Document Approver in Hunter Water's *Standard – Integrated Management System Document Management* must approve in writing the issue of any updated version of STS 680. Any concession to any requirement in *STS 680 – Odour Control Units* is valid only when authorised in writing by the Document Owner.

3 Definitions

Where the following term, abbreviation or expression occurs in this STS, it is defined as follows, unless the context implies otherwise:

Table 1 – Abbreviations and Term

Abbreviation	Term
ASTM	American Society for Testing and Materials
BTF	Biotrickling filter
dBA	Decibels
EBRT	Empty Bed Residence Time (seconds) of the gas
EPA	Environmental Protection Authority (NSW)
FRP	Fibre Reinforced Plastic
H_2S	Hydrogen Sulphide
HDPE	High Density Poly Ethylene
HMI	Human Machine Interface
IFC	Issued For Construction
LEL	Lower Explosive Limit
O&M	Operation and Maintenance
OCU	Odour Control Unit
ou	odour units (measurement) as defined in AS/NZS 4323.3
P&ID	Process and Instrumentation Diagram
ppm_v	Parts per million by volume
PVC	Poly Vinyl Chloride
REF	Review of Environmental Factors
RPZ	Reduce Pressure Zone
SCADA	Supervisory Control And Data Acquisition
STS	Standard Technical Specification
VOC	Volatile Organic Compounds
VSD	Variable Speed Drive
WAC	Work As Constructed
WWPS	Wastewater Pumping Station
WWTW	Wastewater Treatment Works

4 Design

4.1 General

Guidance on the development of OCU designs and project delivery is provided in Appendix E - Design development guidelines.

4.2 Design Inputs

Where an OCU has been confirmed, undertake investigations to determine the specific requirements for the OCU.

These investigations may include desktop study, field testing and modelling.

Design inputs must include the characterisation of foul air to be treated, including:

- Flow rates of foul air to be treated: Current and future, average and peak.
- Physical properties of air to be treated such as ambient pressure, temperature, and humidity.
- Odorous compounds to be treated
- Odour load as a function of concentration of odorous compounds x flow rate of foul air to be treated. Consider current and future concentration of odorous gas component(s) and fluctuation during different time/season as exhibited as an 'Average' and a 'Peak' concentration.

Consideration must be given to potential changes in odour loads (consider both changes to concentration of odorous compounds, and changes in air flow rates) over the operational life of the OCU. This may include temporary step changes or gradual changes. For example, a temporary step change in odorous gases may result because of operational problems with an upstream chemical dosing unit, or a gradual decline in odour loads may occur due to growth in the catchment population leading to reduction in retention times and sulphide build up. How potential step changes are to be accounted for in OCU design is to be discussed with Hunter Water on a site-specific basis.

4.3 Selection of OCU Type

The types of OCUs covered by this standard and in use at Hunter Water sites are:

- Activated carbon filter(s)
    - Mechanically assisted
    - Passive above ground
    - Passive below ground (none currently)
- Biotrickling filter
    - Standalone unit
    - With polishing activated carbon
- Biofilter (enclosed)
    - Standalone unit
    - With polishing activated carbon

- Biofilter (open topped)

Appendix D - OCU Selection provides some guidance on the selection of the type of OCU.

The selected type of OCU must be approved in writing by Hunter Water in each instance.

5 Drawings and documentation

5.1 OCU Supply Proposal Documentation

The following information must as a minimum be submitted with the proposal by a Tenderer for supply of an OCU.

- Completion of the technical specification sheet (see section 6.1.1).
- Details of any non-conformances relating to this technical specification.
- Suitable fit for purpose calculations
- Manufacturer's catalogue information including equipment type, model number/designation, operating characteristics and relevant technical product brochures.
- Basic description of proposed OCU system, including process flow description.
- Details of expected odour removal performance and statement of performance guarantees offered.
- The Tenderer's Scope of Supply, including limits of contract and any assumptions made by the Tenderer.
- List of main equipment items, motor list, and instrument list.
- Details of media offered, including media life guarantee and details of specific tests that illustrate this guarantee.
- Details of instruments proposed.
- Civil/Structural requirements (to be provided by others), e.g. preliminary footprint dimensions, dead weight, operating weight, and dynamic loading criteria.
- Drawings with the proposed layout complete with key dimensions, showing ductwork, access road and access platforms
- P&ID drawings.
- Media, chemical and utility consumption based on design average and maximum conditions.
- Reference lists and relevant case studies demonstrating Supplier's previous experience.
- List of any special tools and lifting devices.

5.1.1 Technical specification sheets

The defined performance requirements for the OCU may be documented in the appropriate "technical specification sheet" excel template. These are available from Hunter Water as an Excel file.

On occasions when the template has been filled in during design phase and provided to the Contractor, the Contractor must complete the appropriate sections of the spreadsheet which detail the specification of the OCU option offered and submit to Hunter Water.

Templates are available for:

- Instrumentation
- Extraction fan

- Vent stack
- Open topped biofilter
- Biofilter
- Biotrickling filter
- Activated carbon

Example Usage: If a BTF + Activated carbon polishing unit were to be installed the following 5 technical sheets would need to be complete to cover all system components: Instrumentation, Extraction fan, Vent stack, Biotrickling filter, and Activated carbon.

5.2 Work as Constructed Information

Work as constructed information must be provided in accordance with the requirements of STS 903.

6 OCU Requirements

6.1 General

General requirements for OCU design are listed below.

OCUs must

- be safe to construct, operate, maintain and decommission in accordance with the relevant legislation requirements. Legislation relevant to odour control systems at Hunter Water includes:
    - Work Health and Safety Act 2011 (WHS Act)
    - Work Health and Safety Regulation 2011 (WHS Regulation)
    - Protection of the Environment Operations Act 1997 (POEO Act)
    - Protection of the Environment Operations (General) Regulation 2009
    - Protection of the Environment Operations (Clean Air) Regulation 2010
- comply with all relevant statutory and regulatory requirements, Standards and Codes of Practice.
- have a design life for OCU system equal to required OCU service life as agreed by Hunter Water, up to 20 years. If a service life is not defined, then the design life must be at least 20 years, excluding consumables such as filter media. Refer to STS 500 and STS 600 for required design life of specific components that form part of the OCU system.
- provide reliable and effective odour removal to a level specified in the minimum requirements outlined in Section 7.3 of this Specification
- not be a noise nuisance for sensitive receptors and not exceed WHS noise requirements as outlined in Section 7.3 of this Specification
- not cause interruption to the normal operation of the Hunter Water sewer system.

6.2 Compliance with other Hunter Water STSs

All works must comply with other relevant Hunter Water STSs as listed in Appendix A: Standards and related documents, in particular STS 600 and STS 500.

6.3 Odour Control Performance Requirements

OCU treatment performance requirements are as per the details referenced from Table 2.

Table 2 - Summary of table references for OCU Treatment Performance Requirements

Treatment Requirement	Performance Requirements	Pass Criteria	Sampling Requirements
Odour removal performance	Table 3	Table 3	See Section 14.4.6
Contaminant removal performance	Table 4	Table 5	See Section 14.4.6
Foul air capture rate	Table 6	Table 7	See Section 14.4.6

Table 3 - Odour removal, performance requirements and pass criteria

Type of OCU	Maximum Odour Concentration at outlet (stack if stack is installed)	Pass Performance Requirement
OCU with activated carbon polishing	<= 500 ou	100% of samples
OCU with only biological treatment (i.e. biofilter, biotrickling filter)	<= 1000 ou (Note 1)	100% of samples
Alternative criteria: All types of OCUs	At a level that is demonstrated by dispersion modelling using a Puff type model to achieve no odour nuisance at the nearest residence or public space, as defined by the relevant EPA document. See Note 2	N/A
Table Notes		
Note 1: *1,000 ou is typical for the discharge from biological treatment that is treating foul air from wastewater that is from >90% domestic source. Mixed discharges from industrial or trade waste (for example hospitals, wharfs or other sources with a high VOC component) can only practically achieve 2,500 ou on a high percentile basis. If the source of foul air is from a location with a high portion of industrial waste, an activated carbon polishing system is required.*		
Note 2: *Current relevant document is" Technical framework: Assessment and management of odour from stationary sources in NSW" and associated texts.*		

Table 4 - Contaminant removal, performance requirements

Contaminant	**Design minimum % removal** (Note 1 & Note 2)	**Maximum outlet concentration** (Note 2)
OCU Type: Activated carbon removal		
Hydrogen sulphide (H_2S)	>99.5%	0.05 ppm_v
Dimethyl sulphide (DMS)	>90%	*Note 3*
Mercaptans (R-SH)	>90%	0.02 ppm_v
VOC (as isobutylene)	>90%	*Note 3*
Ammonia	>90% (WWTWs)	*Note 3*
OCU Type: Biotrickling Filter Removal		
Hydrogen sulphide (H_2S)	>99.5% (Note 4)	0.05 ppm_v
Dimethyl sulphide (DMS)	>60%	*Note 3*
Mercaptans (R-SH)	>90%	0.02 ppm_v
VOC (as isobutylene)	>60%	*Note 3*
Ammonia	>60%	*Note 3*
OCU Type: Biofilter Removal (enclosed and open-topped)		
Hydrogen sulphide (H_2S)	>99.5% (Note 4)	0.05 ppm_v
Dimethyl sulphide (DMS)	>60%	*Note 3*
Mercaptans (R-SH)	>60%	0.02 ppm_v
VOC (as isobutylene)	>60%	*Note 3*
Ammonia	>60%	*Note 3*

Table Notes

General Note: *Where an odorous substance is not listed in this table, there must be sufficient removal of the substance to achieve the stack discharge maximum odour concentration (at peak load) as specified in*

Table 3

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Note 1: *The following formula defines the removal efficiency for odorous components:*

% removal = (inlet – outlet concentration) / inlet concentration x 100

Removal efficiency must be calculated for each individual set of component concentrations.

Note 2: *Where maximum outlet concentration is below the requirements listed, the removal rate criteria is not applicable*

Note 3: *There must be sufficient removal of the odorous substance to achieve the stack discharge maximum odour concentration (at peak load) as specified in*

Table 3

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Note 4: *If the biological OCU is coupled with downstream carbon polishing, the minimum H_2S removal rate can be reduced from 99% down to 95%.*

Table 5 - Contaminant removal, pass criteria

Sampling Method	Performance criteria	Criteria Assessment
Discrete	Design minimum % removal	The pass rate is the more lenient of achieving either; 1 sample that fails, OR < 6% samples fail (rounding-up)
	Maximum outlet concentration	*same as above*
Continuous	Design minimum % removal	>99.9% of results passing calculated on a 5-minute moving average of raw data (of assumed 1-minute data resolution)
	Maximum outlet concentration	*same as above*

Table 6 - Foul air extraction, performance requirements

Foul Air Extraction	Criteria
Overarching design criteria for any covered process unit that has mechanical foul air extraction:	Pressure differential with a magnitude **greater than 15Pa** between the ambient area (positive side) and the ventilated area (negative side).

Table 7 - Foul air, extraction pass criteria

Performance Monitoring Duration	Performance criteria	Criteria Assessment
14 days of continuous pressure monitoring with instrument capable of recording pressure to 0.1Pa resolution, monitoring at least every 60 seconds.	Continuous negative pressure.	Pass rate is >99% compliance

Table 8 - Foul extraction, guidance on calculating airflow for achieving required performance

Table Notes	
Note 1: *This table provides guidance for estimating extraction rates to achieve requirements in* Table 7*. The guidance assumes extraction from a headspace with tight fitting covers. If covers are not tight fitting (generally no greater than 1mm gap anywhere) then ventilation will need to be increased or covers will need to be refurbished to make them tight fitting.* ***Note 2:*** *Alternative methods of calculating minimum required foul air extraction rates may be considered by Hunter Water so long as they account for level changes and consider air velocity through gaps in covers.* ***Examples:*** *Example extraction rate calculations are given in Appendix B - Example Ventilation* Calculations*].*	
OCU Location	**Extraction Rate Guidance**
OCU at **rising main discharges** with no fan, i.e. passive extraction only	70% of the pump flowrate from the upstream rising main during dry weather, being: a) Fixed speed pumps at upstream WWPS: the pump flowrate, or b) Pumps on VSDs at upstream WWPS: 99th percentile of flow rates (representing dry weather pump operation) as measured by the SCADA system [Refer to calculation Example 1 in Appendix B - Example Ventilation Calculations]
OCU at **rising main discharges with a fan** providing active extraction	The greater of the following: - 1 Air Change Per Hour for the sewer headspace of the downstream ventilated sewer. This volume is typically the volume to the next downstream pump station, vent shaft, or area where air flow will be blocked by high wastewater level (e.g. in a variable grade sewer). - 120% of the pump flowrate from the upstream rising main during dry-weather being: a) Fixed speed pumps: the pump flowrate, or b) Pumps on VSDs: 99th percentile of flow rates as measured by the SCADA system - 120% of the maximum velocity [Note 1] of the wastewater multiplied by the cross-sectional area of the dry portion of the sewer (at the time the maximum rate of pumped flow is reached during dry weather). *Note 1: Velocity is typically calculated using Manning's formula for gravity flow, based on discharge flowrate and sewer dimensions.* [Refer to calculation Example 2 in Appendix B - Example Ventilation Calculations]
OCU at **WWPS**	The greater of the following: - 6 Air Changes Per Hour for the headspace of the wet well (i.e. the volume from the bottom water level to the soffit level of the cover). - 120% of the greatest measured rate of positive level change (wet-well filling) within the ventilated area in dry weather [Note 2] multiplied by the cross-sectional area of the wet-well. *Note 2: This can be obtained by identifying the 99th percentile of "rate of level change" (positive values) as measured by the SCADA system. Hunter Water records wet well levels in SCADA. A 1-minute time interval extraction of rate of change data is recommended for analysis.* [Refer to calculation Example 3 in Appendix B - Example Ventilation Calculations]

OCU at **WWTW**	For inlet works The greater of the following: - 12 Air Changes Per Hour for the headspace of inlet works (i.e. the volume from the bottom water level to the soffit level of the cover) and any other connected areas relating to the inlet works. - 120% of the highest expected rate of positive level change in dry weather within the ventilated area multiplied by the cross-sectional area of the inlet works. - 120% of the expected instantaneous air release into the structure (for example this may be from grit sparging gas or fine bubble diffused aeration). [Refer to calculation Example 4 in Appendix B - Example Ventilation Calculations] [Refer to calculation Example 5 in Appendix B - Example Ventilation Calculations] *Where possible, pump rates and air flow rates are to be taken from measured values (from SCADA or others) rather than listed or documented design rates.*

6.4 Other OCU Performance Requirements

Table 9 - OCU Minimum Requirements for Fans, Noise and Vent Stacks

ITEM	REQUIREMENTS
Fan Redundancy	For OCUs at WWTWs - Duty/Standby To be set-up with duty rotation and automatic change-over (through the use of actuated dampers). Non-return dampers (NRD) must not be used. For OCUs within the wastewater network Confirm requirements with Hunter Water's Wastewater Network Operations Team (wwnomailbox@hunterwater.com.au). Duty with boxed spare generally required, however some sites (at the discretion of Hunter Water) may require duty/standby to manage risk of fan failure. Further requirements for fans are given in Section 7.12.1 of this Specification.
Noise level	The noise emitted from the OCU must be the more stringent of the following two requirements: (1) WHS requirement OCUs must comply with the maximum noise requirements specified in STS 600. (2) Amenity requirement This relates to determining an acceptable noise increase for sensitive receptors. Choose Method A or Method B to determine this level. Method A: The minimum requirement is that if there is an increase in site operational noise, that the noise level must be less than the target noise level established as part of the noise impact assessment undertaken for the Review of Environmental Factors. Method B: The sound pressure level at the boundary of the site must not exceed 35 dBA under free field conditions or 5dBA above ambient levels whichever is the highest. *Note: achieving acceptable amenity sound requirements generally requires duct velocities not typically higher than 8 m/s. Duct velocities >8m/s are accepted if the noise generated does not exceed that specified above (refer Section 1.1).* To prove the above criteria has been achieved, undertake a noise survey prior to construction starting, and again as part of commissioning. If noise targets are not achieved, provide additional acoustic remediation until the criteria is achieved.

6.5 Placement of OCUs in Confined Spaces

Placement of OCUs within confined spaces must be avoided where practicable. Single or dual carbon canister with an auto air valve may be installed in confined spaces where the design requires, with the outlet vented to outside of the confined space. All other OCs must be positioned outside of and away from any confined spaces.

6.6 OCU Structure

The OCU structure/vessel material and finish must be resistant to corrosion and UV degradation in the proposed environment to achieve the nominated service life. The structure must be constructed from one of or a combination of the following:

(1) Glass-reinforced plastic (fibreglass); or
(2) Stainless steel grade 316 (where more than 1km from the coast); or
(3) High density polyethylene (HDPE); or
(4) Any other material, being equivalent to item 1 or 2 in strength and durability.

For installation of OCUs near the coast material selection is to be suitable for coastal environments. The material used must not cause difficulty in process operation or cause an inherent health and safety issue. For example, black HDPE may heat up due to IR absorption which, when used for biological systems, can cause microbiological death due to high internal temperatures, or cause a H&S risk due to surface temperature causing burns in some cases (depending upon location). In these exposed areas painting, a shade cloth, or other means to prevent excessive temperature rise may be needed.

The OCU structure must be suitably reinforced and supported to withstand all forces including wind loads, operating pressures (positive or negative), loading and unloading of media, and any other anticipated forces. The magnitude of the imposed actions are to be determined using AS/NZS 1170 using building type with Importance Level 1.

6.6.1 Fibreglass (FRP)

All fibreglass vessels and components must be constructed to BS EN13121:2016 and must consist of an internal corrosion barrier, a structural layer and an outer surface layer, as specified under relevant sections of BS EN13121:2016.

The corrosion barrier must be constructed from corrosion resistant vinyl ester resin, suitable for the application, and must comprise a minimum backing layer of 1200gsm of CSM subject to any additional requirement recommended by the resin supplier. All BS4994 QA requirements relating to the liner and its construction must apply.

The resin and fillers selected for fabrication must be suitable for the chemical used and the intended purpose of the vessel. The resin used must have the minimum performance criteria as specified under relevant sections of BS EN13121:2016 including structural requirements, i.e. ductility and strength.

All designs of Fibre Reinforced Plastic (FRP) tanks must include an independent third-party design review. The fabricator must ensure that the FRP vessel is built to the correct requirements in accordance with BSEN13121 including all QA/QC testing and records according to both BSEN13121 and BS4994 cat 1. In addition, an independent third-party inspector must be appointed to assess the conformity of the fabrication, testing and QA/QC requirements as required by the specification. The inspector must be sufficiently competent to conduct the inspection to the nominated specifications and must be approved by the Principal. The frequency of inspections must be agreed with the Principal and must comprise a minimum of one inspection.

Vinyl Ester resin must be used in both the corrosion barrier, structure and outer surface layer to ensure enhance the corrosion protection throughout the vessel construction.

Any flat fibreglass bearing surfaces must be protected from point loads by use of suitable compressible insertion material.

The design will allow for the periodic inspection and maintenance of the fibreglass structures in accordance with manufacturer's recommendations to ensure delivery of the required asset life.

Any fibreglass walkways and stairs must be designed and installed as per Australian Standards

Ductwork

All fibreglass ductwork must be designed according to SMACNA-1546-1997 and must be inspected and tested in accordance with ASTM D2563 Level II inspection.

6.6.2 High Density Polyethylene (HDPE)

All HDPE vessels must be:

- Fabricated in accordance with DVS 2205
- Suitable for outdoor installation and must be designed to accommodate temperatures that are typical of the installation location.
- Suitably coated to prevent / reduce IR absorption and limit any internal or surface heating that are typical of the installation location.
- Constructed from a UV stabilised HDPE material.
- Have sealed lids such that gaps cannot appear between clamping points.

All HDPE welds must be performed to the standard as outlined by DVS 2205 and DVS 2207. All butt welds must be performed to the standard as outlined in DVS 2207. All vertical welds in round vessels are to be heated tool butt welds.

Nozzles greater than DN 150 must be welded at a distance of at least 100mm from any vertical or horizontal butt weld seam.

6.7 Resistance to corrosion

All internal parts that may be in contact with the odorous gas must be acid resistant, particularly sulphuric acid, and any other chemical used by the OCU.

6.8 Adhesive, Sealants, and Gaskets

All adhesive, sealants and gaskets must be resistant to oil, water, and acid (mainly sulphuric acid). They must be non-supportive of microbial growth and dimensionally stable.

They must also be resistant to any chemicals used by the OCU.

6.9 Inlet Isolation valve

An easily operated positive shut off isolation valve must be provided on the extraction ductwork to the OCU. This valve is to provide a gas tight isolation of the OCU from the inlet sewer gases for the purpose of carrying out maintenance activities. Lightweight dampers are not acceptable for this duty.

All valve spindles, bearings and ancillary components must be stainless steel grade 316, and suitable for operation in an atmosphere where saturated air and H_2S gases are present. Any components where galvanizing is used or where copper or brass components are used will not be accepted.

6.10 Intrinsically Safe / zoning requirements

Design of OCUs will require with the principal to consider a potential risk of an explosive gas atmosphere being present. Comply with AS/NZS 60079.10.1 (Classification of areas – explosive gas atmospheres) and AS/NZS 60079.14 (Explosive atmospheres – Design selection, erection and initial inspection).

The WSAA Guidelines for potentially explosive atmospheres, Chapter 5, may be used to determine applicability.

Regardless of the zonal outcomes, the internals of the OCU must be suitable for Zone 2 as a minimum.

A hazardous area classification assessment, reviewed by or in conjunction with Hunter Water, is to be undertaken on the likelihood of an explosive atmosphere occurring. The outcome of the assessment is to determine if more stringent hazardous zoning of the OCU internals, as either Zone 1 or Zone 0, is required.

If an OCU is zoned either Zone 1 or Zone 0, then install a suitable monitoring system (including LEL monitors as discussed in Section 13.2.6) and design the unit to prevent ignition of hydrocarbons when detected as per requirements of AS/NZS 60079. Any control measures for Zone 1 or Zone 0 classification are to be discussed with Hunter Water during the design phase. Such measures may include operational interlocks for automatic shutdown of the OCU, alarms, or use of appropriate equipment to prevent potential fire / explosion (e.g. flame arrestor or other such measures).

Where it is deemed necessary, a flame arrestor must be designed and installed so that any liquid condensation must drain away and not pool.

6.11 Vent Stacks

For odour control units at network facilities such as pump stations and sewage pipe networks, a vent stack must be provided to exhaust the treated air vertically from the odour treatment processes unless otherwise specified by the Principal.

Height:

The discharge vent stack foundation must be designed to support a minimum vent stack height of 12m.

(Note a vent stack height of less than 12m may be installed as defined by requirements below, however in all cases the base must be designed for minimum 12m to enable retrofit of a taller vent stack if required in the future.)

The default vent stack height requirements for discharge of treated air from an OCU are the greater of:

- 9m in height
- 2m above the roof level of the any nearby buildings or OCU vessels.

Hunter Water's Wastewater Network Operations Team must be consulted with to confirm project specific requirements (wwnomailbox@hunterwater.com.au).

General vent stack requirements:

All vent stacks must be provided with a hatch to install a mobile H_2S monitoring logger within the vent stack shaft, to allow for intermittent monitoring of foul air leaving the stack. These access hatches must be a minimum of 200mm in height and 120mm wide and be gas tight and lockable. A suitable means of attaching the equipment within the airflow of the vent shaft, must be provided. This access hatch must be provided downstream of any ground-mounted AC unit provided with the stack.

For vent stacks installed with passive activated carbon OCUs (or those which are not continuously operated), install mesh on top of the stack to reduce the risk of wildlife entering the shaft. Mesh must be of a suitable material without requiring maintenance.

Other vent stack compliance requirements & standards:

Vents must be designed in accordance with WSA-02 2014 (Hunter Water edition) Version 2 with a cone on the outlet to ensure discharge air velocity is >15 m/s to obtain maximum dilution with the surrounding air.

Further general guidance on placement of vent stacks must be obtained from Hunter Water's manual for wastewater pump station design.

Further requirements for vent stacks are given in Hunter Water's Standard Construction Practice (SCP) drawing 1003 and in Section 7.11 of this Specification.

6.12 Fans

6.12.1 Fan Redundancy

Requirements for fan redundancy are specified in Table 9

All systems fan(s) are to be installed downstream of the media and draw air through the media under suction, in order to remove the risk of gas leaks under pressure.

For enclosed biofilters or biotrickling filters that are combined with activated carbon polishing, a single fan is to be installed downstream of both units.

For activated carbon type filters, moisture ingress to the activated carbon filter must be managed with pre-filters, not through the use of fans upstream of the media.

6.12.2 Fan Selection

The fan(s) must be selected to provide the designated airflow under the system head pressure. The fan must be centrifugal with forward or backward curved impellers and must be suitable for the required design.

All fans above 200 L/s must have a variable speed drive (VSD).

Fans must be fitted with a flameproof motor Class 1 Division 2 in accordance with IEEE Standard 1349.

Fan performance curves must be provided with the design documents. Type test certificates are only acceptable for fans under 5 kW.

The fan must be fully compliant for the appropriate Zone classification in accordance with AS/NZS 60079.

Fan noise is to be within the acoustic limits described in Table 9. Where required, the fan must be lagged and fitted with discharge and inlet silencers.

6.13 Dampers & Valves

Dampers must be provided to perform the functions of diverting or modulating the airstream to the OCU as required and as directed by the monitoring and control system.

Dampers that are intended for air diversion only must operate either in the fully open or fully closed position.

The dampers must be single thickness, factory assembled units. Each unit must be supplied for heavy-duty operation for field assembly and must operate through 90 degrees of operation, from fully open to fully closed.

All damper spindles, bearings and ancillary components must be stainless steel, FRP, HDPE or PVC and suitable for operation in an atmosphere where saturated air and H_2S gases are present. Any components where galvanizing is used or where copper or brass components are used must not be accepted.

All stainless steel, HDPE or PVC dampers supplied have to meet the following requirements;

- Internal / external seams and body / flange joints are to be fully welded.
- Pressure tested for leaks prior to installation.
- Faulty welds (pinholes), runny (fast), or blop (slow) or cold lap welds/joints are to be ground out and re-welded.
- Installed damper/s with fault welds must be removed and repaired on floor. Repaired damper/s must be retested before installation.
- All welds and surrounding affected metal by welding process must be cleaned and passivated.
- Application of sealant to incomplete welds or faulty welds is not an acceptable practice.

Where pipe diameter is less than 300mm, a butterfly valve composed of suitable, non-corrodible material, may be used instead of a damper.

6.13.1 Volume Control Dampers

Dampers must be manufactured in non-corrodible material, of rugged construction and must be free of rattles, fluttering or slack movement, and capable of adjustment over the necessary range without excessive self-generated noise or the need for special tools.

Blades must be without sharp edges and sufficiently rigid to eliminate movement when locked. Blades minimum thickness must be 1.6 mm.

Damper bearings must be engineering plastic sleeve bearings. Where the operating temperature is expected to exceed 50 °C, nylon must not be used. Access for lubrication of bearings must be provided.

Spindles must be grade 316 stainless steel, securely fixed to damper blades with minimum diameter as follows:

- Blade diameter ≤ 600 mm 10 mm
- Blade diameter > 600 mm 12 mm

The damper must be capable of being adjusted and locked in the following blade positions: "Open", "10° to open", "20° to open", "30° to open" and "Closed". The positions must be clearly and permanently labelled.

6.13.2 Non-Return Dampers

Non-return dampers are not acceptable for duty/standby fan isolation. Where a non-return damper would normally be required for this purpose, an actuated damper must be used instead.

6.14 Access

Adequate access must be provided to allow all expected operational and maintenance activities to be carried out in a safe and efficient manner.

Suitable road access must be provided for large vehicles required for media and equipment (such as fans, pre-filters or pumps) removal and installation (such as vacuum tankers, HIAB trucks or cranes).

Platform access must be provided for media removal and replacement. It must be large enough to hold two people and a pallet of media unless otherwise agreed by Hunter Water.

Platforms where required must be supported from the ground rather than from the adsorber and ductwork.

6.14.1 On-site documentation

A suitable lockable location must be provided beside the OCU to provide storage of plant documentation (such as O&M manuals, Hazard ID list, plant diary, calibration records, and so on)

6.15 Site water supply

If one is not already provided on site, a water supply with backflow prevention must be provided in close proximity to the OCU if required for process use. The Reduced Pressure Zone (RPZ) valve must be installed in a standard lockable cage. If an RPZ is already available on site, the water connection for the OCU must be connected downstream of the RPZ to ensure backflow prevention to the water main. In the event that the water pressure / flowrate from the water source does not comply with the peak flow needs, provide a buffer storage tank and booster pump set to achieve stable OCU operation.

For OCUs involving biological processes, a safety shower must be provided in close proximity to the OCU, which is supplied separately from the RPZ protected process water supply. Any safety showers must be designed and installed in accordance with the requirements of STS 670.

6.16 Civil related

The design and construction of the civil works must be in accordance with the requirements contained in Hunter Water Standard Technical Specifications.

6.16.1 Foundation

The OCU must be located on a concrete slab with a rubber mat between the tank and the concrete. The concrete slab must comply with STS 104 and STS 404.

6.16.2 Drainage

The OCU must have gravity drainage facilities to remove condensate. The material of construction must be sulphuric acid resistant. Drains from the heater/demister must also be heat resistant. The drainage must be directed to a permissible disposable location, such as a wet well or sewer and no potentially basic/chlorine laden waste streams are to be mixed.

Each drainage point must be from the lowest point in the item being drained and sufficient drainage points must be supplied to prevent any condensate from collecting in the OCU or ductwork.

Drains may only be combined for gases of like quality and pressure. No drain from downstream of the media bed is to be connected to any drain from upstream of the bed.

All drain discharge points must have a water seal, which can be easily checked/refilled and removed for safe cleaning by the operator. The diameter of the water trap needs to be minimum 50mm and a height needs to sufficient to overcome the pressure difference and is typically at least 100mm. Where possible water traps should be shaded to minimise evaporation from water seals.

6.16.3 Fencing

Where specified in the contract, an OCU is to be installed with a new fence to enclose new OCU assets.

Supply and install a lockable site security fence mounted to new concrete slab with locked 1.2m wide personnel entry gate suitable for HWC standard padlocks. Fence to be Black 2.1m high in “school style” with crimped spear on top. Where a length of ducting is outside of the fenced area provide security mesh barrier around ductwork to protect from vandalism.

6.16.4 Colour

The colour of all enclosed media storage vessels, except for vent stacks, must be either black or in accordance with WSA 201 and Sydney Water’s supplement to WSA 201.

The colour of vent stacks must be in accordance with WSA-02 2014 (Hunter Water edition) Version 2.

For OCUs at WWTWs, the preferred colours are as follows:

1. Vessels (BTF, AC); Ductworks/ducts; and Vent stack: Dove Grey/Mist Green or similar colour to blend in with background.
2. For Nutrient tank: light colour to prevent the material heating up.

6.17 Facility and Equipment Identification and Labelling

- Contact Hunter Water’s Operational Information Team (asset.information@hunterwater.com.au) for details of what signage and labelling is required when new OCU equipment is installed. All equipment must have unique identification numbers as assigned by Hunter Water.

7 Mechanically Assisted Activated Carbon OCU

This section applies to activated carbon systems that include mechanically assisted ventilation.

A generic P&ID of this system is provided in Appendix C.

7.1 General

The activated carbon adsorption units must be capable of continuously treating odorous air up to 100% relative humidity (rH) at specified flow rates, even if an in-line heater is provided.

The clean air from the unit discharge outlet must meet discharge odorous gas limit concentrations as specified in Section 7.3.

The activated carbon adsorption system must be supplied complete with all auxiliary equipment required for system operation. The activated carbon media must also be supplied, unless Hunter Water has exercised its right to free supply the activated carbon.

The activated carbon filter system must consist of (but not be limited to):

- an inlet isolation valve,
- pre-filter,
- flame arrestor (where required),
- heater/demister (where required),
- activated carbon housing and activated carbon media,
- temperature probes to alarm on bed overheat (only when a heater is used)
- extraction fan(s),
- discharge stack,
- control equipment panel, and
- monitoring equipment.

7.2 Pre-filter(s)

One easily removable and cleanable pre-filter assembly must be installed downstream of the inlet isolation valve and upstream of all other OCU equipment. This pre-filter is intended to remove fats, greases, particulate matter and aerosols from the airstream and hence protect the flame arrestor (if required) and the activated carbon media from contamination. Suitable cleaning facilities for the pre-filter must be provided.

The pre-filter must be easily obtainable and of the honeycomb type or mesh type designed to remove particulate matter and must have a removal efficiency of 96% based on No.3 dust to AS 1324.2, and of corrosion resistant construction materials. The pre-filter design must be sufficient to provide consistent flow to the unit for a period of one month between cleaning events, whilst not creating a manual handling issue for cleaning.

The filter(s) must be mounted in a frame and be constructed to prevent bypassing of the filter by inlet air.

One spare set of filter(s) must be supplied as well as a suitable container and detergents for cleaning the filters on site. The cleaning container must be able to be drained back to the sewer. A suitable container for transporting the filters offsite for cleaning must also be provided.

The design of the pre-filter must facilitate easy removal of the pre-filter for cleaning/replacement without creating a source of gas leaks. The pre-filter must be suitable for cleaning via high pressure gurney or similar without potential for deformation or damage.

The filter housing must have a graded floor to a drain (minimum 40mm) connected back to the sewer via a visible water seal. The water seal must be able to be easily checked/filled manually. The pre-filter, filter housing and drain must be resistant to condensate attack.

Where a pre-filter is supplied, appropriate means for washing it must also be provided.

7.3 In-Line Heater/Demister

Conduct a whole life cost analysis whether an in-line heater is provided or not, showing whether the capital and operating cost of a heater justifies the reduction in activated carbon usage.

In the event that analysis shows an in-line heater is required, it must be provided on the inlet side of the adsorber unit to ensure that the temperature of the saturated air to the OCU can be raised to achieve reduced humidity to prevent moisture entrainment and optimal adsorption in the activated carbon bed.

The in-line heater must be of the black body type and must be fitted with over-temperature cut-out in the event that fan failure or similar prevents air movement over the heater elements. The in-line heater must not operate unless the fan is running and airflow through the inlet ducting is ensured. Temperature measurement and indicators must be provided on the inlet and outlet of the heater. These must be used to switch on/off the heater elements in stages to maintain a temperature difference between inlet and outlet of about 5 degrees Celsius. All heaters must be provided with a hard-wired high temperature thermocouple to prevent overheating.

The heater box must be adequately drained to the sewer to ensure the heater elements do not become immersed in condensate. The drain must be both resistant to condensate attack as well as high temperatures should the heater overheat.

Performance requirement of in-line heater

The capacity of the heater should be sufficient to reduce the relative humidity to less than 80% for the design inlet airflow with a relative humidity of 100% at 20 degrees Celsius.

7.4 Media vessel

Design of the activated carbon adsorption units (vessel containing the carbon) must employ methods to prevent caking, solidifying and blooming of the impregnated activated carbon.

The activated carbon adsorption units must be designed to withstand both the operating gas pressures (whether operating under a vacuum as preferred or under positive pressure) as well as any other stresses that might be expected during loading and unloading of the media (for example, people standing on top with carbon).

The carbon vessel and associated ductwork must be designed to minimise pressure drop, prevent any short circuiting of gas flow, and provide easy access for maintenance.

The activated carbon vessel, internal components, and structural components must be made of corrosion resistant material as specified in Section 7.6.

Where fibreglass is used, the material (including resins) selected, must be suitable and have resistance to activated carbon, the products of reaction, and the general sewage environment.

The drain line must have a swan necked lute or similar to provide a water seal and prevent foul air bypassing the media by discharging through the drain line. The area that the drain goes (for example the wet well) must be corrosion resistant. Refer to Section 7.16.2 for further requirements relating to drainage.

7.4.1 Vessel Access Hatches

The design must include lockable access hatches, with standard key types as advised by the Principal, for loading and removal of spent carbon, and for inspection of any other ancillary equipment. The hatches must be of sufficient size (generally 800mm diameter) to allow both removal of carbon by suction hose through the top, and by manual shovelling through the side. The hatches must allow the easy removal of any internal components such as screens for maintenance purposes. The top hatch should be removable.

Fully removable lids can be provided in lieu of access hatches so long as there is a lockable access hatch, with standard key types as advised by the Principal, for inspection of any other ancillary equipment and insertion of copper rods.

7.5 Monitoring and Control

Monitoring and control systems must be provided, as detailed in Section 13 of this Specification.

7.6 Adsorptive Media – Supply and Material Requirements

Include information on the specification and price of the activated carbon intended to be supplied in the concept design for review.

The Principal reserves the right to free supply the activated carbon for the OCU and not use another media.

The Principal reserves the right to specify the carbon to be used for detailed design of the OCU. In this case, Hunter Water will provide performance information of the proposed carbon.

Should the Principal agree to use another carbon media, it must comply with the following requirements:

- The carbon media must meet the minimum specifications of one of the three carbon media types given by Table 10, Table 11 and Table 12.
- Provide an analysis sheet for each batch of activated carbon media. Random sampling may be carried out by the Principal for product quality testing. The testing may be made by any laboratory approved by the Principal.
- The adsorptive media must be either impregnated activated carbon or other similar proprietary media that is predominantly an activated carbon material, chemically treated to adsorb the constituent gases from the collected airstream.
- The carbon must be extruded, steam activated and impregnated with sodium hydroxide or potassium hydroxide, potassium iodide or copper oxide. Details of the selected adsorptive media, and its performance characteristics, particularly moisture ingress must be provided. Peat, coconut shell or high-grade coal must be used as the base material for manufacture of the carbon.
- The activated carbon must also be required to absorb levels of hydrocarbons that may be present at times.

Table 10 - Sodium Hydroxide/Potassium Hydroxide (Caustic) Impregnated Activated Carbon (NaOH/KOH)

PARAMETER	REQUIREMENT	TEST METHOD
Potassium Hydroxide or Sodium Hydroxide content	up to 10%	
Apparent Density	0.45 to 0.62 g/mL	ASTM D2854
Ball-Pan Hardness	95 minimum	ASTM D3802
Particle Diameter	4 mm	ASTM D2862
Particle Length	6 mm	ASTM D2862
Mean Particle Diameter	3.6 to 4.7 mm	ASTM D2862
Surface Area	1000 m^2/g minimum	N_2 BET Method
Hydrogen Sulphide Breakthrough Capacity	0.06 H_2S g/cm^3 Carbon minimum	ASTM D6646

Table 11 - Potassium Iodide Impregnated Activated Carbon

PARAMETER	REQUIREMENT	TEST METHOD
Potassium Iodide content	1.8% minimum	
Apparent Density	0.40 to 0.60 g/mL	ASTM D2854
Ball-Pan Hardness	90 minimum	ASTM D3802
Particle Diameter	3 to 4 mm	ASTM D2862
Particle Length	6 to 8 mm	ASTM D2862
Mean Particle Diameter	3.6 to 4.8 mm	ASTM D2862
Surface Area	1000 m^2/g minimum	N_2 BET Method
Hydrogen Sulphide Breakthrough Capacity	0.09 H_2S g/cm^3 Carbon minimum	ASTM D6646

Table 12 - Copper Oxide Impregnated Activated Carbon

PARAMETER	REQUIREMENT	TEST METHOD
Copper Oxide content	5% minimum	
Apparent Density	0.40 to 0.55 g/mL	ASTM D2854
Ball-Pan Hardness	90 minimum	ASTM D3802
Particle Diameter	2 to 3.5 mm	ASTM D2862
Particle Length	3 to 5 mm	ASTM D2862
Mean Particle Diameter	2.25 to 3.89 mm	ASTM D2862
Surface Area	1000 m_2/g minimum	N_2 BET Method
Hydrogen Sulphide Breakthrough Capacity	0.06 H_2S g/cm^3 Carbon minimum	ASTM D6646

7.7 Adsorptive Media – Volume Design and Placement

- The adsorptive media must be evenly distributed in the bed so that no bypassing or short circuiting of foul air occurs within the OCU.

Contact time

- The depth of activated carbon media must be such that the minimum contact time for the foul air stream in the OCU is at least 3.0 seconds EBRT at maximum design airflow. This must be achieved without exceeding the manufacturer recommended gas velocity through the activated carbon (typically maximum 25-30 cm/s).

Media design life

- The media life is defined as the length of time between replacements of the activated carbon media based on breakthrough of gas contaminants above the target design levels.
- The baseline requirement is that the minimum activated carbon design bed life shall be 12 months based on the agreed average gas contaminant loading rate. A shorter designed bed life may be considered if it results in an optimised solution with respect to asset size/placement, capital cost, and/or aesthetics. Any deviation from this requirement must be discussed and agreed with the Principal.
- Calculations have to be submitted to the Principal, substantiating the amount of carbon to meet the carbon bed life specified.

8 Passive activated carbon OCU

This section applies to activated carbon systems that include passive ventilation.

Passive systems are only acceptable on sealed systems (such as rising main air vents, and some discharge maintenance holes).

They are not usually suitable for use at pumping stations, gravity lines and other infrastructure that cannot be sealed to provide sufficient differential pressure to drive the gas through the system. Permission from the Principal is required to use a passive system in these situations (unless it is already allowed / nominated in project specific documents). A condition of this permission is the provision of design calculations comparing pressure losses through the activated carbon unit to pressure losses further downstream proving that the airflow will be forced through the passive system (rather than escaping from the sewer through other means).

A generic P&ID of this type of OCU system is provided in Appendix C .

8.1 General

Passive activated carbon units must be designed to treat the foul air flowrate and discharge odorous gas limit concentrations as specified in Section 7.3.

The activated carbon adsorption units must be capable of intermittently treating odorous air at 100% relative humidity at specified flow rates.

The activated carbon adsorption system must be supplied complete with activated carbon media.

The activated carbon filter system must generally consist of (but not be limited to):

- an inlet isolation valve,
- activated carbon housing and activated carbon media,
- drain line, and
- discharge stack (unless retrofitting an OCU to an existing stack).

All passive activated carbon type OCUs must be mounted at ground level or, where there are particularly strong visual amenity issues, underground (refer to Section 9.5 and 7.5). Vent top filters will not be accepted.

8.2 Pre-filter(s)

A pre-filter is not required in the design of a passive activated carbon OCU.

8.3 In-Line Heater/Demister

An in-line heater/demister is not required in the design of a passive activated carbon OCU.

8.4 Media vessel

Design of the activated carbon adsorption (media) units must employ methods to prevent caking, solidifying and blooming of the impregnated activated carbon.

The activated carbon adsorption units must be designed structurally to withstand both the operating gas pressures as well as any other stresses that might be expected during loading and unloading of the media, even if the carbon adsorption unit is intended to be wholly replaced.

Design the adsorber unit and associated ductwork to minimise pressure loss, prevent any short circuiting of gas flow, and provide easy access for maintenance.

Where the passive activated carbon unit is treating foul air from a source where foul air cannot travel anywhere else (for example foul air from an auto air valve) the pressure loss across the unit must be less than 30% of the pressure of the foul air supplied to the activated carbon unit (for example, 30% of the pressure needed to open the auto air valve).

Where the passive activated carbon unit is treating foul air from any other sources (for example a maintenance hole), the pressure loss across the unit must not exceed 50 Pa under normal operating conditions being during times when foul air is likely to be pushed through the unit (for example when upstream sewer pumps are pumping). This may require the carbon to be an annular type bed, rather than a deep filter type bed.

The activated carbon vessel, internal components, and structural components must be made of corrosion resistant material as specified in Section 7.6. Where fibreglass is used, the material (including resins) selected, must be suitable and have resistance to activated carbon, the products of reaction, and the general sewage environment.

The top of the vessel must be easily accessed for the operator to insert and retrieve a copper rod for determining bed depth depletion.

The drain line must have a swan necked lute or similar to provide a water seal and prevent foul air bypassing the adsorber by discharging through the drain line. The area that the drain goes (for example the wet well) must be corrosion resistant.

8.5 Underground Units

No OCU must be placed below ground without written approval from the Principal.

The unit must be designed to be as unobtrusive as possible with covers flush with the ground level.

Underground OCUs must be provided within a pit that allows access to all equipment needing operation, removal, replacement or refurbishment.

All internals of the pit, along with the cover, must be made from corrosion resistant materials.

Prior to the construction of the pit, all relevant dial before you dig (DBYD) and services checks must be conducted.

The pit must have suitable drainage to prevent water or condensate accumulation. Any drain lines back to a sewer system must be equipped with suitable water traps to prevent foul air bypassing the OCU. All condensate drains must be made from non-corrodible materials. Proposed sewer connection points are to be inspected. Condensate draining onto unprotected concrete surfaces is not acceptable – where this cannot be avoided, protective coatings shall be provided. Where the drainage line is below the sewer overflow level, a non-return valve (NRV) shall be provided, to prevent sewage entering the OCU pit. The NRV should require minimal pressure to open, and shall be confirmed by Hunter Water. Refer to additional guidance in Section 7.16.2.

8.6 Monitoring and Control

A monitoring and control system won't be required in the design of a passive activated carbon OCU.

8.7 Adsorptive Media

Requirements for activated carbon adsorptive media are as per Section 8.6 and Section 8.7 of this document.

9 Biotrickling filter OCU with or without carbon polishing

This Section provides content that is specific to biotrickling filter type OCUs. It covers biotrickling filters that are installed with combined secondary treatment from an activated carbon unit, and stand-alone biotrickling filters.

A combination of biotrickling filter with an activated carbon polishing filter is more common in the Hunter Water networks.

Stand-alone biotrickling filters (i.e. units without a secondary form of treatment such as activated carbon) are not preferred by the Principal in the wastewater network and will not normally be accepted in built up areas or where they would be close to neighbouring residents unless the Supplier can prove reliable long-term operations with sufficient performance.

Generic P&ID of stand-alone biotrickling filter and activated carbon are provided in Appendix C .

9.1 Pre-filter

A pre-filter will not normally be required. However, if a flame arrestor is required upstream of the biotrickling filter, then a pre-filter that meets the requirements of Section 8.2 must be provided.

9.2 Biotrickling Filter Unit

The biotrickling filter units must be capable of continuously treating odorous air at the specified flow rates and be designed to meet the minimum required performance criteria as nominated in Section 7.3.

The biotrickling filter must be supplied complete with all auxiliary equipment required for system operation. The biotrickling filter unit must generally consist of (but not be limited to):

- an inlet isolation valve,
- an inlet humidifier (if required)
- one or more contactors containing a suitable bio growth media and support frame,
- a liquor recirculation system to maintain the media in a moist state (if part of the suppliers' design),
- a liquor decant and makeup (water and nutrients where required) system,
- extraction fans,
- discharge stack,
- control equipment panel, and
- monitoring equipment.

The biotrickling filter and associated ductwork must be designed to minimise pressure drop, prevent any short circuiting of gas flow, and provide easy access for maintenance.

9.2.1 Humidification

A humidifier may be required on a BTF where the wetting rates are low or the media provided does not have sufficient liquid holdup to keep the media suitably wet.

Where a humidifier is required, foul air must be passed through a humidification step where the relative humidity of the gas is raised to a minimum of 90%. This humidification step must also be designed to remove particulate matter from the air stream.

Potable Water must be used for humidification. Water flows must generally be provided with a flow indicator and valving to adjust the flow to the various injection points.

9.2.2 Media - Volume Design and Placement

The number of media layers and treatment stages are as specified by the Supplier in order to comply with the removal efficiencies nominated in Section 7.3 for the agreed contaminant loads.

A minimum EBRT of 10 seconds is required under normal operation and an EBRT of 8 seconds when one tower is offline if more than one tower is provided. It is noted that these are minimum values, and actual bed volumes must be calculated based upon required active surface area and specific surface of media provided (m^2/m^3).

Structured media must be installed on site, or if installed in the factory, the vessel sections must be transported and stored in the orientation to which they are to be installed to prevent media sagging and resulting short-circuiting. At the request of the principal, open the vessel and demonstrate that no sagging has occurred.

9.2.3 Media – Material Requirements

All media parameters must be provided on request of the principal. The withholding of process critical parameters under the guise of “proprietary media” or Intellectual property will not be accepted.

Submit calculations to the Principal, substantiating the choice of media to meet the required performance and life span.

The media must be designed to not suffer from blockage or short circuiting over its operational life span.

The use of pelletized or other form of activated carbon within the BTF is not acceptable under any circumstances because;

- The packing characteristics are not suitable for BTF operation.
- Carbon is prone to breakdown resulting in media slumping and bed blockage.
- Use of activated carbon or carbon in any form within the BTF will invalidate the performance test.

Performance requirement

The media should be guaranteed for at least 10 years without the requirement of media change-out, without pressure drop increase (no increase after start-up period) nor shrink or compact (maximum 5% compaction of the original bed depth).

Examples or specific tests illustrating that the media can be guaranteed must be provided as part of the proposal.

9.2.4 Structure - Material Requirements

The biotrickling filter must be designed structurally to withstand both the operating gas pressures (whether operating under a vacuum as preferred) as well as any other stresses that might be expected during loading and unloading of the media (for example, need to provide support for at least two people standing on top typically 200 kg plus the media).

The biotrickling filter shell, internal components, and structural components must be made of corrosion resistant as specified in Section 7.6. Where fibreglass is used, the suitability of this material with resins selected for resistance to biological attack, the products of reaction and the general sewage environment must be demonstrated.

9.2.5 Access hatches

The design must include access hatches for loading and removal of support media, and for inspection of any other ancillary equipment (nominally 800mm diameter). The hatches must be of sufficient size to allow both removal of bio growth media through the side, and inspection and maintenance of the distribution sprays at the top. The inspection hatch(es) must be designed to allow visual inspection by operators of the sprays and the top of the media during normal operation. The hatches must allow the easy removal of any internal components such as screens for maintenance purposes. In the event that

structured media is used, the vessel must have body flanges provided to allow the removal and replacement of media sections.

9.2.6 Demister

A demister must be provided to prevent any carryover of liquid droplets with the outlet gas stream.

9.3 Additional Requirements for Standalone BTF Units

If the biotrickling filter does not have activated carbon polishing, the biotrickling filter must have a minimum of two individual stages providing at least one stage with an acidic pH to provide optimal conditions for the autotrophic micro-organisms and at least one stage with a neutral pH (pH 6-8) to provide optimal conditions for the heterotrophic micro-organisms.

9.4 Activated Carbon Polishing Unit

If activated carbon polishing is required the activated carbon polishing unit must comply with all requirements of Section 8 of this Specification, however a pre-filter is not required.

9.5 Leachate management

Leachate and other potentially corrosive waste streams from the system must be collected in a designated pump station designed to handle corrosive liquids with emergency overflow, duty/assist pumps and level monitoring with backup level switches for pump control and system monitoring. Leachate disposal and overflow receival location requires consideration of the discharge environment and impacts on wastewater treatment systems.

All pipework and pumps that transfer leachate or corrosive liquids are to be designed in accordance with STS 670 Chemical Handling. Leachate pipework label to be purple (chemical) and state “Leachate”.

The design must include but not limited to continuous pH monitoring of leachate, chemical splash guarding, signage and pipe labelling, capability to isolate, drain and flush out leachate for safe maintenance of equipment.

9.6 Monitoring and Control

Monitoring and control systems must be provided, as detailed in Section 13 of this Specification.

9.7 Liquor Recirculation System

Liquor recirculation systems are sometimes required depending on whether the Supplier requires such a unit for operation to meet the performance requirements nominated in Section 7.3.

If required, a minimum of two pumps in duty/standby arrangement, with automatic change-over, must be provided to recirculate the sump liquor. The pumps must be centrifugal pumps and mechanically sealed. The pump head and seals must be suitable for the corrosive nature of the sump liquor.

A sump purge valve must be provided to flush out contaminant build up within the reticulation system. This must be automatically controlled and allow for operator adjustment.

Flow indication must be provided for each component flow on the recirculation system including flows to the humidifier (if present), to the spray in each contactor, and to monitoring systems.

A no flow alarm must be provided should the recirculation of sump liquor fail. Similarly, a low liquor sump level alarm should stop the recirculation pumps. Failure of the reticulation system must be connected to the HMI or SCADA system.

Any automated valves must be provided with a manual by-pass.

9.8 Once Through Systems

Where a liquor recirculation system is deemed by the Supplier to not be required, a once-through type system must provide all flow indications and alarms to ensure that proper water flows is provided for each component flow on the system including flows to the humidifier (if present), to the spray in each contactor and to monitoring instruments.

9.9 Nutrient Dosing System (if required)

The Supplier, upon being provided with the effluent quality and water available on site, will determine whether a permanent nutrient dosing system is required. If it is required, the location of dosing must be into the feed water line. For OCUs located at WWTWs, the use of Reclaimed Effluent (RE) is preferred to limit the usage of potable water, and the design of the BTF must incorporate consideration for RE.

The selected chemical system can be dry or liquid. If dry product is selected, the storage and loading must be designed to minimise manual handling such as carrying, lifting and emptying bags into the dosing tank.

The nutrient system must comply with the relevant sections of Hunter Water's STS 670 Chemical Storage and Delivery Systems, including the need for bunding. Whilst the requirement for bunding is to be reviewed on a site-specific basis in accordance with STS 670 and confirmed with Hunter Water, as a general recommendation bunding is to be provided for the nutrient dosing tank, however bunding requirement for liquid nutrient delivery tanker may be discussed depending on site and sensitive environment.

10 Enclosed biofilter OCU with or without activated carbon polishing

This Section provides content that is specific to enclosed biofilter type OCUs. It covers biofilters installed with a combined activated carbon unit for secondary treatment, and stand-alone biofilters.

Generic P&ID of stand-alone biofilter and activated carbon are provided in Appendix C .

10.1 Pre-filter

A pre-filter will not normally be required. However, if a flame arrestor is required upstream of the biofilter, then a pre-filter will be required. If a pre-filter is required, see Section 8.2 of this Specification.

10.2 Biofilter Unit

The biofilter units must be capable of continuously treating odorous air at the specified flow rates and be designed to meet the minimum required removal efficiency as nominated in Section 7.3 following commissioning.

Standalone biofilter units must also meet the maximum outlet concentration as nominated in Section 7.3. The biofilter must be supplied complete with all auxiliary equipment required for system operation. The biofilter unit must generally consist of (but not be limited to):

- an inlet isolation valve,
- an inlet humidifier
- one or more contactors containing a suitable bio growth media and support frame,
- a liquor recirculation system to maintain the media in a moist state (if part of the suppliers' design),
- a liquor decant and makeup (water and nutrients where required) system,
- extraction fans,
- discharge stack,
- control equipment panel, and
- monitoring equipment.

The biofilter and associated ductwork must be designed to minimise pressure drop, prevent any short circuiting of gas flow, and provide easy access for maintenance (access platform may be required).

10.2.1 Humidification

Humidifiers are required on all biofilters.

Foul air must be passed through a humidification step where the relative humidity of the gas is raised to a minimum of 90%. This humidification step must also be designed to remove particulate matter from the air stream.

Potable Water must be used for humidification. Water flows must generally be provided with a flow indicator and valving to adjust the flow to the various injection points.

10.2.2 Media – Volume Design and Placement

The material composing the bed is to be at least 0.9 metres deep and have a surface loading of no more than 1.5 m^3/minute.m^2 during normal operation. The maximum media depth must be 1.5m. This material is to be composed of particles sized to deliver a pressure drop, when new of approximately 300 Pa. Alternatives to the above may be acceptable as long as a proven track record can be provided for a minimum of 5 years of continuous operation showing good treatment and pressure loss characteristics.

Moisture content throughout the bed must be between 45% and 65% dry weight.

The number of media layers and treatment stages, as well as the EBRT, must be determined by the Supplier based on the necessary treatment for each odorous component, not just hydrogen sulphide.

Calculations supporting the design, in order to comply with the removal efficiencies nominated in Section 7.3, must be submitted to the Principal as part of the design, including assumptions on the mass transfer

rate of different contaminants at standard conditions (sometimes referred to as K0) and specific surface areas of media.

10.2.3 Media – Material Requirements

Media will be of a design such that it provides sufficient surface and contact time to treat agreed contaminant loads to the agreed discharge quality and provide the required nutrient and pH buffering.

The media must be designed to not suffer from excessive degradation, blockage, or short circuiting over its operational life span.

Performance requirement

The media should be guaranteed for at least 2 years without the requirement of media change-out, without pressure drop increase (no increase after start-up period) nor shrink or compact (maximum 5% compaction of the original bed depth).

Examples or specific tests illustrating that the media can be guaranteed must be provided as part of the proposal. Proprietary media will be considered by Hunter Water, but the preference is for media that can be sourced from more than one supplier. Media components must be available from sources other than the original supplier. The makeup of the media must be provided in volume ratios with the proposal and handover documents. The assumed media specific surface must be provided.

10.2.4 Structure - Material Requirements

The biofilter must be designed structurally to withstand both the operating gas pressures (whether operating under a vacuum as preferred or otherwise) as well as any other stresses that might be expected during loading and unloading of the media (for example, need to provide support for at least two people standing on top typically 200 kg plus the media).

The biofilter shell, internal components, and structural components must be made of corrosion resistant as specified in Section 7.6. Where fibreglass is used, the suitability of this material with resins selected for resistance to biological attack, the products of reaction and the general sewage environment must be demonstrated.

10.2.5 Access hatches

The design must include access hatches for loading and removal of support media, and for inspection of any other ancillary equipment. The hatches must be of sufficient size to allow both removal of bio growth media through the side, and inspection and maintenance of the distribution sprays at the top. The inspection hatch(es) must be designed to allow visual inspection by operators of the sprays and the top of the media during normal operation. The hatches must allow the easy removal of any internal components such as screens for maintenance purposes.

10.2.6 Demister

A demister must be provided to prevent any carryover of liquid droplets with the outlet gas stream.

10.3 Activated Carbon Polishing Unit

If activated carbon polishing is required the activated carbon polishing unit must comply with all requirements of Section 8 of this Specification, however a pre-filter is not required.

10.4 Monitoring and Control

Monitoring and control systems must be provided as detailed in Section 13 of this Specification.

11 Open topped biofilter OCU

Open topped biofilter (i.e. soil bed) OCUs are not preferred by Hunter Water and will not normally be accepted in built up areas or where they would be close to neighbouring residents should the plans for the area involve future nearby developments. Open topped biofilter OCUs will only be approved at WWTWs.

Open topped biofilter must be designed to achieve the performance requirements of biological type OCUs.

A generic P&ID of open topped biofilter type OCU systems is provided in Appendix C .

11.1 Pre-filter

A pre-filter will be required and must be provided as per Section 8.2 of this Specification.

11.2 Humidification

Foul air must be passed through a humidification step where the relative humidity of the gas is raised to a minimum of 90%. This humidification step must also be designed to remove particulate matter from the air stream.

Potable Water must be used for humidification. Water flows must generally be provided with a flow indicator and valving to adjust the flow to the various injection points.

11.3 Plenum

An air distribution plenum must be provided at the base of the open topped biofilter. This plenum must be made of non-corrodible material and must be designed to evenly distribute air across each section of the biofilter. A mesh must be installed on top of the plenum to ensure media does not fall into the plenum.

The base of the plenum must be angled to a sump or drain.

Slotted piping in lieu of an inlet plenum must not be allowed.

Inlet ductwork to the plenum must not pass directly through the biofilter media.

11.4 Bed Design

The humidified air is to be split equally between two (2) or more separate and isolatable treatment sections of the biofilter. This requirement allows repairs or renewal to be performed upon the biofilter sections separately while maintaining foul air treatment.

The open topped biofilter as a whole must be able to work effectively with one section offline.

Each section of the biofilter must have an array of humidified foul air ducts that are designed to evenly distribute foul air within the section.

Where cold temperatures, frosts may cause inactivation of the microorganisms on the media, adequate measures (such as having a sufficiently deep bed, shade sails) must be taken.

The design of the biofilter must allow ease of media replacement in one section without damage to other sections, the plenum or underfloor drains.

The biofilter media is to be at least 0.9 metres deep and have a surface loading of no more than 1.5 m^3/minute.m^2 during normal operation. The maximum media depth must be 1.5m. This material is to be composed of particles sized to deliver a pressure drop, when new of approximately 300 Pa. Alternatives to the above may be acceptable as long as a proven track record can be provided for a minimum of 5 years of continuous operation showing good treatment and pressure loss characteristics.

Moisture content throughout the biofilter must be between 45% and 65% dry weight.

11.4.1 Contact time

The EBRT must be determined based on the necessary treatment for each odorous component, not just hydrogen sulphide. Calculations supporting the design must be submitted to the Principal as part of the design, including assumptions on the mas transfer rate of different contaminants at standard conditions (sometimes referred to as K_0) and specific surface areas of media.

11.5 Media

At the bottom of the biofilter, there must be a layer of very coarse (50-150mm particle size) hardwood media to optimise distribution through the whole biofilter. This should encompass approximately a third of the total biofilter bed depth. Eucalyptus type woodchips must not be used for this layer.

The majority of the remaining media must be a homogeneous mix of wood chips and compost with no more than 30% of the wood chips being soft woods. Particle size must be between 20mm and 60mm.

A top dressing of 25mm to 40mm of media with particle size of less than 40mm must be provided to aid in moisture retention.

Alternatives to the above may be acceptable as long as a proven track record can be provided for a minimum of 5 years of continuous operation showing good treatment and pressure loss characteristics.

11.6 Drainage system

Each section must have an installed underdrain system by which excess water is collected and discharged via a collection sump and pumped or gravitate to waste.

The sump must be designed to ensure occasional sampling of pH and conductivity can be conducted.

The drain line must have a swan necked lute or similar to provide a water seal and prevent foul air bypassing the biofilter by discharging through the drain line.

The underdrain and the area that the drain goes (for example a wet well) must be corrosion resistant.

11.7 Wall Structure

All open topped biofilter walls must be constructed out of, or lined with, non-corrodible materials.

Sloping walls are preferred for open topped biofilters. Where sloping walls cannot be provided, a short horizontal return placed at right angles to the side wall must be provided, as per Figure 1 below, to direct air flow towards the centre of the biofilter bed. This is to ensure foul air does not short circuit up the side walls after the media has compacted away from the wall.

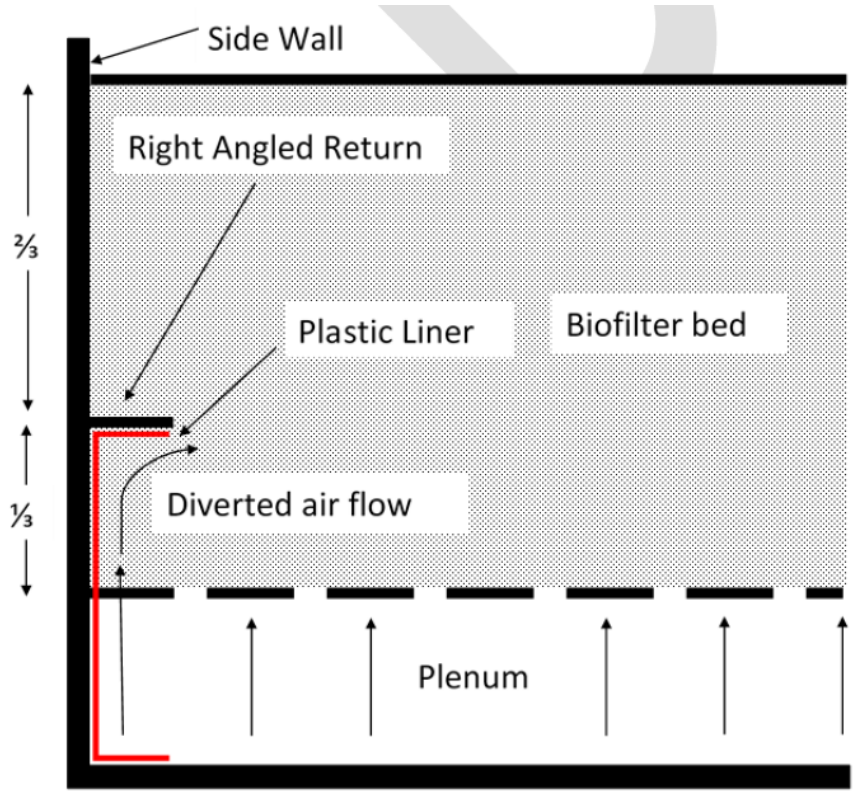

Figure 1 - Cross-section of right angle return on straight open topped biofilter walls

11.8 Irrigation

The moisture content of each section of the biofilter must be controlled through the use of an irrigation system (one per section of biofilter). The irrigation system must be run for a manually adjustable time. The flow rate must also be manually adjustable through the use of a diaphragm valve.

11.9 Monitoring and Control

Monitoring and control systems must be provided as detailed in Section 13 of this Specification.

12 OCU monitoring and Control Systems

12.1 General

These specifications relate to the monitoring of the OCU systems.

A discussion relating to requirements of specific on-line monitoring systems is provided in Section 13.2 and details on what systems are needed for each type of OCU in Section 13.3.

Instrumentation must be protected from sunlight, rain, magnetic fields, and vibration.

All instrumentation equipment must be selected from the Hunter Water approved products list unless written approval from Hunter Water is provided.

Fan operation must be monitored via SCADA including fan status (running, available, fault), power status (healthy, fault).

12.2 On-Line Monitoring Systems

Provide all the services, equipment, fixtures, and fittings required to achieve a complete, fully integrated, and operational monitoring system meeting all of the design conditions, testing requirements and warranty conditions as specified herein.

The monitoring system must comply with Hunter Water's STS 550 General Requirements for SCADA and Automation Systems and STS 500 - General Requirements for Electrical Installations.

A generic P&ID for on-line monitoring systems is provided in Appendix C .

12.2.1 Online H2S gas monitoring

12.2.1.1 General

H_2S gas is specifically referenced in this document as it is generally the predominant odorous sewer gas, and as such must be used as the online indicator gas for sewage odours that are present in the airstream at the inlet and outlet of an OCU.

In some cases, the Principal will specify additional odorants of interest, or different target odorants. Where these odorants can be monitored online, the below also holds for these gases.

12.2.1.2 When required, where to install

Bio filters and biotrickling filters installed at wastewater treatment works must be installed with permanent H_2S analysers that monitor the inlet, inter-stage and outlet OCU performance. Where an activitated carbon unit is used in conjunction with a biotrickling filter, the activated carbon unit must also be installed with permanent monitoring. For example, a biotrickling filter unit followed by an activated carbon unit, will

require an H_2S monitor on the inlet to the biotrickling filter, on the outlet of the biotrickling filter and on the outlet of the activated carbon unit.

For sites where permanent installations are not required, access for mobile H_2S monitoring equipment along with suitable means of attaching the equipment, must be provided on the inlet, inter-stage and outlet areas of the OCU to intermittently monitor performance. These access hatches must be a minimum of 120mm diameter and be lockable.

The H_2S analyser must be installed near the sampling port (a maximum of 6 m). This is to prevent the decomposition of sampled gases before presentation to the analyser.

12.2.1.3 Accuracy

H_2S analysers must be calibrated in ppm_v H_2S and have a local display as well as being connected to the SCADA or HMI.

The H_2S monitors must provide reliable on-line monitoring of H_2S in the monitored gas stream at the required accuracy (see Section 13.2.1.12 Analysers). The required accuracy will be determined by the designed output concentration. Sensors are to be selected with a measurement range appropriate for the expected H_2S concentrations.

12.2.1.4 Sampling lines and ports

Gas sampling arrangements must consist of sampling ports into the ductwork to ensure gas samples are not taken from the duct wall. Each of these sample ports must terminate in 12 mm full bore non-corrodible ball valves.

The outlet from the sampling port isolation valve is then piped to the condensate trap located in the monitoring cubicle. This line must either rise steadily to the condensate trap or have one high point only. There must be no low points that would act as water traps.

Sampling lines must also meet those requirements for pipework and/or tubing in Table 15.

12.2.1.5 Condensate Trap

A high volume (in the order of 150mL) condensate trap must be used. The trap must have a clear bowl to visually check its performance and must contain a suitable media to promote condensation. The trap will be connected to the suction side of the sample pump.

12.2.1.6 Drier

Humid air is often the cause of H_2S analyser poisoning. A nafion or similar de-humidifier must be provided so that the instrument is operating within its normal operating range.

12.2.1.7 Sampling Pump

A sample pump must be provided to withdraw gas from the sampling port (and the condensate trap if applicable) and provide a sufficient gas sample volume to the analyser.

The pump is to be of the positive displacement, diaphragm or high-speed graphite vane types or other suitably approved type, which provide a gas sample stream at constant flow and constant pressure to the

analyser. The pump is to be capable of withstanding system back pressure and must have a capacity of approximately 5 L/min at commissioning (a minimum flow of 1 L/min to the sensor).

12.2.1.8 Flow Control Valves

From the outlet of the sampling pump the flow must be split to two (2) flow control valves, one to control the flow to the H_2S analyser, and the other controlling a side waste stream that is piped back to the ductwork. One of these valves is typically incorporated into the flowmeter going to the H_2S analyser.

All flow control valves must be of the high tolerance needle type valve, with stainless steel fittings and accessories. The valves must be suitable to operate in the conditions of the online monitoring system, and must be sized to suit the required flowrate at midrange of the valve performance characteristics.

12.2.1.9 Flow Indicator

The flow indicator must be of the rotameter type, with a full-scale deflection of 1 L/min. The meter will be selected to ensure that all internal surfaces are suitable for the gases present in the sample airstream. The flow meter will be installed upstream of the analyser.

12.2.1.10 Manual Sampling Ports

Manual sampling ports must be provided on the inlet sample line as well as on the discharge of the sample pump, to allow manual gas testing. The sampling port must terminate in 12 mm full bore non-corrodible ball valve pointing upwards.

12.2.1.11 Return of Foul Air

Additional tapping points, typically two (2), will be required upstream of the OCU for return of the foul air samples from the H_2S meters.

12.2.1.12 Analysers

Analysers must be selected and installation designed for minimal maintenance, servicing or fouling.

Two principles of measurement must be acceptable for monitoring H_2S gas levels, these being Electrochemical cell or photo optical methods.

Electrochemical Cells

Electrochemical cell type sensors must be of proven design and capable of operating within the performance parameters and conditions described below.

Table 13 - Electrochemical Cells Specifications

ITEM	SPECIFICATION
Sampled Air Relative Humidity	15% to 90%
Temperature Range	-5°C to +40°C
Repeatability	2% of signal
Drift	Less than 5% per month

Operating Pressure	± 10% ambient
Output Signal	4 to 20 mA
Service Life	1 to 2 years
Response Time	Zero to +95% in 60 seconds
Recovery Time	1 to 5 minutes
Minimum Detection Limit	0.1 ppm_v
Maximum Range (inlet)	0 to between 100 to 1000 ppm_v as suited to the expected inlet concentrations

Photo Optical “Paper Tape” or “Chemcassette” method

The Principal will only accept this method of monitoring for the outlet of OCUs at WWTWs. The paper tape type sensors are particularly sensitive to variation in ambient temperature. Where there may be the likelihood of ambient temperatures more than 25°C, an air-conditioned controlled temperature environment must be provided in the monitoring cubicle, to ensure that the temperature of the paper tape cassette is maintained at 25°C.

Paper tape type sensors must be of proven design and capable of operating within the performance parameters and conditions described below.

Table 14 - Photo Optical Analyser Specification

ITEM	SPECIFICATION
Sampled Air Relative Humidity	15% to 90%
Ambient temperatures	-5°C to +40°C
Repeatability	2% of signal
Drift	less than 5% per month
Operating Pressure	± 10% ambient
Output Signal	4 to 20 mA
Service Life (tapes)	1-month average for LP tapes
Sample Time	10 minutes maximum
Lower Detection Limit	0.005 ppm_v
Minimum Range (outlet)	0 to between 1500 to 20,000 ppb_v as suited to the expected outlet concentrations.

12.2.1.13 Pipework, Tubing and Ancillary Fittings

All pipework, tubing and ancillary fittings (nominal internal diameter at least 6mm) within the sampling and monitoring systems must be as scheduled in the table below in order to be resistant to corrosion and chemical absorption.

Table 15 - Pipework, Tubing and Ancillary Fittings Specification

ITEM	SPECIFICATION
Pipework (rigid pipe)	All rigid pipework will be in uPVC
Tubing (Flexible)	All flexible tubing to be used only within the cabinet and will be PTFE (Teflon®) or equivalent and be connected to barbed hose fittings. Flexible tubing must be aligned to ensure there are no low points that can act as water traps.
Ancillary Fittings	All fittings that provide connection will be stainless steel grade 316 of the highest-grade compression type, providing proper seals to prevent low level gas escape.

All internal lines and surfaces are to be subjected to a passivation gas treatment in order to minimise chemical absorption.

All lines must be graded to prevent capture of moisture and pressure drops due to moisture entrapment. Pipework must provide a steady rise (preferred) or a maximum of one high point – no low points will be acceptable.

All rigid sample lines are to be fixed where applicable by proper clamps that are similar or equal to 'Stauff' type. Mechanical protection of sample lines will be provided in those areas where potential damage to the line may occur. All sample lines are to be kept to a minimum length.

Materials of construction for the pipework that has not been specified will not be accepted.

12.2.1.14 Monitoring cubicle

All electronic components of the monitoring system must be mounted in a cubicle compliant with STS 500.

The cubicle must nominally contain all required H_2S monitors and possibly others, such as LEL and differential pressure, transmitters. Careful layout of this cubicle is required with regard to levels to achieve steady grading of all sample tubing while also achieving a practical layout that allows both easy reading of displays and easy access for maintenance.

12.2.2 Differential Pressure Gauges

Differential pressure gauges must be calibrated in Pascals. They must be provided to measure the head loss across the equipment of interest. The connections to the gauge must be a minimum 10mm uPVC with condensate pots on both connections.

At most sites, only a local pressure gauge display is required. However for some sites, as directed by Hunter Water, in addition to a local display the device is to be connected to the Hunter Water SCADA system and HMI (if provided) and set with a high pressure loss alarm.

12.2.3 Air Flow Switches

Air flow switches must be provided for all installed fans.

Airflow monitors (one flow switch per fan outlet) must be provided to indicate whether a fan is running when called to operate. Failure of air flow must initiate Duty / Fan change-over (where one is present),

with failure of airflow used to lock out operation of any duct heater (and any other equipment of concern). The airflow monitor must be installed on the downstream side of the fan and upstream of the fan isolation damper valve.

12.2.4 Water Flow Indicators

Where water flow indicators are on lines less than 50mm, local indication only must be required. For flow indicators on lines greater than 50mm, a flow transmitter must be provided with data being sent back to the SCADA or HMI, as well as a local indication.

12.2.5 Temperature Transmitters

If a heater is required then temperature transmitters must be provided on the inlet and outlet of the heater unit, as well as on the activated carbon OCU outlet. These transmitters must be calibrated in degrees Celsius (°C) and must have a local display. The heater outlet and activated carbon outlet temperature transmitters must be set with a high temperature alarm that causes the heater to be shut off automatically. In addition, the outlet temperature transmitter must be connected to the Hunter Water SCADA and HMI (if provided).

12.2.6 LFL monitors

If the OCU is ventilating from a part of the sewer that has been identified as being a Zone 0 or Zone 1 area (as defined following investigation in Section 7.10), a Lower Flammable Limit (LFL*) monitor must be provided and the OCU must be interlocked to shut down the unit at >5%**

NOTE: * LFL is defined as the concentration of flammable gas, vapour or mist in air below which an explosive gas atmosphere will not be formed. For methane, the LFL is 5% (by volume) in air.

** Where the LEL has the potential to be >5% there will need to be an assessment on whether the installation is in a Zone 2 classified area. The definition of a Zone 2 classified area is a place in which an explosive gas atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist is not likely to occur in normal operation but, if it does occur, will persist for a short period only. If so, appropriate requirements are to be included.

12.2.7 Calibration

Calibration must be provided on all equipment supplied within the sampling and monitoring system. The calibration of all analysers, whether they are of the electrochemical or the photo optical type, will be carried out in accordance with either of the approved methods as detailed in the following;

- AS 3580 Method 2.1 – “Preparation of Reference Test Atmospheres – Permeation Tube Method”
- AS/NZ 3580 Method 2.2 – “Preparation of Reference Test Atmospheres – Compressed Gas Method”

Where proprietary calibration methods are used in checking the calibration of an analyser, the complete unit will be required to undergo calibration checks on a scheduled basis, to ensure that the total unit, and not simply the equipment electronics, is in full calibration.

12.3 Monitoring and Control Requirements for Different Types of OCUs

All OCUs must be designed for unmanned remote operation fully automated with allowance for manual operation.

Sites are subject to power failure. The equipment must be designed for automatic restart when the power returns.

The monitoring and control requirements for each type of OCU are detailed below.

The section below presents baseline monitoring requirements, along with additional monitoring requirements which may be required at the direction of Hunter Water. The OCU Designer is to contact Hunter Water's Wastewater Network Operations Team to seek direction on monitoring requirements at Concept Design Phase (wwnomailbox@hunterwater.com.au).

12.3.1 Passive Activated Carbon Type OCU

No online monitoring or control system must be provided for these types of OCUs

12.3.2 Mechanically Assisted Activated Carbon Type OCU

The following must be provided on all mechanically assisted activated carbon type OCUs:

- Three permanent sampling ports must be provided on the adsorber, each at increasing depths across the activated carbon media bed (for example, at 25%, 50% and 75% of the bed depth). These must be terminated in 12mm full bore ball valves and be designed to withdraw a representative gas sample at that depth without blockage or escape of the carbon media.
- One air flow switch must be provided. This will generate a no flow alarm when activated and the alarm will be shown on the HMI (if provided) and sent to the WWTW or the HQ SCADA system. The activation of the no flow alarm will shut down the fan. If an installed Standby fan is provided, duty rotation will then occur.
- Differential pressure transmitter must be provided across the pre-filter. This must alarm on SCADA if the differential pressure is greater than a pre-set value.
- Differential pressure gauge (local indication only) over the activated carbon media bed.

Where a heater is installed, the following will also be provided:

- Temperature transmitters on the inlet and outlet of the heater will be provided with local display and data sent to the HMI and WWTW or Head Office SCADA. Heater outlet temperature will alarm if going above a user adjustable value (nominally 50˚C)
- Temperature transmitter on bed outlet will be provided with local display and data sent to the HMI and WWTW or Head Office SCADA. Outlet temperature will alarm if going above a user adjustable value (nominally 50˚C) indicating bed fire.
- A no flow alarm from the fans, which if sustained will shut down the heater
- When the heater is off, an alarm will register. This must be masked when the fan is off.

Where specified by Hunter Water, the following additional monitoring is to be provided:

Additional monitoring - Level 1:

- Differential pressure transmitter over the activated carbon media bed.

- An alarm when the pressure loss is greater than a pre-set value (nominally 500 Pa).

Additional monitoring - Level 2:

- Requirements of Level 1
- H_2S analysers on the inlet and outlet of the OCU. If there is a biological stage prior to the activated carbon unit, the inlet analyser can be combined with the outlet from the biological stage so only one analyser needs to be provided as inter-stage. To clarify, sites with a biological stage, followed by an AC stage will require 3 H_2S analysers in total.
- An alarm on the outlet of the OCU when the H_2S is greater than a pre-set value (nominally 1ppm_v)

12.3.3 Biotrickling Filter Type OCU

The following must be provided on all biotrickling filter type OCUs:

- One air flow switch must be provided. This will generate a no flow alarm when activated and the alarm will be shown on the HMI and sent to the WWTW or the Head Office SCADA system. The activation of the no flow alarm will shut down the fan. If an installed Standby fan is provided, duty rotation will then occur.
- Differential pressure transmitter must be provided across the pre-filter (where installed). This must alarm if the differential pressure is greater than a pre-set value.
- Differential pressure transmitter must be provided across the biotrickling filter media (one per bed). This must alarm if the differential pressure is greater than a pre-set value (nominally 1,000 Pa).
- High level switch must be provided in the sump. This must generate an alarm when activated and indicate a blockage on the drain line.
- Water flow transmitter must be provided on the water supply line.
- 'No flow' switch must be provided on the potable water supply line. This must generate an alarm when the solenoid is open and the switch is activated indicating no water flow to the system.
- pH meter must be provided in the sump discharge line. This will alarm when the pH falls outside of a pre-set range (both high and low)

Where a recirculation system is installed, the following will also be provided:

- pH meter must be provided on the recirculation line instead of in the sump discharge line. This will alarm when the pH falls outside of a pre-set range (both high and low)
- Flow switch must be provided on recirculation line. This will alarm and cause duty changeover of pumps when activated.
- Level indicator must be provided in the contactor sump.

Where a nutrient storage and dosing system is provided, the following will also be provided:

- Low level switch on nutrient storage tank. When activated, this will interlock the dosing pump.
- Level switch on nutrient storage tank. When activated, this will indicate more nutrient should be ordered.

Where specified by Hunter Water, the following additional monitoring is to be provided:

- H_2S analysers on the inlet and outlet of the OCU. If there is an activated carbon stage after the biotrickling filter, the outlet analyser can be combined with the inlet from the activated carbon stage so only one analyser needs to be provided as inter-stage. To clarify, sites with a biological stage, followed by an AC stage will require 3 H_2S analysers in total.
- An alarm on the outlet of the OCU when the H_2S is greater than a pre-set value (nominally $1ppm_v$)

12.3.4 Biofilter Type OCU

The following must be provided on all biofilter filter type OCUs:

- One air flow switch must be provided. This will generate a no flow alarm when activated and the alarm will be shown on the HMI and sent to the WWTW or the HQ SCADA system. The activation of the no flow alarm will shut down the fan. If an installed Standby fan is provided, duty rotation will then occur.
- Differential pressure transmitter must be provided across the prefilter (where installed). This must alarm if the differential pressure is greater than a pre-set value.
- Differential pressure transmitter must be provided across the biofilter media (one per bed). This must alarm if the differential pressure is greater than a pre-set value (nominally 1,000 Pa).
- High level switch must be provided in the sump. This must generate an alarm when activated and indicate a blockage on the drain line.
- 'No flow' switch must be provided on the potable water supply line. This must generate an alarm when the solenoid is open and the switch is activated indicating no water flow to the system.

Where specified by Hunter Water, the following additional monitoring is to be provided:

- H_2S analysers on the inlet and outlet of the OCU. If there is an activated carbon stage after the biofilter, the outlet analyser can be combined with the inlet from the activated carbon stage so only one analyser needs to be provided as inter-stage. To clarify, sites with a biological stage, followed by an AC stage will require 3 H_2S analysers in total.
- An alarm on the outlet of the OCU when the H_2S is greater than a pre-set value (nominally $1ppm_v$)

12.3.5 Open topped biofilter Type OCU

The following must be provided on each bed of all open topped biofilter type OCUs:

- One air flow switch must be provided. This will generate a no flow alarm when activated and the alarm will be shown on the HMI and sent to the WWTW or the HQ SCADA system. The activation of the no flow alarm will shut down the fan. If an installed Standby fan is provided, duty rotation will then occur.
- A differential pressure transmitter must be provided across the open topped biofilter with one side of the transmitter measuring discharge from the fan(s) and the other side open to atmosphere. This must alarm if the differential pressure is greater than a pre-set value (nominally 1,000 Pa). This must alarm if the differential pressure is less than a pre-set value (nominally 100Pa).
- A low flow switch must be provided on the water supply line to the humidifier.

13 Commissioning

13.1 General

Commissioning is the process of firstly checking the performance of individual elements of the new works and then the checking and tuning of the system as a whole, to bring the works into service. It is also validating the overall performance outcomes of the system against those targeted.

Commissioning will proceed along the following steps:

(1) Factory Acceptance Testing – This testing ensures that the OCU will likely be able to perform before shipping.
(2) Site Commissioning (Site Acceptance Testing) – This testing ensures that the OCU will continuously operate as intended after being installed in the field.
(3) Performance Testing (Proof of Performance Testing) – This testing ensures that the continuously operating OCU will meet its relevant performance requirements.

Plans covering steps (1) *pre-commissioning* and (2) *site commissioning* are to prepared and submitted to the Principal in accordance with requirements as set out in the project specification and Sections 14.2 and 14.3 of this document.

A separate **Performance Testing Plan** (covering Step 3), that is specific to the new OCU installed, is to be prepared in accordance with requirements in Section 14.3.1 of this document.

13.2 OCUs - Factory Acceptance Testing

Pre-Commissioning of the OCU must be carried out at the factory, prior to transportation to the relevant sites. The nominated representative must inform the Principal two weeks prior to when the Factory Acceptance Testing will occur so the Principal or their representative can attend if desired. The pre-commissioning work must include the following if applicable:

- Running of the OCU and the testing of each fan's operation against its performance curve and design operating point.
- Testing of the control logic, sensors and programming.
- Testing of fail-safes and HMI/SCADA alarms.
- Testing of dosing units, including pipe work, if pre-constructed.
- Structural integrity of OCU vessels.
- The whole structure of each OCU must be examined for any fugitive emissions that may be the result of leaks.
- Vacuum and pressure testing.
- Air flow rates and designed retention times are to be confirmed.
- Noise testing using certified testing equipment.

The OCU must not be transported to site until the Principal's representative has accepted the tests.

13.3 OCUs and Site Commissioning (Site Acceptance Testing)

Following installation, the OCU must be test run must be, to the satisfaction of the Principal, for a minimum period of fourteen (14) consecutive days, without any major faults or alarms requiring attendance on site.

Conduct on site performance tests to the Principal's satisfaction. At a minimum, the following must be checked or carried out:

- Pressure, relative humidity, and flow rate of inlet and outlet gases
- Equipment operation and adjustment checks.
- Casing and insulation joint testing, for example, using soap bubble test at operating pressure.
- Noise testing using certified testing equipment.
- Structural inspection by a certified Structural Engineer.
- Smoke testing showing flow distribution (Open topped biofilter type OCU only)
- Controls and Alarms

During the test run period, maintain the OCU in a proper working manner. The unit must be used to demonstrate system performance to the Principal's satisfaction. Carry out any work necessary to ensure the OCU is working correctly. At the end of this period, issue a certificate to verify that the unit is working properly.

Supply all WAC Drawings, O&M Manuals along with trouble shooting guidelines and these must be verified during the commissioning period. The O&M Manuals must be in accordance with STS 906.

13.3.1 Integrity of Ductwork System

The complete ductwork system, through the main duct, adsorber inlet and outlet ducts, any bypass duct and stacks, must be completely gas tight and soap bubble tested at the operating pressure of the OCU. The principal has the right to request a leakage test (as defined in ASHRAE) to prove that an airtight system has been achieved. All vessels must be pressure / vacuum tested in accordance with the relevant code.

13.3.2 Noise

All noise testing must comply with NSW EPA's The Protection of the Environment Operations (Noise Control) Regulations 2017 – Approved methods for Testing Noise Emissions. Measured noise levels must comply with those stated in Table 9.

13.4 OCUs and Performance Testing (Proof of Performance Testing)

13.4.1 General

Performance testing applies to all OCUs, except passive activated carbon units.

Field performance tests must be carried out after Factory Acceptance Testing and Site Acceptance Testing of the plant and, for biological systems, after any Contractor nominated acclimatisation period. Whilst the intent of the Site Acceptance Testing is to ensure the OCU operates reliably (as in the fans and

other equipment continue to work as intended), the intent of the Proof of Performance Testing is to show that the OCU achieves the necessary performance.

13.4.2 Aspects of Performance Testing

Undertake performance and systems tests to demonstrate acceptable performance, as defined by:

- Successful operation of each item of equipment during the Performance Test.
- Overall system operation meets the performance criteria described in this specification, including correct operation in all control modes, e.g. in manual, local, and auto control.
- Inlet gas contaminant removal performance meets the criteria provided in this specification.
- Foul air flow rate meets the criteria specified in the Technical Data Sheets.
- The maximum pressure loss for effective operation of the OCU as determined in design.
- Utility use (power, water and chemical) meet the values determined during design.

Supply all test materials, temporary test equipment, consumables and experienced personnel required to demonstrate compliance with the specification.

Operate and be responsible for test equipment used during performance testing. Before making any changes to the OCU that could affect equipment or processes external to the OCU, advise the plant operators or, in the case of the unit being at a pumping station, the Principal of the intended change.

The Principal has the right to observe, sample, and carry out any tests in parallel during performance testing.

The Principal will give notice in writing of final acceptance following the successful completion of the performance testing.

13.4.3 Performance Testing Plan

A Performance Testing Plan must be submitted to the Principal for approval 4 weeks prior to commencing the testing.

Scope of the plan is to include the following:

- The proposed performance assessment time frame.
- Methods for verification of the performance requirements and acceptance criteria listed in Section 7.3 and 7.4, and in accordance with requirements in this document section.
- Methods to obtain all measurements and make calculations.
- Contingency plans for wet weather

13.4.4 When tests can be carried out

Timing performance testing

The following conditions must be satisfied for performance testing to be carried out:

- OCU equipment has reached its optimal operational set-up.
- There are normal operating conditions at the WWTW, or if OCU is in the network - normal network conditions.

Specifically, *odour* and *contaminant* performance assessment must only be carried out:

- During dry weather: Following wet-weather, testing must not be undertaken until the plant has recovered to dry weather H_2S concentrations and flow conditions. Timing for this is to be confirmed with Hunter Water, and will be no sooner than 1 week after a significant rain event .
- Between the month of November to April (inclusive): In the situation where commissioning is planned for the period May until October (inclusive), testing of aspects other than odour and contaminant removal performance can be carried out, however these tests will need to be completed during warmer conditions.

The Principal must approve of the proposed performance assessment time frame.

Prior to performance testing

Before performing any tests, arrange with the Principal to inspect the installation. When the following prerequisites are completed, the Principal will confirm a time for conducting the performance tests:

- The Principal has inspected the plant after commissioning and is satisfied with the installation and its function.
- All documentation associated with commissioning have been received and approved by the Principal.
- All test equipment used during tests must have a current calibration certificate (issued within the preceding 12 months) verifying its accuracy.

13.4.5 Operation during test period

No manual adjustment of valves or instrumentation associated with the OCU will be allowed during the test period.

Over the period, the foul air flow rate through the OCU and the OCU inlet gas pressure must be maintained as close as practical (+/- 5%) to the design conditions.

13.4.6 Sampling

The type of sampling required to confirm system performance against requirements in Section 7.3 is outlined in Table 16.

Table 16 – Type of performance assessment sampling

Performance Parameter	Sampling for performance assessment	
	Discrete	Continuous
Contaminants		
Hydrogen sulphide (H_2S)	x	X
Dimethyl sulphide (DMS)	x	
Mercaptans (R-SH)	x	
VOC (as isobutylene)	x	
Ammonia	x	
Other		
Odour Units (ou)	x	

Pressure differential from extracted headspace		X

13.4.6.1 Discrete sampling

The number of discrete gas samples required for analysis of contaminants and odour is as per Table 17.

Samples are to be collected on either side of an odour control unit. One sample set is comprised of two samples, one on the “inlet” side of the OCU, and one on the “outlet" side of the OCU. The inlet and outlet samples should be taken at approximately the same time to allow removal efficiency performance to be calculated. For units that are a biological process followed by AC, sampling is to occur for both units to determine individual removal efficiency and maximum outlet concentrations. The sample between the units can be considered the “outlet sample” for the biological process and the “inlet sample” for the AC.

Table 17 - Contaminant removal grab sample requirements

OCU Location	No. of sample days	Sample days	No. of sample sets per day[NOTE 1]	Total no. of samples [NOTE 2]
WWTW	7	Non-consecutive, and inclusive of one weekend day	2	28
Major WWPS	3	Non-consecutive, and inclusive of one weekend day	2	12
All other WWPS	2	Consecutive days	2	4
Table Notes				
Note 1: *Each set of inlet/outlet samples must be taken at greater than 1-hour intervals, and the samples should be taken at the time of the day when the OCU is most likely to receive the peak odour load (notionally from about 9 am till 12 pm).* ***Note 2:*** *If the biological process is followed by an AC unit the total number of samples taken will be increased by 50%.*				

Sample collection, transportation and analysis

The collection, transport and analysis of the odorous air samples must be carried out in accordance with the requirements AS/NZS 4323.1 and 4323.3.

Care must be taken to prevent the contamination of the sampling and analysis equipment of the low odour samples by the high odour samples.

Laboratory analyses must be done by an independent NATA accredited testing group or university lab. The testing group proposed must be reviewed and accepted by the Principal.

13.4.6.2 Continuous sampling

H_2S Sampling

Continuous H_2S gas data is to be collected simultaneously by instruments deployed on the OCU inlet AND outlet gas stream(s).

If permanent instrumentation is set up as part of this system this data can be used, else portable instruments are to be set up for the test period.

The continuous H_2S monitoring instruments are to be provided with a recent calibration certificate showing proper calibration of the instrument. For the inlet airstream, a 0-200 ppm_v range (or 0-1,000ppm_v range if the average is anticipated to be 50ppm_v or greater) and for the outlets a 0-10 ppmv range will be used with a resolution of 0.1 ppmv or lower.

Table 18 specifies the duration and resolution of continuous H_2S gas data to be collected and analysed against the performance criteria in Section 7.3.

Table 18 – Continuous H_2S monitoring requirements

OCU Location	Continuous monitoring period	Minimum sampling resolution
WWTW	14 days	1 sample per minute
Major WWPS	14 days	1 sample per minute
All other WWPS	7 days	1 sample per minute

Pressure differential sampling

Requirements for pressure differential sampling between the OCU treated headspace and the ambient environment are as per those detailed in Table 6, Section 7.3.

13.4.7 Analysis of Results

The collected sampling data must be used to assess OCU performance against the requirements in Section 7.3 of this document.

13.5 Reporting

Within 10 working days of the completion of the test period, provide to the Principal a written test report showing all laboratory and field test results. The report must state the conclusions of the tests with reference to the performance criteria. It must include copies of the performance test data log.

All tests and inspections must be documented identifying the date of the test, inspector's name, equipment used, results, and any adjustment action taken.

13.6 Performance failures

If the OCU fails to meet the performance requirements, the problems must be rectified immediately. Carry out all work necessary to ensure and prove that the equipment achieves the specified performance, at no extra cost to the Principal. When rectification work is complete, the equipment must be retested to verify that the specified performance has been achieved.

If after two re-tests the performance requirements are still not met, then at the Principal's discretion only, the Principal may elect to accept the system as is, make system modifications at the sole expense of the Contractor, or obtain a replacement at the expense of the Contractor. If system modifications are deemed necessary, additional tests must be performed until performance requirements are proven to be met. All costs associated with re-testing must be borne by the Contractor.

The maximum time between each re-test will be 30 days.

14 Document Control

Document Owner:

Required Reviewers:

Document Approver:

Document review date is as per the Integrated Management System Standard (HW2013-421/22.002).

Version	Author	Details of Change	Approval Date	Approved By
1	Hunter Water: Planning & Engineering	Initial release	9 Dec 2024	Executive Manager Customer Delivery

Appendix A: Standards and related documents

Standards

For clarity, where a Standard has several Parts and/or Amendments and/or Supplements, the Reference Number is for the leading Part of the Standard and the Title notes what additional elements are included.

Table 19 - Standards

Reference Number	Title
AS/NZS ISO 9001:2008	Quality Management Systems – Requirements
American Society for Testing and Materials	
ASTM D2563	Standard practice for classifying visual defects in glass-reinforced plastic laminate parts

Reference Number	Title
ASTM D2854	Standard test method for apparent density of activated carbon
ASTM D2862	Standard test method for particle size distribution of granular activated carbon
ASTM D3802	Standard test method for ball-pan hardness of activated carbon
ASTM D6646	Standard test method for determination of accelerated hydrogen sulfide breakthrough capacity of granular and pelletized activated carbon
Australian Standards	
AS 1324.2	Air filters for use in general ventilation and air conditioning - Methods of test
AS 1939	Degrees of protection provided by enclosures for electrical equipment (IP Code)
AS 3580.2.1	“Preparation of reference test atmospheres – permeation tube method”
AS 1345	Identification of the contents of pipes, conduits and ducts
AS 4254	Ductwork for air handling systems in buildings
AS 1657	Fixed Platforms, Walkways, Stairways and Ladders – Design, Construction and Installation.
AS 4775	Emergency eyewash and shower equipment
Australian and New Zealand Standards	
AS/NZS 4323.1	Stationary source emissions – Selection of sampling positions
AS/NZS 4323.3	Stationary source emissions - Determination of odour concentration by dynamic olfactometry
AS/NZS 3580.2.2	Methods of sampling ambient air - Compressed gas method
AS/NZS ISO 9001	Quality management systems
AS/NZS 60079	Classification of hazardous areas
European Standards	
EN 13121	GRP tanks and vessels for use above ground
BS 4994	Specification for design and construction of vessels and tanks in reinforced plastics
WSA 201 - 2017	Manual for selection and application of protective coatings
ISO 6141	Gas analysis – Contents of certificates for calibration gas mixtures
ISO 6142	Gas analysis – Preparation of calibration gas mixtures – Part 1
ISO 6143	Gas Analysis – Comparison Methods for Determining and Checking the Composition of Calibration Gas Mixtures
DVS 2207	Welding of thermoplastics – Heated element welding of pipes, piping parts and panels made out of polyethylene
DVS 2205	Calculations of thermoplastic tanks and apparatus

Reference Number	Title
Other Standards	
SMACNA-1546-1997	Thermoset FRP duct construction manual

Other related documents:

The following documents are referred to in this Specification.

“Air Pollution Measurement Manual” – A Practical Guide to Sampling & Analysis, Volumes 1 & 2, Clean Air Society of Australia and New Zealand (CASANZ)

“Handbook of Air Pollution Analysis”, edit. Roy M. Harrison & Roger Perry. Chapman & Hall, printer/publisher: University Press, Cambridge 1986 ISBN 0412 244101

IEEE Standard 1349 – Guide for application of electric motors, Class 1 Division 2: Hazardous (Classified) locations

“Technical framework: Assessment and management of odour from stationary sources in NSW” – Environmental Protection Agency (NSW), 2006

“Technical notes: Assessment and management of odour from stationary sources in NSW” - Environmental Protection Agency (NSW), 2006

“Protection of the Environment Operations Act 1997 (POEO Act) No. 156”, Legislation NSW, 1997

“Noise Policy for Industry”, Environmental Protection Authority, October 2017

Hunter Water Standards

Hunter Water’s Standard Technical Specification (STS) 105 - Security at Hunter Water Corporation Assets

Hunter Water’s Standard Technical Specification (STS) 500 – General Requirements for Electrical Installations

Hunter Water’s Standard Technical Specification (STS) 550 – General Requirements for SCADA and Automation Systems

Hunter Water’s Standard Technical Specification (STS) 600 – General Mechanical Requirements

Hunter Water’s Standard Technical Specification (STS) 640 – Lifting Equipment

Hunter Water’s Standard Technical Specification (STS) 670 – Chemical Storage and Delivery Systems

Hunter Water’s Standard Technical Specification (STS) 903 – Work As Constructed (WAC) Information

Hunter Water’s Standard Technical Specification (STS) 904 – Preparation of Electrical Engineering Drawings

Hunter Water’s Standard Technical Specification (STS) 906 – Operation and Maintenance Manual Requirements

Hunter Water's Standard Technical Specification (STS) 911 – Preparation of Civil, Structural and Mechanical Engineering Drawings

Sewerage Code of Australia (Hunter Water Edition) WSA 02-2002-2.1

Sydney Water Standards

Deemed To Comply Drawing for Facility Fencing DTC-5000 and 5001

Sydney Water's Supplement to WSA 201

Appendix B - Example Ventilation Calculations

Example 1: rising main discharge with no fan

If a gravity sewer downstream from a rising main discharge is to have only passive extraction (no fan) and has an upstream fixed speed pump rate of 20 L/s then:

> The required minimum flow rate based on 70% of the upstream sewer plump flowrate is: 70% of 20 L/s = 14 L/s.

Example 2: rising main discharge with a fan

If a gravity sewer downstream of a rising main discharge is intended to be ventilated by a fan, has a sewer headspace volume of 100 m^3, an upstream fixed pump rate of 20 L/s, an expected maximum velocity of 1 m/s and a dry portion cross section area of 0.075 m^2 then:

> The required minimum flow rate based on air changes per hour is: 1 / h x 100 m^3 / 3,600 s/hr x 1,000 L/m3 = 27.8 L/s.
>
> The required minimum flow rate based on 120% of the upstream sewer pump flowrate is: 120% of 20 L/s = 24 L/s.
>
> The required minimum flow rate based on 120% of the maximum velocity of the wastewater multiplied by the cross-sectional area of the dry portion of the sewer is: 120% of 1m/s x 0.075 m^2 x 1,000 L/m^3 = 75 L/s.
>
> The required minimum flow rate is the greatest of the three, being 75 L/s.

Example 3: wastewater pump station

If a WWPS wet well has a headspace volume at the lowest operating level of 18 m^3 and the measured 99th percentile positive (i.e. filling) rate of level change is 180 mm/min with a 10m^2 surface area then:

> The required minimum flow rate based on air changes per hour is: 6 /h x 18 m^3 x 1000 L/m^3 / 3600 s/h = 30 L/s.
>
> The required minimum flow rate based on 120% of measured 99th percentile level change is: 120% of 180 mm/min x 10m2 / 60 s/min x 1000 L/m^3 / 1000 mm/m = 36 L/s
>
> The required minimum flow rate is the greater of the two, being 36 L/s.

Example 4: wastewater treatment works – inlet works

The aerated grit removal system within an inlet works of a WWTW has a headspace volume at the lowest operating level of 120 m^3, an expected level change of up to 180 mm/min with a surface area of 80 m^2, and an aeration rate of 540 m^3/hour then:

The required minimum flow rate based on air changes per hour is: 12 /h x 120 m^3 x 1000 L/m^3 / 3600 s/h = 400 L/s.

The required minimum flow rate based on 120% of expected level change is: 120% of 180 mm/min x 80m^2 / 60 s/min x 1000 L/m^3 / 1000 mm/m = 288 L/s.

The required minimum flow rate based on 120% of instantaneous air release into the inlet structure headspace is: 120% of 540 m^3/h x 1000 L/m^3 / 3600 s/h = 180 L/s.

The required minimum flow rate is the greatest of the three, being 400 L/s.

Example 5: wastewater treatment works – secondary treatment process

The anoxic zone of a secondary treatment process of a WWTW has a headspace volume at the lowest operating level of 120 m^3, an expected level change of up to 0 m^3/h (it is weir controlled) and an aeration rate of 0 m^3/h (there is no aeration) then:

The required minimum flow rate based on air changes per hour is: 6 x 120 m^3 x 1000 L/m^3 / 3600 s/h = 200 L/s.

The required minimum flow rate based on 120% of expected level change is: 120% of 0 m^3/h 1000 L/m^3 / 3600 s/h = 0 L/s.

The required minimum flow rate based on 120% of instantaneous air release into the anoxic zone structure headspace is 120% of 0 m^3/h 1000 L/m^3 / 3600 s/h = 0 L/s.

The required minimum flow rate is the greatest of the three, being 200 L/s

Appendix C - Reference P&IDs for Odour Control Units

List of Reference P&ID listed below are available on STS 680 P&IDs combined file:

P001 – Mechanically assisted activated carbon filter

P002 – Passive activated carbon filter

P003 – Biotrickling filter

P004 – Enclosed biofilter

P005 – Open topped biofilter

P006 – H_2S monitoring system

P007 – Treated air to stack

Appendix D - OCU Selection Guidance

Guidance on relative differences between OCUs

This appendix provides background information for Designers on the process for OCU selection and design.

Different types of OCU have different performance characteristics. These must be considered thoroughly when selecting the type of OCU that will perform best given:

(1) the type and concentration of odorous components (including variability),

(2) the flowrate of foul air to be treated (including variability), and

(3) the level of treatment required given the local amenity considering both sensitivity to odour issues, and sensitivity to visual amenity.

Attention must also be given to the installation and operation and maintenance requirements of the unit. Key site installation constraints include available space, ease of access, availability of electricity/water to site, proximity to sensitive receptors, and the need to clear vegetation. Operation and maintenance considerations include expected replacement frequency of media/filters and ease of changeover process, consumption of water, availability of critical spare parts, and anticipated frequency of minor service visits.

A summary of the different types of odour control systems is provided in Table 15.

Table 20 - Summary of odour control systems

	Activated Carbon Filters	**Biotrickling Filter**	**Biofilter (enclosed)**	**Open Topped Biofilter (Soil Bed)**
Description	Odorous contaminants removed through physical and chemical adsorption onto activated carbon media. Well suited in areas where no/low services are present. Mechanically assisted units include a fan downstream of the media. These are used where without fans, foul air could escape through other air pathways. Passive units are well suited for intermittent loads. No fan is provided. These are suited where foul air cannot escape through other areas.	Biological processes remove odorous contaminants, but media is inert meaning nutrients need to come from an external source. Irrigation water can be recirculated for high contaminant loadings, or once through for lower loadings.	Uses media as area for biological processes to remove odorous contaminants. Nutrients for biological processes come from the media itself. Irrigation is once through only.	Biological processes remove odorous contaminants, but media is inert meaning nutrients need to come from an external source. Irrigation water can be recirculated for high contaminant loadings, or once through for lower loadings.
Relative land use	Low	Low	High	High
Relative energy input	Low	Medium	Low	Low
Relative water use	None	High	Medium	Medium to High
Relative operating cost	High	Low	Low	Low
Dispersion characteristics of treated air	Good	Good	Good	Poor

Chemical scrubbers type OCUs must only be considered in treatment plants. Chemical scrubbers are not permitted at sewage network facilities. This is due to the hazardous nature of the chemicals used. Note that chemical scrubbers are not covered in this specification and will only be approved under certain circumstances where the justified benefits outweigh the risks.

Open-topped biofilters (i.e. soil beds) have poor dispersion characteristics of treated air compared to other technologies. They are not suitable for areas where urban encroachment is likely. The use of open topped biofilters will only be considered at WWTWs where a suitable buffer zone is present. Open topped biofilters must only be considered when average hydrogen sulphide concentration does not exceed 10ppm and the peak concentration of any contaminant does not exceed 4 times the average concentration for that contaminant.

Selection considerations

In selecting an odour control unit, the following must be considered:

- Variability in load
- Quantum of load
- Amenity

Variability in Load

This characteristic is used to describe the nature of the odour problem. Intermittent loads suit treatment by OCUs which involve variations on activated carbon, whereas stable loads are more suited to OCUs involving biological treatment.

If the load (i.e. the flow and concentration combined) is intermittent, or highly variable, as is common from releases from automatic air valves on rising mains, a biological solution will not be suitable. This is generally when expected peaks are over 4 times greater than average loads, or where flow is non-continuous. This is because biological treatment requires a relatively stable load to allow the biomass to grow.

Quantum of Load

This characteristic is used to describe the nature of the odour problem. Loads that are generally greater than 50ppm would be considered high loads. Discharges with high loads where biological treatment is recommended require a biotrickling filter, rather than a biofilter.

Amenity

Amenity is about assessing how much the local populace value their surroundings, and balancing the impacts of installing new odour control infrastructure (such as visual and noise) against the benefits of reducing unpleasant sewer odours.

Considering amenity in OCU selection requires assessment of

(1) number of sensitive receptors exposed to odour nuisance
(2) e (including how close they are located to the odour generation site and the expected quantum and variability of odour load)
(3) the type of sensitive odour receptors (e.g. permanent residents, holiday makers, businesses, schools),
(4) and the expectations of receptors for odour management.

Areas with higher levels of odour sensitivity should include odour control units which have an activated carbon polishing stage.

Appendix E - Design development guidelines

Deliverable Summary

In the situation where an OCU is being delivered through conventional investigation and delivery phases, a summary of deliverables for each phase is provided below. Note that for smaller projects as nominated by Hunter Water, not all deliverables listed below will be applicable.

Concept Design

- Concept design report (for requirements see Appendix E - Design development guidelines).
- General site layout
- Piping and instrumentation diagram
- Details and price of any activated carbon intended to be used

Detailed Design

- All relevant drawings of the OCU and connection details
- Calculations substantiating:
    - the amount of carbon to meet the carbon bed life specified (if using activated carbon) and/or
    - the choice of BTF or Biofilter media to meet the required performance and life span and/or
    - the size of the open topped biofilter.
- Materials of construction of the OCU and Ductwork
- Risk assessment report (i.e. review of hazardous zoning)
- Fan performance curves
- Price for supply and lead time of additional fans
- Electrical circuit layouts
- Control panel layout
- List of critical spare parts

Commissioning Phase (handover)

- Testing and Commissioning Plan
- Performance Testing Plan
- Certificate verifying the unit is working properly
- All relevant WAC drawings compliant with STS 904 and STS 911
- O&M Manual as per STS 906
- An analysis sheet for any batch of activated carbon media provided

- Any other files created have to be relevant to the design/management of OCU, as editable file copies in a format suitable for the Principal (for example, Microsoft Word and Excel documents, AutoCAD for drawings and so on and compliant with other relevant Hunter Water STSs)
- Report on Performance testing results
- Operation and maintenance training

Concept Design Development

For delivery of OCUs that are to follow conventional Concept Design, the below text outlines the expected design considerations.

All features that may affect the design, operation and maintenance of the OCU must be documented and considered in the concept design.

Data for the design of an OCU must be collected and clearly documented including all calculations and assumptions.

The submitted information must include, but not be limited to:

- Concept design report including:
    - Background Information on the location of the infrastructure being ventilated
    - A risk assessment
    - Odour complaint summary as provided by Hunter Water.
    - Record of any operational issues that may contribute to odour, for example upstream chemical dosing unit malfunction, stranding or build-up of sediment. This information will also be provided by Hunter Water.
    - Corrosion assessment – Assess the corrosion risk of the asset (looking for material that can be corroded), before any expected benefits from implementation of an OCU.
    - Any modelling works completed (including liquid phase, gas phase or dispersion modelling) (if modelling has been completed)
    - Proposed type of OCU and reasoning for selection (see Appendix D - OCU Selection)
    - Details and price of any activated carbon intended to be used
    - Recommended major spare parts for proposed OCU.
    - Expected electrical load.
    - Diagram showing air flow movements including air inflow and extraction points (see **Note 1** below)
    - Location of treated air discharge.
    - Capital and operating cost expectations over life of OCU
- General site layout concept to allow adequate space around the OCU (including roadway access) for its operation and maintenance, such as the changing of media, and removal of equipment.
- Process and Instrumentation Diagram (P&ID)
- Identification of the applicable environmental and planning approval pathway under the *Environmental Planning and Assessment Act 1979 (EP&A Act)*.

Note 1: *Foul air extraction Points*
The extraction point is to be located to maximise removal of foul air This will generally be as close as possible to location with highest foul air concentration (e.g. riser main discharges or weirs). The air inlet (if required) must be of one-way type and made of corrosion resistant material (galvanised steel will not be sufficient in this case). It must be located at the furthest point of the space to be ventilated and admitted as close to top water level as possible.

Project Hold Points

The delivery of an OCU project must incorporate a number of hold points where Hunter Water approval is required before the next stage of work is progressed. These hold points must be incorporated into planning for project delivery, and into contract documentation where required.

The general requirement for hold points are as follows:

- **End of Concept Design Phase:** The Principal must be provided with all concept design deliverables, including details of the adopted design criteria. Do not proceed with detailed design of the unit until the Principal provides written approval.
- **End of Detail Design Phase:** The Principal must be provided with all detailed design deliverables, including details of any deviations from this Standard Specification. Do not proceed with ordering or manufacturing of the unit until the Principal provides written approval.
- **Issued for Construction (IFC) Phase** (if an IFC phase is incorporated into project delivery): The Principal must be provided with Issued for Construction (IFC) drawings. Do not proceed with ordering or manufacturing of the unit until the Principal provides written approval.
- **Prior to Commissioning:** Prior to the OCU being transported to site, the Principal must be provided with, and have accepted the results of all relevant Factory Acceptance Tests and Inspection and Test Plan.
- **End of Commissioning Phase (Handover):** The Principal must be provided with all post construction documentation, including results from Performance Testing documenting proof that the equipment achieves the specified performance. The asset will not be handed over to Principal until written approval for handover has been provided by the Principal.