GOULBURN VALLEY WATER

3.4 Ventilation of Sewer Networks

DESIGN GUIDELINE

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System	Asset Management
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Note: With each edit to this document, the following must be completed. Also if a document is being reviewed and there are no changes, it should be noted that the review was undertaken and the next review date updated.

Details of Review/Changes

Date	Description	Modified By	Approved By
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July 2009	Revised and submitted for approval	Steven Nash	Allen Gale
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Apr 2019	Updated electrical standards	Adam Glasson	Grant Barry

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DESCRIPTION

This guideline is applicable to new and existing sewage pump stations and sewer pressure mains for the establishment of new ventilation infrastructure and repair or replacement of existing ventilation infrastructure within the Corporation's sewer networks.

Ventilation systems such as odour filter units, vent stacks, forced ventilation etc. are necessary to improve the operation and performance of the Corporation's sewer networks. Ventilation facilitates the extraction and controlled release of sewer gases that would otherwise promote corrosion, odour and OHS issues.

OBJECTIVE

The effective ventilation of GVW sewer networks must achieve the following:

- Reduction and control of odour for compliance with regulatory requirements (e.g. EPA licences and requirements),
- Minimise the potential for corrosive environments to form,
- Maximise asset life,
- Reduce odour complaints,
- Maintain safe work environment for GVW personnel and visitors,
- Achieves best industry practice,
- Based on sustainable development, and
- Meet Key Performance Indicator (KPI) targets.

RISK

This Guideline may identify some risks and provides guidance in mitigating these risks. However a further site specific assessment and/or HAZOP are required to address other risks.

All materials in contact with potable water must comply with AS/NZS 4020 and utilise WSAA National Codes and standards where applicable.

Isolation points for all energy sources including electrical, pneumatic and hydraulic must be considered. Installed isolation points are to be listed in the Operations Manuals for all asset types.

Ventilation is required to mitigate the following:

- Corrosion and reduced asset life,
- Non-compliance with EPA licence conditions, particularly odour conditions,
- Creating a hazardous working environment, and
- Failure to meet KPI's.

REFERENCE DOCUMENTS

- WSAA Hydrogen Sulphide Control Manual.
- Sewerage Code of Australia WSA
- GVW Supplement to the Code.
- Gravity Sewer Code
- GVW Supplement to the Code
- AS/NZ 3000: Electrical Installations
- AS1170 Structural Design Actions.
- Environment Protection ACT 197 No. 8056 of 1970 Part VIII – Control of Noise.
- GVW Sewer Network Odour Management Phase 2 Strategy Report - September 2011 (DOC14/14235).
- GVW Sewage Pump Station Design Manual
- GVW General Electrical Specification
- GVW Standard Drawings, DOC16/48254
- GVW Preferred Equipment List.

GLOSSARY OF TERMS

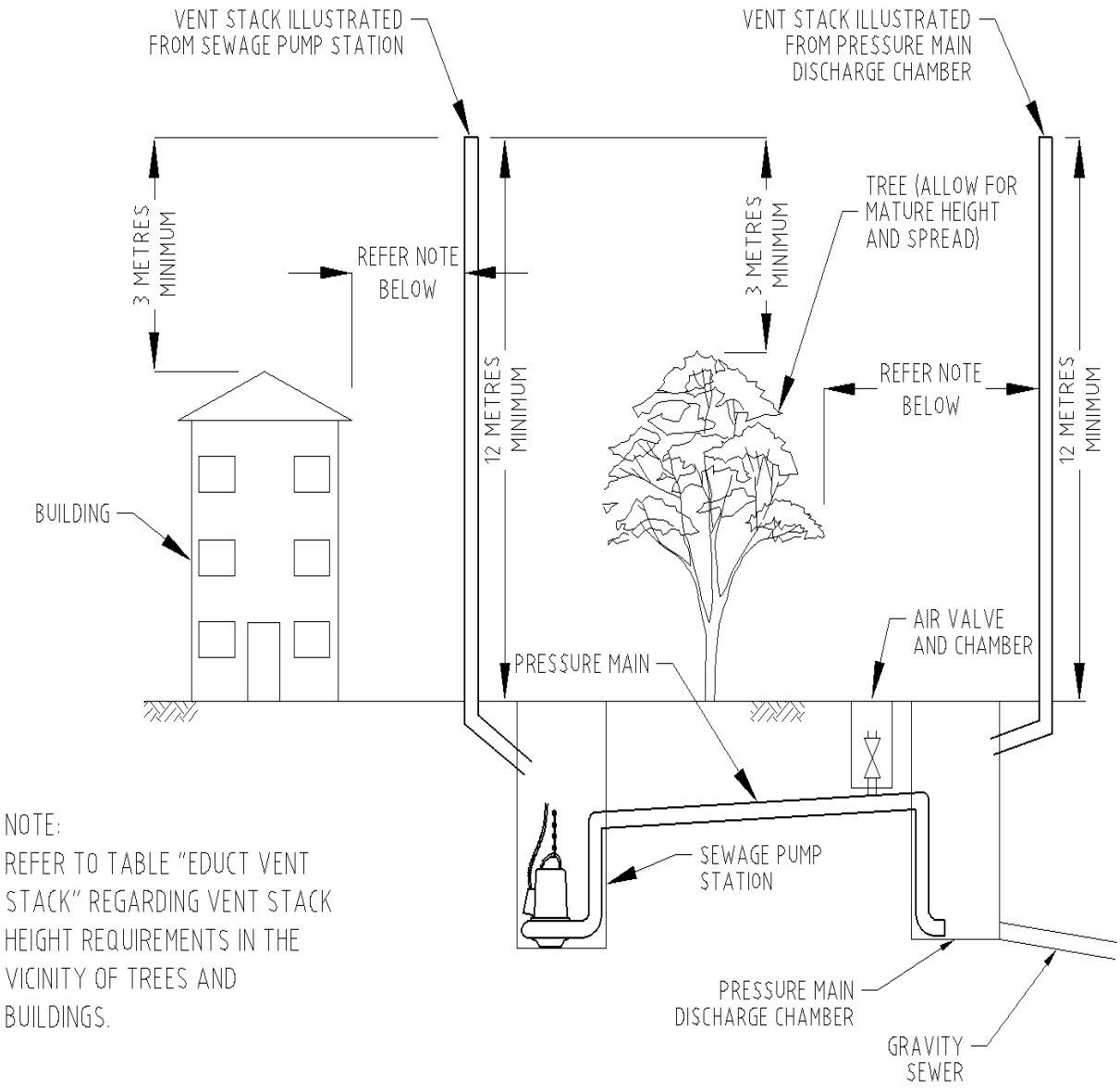
Sewage	Water polluted by use and discharged to a sewer system.
Sewer Pipeline	Pipeline or other construction, usually buried, designed to carry sewage from more than one source. Defined as a gravity sewer, sewer pressure main or sewer rising main.
Chamber	Defined as a sewage pump station, sewer manhole, sewer pressure main discharge pit or air valve pit.
Natural Ventilation	No mechanical assistance to induce air flow. Relies on atmospheric factors and weather conditions and/or change in sewage level in sewers and pump stations to generate airflow.
Forced Ventilation	Relies on mechanical means such as fans to generate air flow at a controlled rate.
Fugitive Odours	The unintended escape of odours at ground level from a pump station or discharge chamber. Can be due to poor sealing around access lids, pipework, slab protrusion etc., poor wet well construction or the induct (Ashdown) vent working in reverse.

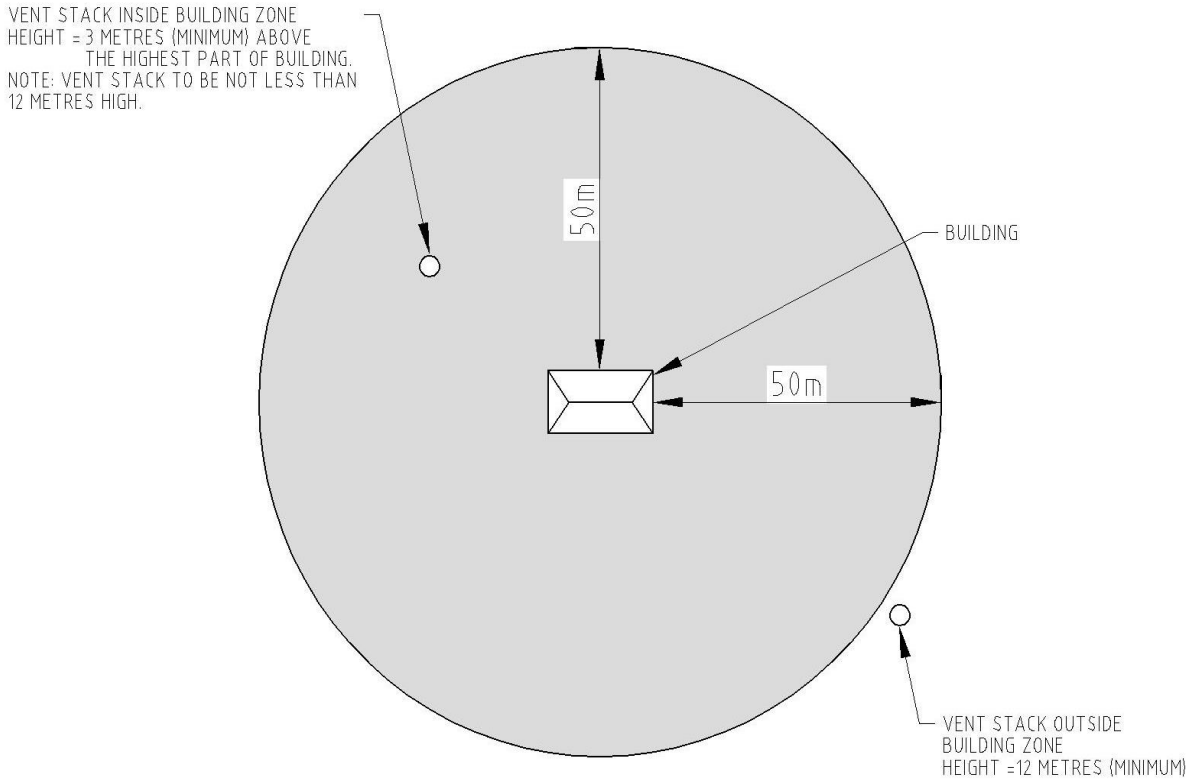
ABBREVIATIONS

GRP	Glass Reinforced Plastic pipe
PVC	Polyvinylchloride pipe
TWL	Top Water Level
PDWF	Peak Dry Weather Flow
NRV	Non return valve
m/s	metres per second
l/s	litres per second

Pa	Pascal
M	metres
mm	millimetres
ss	Stainless steel
ABS	Acrylonitrile Butadiene Styrene pipe
Dia.	Diameter
dBA	Decibels
m^3/hr	Metres cubed per hour
UV	Ultraviolet
VFD	Variable Frequency Drive
DOL	Direct on line
GVW	Goulburn Valley Water

SCHEMATIC PLAN

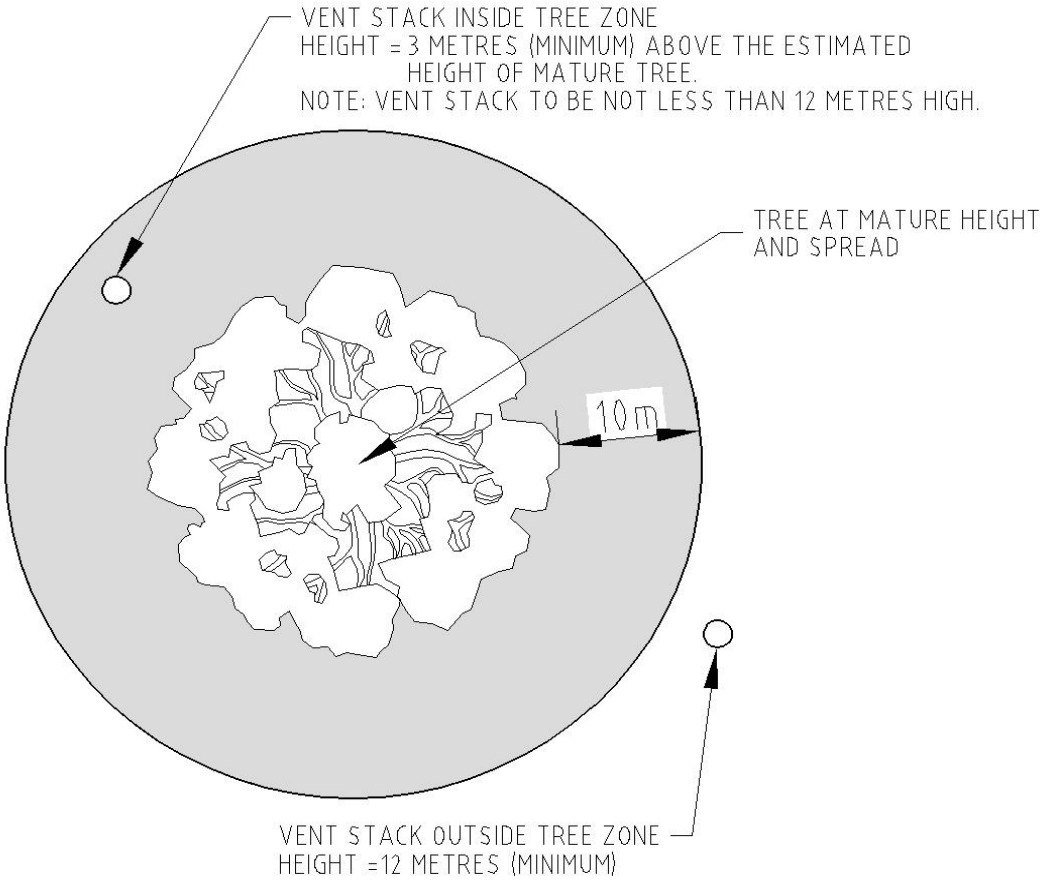




PLAN VIEW - VENT STACK ADJACENT TO BUILDING

New vents/houses 50 m separation distance.
Existing vents – if < 50 m then may require taller vent. Undertake risk assessment.
Trees - separation distance is not an issue. Stack can be within canopy, provided it is 3 m higher than the mature tree height.

Aesthetics of the surrounding landscape is to be considered and consultation is to be undertaken with adjoining land owners to determine the final location of the vent stack.



PLAN VIEW - VENT STACK ADJACENT TO TREE

COMPONENT DESCRIPTION:

For purposes of simplifying the requirement, the Guideline is categorised into the following:

- Developer Works – Residential Developments
- Developer Works – Industrial/Commercial Developments
- Existing Pump Stations and pressure main discharge chambers

1. Developer Works – Residential Developments

The design of all new sewage pump stations and pressure sewer main discharge chambers for residential developments shall include the provision of "natural" ventilation as a minimum, in accordance with this guideline.

2. Sewage pump stations

Sewage pump station "natural" ventilation design shall generally consist of the following elements:

- An induct vent (Ashdown vent or similar)
- An educt vent stack
- Structural design of the vent stack and footing taking into consideration the height, ground conditions and wind category
- Provision for an educt fan to be retrofitted by GVW at a future time

In accordance with GVW's Sewage Pump Station Design Manual, the ventilation ductwork is to pass through the valve pit and allowance is to be made for the future installation of an educt fan and motor within the valve pit. Pits are to be designed with adequate person access space for maintenance purposes, drainage back to pump station wet well, adequate air flow for electric motor cooling and trafficable where required. Ductwork is to be designed on an angle allowing for drainage back to the wet well.

Refer to Section (Design and Component Requirements:) for Valve pit requirements.

A component checklist is also provided to assist the designer. For developer construct projects this would accompany the consultant Detailed Design Certification documentation. Refer to Section (Design and Component Requirements:).

3. Pressure mains and discharge chambers

The design hydraulic retention time in pressure mains shall be minimised (e.g. minimise length and diameter of pressure mains) to reduce odour generation.

Pressure main discharge chambers shall generally be provided with a vent stack to provide "natural" ventilation similar to pump stations. Alternatively, where there are long pressure main lengths with lengthy hydraulic retention times, or if aesthetics and site specific constraints are a problem, then odour control filter units may be approved for use by GVW. Refer to GVW's Preferred Equipment List for details.

GVW, under certain circumstances may review a proposed development and if deemed necessary, require "forced" ventilation to be provided at the Developers expense either in

the first instance or retrofitted at subsequent stage of a development. Factors affecting this decision would include, topography, size of the catchment, retention times and the amenity of the area. The confined space shall be treated as such under Occupational Health and Safety regulations.

The proposed ventilation arrangements for a development are to be covered in the GVW Developer Construct – Feasibility Report.

4. Developer Works – Industrial/Commercial Developments:

The consultant is to make a risk assessment as to whether "natural" ventilation or "forced" ventilation would be required for a pump station to serve a proposed industrial/commercial development. It is anticipated that some assistance or guidance may be required from a suitably experienced odour control consultant and GVW. The assessment is to form part of the GVW Developer Construct - Feasibility Report pertaining to the sewage pump station requirements and should take the following factors into consideration:

- Zoning i.e.: heavy industries, food industries, commercial, business etc.,
- Type of industries and nature of waste i.e.: likelihood of producing odours,
- Catchment size,
- Retention times in upstream sewer network,
- Volume of wastewater,
- Incoming wastewater flowrate,
- Incoming long pressure mains,
- Length of discharge pressure main,
- Location of Pump Station in relation to building envelopes/offices, trees and vegetation etc., and
- Topography.

Pressure main discharge chambers shall generally be provided with a vent stack to provide "natural" ventilation. Alternatively, where there are long pressure main lengths with lengthy hydraulic retention times, or if aesthetics and site specific constraints are a problem, then odour control filter units may be approved for use by GVW. Refer to GVW's approved Preferred Equipment List for details.

In accordance with GVW's Sewage Pump Station Design Manual, the ventilation ductwork is to penetrate through the valve pit. Where "forced" ventilation **is** required, educt fans shall be installed within the valve pit. Where "forced" ventilation **is not** required, allowance is still to be made for the future installation of an educt fan and motor. Pits are to be designed with adequate person access space for maintenance purposes, drainage back to pump station wet well, adequate air flow for electric motor cooling and trafficable where required.

Refer to Section (Design and Component Requirements:) for Valve pit requirements.

A proposed component checklist is also provided to assist the designer. For developer construct projects this would accompany the consultant Detailed Design Certification documentation. Refer to Section (Design and Component Requirements:).

5. Existing Pump Stations and Pressure Main Discharge Chambers:

Where an existing pump station is being considered for refurbishment, replacement or odour mitigation, a detailed assessment shall be undertaken to ascertain if “natural” or “forced” ventilation is required. It is anticipated that some assistance or guidance may be required from a suitably experienced odour control consultant and GVW.

Pump stations within the system already having multiple catchments discharging into it shall be deemed to require “forced” ventilation.

For existing pump stations, educt fans may be installed:

- Within the existing valve pit (space permitting),
- Within a separate dedicated pit, and
- Above ground subject to GVW approval in a noise controlled cabinet.

Note: it is preferred that the fan and motor be installed below ground for better noise and temperature control.

Where a fan is to be installed above ground, noise attenuation is an important design consideration with regard to the adverse effects on nearby residences, offices and the amenity of public open spaces. Above ground installation of fans require covers to prevent direct sunlight on the fan and motor.

Pits are to be designed with adequate person access space for maintenance purposes, drainage back to pump station wet well, adequate motor cooling ventilation and trafficable where required. Pit surrounds need to have consideration of falls protection and be capability of supporting access/egress/confined space retrieval system under the Occupational Health and Safety regulations. Refer to Section (Design and Component Requirements:) for Valve pit requirements.

A proposed component checklist is also provided to assist the designer. For Developer Construct projects this would accompany the consultant Detailed Design Certification documentation. Refer to Section (Design and Component Requirements:).

All existing sewer pressure main discharge chambers being considered for refurbishment, replacement or odour mitigation shall be subject to a detailed assessment on a case by case basis regarding ventilation options within the framework of the guidelines. The preference is for “natural” ventilation i.e. a vent stack wherever possible.

6. Commissioning:

Natural Ventilation

The commissioning process is to be repeated when the pumps are both running and stopped.

- Check for fugitive odours around the pump station or pressure main discharge chamber at ground level using a certified tested and calibrated hydrogen sulphide concentration meter.
- Check that air is being drawn into the chamber through the induct vent (smoke test or tissue or similar).
- Measure and record the hydrogen sulphide concentration in the vent stack through the sampling point.
- Record the weather and wind conditions at the time of commissioning.

Forced Ventilation

The commissioning process is to be repeated when the pumps are both running and stopped.

- Check for fugitive odours around the pump station or pressure main discharge chamber at ground level using a certified, tested and calibrated odour meter.
- Confirm that air is being drawn into the chamber through the induct vent (smoke test or tissue or similar).
- Measure and record the air pressure and velocity in the educt vent stack through the sampling point.
- Measure and record the air pressure inside the pump station wet well to confirm that a negative air pressure has been achieved.
- Measure and record the hydrogen sulphide concentration in the vent stack through the sampling point.
- Record the weather and wind conditions at the time.

7. Design and Component Requirements:

The following tables are provided to assist with the detailed design of “natural ventilation” and “forced ventilation” systems for the control of odours.

Ventilation Air Flow at Sewage Pump Stations and Discharge Chambers

Description	Natural Ventilation	Forced Ventilation
Negative air pressure within covered chambers	Can’t be controlled	5 Pa minimum 10 to 20 Pa maximum
Educt air flow rate (l/s)	Not applicable	Adopt whichever is greater for the following: • Achieve >2 x Peak Dry Weather Flow (PDWF) Or 12 air changes per hour

Description	Natural Ventilation	Forced Ventilation
Discharge velocity from vent	Not applicable	Minimum 10 m/s Design 12 m/s Maximum 15m/s
Inlet vent pipe velocity	Not applicable	2 m/s minimum Design 3m/s - 5m/s depending on length of inlet pipe Note: inlet orifice to be choked sufficiently to produce the required negative air pressure. i.e. capacity of inlet pipe should not allow for pressure to balance out inside the chamber
Total air pressure head loss in inlet air pipe	Not applicable	>10 Pa
Topography	Not applicable	Windy or exposed conditions to allow for additional negative pressure within the chamber

A suitably experienced odour control consultant may need to be consulted to design forced ventilation systems.

Educt Vent Stack

Description	Natural Ventilation	Forced Ventilation
Height	Min. 12m	Min. 12m
Height adjacent to buildings within a 50m radius	Min. 3.0m above highest part of the building	Min. 3.0m above highest part of the building
Height adjacent to trees within a 10m radius to the foliage of tree at its mature spread	Min. 3.0m above the estimated mature height of the tree	Min. 3.0m above the estimated mature height of the tree
Diameter (excluding discharge cone)	To match largest incoming gravity sewer • Min. 150mm dia • Max. 300mm dia	To match largest incoming gravity sewer • Min. 150mm dia • Max. 300mm dia
Material	• GRP • Galvanised Steel Pipe with PVC internal liner	• GRP • Galvanised Steel Pipe with PVC internal liner
Colour – to be assessed to reduce visual impact	• Unpainted Galvanised Steel • Heritage Green • Colour matched to surrounding environment	• Unpainted Galvanised Steel • Heritage Green • Colour matched to surrounding environment

Description	Natural Ventilation	Forced Ventilation
Cowling or rotor at the top of the vent stack	Required to be fitted	Not to be fitted
Drainage	Pipework from vent stack must drain back to pump station or chamber	Pipework from vent stack must drain back to pump station or chamber
Sampling point	To be a 80mm dia. sealed flanged branch on the side of the vent stack covered with a blank flange. NOTE: to be in the range of 1.4m to 1.6m measured from ground level	To be a 80mm dia. sealed flanged branch on the side of the vent stack covered with a blank flange. NOTE: to be in the range of 1.4m to 1.6m measured from ground level

Duct Work

Description	Natural Ventilation	Forced Ventilation
Pipe material	Fibre Reinforced Plastic (FRP) or 316SS	Fibre Reinforced Plastic (FRP) or 316SS
Jointing	Flanged with gaskets	Flanged with gaskets
Fittings material	316SS	316SS
Fan inlet/outlet couplings	Not applicable	Flexible (to allow for vibration)
Ductwork support	<3.0m centres	<3.0m centres
Pressure rating	Not applicable	To be a minimum of 1.5 times maximum operating air pressure
Lagging for noise control	Not required	As required
Pressure measuring points (these are for undertaking checks on air pressure)	Not required	Required to be assessed in the detailed design phase
Dampers	316SS quadrant fitting with position indicator and position clamping device	316SS quadrant fitting with position indicator and position clamping device
Rainwater and condensation drainage from lowest point on the ductwork back to pump station or chamber	Required – with a gooseneck in the drainage pipework	Required – with a gooseneck in the drainage pipework

Valve Pit

Description	Natural Ventilation	Forced Ventilation
Valve pit	Absolute minimum internal size of 1750mm square or 1950mm diameter	Absolute minimum internal size of 1750mm square or 1950mm diameter
Ventilation pit	Preferred minimum internal size of 1200mm square or 1500mm diameter	Preferred minimum internal size of 1200mm square or 1500mm diameter

Induct Vent

Description	Natural Ventilation	Forced Ventilation
Ashdown vent or similar	Required (cast iron)	Required (cast iron)
Ashdown vent location	Refer to Sewage Pump Station Design Manual	Refer to Sewage Pump Station Design Manual
Inlet air pipe diameter	Required (diameter to be assessed in detailed design phase)	Required (diameter to be assessed in detailed design phase) Note: sized to produce required inlet velocities and negative air pressure
Inlet air pipe material	PVC or ABS (refer to Sewage Pump Station Design Manual for details)	PVC or ABS (refer to Sewage Pump Station Design Manual for details)
Inlet air pipe length	Extend to within 0.5m of TWL (refer to Sewage Pump Station Design Manual for details)	Extend to within 0.5m of TWL (refer to Sewage Pump Station Design Manual for details)
NRV on inlet pipe	Required	Not required

Electrical/Telemetry - General

All electrical work is to be as per AS/NZ 3000 and the GVW General Electrical Specification.

Description	Natural Ventilation	Forced Ventilation
Electrical conduit	Required for future fan – To be 50mm conduit to switchboard with long sweep bends, draw wire and sealed both ends	To be 50mm conduit to switchboard with long sweep bends, draw wire and sealed both ends
Variable frequency controller in the electrical control cabinet	Not Required, however space to be made available on switchboard for future installation. Size to be determined by ultimate design	Required
Fan and motor situated within valve pit	Spacer piece only to allow for fitting a fan in the future	To be mounted on a 316SS support bracket affixed (bolts / fasteners) to the pit wall
Fan and motor situated above ground	Not applicable	To be mounted on a concrete base slab with a lockable steel mesh security cage. Note: cage is to have solid steel top for protection against direct sunlight and

Description	Natural Ventilation	Forced Ventilation
		rainfall
Valve pit high water alarm	Not applicable	Required – to be connected to telemetry system
Telemetry aerial mounting point	• To be 6.0m from ground level • FRP vent stack – 100mm wide x 3mm thick galvanised steel band with a bracket for attaching aerial. Note: clamp to have 5mm thick neoprene or insertion rubber lining • Galvanised steel vent stack - 30mm wide x 3mm thick galvanised steel band clamp with a bracket for attaching aerial	• To be 6.0m from ground level • FRP vent stack – 100mm wide x 3mm thick galvanised steel band with a bracket for attaching aerial. Note: clamp to have 5mm thick neoprene or insertion rubber lining • Galvanised steel vent stack - 30mm wide x 3mm thick galvanised steel band clamp with a bracket for attaching aerial
Telemetry conduit	To be 32mm conduit to switchboard with long sweep bends, draw wire and sealed both ends. Note: conduit to be installed through concrete footing and vent stack base plate to rest against base of stack	To be 32mm conduit to switchboard with long sweep bends, draw wire and sealed both ends. Note: conduit to be installed through concrete footing and vent stack base plate to rest against base of stack

Electrical – Fan and Motor Components

Description	Forced Ventilation Only
Fan	
Fan supplier	Refer to GVW's Preferred Equipment List
Type	Centrifugal with capacity >2000m^3/hr
Design capacity	1.2 x normal operating duty
Duty	Continuous
Fan construction, material and finish	316SS • 2B finish • Anti-sparking construction • All welds passivated (glass bead)
Fan supports and brackets	316SS
Motor	
Drive	Direct
VFC	Required - Refer to GVW's Preferred Equipment List
Phases	3 phase – EXN or EXE
Efficiency	High
Manufacturer	Refer to GVW's Preferred Equipment List
Poles	4

Description	Forced Ventilation Only
Exposure rating	• IP56 – if situated inside protected from the elements. Good flow through ventilation to be provided • IP66 – if situated outdoors in and subjected to the elements • Motor to have UV resistant cooling fans
Coating	Factory applied epoxy
Bearings	Greased for life type
Terminal box	Side mounted - Cables side/bottom entry
Moisture control	As required – Provide porous drain plugs as a minimum
Thermistors	Not required
Factory test certificate	Required
Protection Controls	Relevant Overload if DOL
Fan/motor operation	Status monitoring of fan drive from a proximity sensor on the motor shaft and a non-urgent alarm
Noise Control	
Maximum accumulate noise level of fan and motor (at 1m horizontal and 1m vertical)	<80dBA in duct <60dBA in case

Proposed Component Details

A proposed component checklist is provided to assist the designer and is to be read in conjunction with the detailed requirements shown above. For developer construct projects this could accompany the consultant Detailed Design Certification documentation.

Component	Details/Supplier/Manufacturer (Designer to Complete)
Vent stack height	
Vent stack material and diameter	
Vent stack discharge cone diameter	
Vent stack colour	
Ductwork pipe material and diameter	
Dampers	
Inlet air pipe material and diameter	
Inlet pipe NRV	
Fan	
Fan capacity	
Motor	
Motor exposure rating	
VFD	
Fan location	

SITE PHOTOS: