STANDARD

Sydney WATER

ODOUR CONTROL UNIT

STANDARD SPECIFICATION

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1 GENERAL

1.1 Scope

This document specifies the design and installation requirements for Odour Control Units (OCUs) in Sydney Water's sewerage network.

1.2 Objective

The objective of this Standard Specification is to provide designers, manufacturers, and installers of an OCU with Sydney Water's requirements for its design, construction, installation and performance testing.

This document is written in the directive style. Where an obligation is given, and it is not stated who is to undertake these obligations, they are to be undertaken by the Contractor.

Where a submission, request, or proposal is required, and it is not stated who the recipient shall be, it is to be provided to Sydney Water's representative for written approval.

1.3 Purpose

In the procurement of an OCU, it is intended that this document would be appended to a procurement Contract document for a specific site where it would provide the general requirements for an OCU. Any additions, variations, or one off requirements for that specific site would be included in the Contract document itself. Unless specifically required otherwise in the Contract document, this Standard Specification shall be complied with.

The contract document shall provide for three hold points in the procurement process as follows:

- Sydney Water shall be provided with design criteria and concept design. The Contractor shall resolve with Sydney Water any issues of concern that Sydney Water may have as a result of its review of this information prior to proceeding with detailed design work.
- Sydney Water shall be provided with the detailed design including details of any deviations from this Standard Specification. The Contractor shall resolve with Sydney Water any issues of concern Sydney Water may have as a result of its review of the detailed design prior to proceeding with ordering and manufacturing of the unit.
- In accordance with Sydney Water's Asset Commissioning Standard Administration Procedure WWIMS0035, Sydney Water shall be provided with all Work as Constructed (WAC) documents, such as detailed drawings, trouble shooting guidelines and Operation and Maintenance (O&M) Manuals.

1.4 New Designs and Innovations

This document specifies the minimum requirements for the Works. The Contractor may wish to produce their own alternative design that will comply with these minimum requirements.

Any alternative materials, designs, methods of assembly, and processes that do not comply with specific requirements of this Specification, or are not mentioned in it, but give equivalent or improved performance outcomes to those specified, are not necessarily prohibited.

Written approval from Sydney Water must be obtained for any deviation from this Specification prior to ordering and manufacture of equipment affected by such deviation.

1.5 Style of this Specification

This document is written in the directive style. Where an obligation is given and it is not stated who is to undertake these obligations, they are to be undertaken by the Contractor.

Where a submission, request, proposal is required and it is not stated who the recipient shall be, it is to be provided to Sydney Water representative for approval.

1.6 Responsibilities

Responsibilities relating to the contractual terms and conditions, including financial matters, and site issues are covered in the Head Contract documents. Specific responsibilities are noted in this document, but they do not necessarily describe all the activities required for the Works.

For the purpose of developer funded works, the words “Principal” and “Contractor” in this document shall be replaced with the words “Sydney Water” and “Developer” respectively.

1.6.1 Contractor

The Contractor shall be fully responsible for the detailed design, and construction to fully comply with the requirements in this document and provide a complete functional OCU, which meets all the necessary Standards, Codes of Practice, Industry Standards, and all statutory requirements. The complete systems shall include all pipework, fittings, fans, filters, instruments, and controls, from the point of foul air extraction to the point of treated air exhaust.

In addition, the Contractor shall provide the following, but not limited to:

- Additional equipment as may be necessary for the operation and maintenance of the particular odour treatment system being provided, or as recommended by Sydney Water, the supplier and regulatory bodies.
- Stairs, ladders and walkways, where appropriate, to allow ease of access for changing of media, access sampling points and monitoring equipment, and all storage tanks and equipment. All such stairs, ladders and walkways shall be constructed of appropriate corrosion resistant materials.
- Safety facilities such as safety shower, eyewash station, fire extinguishers, and so on.
- Tags, labels, signs, and other markings, for all these systems which clearly indicate the individual system, chemical contents, hazards, warnings, asset numbers and any other pertinent information in accordance with the requirements of the relevant Standards, Codes of Practice and statutory authorities, and Sydney Water’s Maintenance Management System (MAXIMO).
- O&M Manuals, Unit Process Guidelines, WAC drawings, copies of Programmable Logic Controller (PLC) software programs and any other documents necessary for the optimal operation and maintenance of the OCU.
- Any additional items/equipment requested by Sydney Water.

1.6.2 Principal

The Principal (Sydney Water), through its appointed representative/consultant, shall be responsible to provide input from the various internal stakeholders for the development of both the concept and detailed design required by this Specification. They shall include, but not be limited to:

- This document;
- The concept purpose of the OCU (for example, ventilate sewer pumping station wet well, ventilate one of two sewers feeding the draw off point);
- Location of the OCU;
- OCU expected equipment life term at the location (fixed or temporary);
- Current and estimated future operational parameters, such as catchment population and development staging, sewage characteristics, flow levels, and gas level monitoring data as defined in the needs specification.

1.7 Acronyms, Abbreviations and Definitions

ASTM	American Society for Testing and Materials
CASANZ	Clean Air Society of Australia & New Zealand

dBA	Decibels, the unit of measurement for loudness, weighted for the human ear frequency range
H_2S	Hydrogen Sulphide
HSS	Hydraulic System Services
GPO	General Purpose Outlet, a connection point to access 240 V AC power
Gravity sewer system	Sewer system laid on a grade that allows flow due to gravity alone
HMI	Human Machine Interface, The screen used to interface with PLC or monitoring equipment
IICATS	Integrated Instrumentation, Control, Automation, and Telemetry Systems
LEL	Lower Explosive Limit, the concentration required of hydrocarbons to be at 5% of the concentration at which combustion can occur
MAXIMO	Sydney Water's Maintenance Management System
Pressure sewer system	Sewer system that uses pumping units to generate flow
OCU	Odour Control Unit
OU	Odour Units (measurement)
P&ID	Process and Instrumentation Diagrams
PLC	Programmable Logic Controller
RCD	Residual Current Detector, (safety switch)
RPZ	Reduced Pressure Zone, a backflow prevention device for the protection of drinking water supply
RTU	Remote Terminal Unit
SAP	Standard Administration Procedure
SPS	Sewage Pumping Station
VSD	Variable Speed Drive, a device for controlling the speed of an electric motor by changing the alternating current frequency
WAC	Work As Constructed
WSAA	Water Services of Australia
Wet well	A section of pressure sewer system where sewer is collected prior to being pumped

1.8 Reference Documents

The following documents are referred to in this Specification.

American Society for Testing and Materials

ASTM	American Society for Testing and Materials
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	Australian Standard
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 3536	Reference gases, Parts 1 & 2
AS 3580	Methods of sampling ambient air, Methods 2.1, 2.2 and 2.3

Australian and New Zealand Standards

AS/NZS	Australian Standard/New Zealand Standard
AS/NZS 4323.3	Stationary source emissions - Determination of odour concentration by dynamic olfactometry
AS/NZS 2430	Classification of hazardous areas

European Standards

EN	European Standard
EN 13121	GRP Tanks And Vessels For Use Above Ground

“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

P&ID Drawing for Activated Carbon Unit (SEW1700-S1701)

P&ID Drawing for Chemical Scrubber Unit (SEW1700-S1702)

P&ID Drawing for Biotrickling Filter Unit (SEW1700-S1703)

P&ID Drawing for Soil Bed Filter Unit (SEW1700-S1704)

P&ID Drawing for Monitoring System (SEW1700-S1705)

P&ID Drawing for Treated Air to Stack (SEW1700-S1706)

Sydney Water’s Asset Commissioning Standard Administration Procedure WWIMS0035

Sydney Water’s Instrumentation and Control Standards TOG_TS01

Sydney Water’s IICATS Sewer Odour and Corrosion Standards TOG_TS08

Sydney Water’s Maintenance Related Clauses for Capital and Operational Projects

Sydney Water’s Needs Specification For Scrubber Monitoring Systems

Sydney Water’s Protective Coating Specification PCS 100

Sydney Water’s Technical Specification Part 1 – Civil Works

Sydney Water’s Technical Specification Part 2 – Mechanical Works

Sydney Water’s Technical Specification Part 3 – Electrical Works

WSA 121 – Industry Standard for Biofilters for Odour Control

WSAA Sewerage Code of Australia (Sydney Water Edition)

2 DESIGN

2.1 Performance Requirements

The OCU shall be designed to:

- Provide reliable and effective odour removal to a level specified in the minimum requirements outlined in Section 2.2.3 of this Specification;
- Have a minimum of 20 years service life. This does not apply to consumable components such as filter media;
- Comply with all relevant regulatory requirements, Standards and Codes of Practice including noise;
- Not cause interruption to the normal operation of the Sydney Water sewer system;
- Be capable of automatic operation via connected to Sydney Water's Integrated Instrumentation, Control, Automation, and Telemetry Systems (IICATS);
- Be safe to construct, operate, maintain and decommission.

2.2 Design Criteria and Concept Design

2.2.1 General

The designer shall undertake investigations, which may include desktop study, field testing and modelling to determine the specific requirements for the OCU.

Layout details of the sewer system, where the OCU is to be provided, and its surrounds shall be collected and documented. They shall be used for the selection of the optimal locations of extraction and discharge points. All features that may affect the operation and maintenance of the OCU shall be documented and considered in the design.

Data for the design of an OCU shall be collected and clearly documented including all calculations and assumptions. It shall be submitted to the Principal's representative for written approval prior to commencement of detail design work.

No OCU shall be placed in a "confined space" such as a below ground pit without written approval from the Principal.

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

- Concept design showing the management of air inflows and extraction point to maximise removal of foul air and minimise the potential of gas escape leading to odour and/or corrosion problems;
- Current, peak and future quantity of foul gas required to be treated;
- Physical properties of gas such as pressure, temperature, and humidity;
- Current and future level of odorous gas component(s) and fluctuation during different time/season;
- Location of treated gas discharge;
- Assessment of corrosive substances in the gas and surrounding, which may affect the unit;
- Proposed type 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.

2.2.2 Supply of Activated Carbon Media

For activated carbon type OCUs, the Contractor shall include information including details and price of the activated carbon intended to be supplied in the concept design for review. Sydney Water may agree to proceed with this intended carbon, however reserves the right to specify the carbon to be used for detailed design purposes. In this case, Sydney Water will provide performance information of the carbon to the Contractor, to facilitate the detailed design of the OCU.

Sydney Water also reserves the right to free supply the carbon to be used from its own store.

2.2.3 Minimum Requirements

Unless otherwise specified, the minimum requirements of the OCU are specified below.

OCU Minimum Requirements

ITEM	REQUIREMENTS
Outlet concentration as measured at the exit of the vent stack	Hydrogen Sulphide (H_2S) ≤ 0.1 ppm Mercaptans (Thiols) ≤ 0.02 ppm Odour concentration ≤ 500 Odour Units (OU) Or otherwise, at a level that is demonstrated to achieve no odour nuisance at the nearest residence or public space.
Flow rate	Minimum of 6 x airspace/headspace volume per hour. Refer to notes below for examples. *
Fan(s)	Centrifugal type with forward or backward curved impellers fitted with a flameproof motor Class 1 Division 2 **
Noise level	Not exceeding 35 dBA measured at the OCU, or 5dBA above the surrounding environment noise level whichever is the lower
Discharge vent stack	The discharge vent stack height shall generally comply with the Sewerage Code of Australia for vent stacks (14m above ground level) unless otherwise agreed by the Principal. Typically the vent stack shall be designed to maximise the air velocity out of the top of the stack to obtain maximum dilution with the surrounding air.

Notes

***** Volume examples:

- Sewage Pumping Station (SPS) wet well: if the volume of a SPS wet well at the lowest operating level is 10 m³, then the required *minimum* flow rate is 60 m³/hour.
- Sewer pipeline: if a pipeline has a cross sectional headspace at the low dry weather flow level of 1 m², and a sewer flow velocity of 1m/s (to which the gas velocity must be matched), then the *minimum* required flow rate is:

  (headspace cross sectional area at low peak dry weather flow level) × (gas velocity down sewer)

  $= (1\text{m}^2) \times (1\,\text{m/s}) \times (3600\,\text{s/h})$

  $= 3600\,\text{m}^3\text{/h}$

****** In accordance with IEEE Standard 1349

2.2.4 Selection of Odour Control Unit Type

Different types of OCU have different performance characteristics. These shall be considered thoroughly when selecting the type of OCU that will perform best given the type, volume, concentration and variability of the foul air odorous components. Attention shall also be given to operability, installation and maintenance requirements of the unit, particularly in terms of cost, availability of electricity, availability of critical spare parts, media or chemical replacements, requirements for any confined spaces entry, and ease of access. In particular, although soil bed odour systems will be considered, generally they are not preferred, and will not be acceptable in built up areas or in close proximity to neighbouring residents.

For activated carbon and biotrickling filter systems, it is required that the fans be installed after the treatment component and draw air through the unit under vacuum, in order to remove the risk of gas

leaks under pressure. Operation under vacuum will have implications on the structural design of the various elements and on the operation of the various monitors, and these shall be considered in the concept design.

2.3 General Detailed Design Requirements

2.3.1 General

All materials specified in the design shall be suitable for installation in the proposed environment and be corrosion resistant for at least 20 years service life.

Typically an OCU consists of:

- Control panel, including telemetry system
- Extraction conduit
- Monitors, for example pressure, temperature, humidity, and H_2S gas concentration. This is generally provided in a stand alone panel.
- Pre-filter
- Flame arrestor (where required)
- Pre-heater (where required)
- Main filter/media/process chamber
- Fan(s)
- Exhaust stack
- Gas sample off take points for inlet and outlet gases, and minimum of three points through the media/process.
- Auxiliary access platforms, ladders, water and electricity supply, and safety equipment

To allow easy installation and removal of equipment by lifting devices, suitably designed lifting lugs shall be fitted where necessary. Where the OCU is specified as temporary or moveable, lifting lugs shall be provided on the Unit.

2.3.2 Casing

The odour unit casing material and finish shall be of the following:

1. Glass-reinforced plastic (fibreglass); or
2. Stainless steel grade 316; or
3. Any other material, being equivalent to item 1 or 2 in strength, rigidity, and fire performance.

The OCU structure shall 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.

2.3.3 Fibreglass

All fibreglass vessels and components shall be constructed to EN 13121 and shall consist of an internal corrosion barrier, a structural layer and an outer surface layer, as specified under relevant sections of EN 13121.

The corrosion barrier shall be constructed from either corrosion resistant isophthalic polyester resin or vinyl ester resin, whichever is the most suitable for the application.

The materials used for the construction of the OCU and ductwork shall be nominated for approval prior to ordering the materials. Any cylindrical structures shall consist of resin-reinforced layers with continuous glass rovings in a predetermined pattern with an even constant tension being placed on the rovings.

The structural laminate shall consist of no less than two (2) bi-directional layers of continuous filaments with each bi-directional layer having a minimum glass content equal to three strands of 2400 tex rovings per centimetre width or equivalent measured at right angles to the direction of fibres.

The rovings shall be machine controlled and each bi-directional layer shall overlap to ensure no un-reinforced pockets.

The glass fibre content of the finished structural layer shall be no less than 50% and no greater than 75%.

Any flat fibreglass bearing surfaces shall 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.

2.3.4 Parts

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

All bolts, nuts, and washers shall be made from stainless steel grade 316. Potential for galvanic corrosion shall be minimised.

2.3.5 Adhesive, Sealants, and Gaskets

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

Where applicable, they shall also be resistant to any chemicals used by the OCU.

2.3.6 Inlet Isolation valve

An easily operated positive shut off isolation valve shall 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 shall 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.

2.3.7 Intrinsically Safe

At some locations, analysis of the sewer gases and upstream users may indicate a risk of high hydrocarbon levels. In this situation, the Contractor shall install a suitable monitoring system and design the unit to prevent ignition of the hydrocarbons when detected. This may take the form of automatic shut down of the OCU, with an alarm to IICATS, or use of appropriate equipment to prevent potential fire / explosion. The Contractor shall carry out and document a risk assessment in conjunction with relevant Sydney Water personnel to assess the need for a flame arrestor or other such measures, and if required, where it should be located, and to identify any other control measures which may be needed (for example, methane meter, alarms, operational interlocks and so on).

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

2.3.8 Ductwork

All ductwork shall be fabricated in fibreglass or stainless steel grade 316 to the relevant Australian Standards, unless otherwise specified in relevant sections of this Specification.

The design of the ductwork shall prevent the pooling of any liquid that cannot be easily drained.

Where necessary the ductwork shall be lagged to ensure sound pressure level at the boundary of the site does not exceed 35 dBA under free field conditions or 5dBA above ambient levels whichever is less.

2.3.9 Vent stack

A vent stack shall be provided to exhaust the treated air vertically from the odour treatment processes. The vent stack shall have a minimum exhaust velocity of 15 m/sec.

It shall be formed from spiral welded stainless steel or fibreglass tubing, and shall be self supporting (including stainless steel guy wires where necessary).

Detailed design for the vent stack shall be provided to the Principal for written approval, along with calculations, prior to the fabrication of the stack.

2.3.10 Fans

The fan(s) shall provide exhaust ventilation of the sewer system at the chosen location. For activated carbon and biotrickling filter systems it is preferred that the fans be installed after the contactor and draw air through the contactor under vacuum in order to remove the risk of gas leaks under pressure.

The fans shall be selected to provide the designated airflow under the system head pressure. The fan shall be centrifugal with forward or backward curved impellers, and shall be suitable for the required design. Fan performance curves shall be provided with the design documents.

The fan shall be constructed from materials suitable for the environment in which it will operate. Materials of construction and clearances between impeller and fan scroll shall be provided to ensure that at all times, no spark potential is possible within the fan. The fan shall be fitted with a 4-pole flameproof motor to satisfy the requirements of the relevant classification specified by AS/NZS 2430, and shall be sized to be non-overloading over the range of operation.

Where required, the fan shall be lagged and fitted with discharge and inlet silencers. This is to ensure that the sound pressure level at the boundary of the unit does not exceed 35 dBA under free field conditions, or 5dB above ambient levels whichever is less.

Airflow monitors (one per fan outlet) shall be provided to indicate whether a fan is running when called to operate. Failure of air flow shall be used to lock out operation of any duct heater/demister (and any other equipment of concern) and to raise a failure alarm.

Room in the control panel shall be provided for future installation of a Variable Speed Drive (VSD), should it be required for minor adjustment of fan speed.

The Contractor shall provide a price for supply of an additional fan to be held as a critical spare. The Principal reserves the right to choose whether to take up this option or not.

2.3.11 Integrity of System

The complete ductwork system, through the main duct, adsorber inlet and outlet ducts, any bypass duct and stacks, shall be completely gas tight and soap bubble tested at the operating pressure of the OCU. All ductwork and associated ventilation equipment shall be fabricated and installed to the Standards specified in this document.

Any joints, ducts, bends and so on, that do not meet this requirement shall be remade or replaced at no cost to the Principal.

2.3.12 Valves & Dampers

Dampers shall 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 shall operate either in the fully open or fully closed position. Dampers used to modulate airflow and for balancing purposes shall be fabricated and installed in accordance with the specified Standards in this document, and to materials standards as specified in these Clauses.

The dampers shall be stainless steel or aluminium multiple curved blade gang operated, single thickness, factory assembled units. Each unit shall be supplied for heavy-duty operation for field assembly and shall operate through 90 degrees of operation, from fully open to fully closed.

All damper spindles, bearings and ancillary components shall be stainless steel, 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 shall not be accepted.

2.3.13 Air Curtains

Where the OCU is ventilating a section of sewer an air curtain(s) may be required in the sewer to minimise any short circuiting and/or to focus the draw of air from one direction, for example at the confluence of sewers where only one sewer requires scrubbing. The need for an air curtain shall form part of the Needs Specification and Concept Design supplied by the Contractor and accepted by the Principal. If required, a suitable air curtain shall be designed, fabricated and installed by the Contractor. All aspects of the Principal's requirements for confined space entry shall be complied with when installing the air curtain(s).

2.4 Mechanical Works

The design and construction of the mechanical works shall be in accordance with the requirements contained in Sydney Water's Technical Specification Part 2 – Mechanical Works, unless otherwise specified in this document.

2.5 Electrical

The design and construction of the electrical works shall be in accordance with the requirements contained in Sydney Water Technical Specification Part 3 – Electrical Works.

All equipment shall be new and suitable for its purpose. They shall comply with the Australian Standards and shall be rated for continuous in service condition within a switchboard. All electrical equipment supplied shall be available off the shelf within Australia.

All items of equipment shall be designed, manufactured and installed to perform their required functions reliably and efficiently. Considerations shall be made to ensure the designed system and selected equipment could be operated and maintained safely and efficiently. Particular attention shall be given to equipment installed in an adverse environment and/or exposed to weather.

Live equipment and terminals shall be located behind removable covers or doors, and shrouded, to prevent accidental contact when the control panel's front doors are open, including equipment mounted on doors.

Where more than one item of equipment is supplied and installed to perform a particular function, all such items of equipment shall be identical and completely interchangeable.

The site is subject to power failure. The equipment shall be designed for automatic restart when the power returns.

The Contractor shall develop electrical circuits and control panel layout and submit these drawings to the Principal's representative for review prior to manufacture. The Contractor shall resolve with Sydney Water any issues of concern Sydney Water may have as a result of its review of these drawings prior to proceeding with ordering and manufacture.

All controls will be placed in a free standing painted stainless steel cubicle as used for Sewage Pumping Stations (IP65 rating to AS 1939).

2.6 Telemetry

The OCU shall be designed for connection to the Sydney Water telemetry system in accordance with Sydney Water IICATS Sewer Odour and Corrosion Standards TOG_TS08.

2.7 Instrumentation & Control

All instrumentation shall comply with Sydney Water's Instrumentation and Control Standards TOG_TS01. If there is any discrepancy between this document and the TOG_TS01, it shall be raised to the Principal's representative at the design phase. The Contractor shall resolve any issues of concern with the Principal and obtain written approval from the Principal prior to proceeding with ordering and manufacture.

If local PLC control is required then the Contractor shall use an Allen Bradley micrologic series PLC or other PLC as specified by the Principal.

Where a Human Machine Interface (HMI) is to be provided then a 10-inch colour screen shall be provided with trending capability that will last a minimum of 30 days.

If Sydney Water does not have current versions of the programming software for the PLC and HMI available, then these shall be provided by the Contractor.

Differential pressure transmitters shall be provided to measure the head loss across both the pre filters and the OCU media bed. These transmitters shall be calibrated in Pascals and shall have a local display as well as being connected to the IICATS Remote Terminal Unit (RTU).

If a heater/demister is required then temperature transmitters shall be provided on the inlet and outlet of the heater unit. These transmitters shall be calibrated in degrees Celsius (^{o}C) and shall have a local display as well as being connected to the IICATS RTU.

If additional processes are involved (for example, flame arrestor or biofilter followed by activated carbon unit), then additional differential pressure transmitters are required.

Hydrogen sulphide meters shall be supplied to monitor the inlet and outlet OCU performance. These meters shall be calibrated in ppm H_2S and will have a local display as well as being connected to the IICATS RTU. Refer to Section 7 of this Specification for more detail.

Instrumentation shall not be left exposed to sunlight, the elements, magnetic fields, vibration, or where local indicators are difficult to read, unless written approval is first obtained from the Principal's representative.

2.8 Access and Auxiliary Services

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

Suitable road access shall be provided for large vehicles required for media and equipment removal and installation (such as vacuum tankers, HIAB trucks or cranes).

Platform access shall be provided for media removal and replacement. It shall be large enough to hold two people and a pallet of media unless otherwise agreed by the Principal's representative.

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

A Residual Current Device (RCD) protected 240V General Purpose Outlet (GPO) for general use shall be provided in close proximity to the OCU.

A water supply with backflow prevention shall be provided in close proximity to the OCU for process use. The Reduced Pressure Zone (RPZ) shall be installed in a standard lockable cage.

A safety shower shall be provided in close proximity to the OCU, which is supplied separately from the RPZ protected process water supply. Safety showers are not required for activated carbon and soil bed filter type OCUs.

Where a pre-filter is used, suitable cleaning facilities shall be provided.

A suitable lockable location shall 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)

2.9 Civil Related

The design and construction of the civil works shall be in accordance with the requirements contained in Sydney Water Technical Specification Part 1 – Civil Works, and Sydney Water's Protective Coating Specification, PCS100. Where necessary, relevant Dangerous Goods Regulations shall be complied with.

2.9.1 Foundation

The OCU shall be located on a concrete slab. The slab shall be constructed on a suitably prepared ground. Its thickness and compressive strength shall be adequate to bear the load of the unit. Rubber mats shall be used for fibreglass tanks.

2.9.2 Drainage

The OCU shall have gravity drainage facilities to remove condensate. The material of construction shall be sulphuric acid resistant. Drains from the heater/demister shall also be heat resistant. The drainage shall be directed to a permissible disposable location, such as a wet well or sewer.

Each drainage point must be from the lowest point in the item being drained and must have its own isolation valve. Sufficient drainage points must be supplied to prevent any condensate from collecting in the OCU.

Drains may only be combined for gases of like quality. In particular, 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 by the plant operator.

2.9.3 Fencing

A man proof, cyclone wire fence shall be supplied and installed with a gate at the perimeter of the OCU area. It shall be at least 2.0 m in height. It shall be located so as not to interfere or restrict operational and maintenance activities.

2.10 Facility and Equipment Identification and Labelling

All equipment shall have a unique identification number beginning with SY. Sydney Water designates unique identification number for all its asset and associated equipment, and Sydney Water will assign these.

The facility and equipment identification and labelling shall be in accordance with Sydney Water's Maintenance Related Clauses for Capital & Operational Projects.

A standard Sydney Water Facility Asset sign shall be mounted on the OCU structure.

2.11 Critical Spares

The Contractor shall provide a list of any critical spares they consider necessary, including the cost of provision, with their detailed design submission. The Principal will review the list and advise those items that the Contractor shall provide under the contract.

2.12 Operating and Maintenance Manual

An Operating and Maintenance (O&M) manual shall be provided for the OCU. An acceptable O&M manual is considered a key requirement for successful contractual handover. It shall be provided in both paper form (2 copies) and electronic form (PDF format for every component). In addition editable file copies shall also be provided where created by the Contractor in a format suitable for Sydney Water (for example, Microsoft Word and Excel documents, AutoCAD for drawings and so on).

The manual shall be in accordance with Sydney Water's Maintenance Related Clauses for Capital and Operational Projects (Section 6: O&M Manuals).

The manual shall include, but not limited to:

- Overview of the OCU conceptual design and how it fits into the local management of odour and corrosion control, with reference to general location drawing.
- Detailed description of the unit and its components, process, and performance criteria.
- Detailed P&IDs, complete list of all equipment items (including electrical items) and a cross reference to Sydney Water's asset numbers where relevant.
- Detailed information for each supplied piece of equipment (Manufacturer, supplier, model number and so on).
- A list of suppliers and their current contact details.
- Pump and fan curves where relevant (including any test data).

- Standard operating instructions covering all routine work requirements (for example, system start up, shut down, routine monitoring, changing of media and so on).
- Process optimisation and troubleshooting guide.
- Where relevant, a copy of the PLC functional description, Input/Output listings, HMI screen details, electronic copies of PLC and HMI programs, details of the programming software used (including version details) and where it can be obtained.
- Reference listing of all monitoring and alarm signals both locally and transmitted to IICATS. For each alarm this shall include detail of how the alarm generates (primary device, condition, relevant relays and so on).
- Reference listing of all interlocks and system timers (their values and where these are set).
- Recommended routine inspection and maintenance schedule including replacement schedule of treatment media.
- List of any recommended spares to be held.
- Instructions on storage, loading/unloading, and Material Safety Data Sheet (MSDS) of treatment media.
- A drawing register of all drawings supplied (such as drawing number, title, revision number and so on, grouped by type)
- WAC drawings covering all aspects of the OCU installation
- Complete program settings for all programmable equipment (for example, Differential Pressure Transmitters).
- Supplier equipment manuals for all items provided (including electrical equipment)

3 TECHNICAL SPECIFICATIONS – ACTIVATED CARBON TYPE OCU

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

3.1 General

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

The units shall be designed to meet the required efficiency. Outlet conditions for the clean air discharge shall meet discharge odorous gas limit concentration.

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

The activated carbon system shall generally consist of an inlet isolation valve, pre filter, flame arrestor (where required), heater/demister, activated carbon housing and activated carbon media, extraction fan(s), discharge stack, control equipment panel, and monitoring equipment.

The minimum activated carbon design bed life shall be 24 months based on the agreed maximum gas contaminant loading rate. The bed 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 Contractor shall submit calculations to the Principal, substantiating the amount of carbon to meet the carbon bed life specified.

The adsorber shall have a minimum contact time of three (3) seconds with the carbon media.

Design of the adsorption unit shall employ methods to prevent caking, solidifying and blooming of the impregnated activated carbon.

The adsorber shall be designed structurally 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).

3.2 Pre-filter(s)

One easily removable and cleanable pre-filter assembly shall 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.

The pre-filter shall be of the honeycomb type designed to remove particulate matter and shall have a removal efficiency of 96% based on No.3 dust to AS 1324.2, and of corrosion resistant construction materials.

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

One spare set of filter(s) shall 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 shall also be provided.

The design of the pre filter shall facilitate easy removal of the pre filter for cleaning/replacement without creating a source of gas leaks.

The filter housing shall have a drain with a manual isolation valve 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, drain and isolation valve shall be resistant to condensate attack.

3.3 In-Line Heater/Demister

In-line duct heating shall be provided on the inlet side of the adsorber unit to ensure that the temperature of the saturated air to the OCU is raised to achieve less than (<) 90% humidity to prevent

moisture entrainment in the activated carbon bed. The in-line heater shall be of the black body type, and shall 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 shall not operate unless the fan is running and airflow through the inlet ducting is ensured. Temperature measurement and indicators shall be provided on the inlet and outlet of the heater.

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

An activated carbon product that is not susceptible to moisture entrainment, and therefore would not require an in-line heater, may be offered as an alternative. This shall be acceptable, subject to written approval from the Principal.

3.4 Adsorber Unit

The adsorber shell, internal components, and structural components shall be made of either stainless steel grade 316 or fibreglass. Where fibreglass is used, the suitability of this material with resins selected for resistance to activated carbon, the products of reaction and the general sewage environment shall be required. The colour of the odour adsorber unit shall be in accordance with Sydney Water's Protective Coating Specification PCS 100.

The design shall include access hatches for loading and removal of spent carbon, and for inspection of any other ancillary equipment. The hatches shall be of sufficient size to allow both removal of carbon by suction hose through the top, and by manual shovelling through the side. The hatches shall allow the easy removal of any internal components such as screens for maintenance purposes.

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

3.5 Monitoring

Monitoring systems shall be provided, as detailed in Section 7 of this Specification.
Three additional permanent sampling ports shall 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 shall be terminated in 12mm full bore stainless steel ball valves and be designed to withdraw a representative gas sample at that depth without blockage or escape of the carbon media.

The Contractor shall provide any additional sampling points necessary to adequately monitor the performance of the OCU or its key components.

3.6 Adsorptive Media

The Principal reserves the right to free supply the activated carbon for the OCU and not use the media offered by the Contractor – refer to Section 2.2.2 of this Specification. Should the Principal agree to use the Contractors carbon, it shall comply with the following requirements:

- The adsorptive media shall 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 shall 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 shall be provided. Peat, coconut shell or high grade coal shall be used as the base material for manufacture of the carbon.
- The depth of media shall be such that the minimum contact time for the airstream in the OCU is at least 3.0 seconds. The adsorptive media shall be evenly distributed in the bed so that no bypassing or short circuiting of foul air occurs within the OCU.
- The activated carbon shall also be required to absorb levels of hydrocarbons that may be present at times.

- The design life of the adsorptive media shall be a minimum of 24 months. The activated carbon shall have a removal efficiency of not less than 99% for other sewer based odours.

The carbon media shall meet the following minimum specifications.

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

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

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	0.07 H_2S g/cm^3 Carbon minimum	ASTM D6646

An analysis sheet shall accompany each batch of 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. All costs associated with the test work shall be borne by the Contractor.

4 TECHNICAL SPECIFICATIONS – BIOTRICKLING FILTER TYPE OCU

A generic P&ID of this system is provided in Appendix B. Multi stage designs and units with optional activated carbon polishing shall meet the minimums stated here, or better.

4.1 Pre-filter

A pre-filter will not normally be required if the fan(s) are installed downstream of the OCU. However if either a flame arrestor or fans are required upstream of the biofilter, then a pre filter will be required. For details, see Section 3.2 of this Specification.

4.2 Biotrickling Filter Unit

The biotrickling filter units shall be capable of continuously treating odorous air at the specified flow rates and be designed to meet the required efficiency. Outlet conditions for the clean air discharge shall meet discharge odorous gas limit concentration.

The biotrickling filter shall be supplied complete with all auxiliary equipment required for system operation.

The biotrickling filter unit shall generally consist of an inlet isolation valve, one or more contactors containing a suitable bio growth media and support frame, a liquor recirculation system, if part of the suppliers design, to maintain the media in a moist state, a liquor decant and makeup (water and nutrients) system, extraction fan(s), discharge stack, control equipment panel, and monitoring equipment.

Support 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 whilst being open enough to not suffer from blockage or short circuiting. The Contractor shall submit calculations to the Principal, substantiating the choice of media to meet the required performance and life span.

The diameter and height of the biotrickling filter shall be properly sized to meet the specified performance requirements. The biotrickling filter must have a minimum contact time sufficient to provide 90% removal efficiency during normal operation.

The biotrickling filter shall be designed structurally 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).

The biotrickling filter shell, internal components, and structural components shall be made of either stainless steel grade 316 or fibreglass. 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 shall be demonstrated.

Where the design of the biotrickling filter includes an activated carbon polishing unit, the unit shall be adequately protected from aerosols and humidity. Monitoring of gas levels prior and after the activated carbon unit shall be provided. It shall be designed to provide sufficient contact time and installed in such a manner as to provide simple, safe and effective replacement of the unit.

The design shall include access hatches for loading and removal of support media, and for inspection of any other ancillary equipment. The hatches shall 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 hatches shall allow the easy removal of any internal components such as screens for maintenance purposes.

The bio contactor and associated ductwork shall be designed to minimise pressure drop, prevent any short circuiting of gas flow, and provide easy access for maintenance. The colour of the odour adsorber shall be in accordance with the Sydney Water's Protective Coating Specification PCS 100.

4.3 Monitoring

Monitoring systems shall be provided, as detailed in Section 7 of this Specification.

The Contractor shall provide any additional sampling points necessary to adequately monitor the performance of the OCU or its key components.

4.4 Control system

The biotrickling filter liquor recirculation and decant/makeup systems shall be fully automated with allowance for manual operation. The Contractor shall provide a copy of the controller logic to the Principals representative for written approval.

The biotrickling filter unit shall be installed with the following additional sensors and monitors:

- pH level for the sump liquor – connected to IICATS
- Electrical conductivity for the sump liquor – connected to IICATS
- Level of liquor in contactor sump – connected to IICATS. In addition a manual sight glass shall be provided to allow visual checking.
- Level of nutrient in the nutrient storage tank – connected to IICATS
- Air flow rate – connected to IICATS
- Where required, Lower Explosive Limit (LEL) – connected to IICATS

4.5 Liquor Recirculation System

A minimum of two pumps shall be provided to recirculate the sump liquor. They shall be in duty/standby arrangement. The pumps shall be centrifugal pumps and mechanically sealed. The pump head and seals shall be suitable for the corrosive nature of the sump liquor.

A sump purge valve shall be provided to flush out contaminants build up within the reticulation system.

Flow indication shall be provided for each component flow on the recirculation system including flows to the humidifier, to the spray in each contactor, to monitoring instruments.

A no flow alarm shall 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 shall be connected to IICATS.

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

4.6 Nutrient Dosing System (if required)

A nutrient dosing system shall be provided to dose the sump liquor during purge makeup sequence. The dosing system shall consist of storage tank, duty dosing pump, calibration tube, backpressure valve, pressure gauge and dosing lines. It shall comply with the Sydney Water's Technical Specification, Part 2 Mechanical Works, Section M36: Chemical Dosing.

5 TECHNICAL SPECIFICATIONS – CHEMICAL SCRUBBER TYPE

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

5.1 General

Chemical Scrubbers shall only be used in treatment plants, and not the networks. This is due to the hazardous nature of the chemicals used.

Each scrubber shall be a counter-current, packed-bed tower design with bottom gas inlet, top recirculation flow inlet. A mist eliminator shall be installed at the scrubber outlet to prevent venting of entrained droplets. The mist eliminator shall be sized to remove entrained droplets from the scrubbed gas stream and prevent fogging at the outlet of the vent stack.

The scrubber packing shall either be a randomly packed or structurally packed type. The diameter and height of the packed bed shall be properly sized to meet the specified performance requirements. Each scrubber shall be mounted on a sump tank integral with the scrubber shell. The sump tank shall be sized to match with the design and operation of its associated scrubber. The tank shall be a vertical, flat bottom storage tank, and shall be fabricated with flanged nozzles, including the following:

Scrubber (top);

Access hatch/es, as far as practicable (top);

Recirculation pump suction (side);

Chemical make-up inlet(s) into recirculation line;

Make-up water inlet (side);

Overflow (side);

Drain (bottom).

The tank nozzles shall be located as recommended by the Contractor to provide easy access and to minimise piping. All nozzle locations shall be clearly labelled and located on the Shop Drawings. Required structural supports, hold down and lifting lugs shall be installed. The size and configuration of access points shall be designed to minimise the severity of the confined space within the scrubber.

The tower and the sump tanks shall be fabricated of fibreglass reinforced plastic or approved equal which is resistant to the chemicals used in and removed by the scrubbing process and shall be fabricated in accordance with the requirements specified in EN 13121.

Monitoring systems shall be provided, as detailed in Section 7 of this Specification.

5.2 Liquor Recirculation System

A minimum of two pumps shall be provided to recirculate the sump liquor. They shall be in duty/standby arrangement. The pumps shall be centrifugal pumps and mechanically sealed. The pump head and seals shall be suitable for the corrosive nature of the sump liquor.

A sump purge valve shall be provided to flush out contaminants build up within the reticulation system.

Flow indication shall be provided for each component flow on the recirculation system including flows to the spray in each contactor.

A no flow alarm shall 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 shall be connected to IICATS.

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

5.3 Chemical Dosing System

A chemical dosing system shall be provided to dose the recirculation line. The dosing system shall consist of storage tank, duty/standby dosing pumps, calibration tube, backpressure valve, pressure

gauge and dosing lines. It shall comply with the Sydney Water's Technical Specification, Part 2 Mechanical Works, Section M36: Chemical Dosing.

6 TECHNICAL SPECIFICATIONS – SOIL BED BIOFILTER TYPE OCU

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

Soil bed OCUs are not preferred by Sydney Water and will not normally be accepted in built up areas or where they would be close to neighbouring residents. The design, construction, and commission of biofilters odour control unit shall be in accordance with WSA 121 – Industry Standard for Biofilters for Odour Control. Monitoring systems shall be provided, as detailed in Section 7 of this Specification. In addition, it shall meet the following requirements:

1. That all collected air be passed through a humidification step where the relative humidity of the gas is raised to a minimum of 90%. This humidification step shall also be designed to remove particulate matter from the air stream.
2. Industrial water shall be used for humidification where available. Water flows shall generally be provided with a flow indicator and valving to adjust the flow to the various injection points.
3. The humidified air is to be split equally between two (2) or more separate and isolatable treatment sections of the bed. This requirement permits repairs or renewal to be performed upon the system beds separately while maintaining foul air treatment.
4. Each section of the system shall have an array of humidified foul air ducts that are designed to evenly distribute foul air within the section. Each section will also have installed a system by which excess water is collected and discharged via a collection sump and pumped or gravitate to waste. The unit shall be corrosion resistant.
5. The material composing the bed is to be at least 1.2 metres deep and have a surface loading of no more than 1.5 m^3/minute.m^2 during normal operation. This material is to be composed of particles sized to deliver a pressure drop when new of approximately 300 Pa.
6. The moisture content of the bed is to be controlled by a timer plus either:
    a. Two (2) moisture monitors installed in each section of the biofilter bed at different depths in the bed, or
    b. Two (2) temperature sensors installed in each section of the biofilter bed at different depths in the bed.

    These control systems will manage the flow of irrigation water over the surface of each section of the bed. The use of moisture monitors will require a control loop that maintains predetermined moisture content in the bed at each sensor. The use of temperature sensors will control the temperature difference between the inlet humidified air and each position in each section of the biofilter bed to be no more than 1°C. These control functions are to be programmed into the OCU control.
7. Where cold temperatures, frosts and snow may cause inactivation of the micro organisms on the media, adequate measures (such as having a sufficiently deep bed, shade sails) shall be taken.
8. The biofilter bed will be designed to produce an exit odour concentration which conforms to the most stringent of;
    - No more than 1,000 OU, determined in accordance with AS/NZS 4323.3, “Stationary source emissions Part 3: Determination of odour concentration by dynamic olfactometry”, and
    - As determined by dispersion modelling to not cause any predicted odour impact on any sensitive receptor in combination with all other odour sources on the plant site during normal summer operation.
9. The soil or compost bed shall maintain the designed odour performance throughout the design life of the unit.
10. The design of the bed will allow ease of media replacement without damage to other components of the bed.

7 TECHNICAL SPECIFICATION - MONITORING SYSTEM

These specifications relate to the monitoring of H_2S gas, as this gas is usually the predominant gas in sewer systems. Hence H_2S will be used as the indicator gas for sewage odours that are present in the airstream at the inlet and outlet of the OCU.

7.1 Standards & Recognised Practices

The standards that will be referred to and that are to be followed in the procurement, installation and maintenance of both high and low level monitoring systems are as follows:

- "Air Pollution Measurement Manual" – A Practical Guide to Sampling & Analysis, Volumes 1 & 2, Clean Air Society of Australia & New Zealand (CASANZ).
- AS 3536 – Reference Gases, Parts 1 & 2.
- AS 3580 – Methods for Sampling & Analysis of Ambient Air, Methods 2.1,2.2,2.3
- "Handbook of Air Pollution Analysis", edit. Roy M. Harrison & Roger Perry. Chapman & Hall, printer/publisher: University Press, Cambridge 1986 ISBN 0412 244101

7.2 On-Line Monitoring System

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

The complete monitoring system will consist of the following:

- H_2S analysers
- Sample port arrangement (draws sample away from duct wall)
- Sampling Pumps
- Condensate traps
- Flow Control Valves
- Flow Meters
- Pipework, Tubing & Ancillary Fittings
- Monitoring cubicle
- Data logging and display equipment

7.2.1 H_2S monitors

H_2S monitors shall be provided on the inlet and outlet of each unit process of the OCU. For example, a biotrickling filter followed by an activated carbon scrubber, then additional H_2S monitors will be required to assess the performance of each unit process. As a minimum, H_2S monitors shall be provided on the inlet and outlet of every individual OCU.

The H_2S monitors shall provide accurate and reliable on-line monitoring of H_2S in the monitored gas stream at the required accuracy. The required accuracy will be determined by the designed output concentration.

It is recommended that the H_2S analyser be installed in close proximity (a maximum of 6 m) to the sampling port. This is in order to prevent the decomposition of sampled gases before presentation to the analyser.

7.2.2 Sampling ports

Gas sampling arrangements shall consist of sampling ports into the ductwork to allow the gas flow to be sampled away from the duct wall. Each of these sample ports shall terminate in 12 mm full bore stainless steel ball valve. 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 shall be no low points that would act as water traps. Lines shall meet the requirements set out in Section 7.2.10 of this Specification.

7.2.3 Condensate Trap

A high volume (in the order of 500mL) condensate trap shall be used. The trap shall have a clear bowl to visually check its performance and shall contain a suitable media to promote condensation. The trap will be fitted with an automatic flushing valve. Preferably this valve will be an actuated solenoid valve set to operate from an adjustable timer, usually on for 20 seconds and off for eight (8) hours.

7.2.4 Sampling Pump

A sample pump shall be provided to withdraw gas from the sampling port 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 shall provide a minimum flow of 4L/min to the sensor, at commissioning.

7.2.5 Flow Control Valves

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

7.2.6 Flow Meters

The flow meters shall be of the rotameter type, with a full scale deflection of 4L/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 downstream of the Flow Control Valve and upstream of the analyser.

7.2.7 Manual Sampling Port

A manual sampling port shall be provided on the side waste stream of the monitoring system, to allow manual gas testing. The sampling port shall terminate in 12 mm full bore stainless steel ball valve.

7.2.8 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.

7.2.9 Analysers

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

7.2.9.1 Electrochemical Cells

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

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

ITEM	SPECIFICATION
Recovery Time	1 to 5 minutes
Minimum Detection Limit	0.025 ppm
Maximum Range (outlet)	0 to 5 ppm
Minimum Range (inlet)	0 to 50 ppm

7.2.9.2 Photo Optical "Paper Tape" "Chemcassette" method

The paper tape type sensors are particularly sensitive to variation in ambient temperature. Where there may be the likelihood of ambient temperatures in excess of 25°C, an air conditioned controlled temperature environment shall 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 shall be of proven design and capable of operating within the performance parameters and conditions described below.

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	0.002 ppm
Minimum Range (outlet)	0 to 5 ppm
Minimum Range (inlet)	0 to 50 ppm

7.2.10 Pipework, Tubing and Ancillary Fittings

All pipework, tubing and ancillary fittings within the sampling and monitoring systems shall be as scheduled in the table below in order to be resistant to corrosion and chemical absorption.

ITEM	SPECIFICATION
Pipework (rigid pipe)	All rigid pipework will be in stainless steel grade 316.
Tubing (Flexible)	All flexible tubing to be used only within the cabinet and will be PTFE (Teflon®) or hospital grade silicon
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 fittings to be similar or equal to Swagelok or Hoke.

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

All lines shall be graded in order to prevent capture of moisture and pressure drops due to moisture entrapment. Pipework shall 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. Where colder overnight temperatures are experienced some metal lines may need to be lagged to minimise the occurrence of temperature drops. If this is insufficient then some form of heating may be required in the monitoring cubicle downstream of the condensate trap.

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.

7.2.11 Monitoring cubicle

All electronic components of the monitoring system shall be mounted in a full length free standing cubicle similar to those used for SPS control cubicles (IP65 rating to AS 1939). The cubicle shall be:

- Painted stainless steel grade 316 with double opening doors (no centre pillar & secured top and bottom),
- Fitted with recessed/internal hinges in order to present a clean external face when the cabinet doors are closed,
- Have a lift out weather shield with wind resistant clips,
- Have suitable vents for natural convection,
- Suitable for locking with a padlock.

The cubicle shall include a power distribution board of suitable IP rating with circuit breakers for each instrument, a RCD protected 240V GPO, and auxiliary cubicle items (for example, exhaust fans, light).

The cubicle shall be fitted with a suitable light that is activated by opening the doors, an exhaust fan, and thermostatically controlled heater to prevent condensation during cold periods.

All equipment shall be mounted on full size backboard made from a suitable non metallic material.

The cubicle shall nominally contain all required H_2S monitors 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.

7.3 Calibration

Calibration will be provided on all equipment supplied within the sampling and monitoring system, and will be carried out in accordance with the guidelines stated in Section 7.1 of this Specification.

The calibration of all analysers, whether they be of the electrochemical or the photo optical type, will be carried out in accordance with either of the approved methods as detailed in AS 3580:

- Method 2.1 – "Preparation of Reference Test Atmospheres – Permeation Tube Method"
- Method 2.2 – "Preparation of Reference Test Atmospheres – Compressed Gas Method (Dilution 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, in order to ensure that the total unit, and not simply the equipment electronics, is in full calibration.

8 INSTALLATION

8.1 Approval

Prior to installation, statutory approval from the local authorities shall be obtained.

8.2 Installation Practice

The installer shall be familiar with specification for the works and shall ensure that works are completed in accordance with good industrial practice. Written approval from the Principal and the designer shall be obtained for any deviations from the accepted design.

8.3 Materials and Equipment Inspection

Prior to transportation to site, materials and equipment shall be checked for compliance with the appropriate Specification or Standard by conducting a Factory Acceptance Test (See Section 9.1 of this Specification). The Contractor with the participation of the Principal's representative shall conduct these tests. On site, prior to installation, materials and equipment shall be checked to ensure that they are free from damage caused during transportation and are fit and suitable for use.

9 COMMISIONING

Following installation, the OCU shall be tested and commissioned in accordance with Sydney Water's Maintenance Related Clauses for Capital and Operational Projects (Section 7: Testing and Commissioning). The checklist in Appendix 1 and 2 of Sydney Water's Asset Commissioning Standard Administration Procedure (SAP) WWIMS0035, shall be used by the Commissioning Coordinator to ensure all of the Principal's requirements for asset commissioning are met.

The Contractor shall develop a commissioning plan, which shall be submitted to the Principal's representative for review. Written approval from the Principal's representative shall be sought prior to commissioning.

The Contractor shall provide the necessary expertise and resources for successful commissioning of the unit.

9.1 Pre-Commissioning (Factory Acceptance Test)

Pre-Commissioning of the OCU shall be carried out at the factory in the presence of relevant personnel from the Principal, prior to transportation to the relevant sites. The pre-commissioning work shall include the following:

- 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 IICATS alarms.
- Testing of dosing units, including pipe work, if pre constructed.
- The whole structure of each OCU shall be examined for any fugitive emissions that may be the result of leaks.
- Air flow rates and designed retention times are to be confirmed.

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

9.2 Site Commissioning

Following installation, the OCU shall be test run for a minimum period of one (1) month. The Contractor is responsible for conducting on site performance tests to the Principals satisfaction, to prove compliance with the guarantees. At a minimum, the following shall be checked or carried out:

- Odorous gas component(s) removal rate
- 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.

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

The Contractor shall supply all WAC Drawings, O&M Manuals along with trouble shooting guidelines and these shall be verified during the commissioning period. The O&M Manuals shall be in accordance with Sydney Water's Maintenance Related Clauses for Capital and Operational Projects (Section 6: O&M Manuals).

9.3 Records

All tests and inspections shall be documented identifying the date of the test, inspectors name, equipment used, results, and any adjustment action taken.

Fully detailed written reports shall be provided to the Principal's representative following a successful commissioning.

9.4 Handover

The Asset Commissioning SAP shall be followed to ensure all issues are finalised before handover of the OCU to Sydney Water's Operations Division.

10 DOCUMENT CONTROL

Title: Add Title		
Current review date: 18/01/2011	**Review Period:** 2 years	**Registered file:** 2010/01346F
BMIS file name: ACP0004		
Document owner:	Janssen Chan – Policy, Standards & Materials Manager	
Prepared by:	Sally Rewell – Chemical Engineer José González – Technical Specialist	
Stakeholders Consulted:	Alfred Soliman – Product Strategy Planner Fredrick Rodrigo – Maintenance Engineer Officer 5-6 Gilbert Baes – SCADA Project Engineer Gino Iori – System Operations Officer 5-6 Jeffrey Scott – Plant Manager Level 2 Louisa Vorreiter – Asset Class Strategy Leader Matthew Whalan – System Operations Officer 1- 4 Philip Duker – Water Technical Manager Rod Mackenzie – Senior Planner	
Approved by:	Janssen Chan – Policy, Standards & Materials Manager	

11 CHANGE HISTORY

Version	Date revised	Approved by	Author/s	Brief description of change
1	13/12/10	Janssen Chan	Sally Rewell & José González	First issue
2	18/1/11	Janssen Chan	Sally Rewell & José González	Minor formatting amendments

APPENDIX A – ACTIVATED CARBON P&ID

P&ID drawing for activated carbon unit (refer to drawing SEW1700-S1701).

APPENDIX B – BIOTRICKLING FILTER P&ID

P&ID drawing for biotrickling filter unit (refer to drawing SEW1700-S1703), and where required, P&ID for activated carbon unit (SEW1700-S1701) and P&ID for treated air to stack (SEW1700-S1706).

APPENDIX C – CHEMICAL SCRUBBER P&ID

P&ID drawing for chemical scrubber unit (refer to drawing SEW1700-S1702).

APPENDIX D – SOIL BED BIOFILTER P&ID

P&ID drawing for soil bed biofilter unit (refer to drawing SEW1700-S1704).

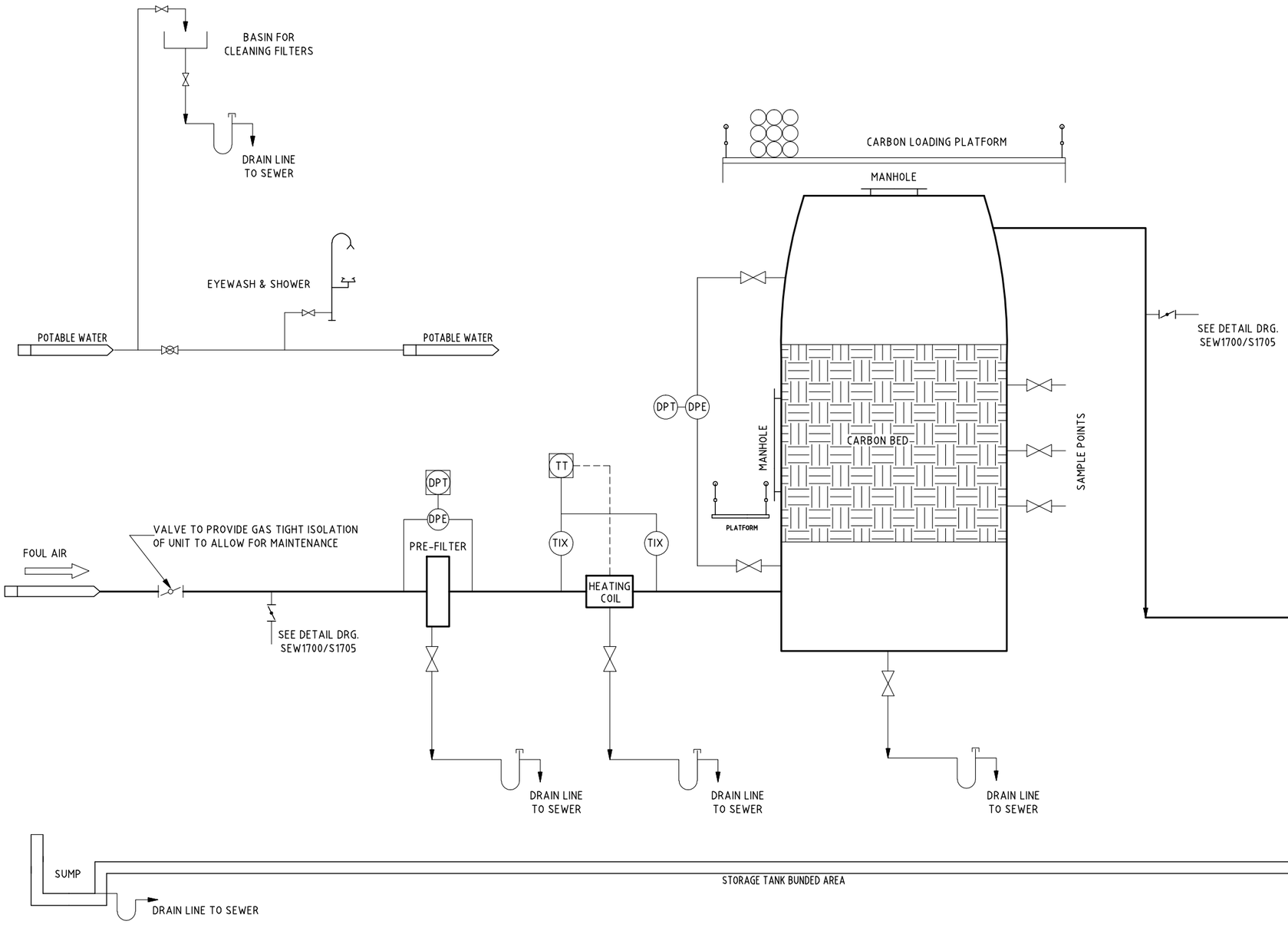
APPENDIX E – MONITORING SYSTEM P&ID

P&ID drawing for monitoring system (refer to drawing SEW1700-S1705).

REFERENCE DRAWINGS

ODOUR CONTROL

CHEMICAL SCRUBBER - PROCESS & INSRUMENTATION DIAGRAM SEW1700/S1702
BIOTRICKLING FILTER - PROCESS & INSTRUMENTATION DIAGRAM.....SEW1700/S1703
SOIL BED FILTER - PROCESS & INSTRUMENTION DIAGRAM.....SEW1700/S1704
MONITORING SYSTEM - PROCESS & INSTRUMENTATION DIAGRAM.....SEW1700/S1705
TREATED AIR TO STACK - PROCESS & INSTRUMENTATION DIAGRAM.....SEW1700/S1706



LETTER	DETAILS OF AMENDMENT	APP'D	DATE
B	GENERALLY AMENDED		18.10.10

DESIGNED M.W.
DRAWN 11/11/09 R.D. SWC
VERIFIED PD.
RECOMMENDED
ACCEPTED
CONTRACT No.

Sydney WATER

ODOUR CONTROL
ACTIVATED CARBON SCRUBBER
PROCESS AND INSTRUMENTATION DIAGRAM

PROJECT No.
SCALE AS SHOWN
A1

DRAWING No. SEW1700 / S1701
FINAL
DRAWING STATUS FINAL
B

SW41 APRIL 2007
PLOT DATE: 14/12/10; 9:10am
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REFERENCE DRAWINGS

ODOUR CONTROL

ACTIVATED CARBON - PROCESS & INSTRUMENTATION DIAGRAM SEW1700/S1701
BIOTRICKLING FILTER - PROCESS & INSTRUMENTATION DIAGRAM.....SEW1700/S1703
SOIL BED FILTER - PROCESS & INSTRUMENTION DIAGRAM.....SEW1700/S1704
MONITORING SYSTEM - PROCESS & INSTRUMENTATION DIAGRAM.....SEW1700/S1705
TREATED AIR TO STACK - PROCESS & INSTRUMENTATION DIAGRAM.....SEW1700/S1706

EYEWASH & SHOWER
HOSE REEL
POTABLE WATER
FSL
PIX
S
RPZ VALVE TRAIN
VENT ø50 uPVC
NaOH STORAGE TANK - LITRES CAPACITY
CALIBRATION CYLINDER
PIT
OVERFLOW
TANKER FILLING POINT
TO BUND SUMP
NaOCL STORAGE TANK - LITRES CAPACITY
ORP
AIX
PH
AIT
COND.
FIX
VALVE TO PROVIDE GAS TIGHT ISOLATION OF UNIT TO ALLOW FOR MAINTENANCE
FROM FOUL AIR SUPPLY
SEE DETAIL SEW1700/S1705
PLATFORM
MANHOLE
MIST ELIMINATORS
INSPECTION PORT
CL_2
H_2S
SEE DETAIL SEW1700/S1705
DPT
DPE
MEDIA
SUMP LIQUOR
LIT
M
OVERFLOW
TO SEW1700/S1701 OR SEW1700/S1706
DRAIN LINE TO SUMP
OPERATING AND STAND BY PUMPS
SUMP
STORAGE TANK BUNDED AREA
DRAIN LINE TO SEWER

LETTER	DETAILS OF AMENDMENT	APP'D	DATE
B	GENERALLY REVISED	APP'D	18/10/10

DESIGNED M.W.
DRAWN R.D. 11/11/09 SWC
VERIFIED P.D.
RECOMMENDED
ACCEPTED
CONTRACT No.

Sydney WATER

ODOUR SCRUBBER CHEMICAL SCRUBBER PROCESS AND INSTRUMENTATION DIAGRAM

PROJECT No.
SCALE AS SHOWN
A1

DRAWING No. SEW1700 S1702
FINAL
DRAWING STATUS FINAL
B

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REFERENCE DRAWINGS

ODOUR CONTROL

ACTIVATED CARBON - PROCESS & INSTRUMENTATION DIAGRAM SEW1700/S1701
CHEMICAL SCRUBBER - PROCESS & INSRUMENTATION DIAGRAM SEW1700/S1702
SOIL BED FILTER - PROCESS & INSTRUMENTION DIAGRAM..... SEW1700/S1704
MONITORING SYSTEM - PROCESS & INSTRUMENTATION DIAGRAM..... SEW1700/S1705
TREATED AIR TO STACK - PROCESS & INSTRUMENTATION DIAGRAM..... SEW1700/S1706

EYEWASH & SHOWER
POTABLE WATER
FSL
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TO BUND SUMP
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MIST ELIMINATORS
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SEW1700/S1705
DPT
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MANHOLE
MEDIA
PLATFORM
VALVE TO PROVIDE GAS TIGHT
ISOLATION OF UNIT TO ALLOW
FOR MAINTENANCE
FROM FOUL AIR SUPPLY
SEE DETAIL
SEW1700/S1705
PH
AIT
AIX
COND.
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AIX
FIX
SUMP LIQUOR
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OVERFLOW
SEE DETAIL DRG.
SEW1700/S1706 OR
WHERE NECESSARY SEE DRG.
SEW1700/S1701.
DRAIN LINE
TO SEWER
OPERATING AND STAND BY PUMPS
SUMP
BIO-TRICKLING FILTER STORAGE TANK BUNDED AREA
DRAIN LINE TO SEWER

LETTER	DETAILS OF AMENDMENT	APP'D	DATE
B	GENERALLY REVISED	APP'D	18/10/10

DESIGNED M.W.
DRAWN R.D. 11/11/09 SWC
VERIFIED P.D.
RECOMMENDED
ACCEPTED
CONTRACT No.

Sydney WATER

ODOUR CONTROL
BIOTRICKLING FILTER
PROCESS AND INSTRUMENTATION DIAGRAM

PROJECT No.
SCALE AS SHOWN
A1

DRAWING No. SEW1700 / S1703
FINAL
DRAWING STATUS FINAL
B

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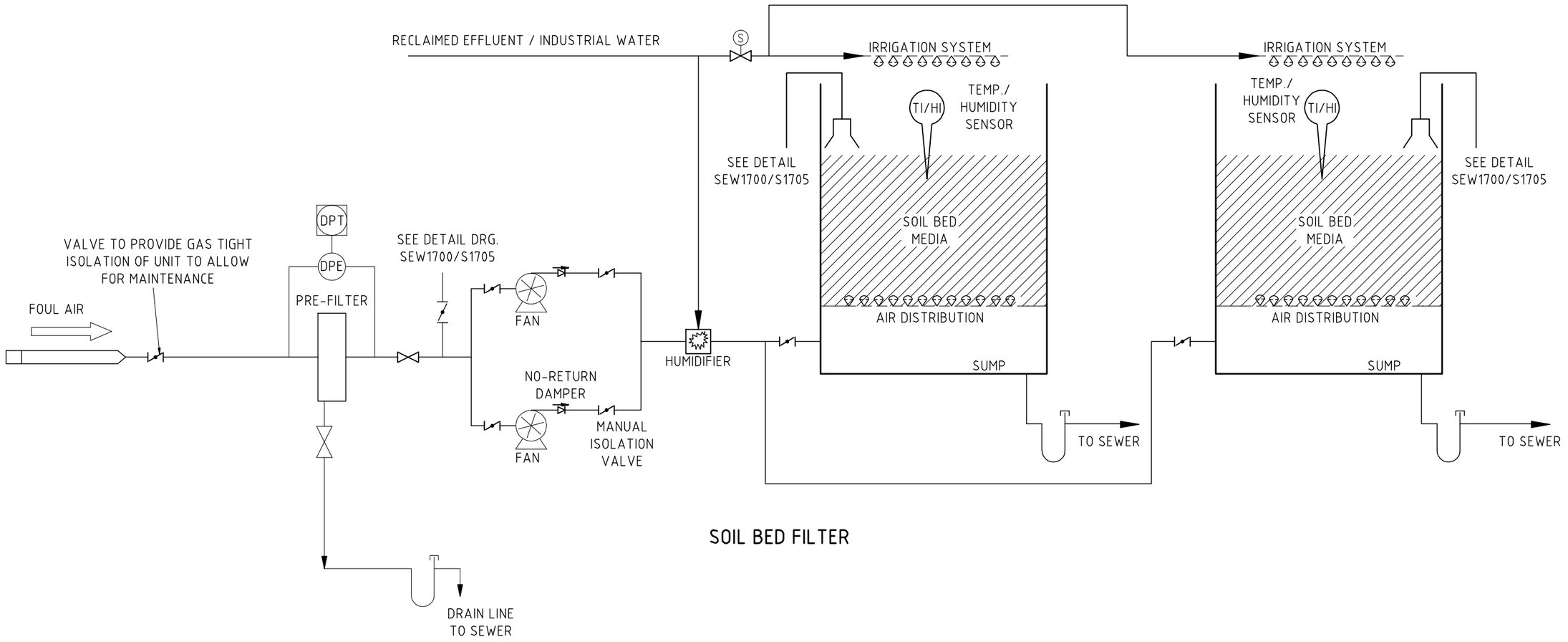

SOIL BED FILTER

REFERENCE DRAWINGS

ODOUR CONTROL

- ACTIVATED CARBON - PROCESS & INSTRUMENTATION DIAGRAM SEW1700/S1701
- CHEMICAL SCRUBBER - PROCESS & INSRUMENTATION DIAGRAM SEW1700/S1702
- BIOTRICKLING FILTER - PROCESS & INSTRUMENTATION DIAGRAM.....SEW1700/S1703
- MONITORING SYSTEM - PROCESS & INSTRUMENTATION DIAGRAM.....SEW1700/S1705
- TREATED AIR TO STACK - PROCESS & INSTRUMENTATION DIAGRAM.....SEW1700/S1706

LETTER	DETAILS OF AMENDMENT	APP'D	DATE

DESIGNED M.W.
DRAWN 18/10/2010 R.D. SWC
VERIFIED P.D.
RECOMMENDED
ACCEPTED
CONTRACT No.

Sydney WATER

ODOUR CONTROL
SOIL BED FILTER
PROCESS AND INSTRUMENTATION DIAGRAM

PROJECT No.
SCALE AS SHOWN
A1

DRAWING No. SEW1700 / S1704
FINAL
DRAWING STATUS FINAL

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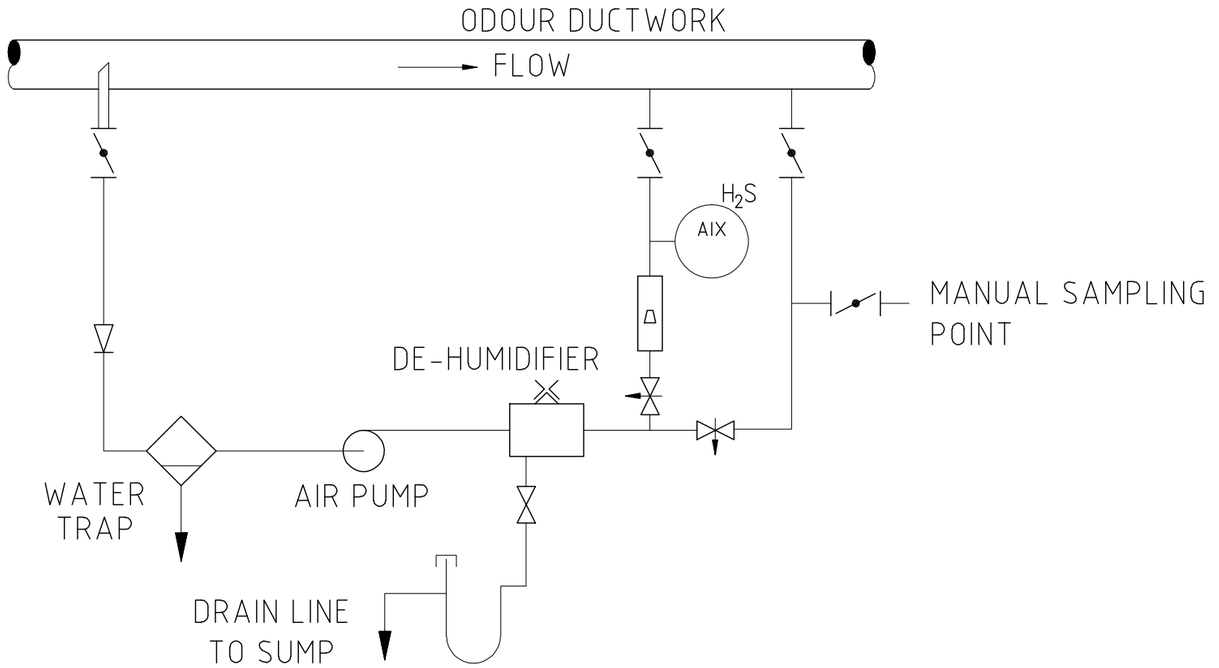

REFERENCE DRAWINGS

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- SOIL BED FILTER - PROCESS & INSTRUMENTION DIAGRAM.....SEW1700/S1704
- TREATED AIR TO STACK - PROCESS & INSTRUMENTATION DIAGRAM.....SEW1700/S1706

LETTER	DETAILS OF AMENDMENT	APP'D	DATE

DESIGNED S.R.
DRAWN R.D. SWC 11/11/09
VERIFIED J.G.
RECOMMENDED
ACCEPTED
CONTRACT No.

Sydney WATER

ODOUR CONTROL
MONITORING SYSTEM
PROCESS AND INSTRUMENTATION DIAGRAM

PROJECT No.
SCALE .R. A1

DRAWING No. SEW1700 / S1705
DRAFT A
DRAWING STATUS FINAL

SW41 APRIL 2007 554

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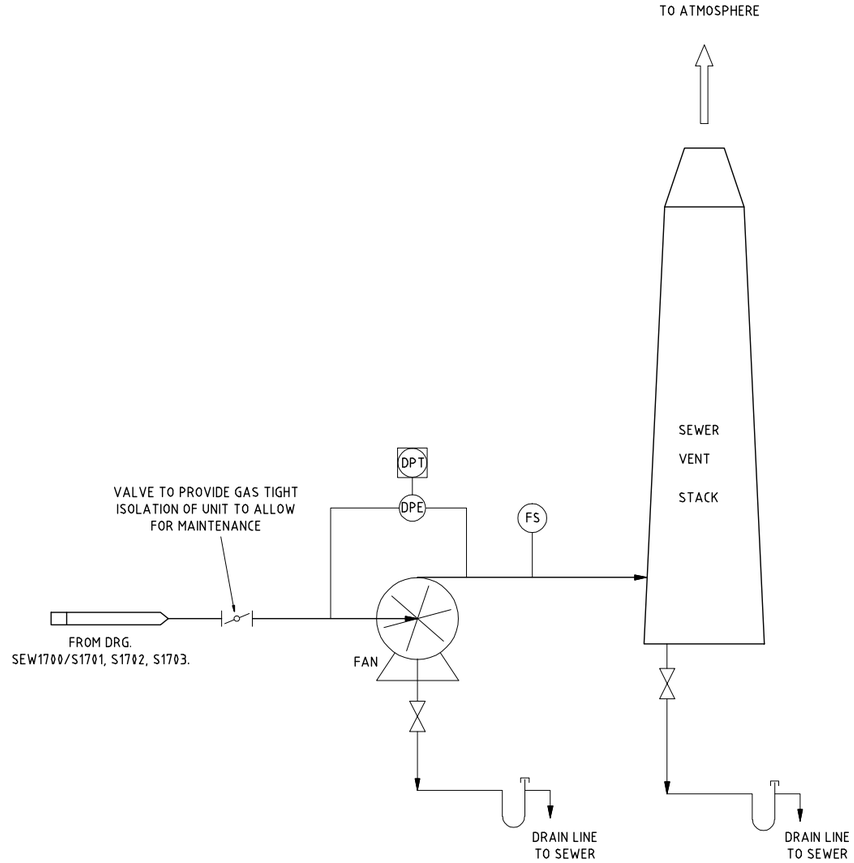

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SOIL BED FILTER - PROCESS & INSTRUMENTION DIAGRAM.....SEW1700/S1704
MONITORING SYSTEM - PROCESS & INSTRUMENTATION DIAGRAM.....SEW1700/S1705

LETTER	DETAILS OF AMENDMENT	APP'D	DATE

DESIGNED J.G.
DRAWN 11/11/09 R.D. SWC
VERIFIED M.W.
RECOMMENDED
ACCEPTED
CONTRACT No.

Sydney WATER

ODOUR CONTROL
TREATED AIR TO STACK
PROCESS AND INSTRUMENTATION DIAGRAM

DRAWING No. SEW1700 S1706
DRAFT A
DRAWING STATUS FINAL
PROJECT No.
SCALE AS SHOWN A1

SWA1 APRIL 2007
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