GREYWACKE GEOTECHNICS

WASTEWATER REPORT

Prepared for: **Nastasi & Associates Consulting Engineers**

Project: Proposed Residential Development

Location: 150 Church Lane, Cranebrook NSW 2749

Project No.: NAAC0577-WW AA

26 February 2021

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1. Introduction

1.1 General

This report is prepared by Greywacke Geotechnics for a proposed residential development at (Lot 1 in DP 1231299) 150 Church lane, Cranebrook NSW 2749. The investigation was carried out in general accordance with Greywacke's proposal and commissioned by Mr. Sean Irwin from Nastasi & Associates Consulting Engineers.

Greywacke Geotechnics has been engaged by the client to undertake an 'onsite wastewater management study' at the above-mentioned site address. This report presents the results of that study.

This report will be submitted to Council to accompany a Development Application (DA) process.

1.2 Objective

The objective of the 'onsite wastewater management study' is to investigate the relevant site, soil, public health and economic factors that can impact on the selection, location and design of an on-site wastewater management system to determine:

- Whether or not the site is suitable for an on-site wastewater management system
- The best practical on-site wastewater management system for the specific site and proposed development.

This study has been prepared in accordance with:

- Australian Standard AS1547: 2012"On-site Domestic Wastewater Management"
- Dept. Local Government 1998, On-site Sewage Management for Single Households,
- Relevant Council Development Control Policies

1.3 Scope of work

The scope of works undertaken for this site evaluation included:

- Desktop Study: An initial investigation to collate relevant information about the site and proposed development prior to the site inspection.
- Site Assessment: An on-site inspection by an engineer or scientist to record land surface, site features, identify potential site constraints and define the most appropriate land application area.
- Soil Assessment: A subsoil investigation by an engineer or scientist to record the soil profile and relevant soil properties within the land application area to determine potential soil limitations.
- System Design: An evaluation of the expected wastewater flowrate, site and soil limitations to select, size and position a waste treatment unit and land application system that will provide the best practical option.
- Operation & Maintenance / Construction & Installation Guidelines

2. Desktop Information

Table 1 Wastewater flowrate

Address	150 Church lane, Cranebrook NSW 2749
Council	Penrith City Council
Proposed Development	Proposed Residential Development
Intended Water Supply Source	Town water
Design Wastewater Allowance	150 L / day / person
Equivalent Population	Up to 8 people (6 Habitable Rooms)
Design Wastewater Flowrate	1200 L / day
Rainfall Station	Penrith Lakes AW S
Evaporation Station	Richmond - UWS Hawkesbury NSW

3. Site Assessment

The following relevant site features were recorded and given a rating in terms of their potential constraints to onsite wastewater management. The three ratings are minor limitation, moderate limitation or major limitation. Only those site features that are rated as being a major limitation to onsite wastewater management are further discussed in the 'Site Assessment Discussion'.

3.1 Landform Description

The landform is described by first dividing an area into landform elements of approximately 40-m diameter. A description of these elements is then provided. These landform elements define the boundaries of this site assessment.

Element	Approx. Slope Tangent (%)	Slope Class	Morphological Type	Relative Inclination	Instability Risk
1	5%	Level	Lower Slope	Linear	Very Low

3.2 Vegetation

The vegetation is described by dividing the study area into vegetation elements. Each vegetation element has a unique set of properties.

Element	Growth Form	Height Class	Cover Class	Structural Formation
A	Grass	Low-Mid	Grass	Grassland

Element	Exposure	Existing Erosion		Landform Element (s)
		State	Type	
A	Excellent	Stabalised	-	1

3.3 Overland Flow

Run-on and run-off potential is largely determined by slope, surface cover and soil infiltration rate.

Landform element.	Run-on	Run-off	Soil - Water Status
1	Slow	Slow	Dry

3.4 Site & Soil Disturbance

The site assessor noted the following disturbance within the effluent application envelope:

None	Description:

3.5 Rocky Outcrops

The site assessor noted the following rocky outcrops within the effluent application envelope:

None	Description:

3.6 Setbacks

The following setbacks from the effluent application area have been proposed after considering Appendix R of AS1547:2012 'On-site Domestic Wastewater Management'. This Appendix provides a recent guide on how to determine setbacks distances based on site-specific constraints identified in this site assessment.

The constraint factors associated with each site feature (refer to Table R1) have been qualitatively assessed using Table R2 and a suitable setback then chosen from within the range stated in Table R1.

Table 2 Setback Constraints

Site Feature	Setback Range	Constraint Factors	Proposed Setback
Dwellings	12m	LOW	> 12m
Property Boundaries, Driveways & Buildings	3 – 6m	LOW	> 3m Upslope > 6m Downslope
Waterways & Dam	40m	LOW	> 40m
Drip Line of Native Trees/Shrubs	1m	LOW	> 1m

3.7 Site Assessment Discussion

A range of site features that can commonly place limitations on on-site wastewater management have been assessed and classified. All features have been shown (refer to **Figure 1**) to place no major limitations to on-site wastewater management.

Figure 1 Indicative landform of dispersal area

4. Soil Assessment

The location of the boreholes excavated during the site inspection is shown on the attached site plan found in Appendix A. Physical and chemical soil properties were recorded on a soil profile log below. On each property two boreholes were excavated, the first borehole was excavated to analyse soil features listed below, and the second borehole excavation was carried out to confirm homogeneous subsoil structure. If soil properties found in the two boreholes on site differ, then samples from both boreholes are taken for analysis.

The following properties were recorded for each soil horizon:

- Horizon depth and type
- Mottling
- Colour
- Structural stability
- Groundwater depth
- Bedrock depth
- Texture
- pH
- Phosphorus Sorption
- Electrical Conductivity
- Coarse Fragments

Bore Hole 1:

Physical Properties: In summary, the soil profile is described below:

Soil Horizon	Depth	Colour	Mottles	Coarse Fragments %	Texture	Structure
A	200	Brown	-	< 10	Clay Loam	Moderate
B	1300	Pale Brown	-	< 10	Light Clay	Strong

Excavation terminated at: 1300 mm

Reason: Soil Depth is a Minor Limitation

Bedrock Depth: > 1300 mm

Water Table Depth: > 1300 mm

Surface Condition: Firm

Figure 2 Soil sample from BH1

Chemical Properties

Soil samples were collected from each major soil horizon and the relevant chemical properties are presented below:

Borehole 1:

Horizon	PH	EC (µS/cm)
B	5.1	42

Bore Hole 2:

Physical Properties: In summary, the soil profile is described below:

Soil Horizon	Depth	Colour	Mottles	Coarse Fragments %	Texture	Structure
A	400	Brown	-	< 10	Clay Loam	Moderate
B	1400	Pale Brown	-	< 10	Light Clay	Strong

Excavation terminated at: 1400 mm

Reason: Soil Depth is a Minor Limitation

Bedrock Depth: > 1400 mm

Water Table Depth: > 1400 mm

Surface Condition: Firm

Figure 3 Soil sample from BH2

Chemical Properties

Soil samples were collected from each major soil horizon and the relevant chemical properties are presented below:

Borehole 2:

Horizon	PH	EC (µS/cm)
B	5.4	28

Bore Hole 3:

Physical Properties: In summary, the soil profile is described below:

Soil Horizon	Depth	Colour	Mottles	Coarse Fragments %	Texture	Structure
A	450	Brown	-	< 10	Clay Loam	Moderate
B	1400	Pale Brown	-	< 10	Light Clay	Strong

Excavation terminated at: 1400 mm

Reason: Soil Depth is a Minor Limitation

Bedrock Depth: > 1400 mm

Water Table Depth: > 1400 mm

Surface Condition: Firm

Figure 4 Soil sample from BH3

4.1 Erodibility / Erosion Hazard

Soil erodibility is the susceptibility of the topsoil to detachment and transport of soil particles. It is a characteristic of the soil surface and varies with time, soil / water status and land use. Soil erodibility classification is stated as low, moderate or high.

Erosion hazard is the susceptibility of an area of land to the prevailing agents of erosion. It is a function of climate, soil erodibility, vegetation cover and topography.

	Boreholes 1	Boreholes 2	Boreholes 3
Erodibility	Low	Low	Low
Erosion Hazard	Slight	Slight	Slight

4.2 Salinity & Drainage

Salinity is the concentration of water-soluble salts contained within a soil. Increases in soil salinity (i.e. salinisation) can occur as a result of irrigation water raising the level of an already saline groundwater. Management of potential salinisation problems involve ensuring that salts introduced to the soil surface are removed (by crop uptake or subsoil leaching) and by ensuring the irrigation area provides adequate subsoil drainage to prevent raising of saline groundwaters into root zones.

Drainage is a statement describing the site and soil drainage that is likely to occur most of the year. It is influenced by soil permeability, water source, landform description, evapotranspiration, slope gradient and slope length.

The drainage of this site should be adequate for the leaching of salts and ensure the groundwater level does not reach the root zone.

A major adverse effect of high soil salinity is the restrictive effects on plant growth. However, for this site the soil salinity levels (as indicated by the electrical conductivity values) are low enough that the adverse effects on plant growth will be minimal.

4.3 Soil Assessment Discussion

A range of soil properties that commonly place limitations on on-site wastewater management have been assessed and classified. In accordance with the Environmental and Health Protection Guidelines all soil properties have been shown to present no major limitations to on-site wastewater management.

5. On-Site Wastewater System Design

The design process adopted here involves an evaluation of the expected wastewater flow, site limitations and soil limitations, to select, size and position a waste treatment unit and land application system that will provide the best practical option.

5.1 Wastewater Treatment:

This report proposes wastewater treatment using a NSW Health accredited (or equivalent) Aerated Wastewater Treatment System (AWTS) as it will produce a high quality effluent suitable for absorption purposes.

5.2 Effluent Application:

This report proposes that effluent application be via a pressure dosed system. Greywacke Geotechnics recommends all of the following methods of absorption (presented below as numbered options) are suitable for installation on this site.

1. **Pressure Dosed Absorption Bed**

Any absorption system must be installed within the proposed absorption shown on the site plan or within the 'available absorption envelope' (if an envelope is shown on your site plan).

The client shall choose whichever of the following absorption options best suits their needs. Before choosing which type of absorption to install, the client must first consider:

- **Appendix D (Operation & Maintenance Guidelines)**
- **Appendix F (Pressure Dosed Beds - Standard Drawings)**

5.3 Effluent Application Area Sizing

The absorption bed area sizing was determined in accordance with table E1 & L1 of AS/NZS 1547:2012.

Proposed Design Loading Rate (DLR):

Strongly Structured Light Clay (Category 4)   12mm / day (Table E1 & L1, AS 1547:2012)

Minimum Absorption Area (Greater of Q/DLR & Water Balance (**Appendix B**)):

$$EDA = \frac{Design\ Flow\ rate(Q)}{Design\ Loading\ Rate(DLR)} = \frac{1200}{12} = 100\ m^2$$

5.4 Site Modifications Recommended

- Maintain 100% reserve area.

6. Recommendations

- Installation of a NSW Health accredited Aerated Wastewater Treatment System (AWTS) with capacity to treat the design flowrate (1200 L/day) to a secondary treatment standard with disinfection.
- Model, schematics and associated documentation of the above treatment type to be provided by client upon consultation with installer/plumber. Schematics and documentation of selected model to be attached upon submission with this report.
- Installation of a pressure dosed absorption system. This area shall be designated for effluent application only.
- Greywacke Geotechnics recommends all the following absorption types are suitable for installation on this site:

Absorption System Type	Minimum area Required
Pressure Dosed Absorption Bed	**100m^2**

- Once the client's septic application has been approved, the client shall choose whichever of the above options best suits their needs in consultation with Council.
- Further site-specific absorption details (for example, distribution line positioning within the proposed absorption area), if required, may be determined in consultation with your plumber/absorption installer.
- Each absorption system must be installed within the proposed land application area shown on the site plan or within the 'available absorption envelope' (if an envelope is shown on your site plan).
- The Pressure Dosed Beds shall be maintained in accordance with the attached "Operation and Maintenance Guidelines" (**Appendix D**).
- Please refer to **Appendix F** for further detailed Pressure Dosed beds and trenches descriptions and standard drawings for guidance during construction and installation.

7. Limitations

This report has been prepared by Greywacke Geotechnics (Greywacke) for Nastasi & Associates Consulting Engineers (Client) and may only be used and relied on by the Client for the purpose agreed between Greywacke and the Client as set out in Section 1.3 of this report.

Greywacke otherwise disclaims responsibility to any person other than the Client arising in connection with this report. Greywacke also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by Greywacke in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. Greywacke has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

Greywacke has prepared this report based on information provided by the Client and others who provided information to Greywacke, which Greywacke has not independently verified or checked beyond the agreed scope of work. Greywacke does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by site conditions, such as the location and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions may change after the date of this report. Greywacke does not accept responsibility arising from, or in connection with, any change to the site conditions. Greywacke is also not responsible for updating this report if the site conditions change.

For and On Behalf of
Greywacke Geotechnics

[redacted]

Charbel Bahi
Geotechnical Engineer

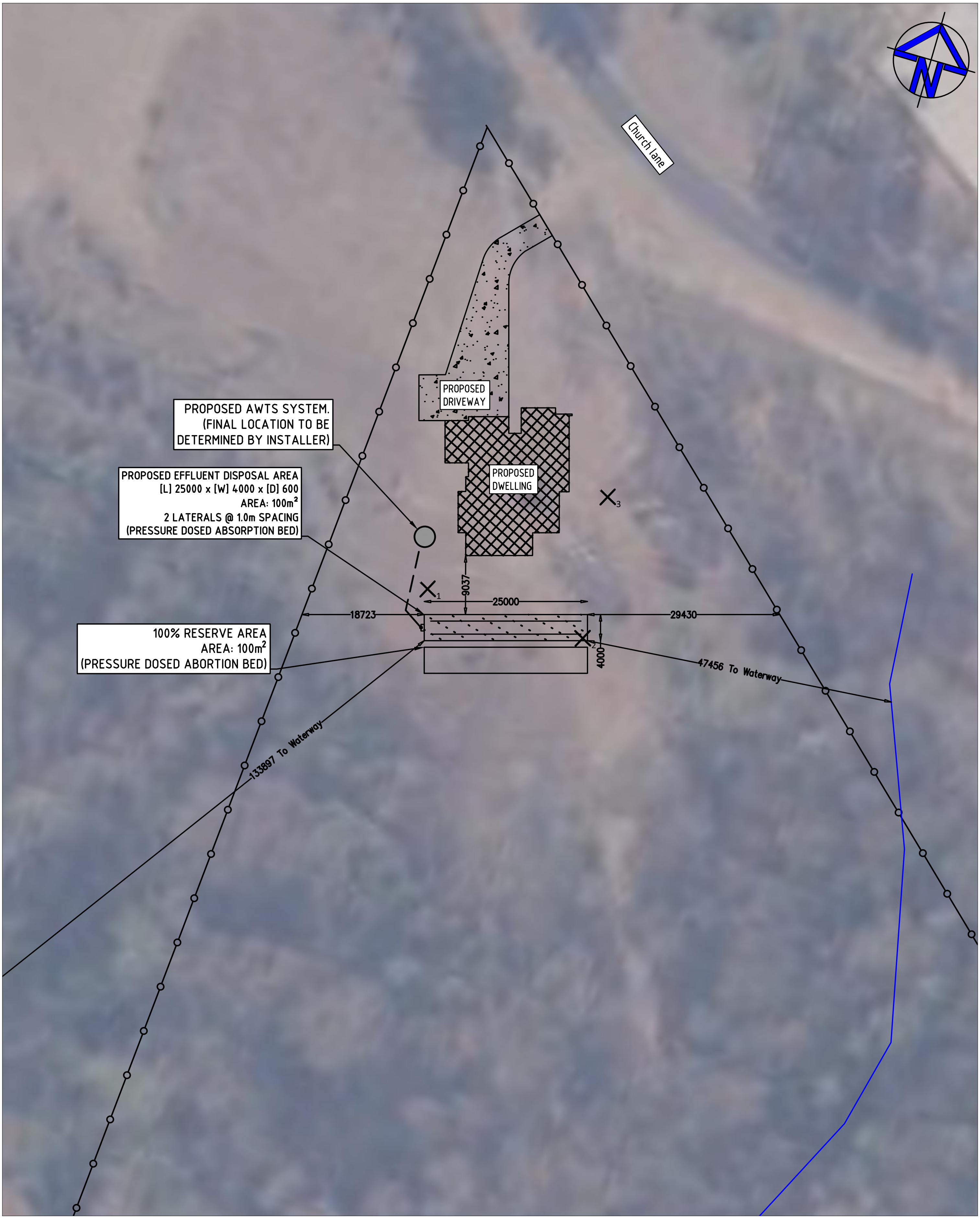
Reviewed by:

[redacted]

Kadir Oncu
Senior Geotechnical Engineer

APPENDICES

Appendix A – Site Plan



LEGEND:

Site Boundary		Watercourses, Dams		Irrigation Pipework		Building Area	
Other Fences		Overland Flow Path		Soil Borehole		Land App. Area	
Landform Element		Surface Spray Sprinkler		Photo Location		Paved Area	

GREYWACKE GEOTECHNICS

Effluent Disposal Investigation
Enviromental Engineering
Acid Sulfate Investigation
Geotechnical Site Investigation
Finite Element Analysis
Slope Stability Assessment

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E: admin@greywacke.com.au
T: (02) 8798 8796 | 0452626300

TITLE: AWTS + PRESSURE DOSED ABSORPTION BED

SHEET SIZE: A4
SCALE: 1:750 @ A4

CLIENT: Nastasi & Associates Consulting Engineer

PROJECT: 150 Church lane, Cranebrook NSW 2749 (Penrith City LGA)

SHEET: 1/1
DATE: 25/02/2021

PROJECT REF / DRAWING NUMBER: NAAC077 - WW AA

Appendix B – Water Balance

Appendix D: WATER BALANCE / WET-WEATHER STORAGE REQUIREMENT-Nominated Area Method

Design Flow Rate	1200	L/day
Bed Area	56	m2
DLR	12	mm/day

Weather Station:

Precipitation: 067113 - Penrith Lakes AWS
Evaporation: 067021 - Richmond - UWS Hawkesbury NSW

Parameter	Symbol	Formula	Units	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Days in Month	(D)		days	31	28	31	30	31	30	31	31	30	31	30	31
Median Precipitation	(MP)		mm/month	79.7	87.4	67.4	34.2	24.8	33.6	19.2	18.8	26.5	45.8	65.7	59.3
Mean daily Evaporation	(E)		mm/day	5.9	5	4	3	2.2	1.7	1.9	2.7	3.8	4.6	5.2	5.8
Monthly Evaporation	(E)		mm/month	182.9	140	124	90	68.2	51	58.9	83.7	114	142.6	156	179.8
Crop Factor	(C)			0.7	0.7	0.7	0.6	0.5	0.5	0.4	0.5	0.6	0.7	0.7	0.7
Evapotranspiration	(ET)		mm/month	128.0	98.0	86.8	54.0	34.1	23.0	23.6	37.7	62.7	92.7	109.2	125.9
Infiltration Rate	(IR)		mm/month	672	672	672	672	672	672	672	672	672	672	672	672
Application Rate	(AR)		mm/month	664.29	600.00	664.29	642.86	664.29	642.86	664.29	664.29	642.86	664.29	642.86	664.29
Monthly variation in effluent depth			mm	-19.62	-28.91	-9.49	-17.13	-5.96	-6.47	-4.23	-9.30	-22.87	-19.11	-25.43	-26.00

Effluent Depth in trench	Yr 1		mm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Yr 2		mm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Yr 3		mm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix C – Laboratory Test Results

CERTIFICATE OF ANALYSIS

Work Order	: **ES2105411**	Page	: 1 of 2
Client	: **Greywacke Geotechnics**	Laboratory	: Environmental Division Sydney
Contact	: Admin Reports	Contact	: Customer Services ES
Address	: Unit 11, 6 Hume Road Smithfield 2164	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: ----	Telephone	: +61-2-8784 8555
Project	: Proposed residential development	Date Samples Received	: 16-Feb-2021 16:40
Order number	:	Date Analysis Commenced	: 19-Feb-2021
C-O-C number	: ----	Issue Date	: 22-Feb-2021 11:35
Sampler	: ----		
Site	: 150 Church lane, Cranebrook NSW 2749		
Quote number	: EN/333		
No. of samples received	: 2		
No. of samples analysed	: 2		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH1 0.3-1.3	BH2 0.4-1.4	----	----	----
			Sampling date / time	16-Feb-2021 00:00	16-Feb-2021 00:00	----	----	----
Compound	CAS Number	LOR	Unit	ES2105411-001	ES2105411-002	--------	--------	--------
				Result	Result	----	----	----
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	**5.1**	**5.4**	----	----	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**42**	**28**	----	----	----

Appendix D – Operations & Maintenance Guidelines

ON-SITE SEWAGE MANAGEMENT SYSTEMS

If you live in or rent a house that is not connected to the main sewer then chances are that your yard contains an on-site sewage management system. If this is the case then you have a special responsibility to ensure that it is working as well as it can.

The aim of this pamphlet is to introduce you to some of the most popular types of on-site sewage management systems and provide some general information to help you maintain your system effectively. You should find out what type of system you have and how it works.

More information can be obtained from the pamphlets:

Your Septic System
Your Aerated Wastewater Treatment System
Your Composting Toilet
Your Land Application Area

You can get a copy of these pamphlets from your local council or the address marked on the back of this pamphlet.

It is important to keep in mind that maintenance needs to be performed properly and regularly. Poorly maintained on-site sewage management systems can significantly affect you and your family's health as well as the local environment.

What is an on-site sewage management system?

A domestic on-site sewage management system is made up of various components which - if properly designed, installed and maintained - allow the treatment and utilisation of wastewater from a house, completely within the boundary of the property.

Wastewater may be blackwater (toilet waste), or greywater (water from showers, sinks, and washing machines), or a combination of both.

Partial on-site systems - eg. pump out and common effluent systems (CES) - also exist. These usually involve the preliminary on-site treatment of wastewater in a septic tank, followed by collection and transport of the treated wastewater to an off-site management facility. Pump out systems use road tankers to transport the effluent, and CES use a network of small diameter pipes.

How does an on-site sewage management system work?

For complete on-site systems there are two main processes:

1. treatment of wastewater to a certain standard
2. its application to a dedicated area of land.

The type of application permitted depends on the quality of treatment, although you should try to avoid contact with all treated and untreated wastewater, and thoroughly wash affected areas if contact does occur.

Treatment and application can be carried out using various methods:

Septic Tank
Septic tanks treat both greywater and blackwater, but they provide only limited treatment through the settling of solids and the flotation of fats and greases. Bacteria in the tank break down the solids over a period of time. Wastewater that has been treated in a septic tank can only be applied to land through a covered soil absorption system, as the effluent is still too contaminated for above ground or near surface irrigation.

AWTS
Aerated wastewater treatment systems (AWTS) treat all household wastewater and have several treatment compartments. The first is like a septic tank, but in the second compartment air is mixed with the wastewater to assist bacteria to break down solids. A third compartment allows settling of more solids and a final chlorination contact chamber allows disinfection. Some AWTS are constructed with all the compartments inside a single tank. The effluent produced may be surface or sub-surface irrigated in a dedicated area.

Composting Toilets
Composting toilets collect and treat toilet waste only. Water from the shower, sinks and the washing machine needs to be treated separately (for example in a septic tank or AWTS as above). The compost produced by a composting toilet has special requirements but is usually buried on-site.

These are just some of the treatment and application methods available, and there are many other types such as sand filter beds, wetlands, and amended earth mounds. Your local council or the NSW Department of Health have more information on these systems if you need it.

Regulations and recommendations

The NSW Department of Health determines the design and structural requirements for treatment systems for single households. Local councils are primarily responsible for approving the installation of smaller domestic septic tank systems, composting toilets and AWTSs in their area, and are also responsible for approving land application areas. The NSW Environment Protection Authority approves larger systems.

The design and installation of on-site sewage management systems, including plumbing and drainage, should only be carried out by suitably qualified or experienced people. Care is needed to ensure correct sizing of the treatment system and application area.

Heavy fines may be imposed under the Clean Waters Act if wastewater is not managed properly.

Keeping your on-site sewage management system operating well

What you put down your drains and toilets has a lot to do with how well your system performs. Maintenance of your sewage management system also needs to be done well and on-time. The following is a guide to the types of things you should and should not do with your system.

DO

- ✓ Learn how your sewage management system works and its operational and maintenance requirements.
- ✓ Learn the location and layout of your sewage management system.
- ✓ Have your AWTS (if installed) inspected and serviced four times per year by an approved contractor. Other systems should be inspected at least once every year. Assessment should be applicable to the system design.
- ✓ Keep a record of desludgings, inspections, and other maintenance.
- ✓ Have your septic tank or AWTS desludged every three years to prevent sludge build up, which may 'clog' the pipes.
- ✓ Conserve water. Conservative water use around the house will reduce the amount of wastewater which is produced and needs to be treated.
- ✓ Discuss with your local council the adequacy of your existing sewage management system if you are considering house extensions for increased occupancy.

DON'T

- ✗ Don't let children or pets play on land application areas.
- ✗ Don't water fruit and vegetables with effluent.
- ✗ Don't extract untreated groundwater for cooking and drinking.
- ✗ Don't put large quantities of bleaches, disinfectants, whiteners, nappy soakers and spot removers into your system via the sink, washing machine or toilet.
- ✗ Don't allow any foreign materials such as nappies, sanitary napkins, condoms and other hygiene products to enter the system.
- ✗ Don't put fats and oils down the drain and keep food waste out of your system.
- ✗ Don't install or use a garbage grinder or spa bath if your system is not designed for it.

Reducing water usage

Reducing water usage will lessen the likelihood of problems such as overloading with your septic system. Overloading may result in wastewater backing up into your house, contamination of your yard with improperly treated effluent, and effluent from your system contaminating groundwater or a nearby waterway.

Your sewage management system is also unable to cope with large volumes of water such as several showers or loads of washing over a short period of time. You should try to avoid these 'shock loads' by ensuring water use is spread more evenly throughout the day and week.

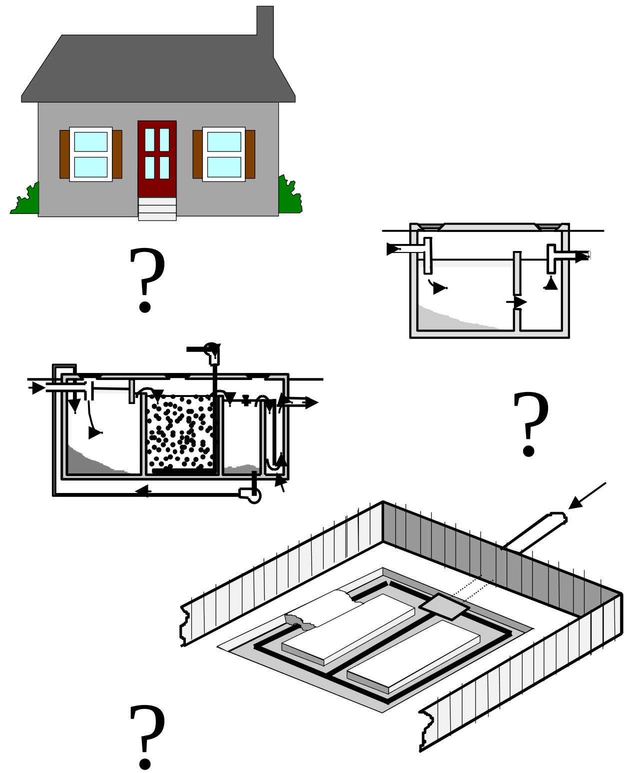
HELP PROTECT YOUR HEALTH AND THE ENVIRONMENT

Poorly maintained sewage management systems are a serious source of water pollution and may present health risks, cause odours and attract vermin and insects.

By looking after your management system you can do your part in helping to protect the environment and the health of you and your community.

For more information please contact:

Managing Wastewater In Your Backyard



Aerated Wastewater Treatment Systems (AWTS)

In unsewered areas, the proper treatment and utilisation of household wastewater on-site is critical in preserving the health of the public and the environment. AWTS have been developed as a way of achieving this.

What is an AWTS?

An AWTS is a purpose built system used for the treatment of sewage and liquid wastes from a single household or multiple dwellings.

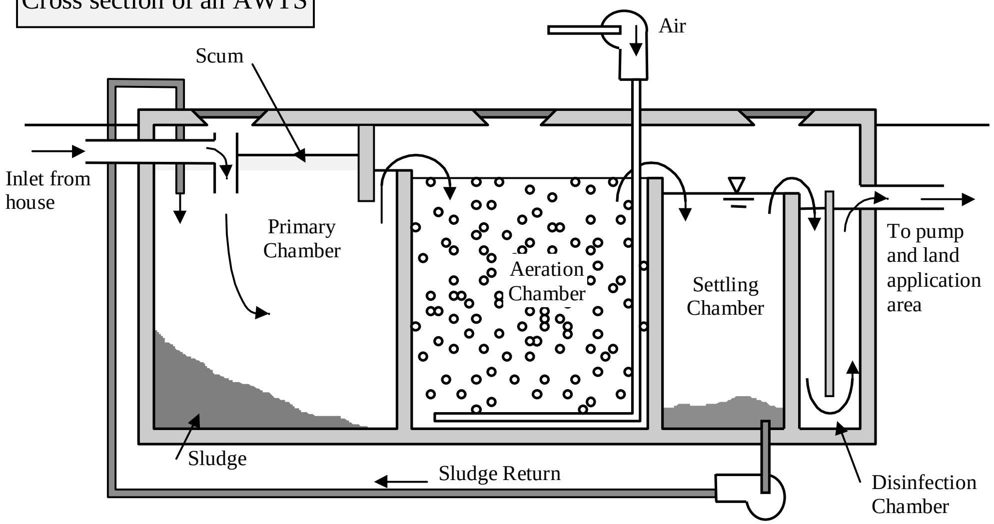
It consists of a series of treatment chambers combined with an irrigation system. An AWTS enables people living in unsewered areas to treat and utilise their wastewater.

How does an AWTS work?

Wastewater from a household is treated in stages in several separate chambers. The first chamber is similar to a conventional septic tank. The wastewater enters the chamber where the solids settle to the bottom and are retained in the tank forming a sludge layer. Scum collects at the top, and the partially clarified wastewater flows into a second chamber. Here the wastewater is mixed with air to assist bacteria to further treat it. A third chamber allows additional clarification through the settling of solids, which are returned for further treatment to either the septic chamber (as shown) or to the aeration chamber. The clarified effluent is disinfected in another chamber (usually by chlorination) before irrigation can take place.

Bacteria in the first chamber break down the solid matter in the sludge and scum layers. Material that cannot be fully broken down gradually builds up in the chamber and must be pumped out periodically.

Cross section of an AWTS



Regulations and recommendations

Local councils are primarily responsible for approving the smaller, domestic AWTSs in their area. The Environment Protection Authority (EPA) approves larger units, whilst the NSW Department of Health determines the design and structural requirements for all AWTSs.

At present AWTSs need to be serviced quarterly by an approved contractor at a cost to the owner. Local councils should also maintain a register of the servicing of each system within their area.

AWTSs should be fitted with an alarm having visual and audible components to indicate mechanical and electrical equipment malfunctions. The alarm should provide a signal adjacent to the alarm and at a relevant position inside the house. The alarm should incorporate a warning lamp which may only be reset by the service agent.

Maintaining your AWTS

The effectiveness of the system will, in part, depend on how it is used and maintained. The following is a guide on good maintenance procedures that you should follow:

DO

- ✓ Have your AWTS inspected and serviced four times per year by an approved contractor. Assessment should be applicable to the system design.
- ✓ Have your system service include assessment of sludge and scum levels in all tanks, and performance of irrigation areas.
- ✓ Have all your tanks desludged at least every three years.
- ✓ Have your disinfection chamber inspected and tested quarterly to ensure correct disinfectant levels.
- ✓ Have your grease trap (if installed) cleaned out at least every two months.
- ✓ Keep a record of pumping, inspections, and other maintenance.
- ✓ Learn the location and layout of your AWTS and land application area.
- ✓ Use biodegradable liquid detergents such as concentrates with low sodium and phosphorous levels.
- ✓ Conserve water.

DON'T

- ✗ Don't put bleaches, disinfectants, whiteners, nappy soakers and spot removers in large quantities into your AWTS via the sink, washing machine or toilet.
- ✗ Don't allow any foreign materials such as nappies, sanitary napkins, condoms and other hygiene products to enter the system.
- ✗ Don't use more than the recommended amounts of detergents.
- ✗ Don't put fats and oils down the drain and keep food waste out of your system.
- ✗ Don't switch off power to the AWTS, even if you are going on holidays

Reducing water usage

Reducing water usage will lessen the likelihood of problems such as overloading with your AWTS. Overloading may result in wastewater backing up into your house, contamination of your yard with improperly treated effluent, and effluent from your system entering a nearby river, creek or dam.

Conservative water use around the house will reduce the amount of wastewater which is produced and needs to be treated.

Your AWTS is also unable to cope with large volumes of water such as several showers or loads of washing over a short period of time. You should try to avoid these 'shock loads' by ensuring water use is spread more evenly throughout the day and week.

Warning signs

You can look out for a few warning signs that signal to you that there are troubles with your AWTS. Ensure that these problems are attended to immediately to protect your health and the environment.

Look out for the following warning signs:

- Water that drains too slowly.
- Drain pipes that gurgle or make noises when air bubbles are forced back through the system.
- Sewage smells, this indicates a serious problem.
- Water backing up into your sink which may indicate that your system is already failing.
- Wastewater pooling over the land application area.
- Black coloured effluent in the aerated tank.
- Excess noise from the blower or pumping equipment
- Poor vegetation growth in irrigated area.

Odour problems from a vent on the AWTS can be a result of slow or inadequate breakdown of solids. Call a technician to service the system.

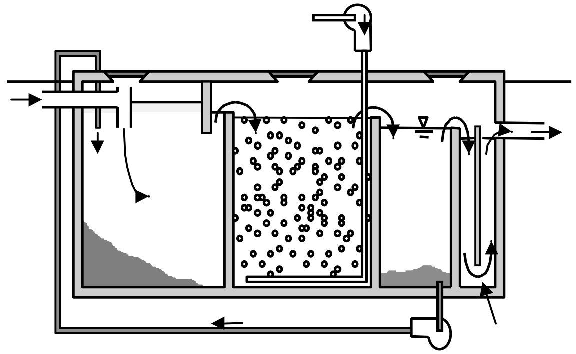
HELP PROTECT YOUR HEALTH AND THE ENVIRONMENT

Poorly maintained AWTSs are a serious source of water pollution and may present health risks, cause odours and attract vermin and insects.

By looking after your treatment system you can do your part in helping to protect the environment and the health of you and your family.

If you would like more information please contact:

Your Aerated Wastewater Treatment System



LAND APPLICATION AREAS

The reuse of domestic wastewater on-site can be an economical and environmentally sound use of resources.

What are land application areas?

These are areas that allow treated domestic wastewater to be managed entirely on-site.

The area must be able to utilise the wastewater and treat any organic matter and wastes it may contain. The wastewater is rich in nutrients, and can provide excellent nourishment for flower gardens, lawns, certain shrubs and trees. The vegetation should be suitably tolerant of high water and nutrient loads.

How does a land application area work?

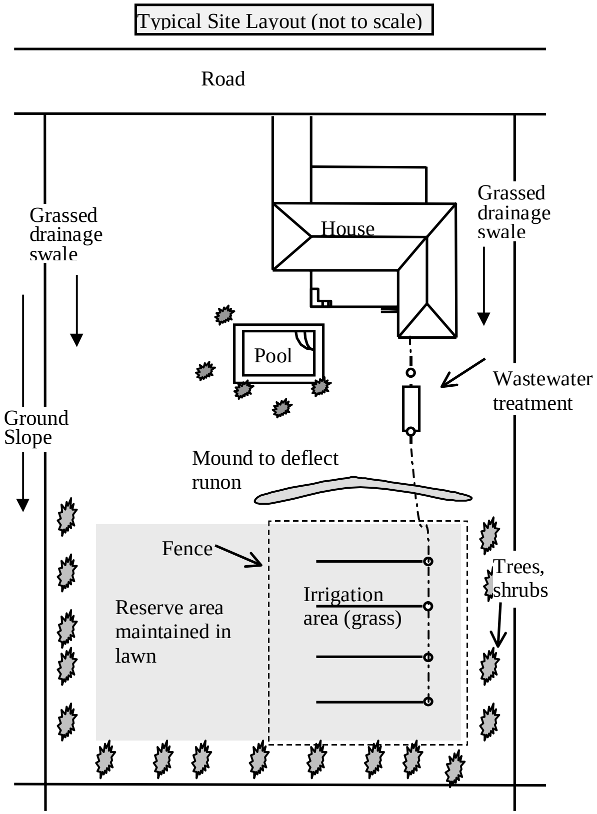
Treated wastewater applied to a land application area may be utilised or simply disposed, depending on the type of application system that is used. The application of the wastewater can be through a soil absorption system (based on disposal) or through an irrigation system (based on utilisation).

Soil absorption systems do not require highly treated effluent, and wastewater treated by a septic tank is reasonable as the solids content in the effluent has been reduced. Absorption systems release the effluent into the soil at a depth that cannot be reached by the roots of most small shrubs and grasses. They rely mainly on the processes of soil treatment and then transmission to the water table, with minimal evaporation and up-take by plants. **These systems are not recommended in sensitive areas as they may lead to contamination of surface water and groundwater.**

Irrigation systems may be classed as either subsurface or surface irrigation. If an irrigation system is to be used, wastewater needs to be pre-treated to at least the quality produced by an aerated wastewater treatment system (AWTS).

Subsurface irrigation requires highly treated effluent that is introduced into the soil close to the surface. The effluent is utilised mainly by plants and evaporation.

Surface irrigation requires highly treated effluent that has undergone aeration and disinfection treatments, so as to reduce the possibility of bacteria and virus contamination.



The effluent is then applied to the land area through a series of drip, trickle, or spray points which are designed to eliminate airborne drift and run-off into neighbouring properties.

There are some public health and environmental concerns about surface irrigation. There is the risk of contact with treated effluent and the potential for surface run-off. Given these problems, subsurface irrigation is arguably the safest, most efficient and effective method of effluent utilisation.

Regulations and recommendations

The design and installation of land application areas should only be carried out by suitably qualified or experienced people, and only after a site and soil evaluation is done by a soil scientist. Care should be taken to ensure correct buffer distances are left between the application area and bores, waterways, buildings, and neighbouring properties.

Heavy fines may be imposed under the Clean Waters Act if effluent is managed improperly.

At least two warning signs should be installed along the boundary of a land application area. The signs should comprise of 20mm high Series C lettering in black or white on a green background with the words:

RECLAIMED EFFLUENT
NOT FOR DRINKING
AVOID CONTACT

Depending on the requirements of your local council, wet weather storage and soil moisture sensors may need to be installed to ensure that effluent is only irrigated when the soil is not saturated.

Regular checks should be undertaken of any mechanical equipment to ensure that it is operating correctly. Local councils may require periodic analysis of soil or groundwater characteristics

Humans and animals should be excluded from land application areas during and immediately after the application of treated wastewater. The longer the period of exclusion from an area, the lower the risk to public health.

The householder is required to enter into a service contract with the installation company, its agent or the manufacturer of their sewage management system, this will ensure that the system operates efficiently.

Location of the application area

Treated wastewater has the potential to have negative impacts on public health and the environment. For this reason the application area must be located in accordance with the results of a site evaluation, and approved landscaping must be completed prior to occupation of the building. Sandy soil and clayey soils may present special problems.

The system must allow even distribution of treated wastewater over the land application area.

Maintaining your land application area

The effectiveness of the application area is governed by the activities of the owner.

DO

- ✓ Construct and maintain diversion drains around the top side of the application area to divert surface water.
- ✓ Ensure that your application area is kept level by filling any depressions with good quality top soil (not clay).
- ✓ Keep the grass regularly mowed and plant small trees around the perimeter to aid absorption and transpiration of the effluent.
- ✓ Ensure that any run off from the roof, driveway and other impermeable surfaces is directed away from the application area.
- ✓ Fence irrigation areas.
- ✓ Ensure appropriate warning signs are visible at all times in the vicinity of a spray irrigation area.
- ✓ Have your irrigation system checked by the service agent when they are carrying out service on the treatment system.

DON'T

- ✗ Don't erect any structures, construct paths, graze animals or drive over the land application area.
- ✗ Don't plant large trees that shade the land application area, as the area needs sunlight to aid in the evaporation and transpiration of the effluent.
- ✗ Don't plant trees or shrubs near or on house drains.
- ✗ Don't alter stormwater lines to discharge into or near the land application area.
- ✗ Don't flood the land application area through the use of hoses or sprinklers.
- ✗ Don't let children or pets play on land application areas.
- ✗ Don't water fruit and vegetables with the effluent.
- ✗ Don't extract untreated groundwater for potable use.

Warning signs

Regular visual checking of the system will ensure that problems are located and fixed early.

The visual signs of system failure include:

- surface ponding and run-off of treated wastewater
- soil quality deterioration
- poor vegetation growth
- unusual odours

Volume of water

Land application areas and systems for on-site application are designed and constructed in anticipation of the volume of waste to be discharged. Uncontrolled use of water may lead to poorly treated effluent being released from the system.

If the land application area is waterlogged and soggy the following are possible reasons:

- Overloading the treatment system with wastewater.
- The clogging of the trench with solids not trapped by the septic tank. The tank may require desludging.
- The application area has been poorly designed.
- Stormwater is running onto the area.

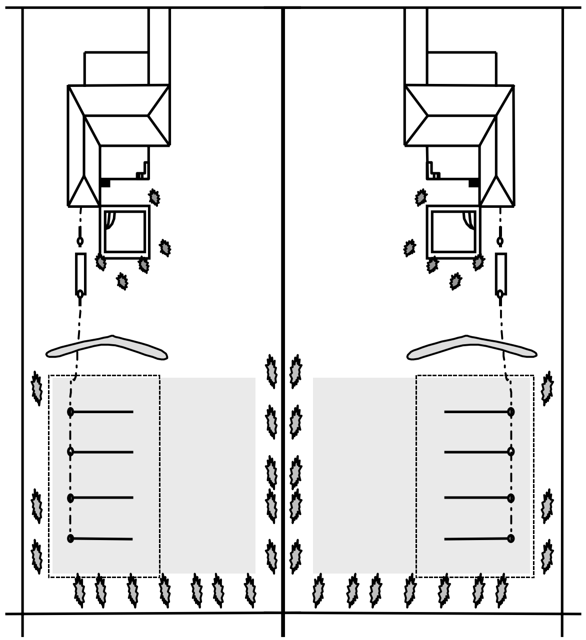
HELP PROTECT YOUR HEALTH AND THE ENVIRONMENT

Poorly maintained land application areas are a serious source of water pollution and may present health risks, cause odours and attract vermin and insects.

By looking after your sewage management system you can do your part in helping to protect the environment and the health of you and your family.

For more information please contact:

Your Land Application Area



Appendix E – Water Conservation

Water Conservation

Whilst this report is based on AA rated plumbing fixtures, AA rated plumbing would further conserve limited water supplies and enhance performance of the irrigation, soil and plant systems. Water saving devices will reduce the volume of water that needs to be applied to the site, and thus reduce the risk of any runoff.

Using the following water saving devices, the average household's water consumption can be reduced from 900 litres to 750 litres per day:

- Dual flush 6/3 litre pan and cistern (average household savings of 93 L/day) *
- AAA rated shower heads to limit flows to 7 L/minute *
- AAA rated dishwasher (not more than 18 litres for each wash cycle) **
- AAA rated washing machine (not more than 22 litres per dry kg of clothes) **

* Source: Independent Pricing and Regulation Tribunal of NS (1996), Water Demand Management: A Framework for Option Assessment

** Source: Sydney Water Demand Management Strategy, October 1995

Low phosphate, low sodium detergents are recommended to help improve the effluent quality. Low sodium detergents ensure that the soil structure, and hence its absorption capacity, is maintained as close as possible to a natural condition. Sodium in laundry powders is used as a filler. Therefore, in general, liquid detergents are preferred over powder. Low phosphorus detergents ensure that optimum plant growth is maintained and that excess phosphorus is not leached into the environment.

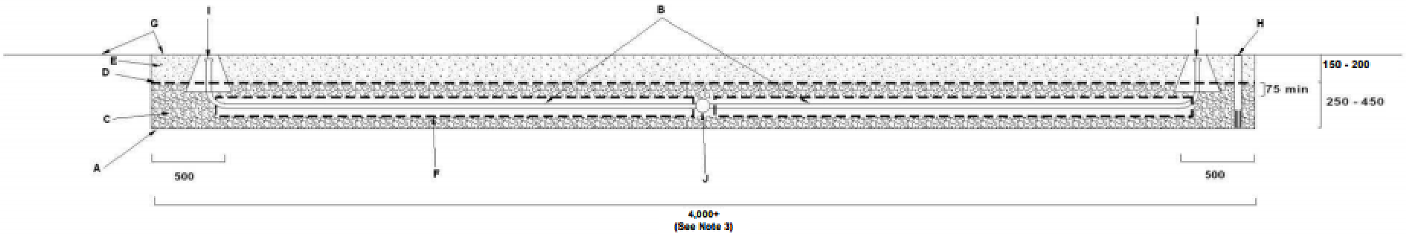
Bleaches, disinfectants and other cleaning compounds can harm wastewater treatment systems, such as septic tanks, because they kill bacteria that colonise the system and help treat wastewater. Use these products sparingly and always check that they are safe for septic systems. Avoid placing oil, paint, petrol, acids, degreasers, photography chemicals, cosmetics, lotions, pesticides and herbicides in the wastewater system. Even small amounts of these products can harm the performance of the onsite effluent management system.

Appendix F – Pressure Dosed Beds

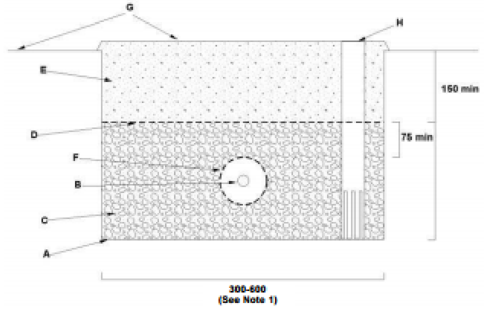
Pressure Dosed Beds

Source: *Design and Installing On-Site Wastewater Systems* (SCA, 2012)

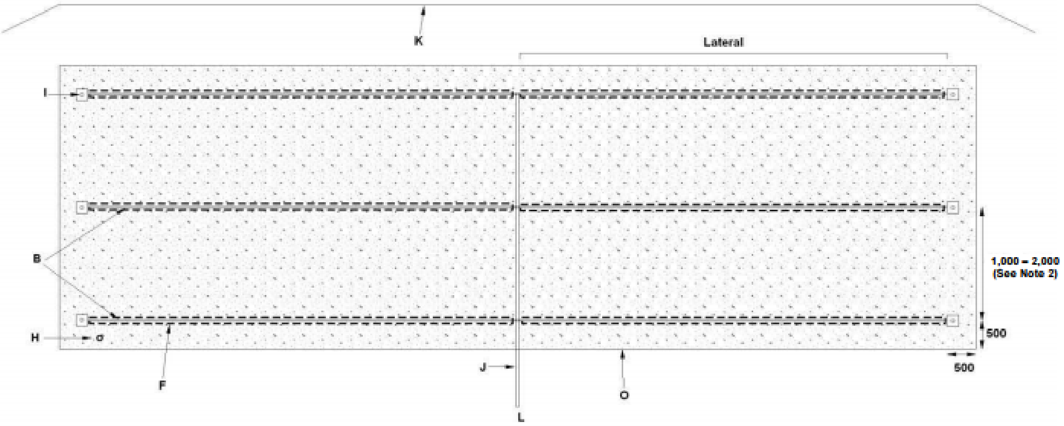
Cross Section: Pressure-dosed Bed



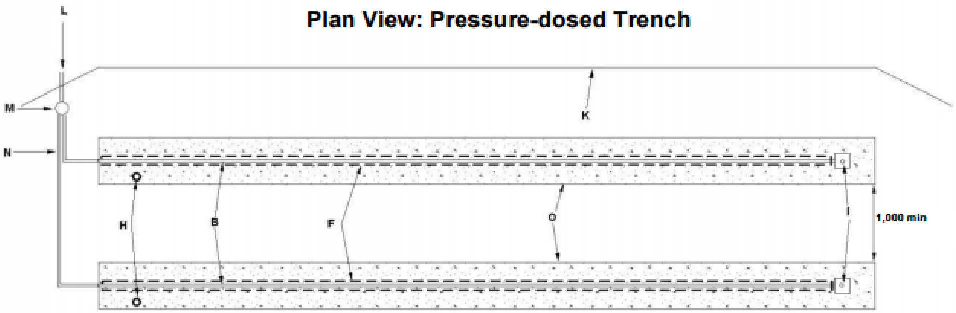
Cross Section: Pressure-dosed Trench



Plan View: Pressure-dosed Bed



Plan View: Pressure-dosed Trench



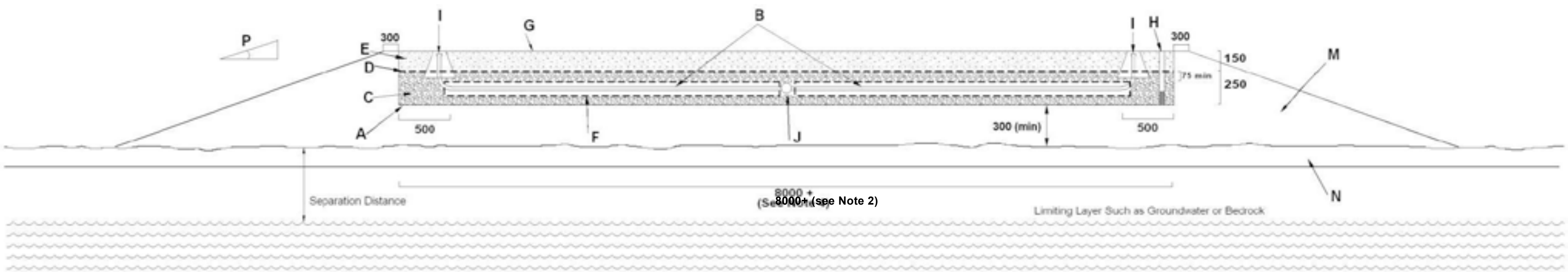
Pressure-dosed Trench / Bed Construction

- **A** The base of the trench / bed must be level to ensure even distribution of effluent. Base levels should be checked with a dumpy / laser level.
- **B** Pressure-dosing manifold consisting of 25 mm PVC pipe with 3 mm holes drilled (deburred) at 400 mm centres facing upwards. Where a dosing siphon is used in place of a pump, holes will need to be 4-5 mm depending on flow rate achieved. The total number and length of laterals will be determined by the required bed size (m^2) and the lateral spacings shown in this drawing.
- **C** 20-40 mm distribution aggregate.
- **D** Geotextile filter cloth.
- **E** Clean local or imported topsoil (sandy loam to clay loam).
- **F** 90 mm slotted PVC or agricultural pipe over manifold laterals.
- **G** Grass must be established across the construction area as soon as possible. Trench / bed surface should be level or slightly mounded.
- **H** Inspection port on downhill side of trench / bed. Made from 50 mm PVC pipe with perforations in the aggregate level of the trench / bed.
- **I** Individual flush points for each lateral. May be a screw cap fitting on a 90 degree elbow level with the bed surface or a pressure controlled flush valve (such as those used for subsurface irrigation systems) inside an irrigation control box. Manual flushing should be carried out at least every 12 months.
- **J** 40 mm PVC dosing manifold. Larger systems may require different pipe sizes and orifice reducers at lateral connection points.
- **K** Upslope stormwater diversion drain (see Standard Drawing 9A for design detail). Sub-soil drainage may be necessary on particular sites.
- **L** Pump dosed effluent from treatment system. The pump must be capable of delivering the total flow rate required for all laterals whilst providing a 1.5 m residual head (ie squirt height) at the highest orifice (with no more than 15% variation in squirt height across the whole bed). For beds with individual laterals no more than 10 m long, it is acceptable to adopt a flow rate of 3.5-4 L/min/lineal metre. Total dynamic head (including friction loss) will need to be determined on a site-specific basis.
- **M** Hydraulically operated indexing valve that delivers effluent to a different trench / bed or set of laterals at each pump cut-in.
- **N** 25 mm polyethylene or PVC dosing manifold.
- **O** Trench / bed dimensions are an example only. The basal area of the land application area must be determined according to the procedures in AS/NZS 1547:2012 and this Manual. .A minimum bed length to width ratio of 3:1 must be adopted when developing individual designs and beds must be installed parallel to the site contours. The location and orientation of the area should be based on a site and soil assessment by a suitably qualified person. The system may comprise a single trench / bed or multiple smaller trenches / beds.

Notes

1. Trenches should optimally be 600 mm wide. Optimum width will balance storage requirements against footprint and required trench length.
2. Nominal lateral spacing of 2,000 mm for clay loams to light clays. 1,000 mm for sandy loams to sands.
3. Consideration should be given to ensuring all beds have a level base when determining an appropriate width. The distribution manifold must also be level. Beds longer than 30 m will require specialist hydraulic design.

Cross Section View



Raised Pressure-Dosed Absorption Bed Construction

A The base of the trench must be level to ensure even distribution of effluent. Base levels should be checked with a dumpy / laser level.

B Pressurised dosing laterals consisting of 25 mm PVC pipe with 3 mm holes drilled (deburred) at 400 mm centres facing upwards. The total number and length of laterals will be determined by the required bed size (m^2) and the lateral spacings shown in this drawing. It is essential that effluent is distributed evenly across the distribution bed. A residual head (or squirt height) of 1.5 m should be achieved across the distribution laterals. The squirt height across the laterals must be tested prior to covering with agricultural / slotted pipe, with no more than 15% variation in height observed. Consideration must also be given to static head and friction loss when sizing pumps. A full hydraulic design must be carried out.

C 20-40 mm distribution aggregate.

D Geotextile filter cloth.

E Clean local or imported topsoil (sandy loam to loam).

F 90 mm slotted PVC or agricultural pipe over manifold laterals.

G Grass must be established across the construction area as soon as possible. The bed surface should be slightly mounded.

H Inspection port on downhill side of trench / bed. Made from 50 mm PVC pipe with perforations in the aggregate level of the trench / bed.

I Individual flush points for each lateral. May be a screw cap fitting on a 90 degree elbow level with the bed surface or a pressure controlled flush valve (such as those used for subsurface irrigation systems) inside an irrigation control box. Manual flushing should be carried out at least every twelve months.

J PVC or polyethylene dosing manifold. Larger systems may require different pipe sizes and orifice reducers at lateral connection points.

K Upslope stormwater diversion drain. Subsoil drainage may be necessary on particular sites.

L Pump dosed effluent from treatment system (minimum primary treatment with an outlet filter).

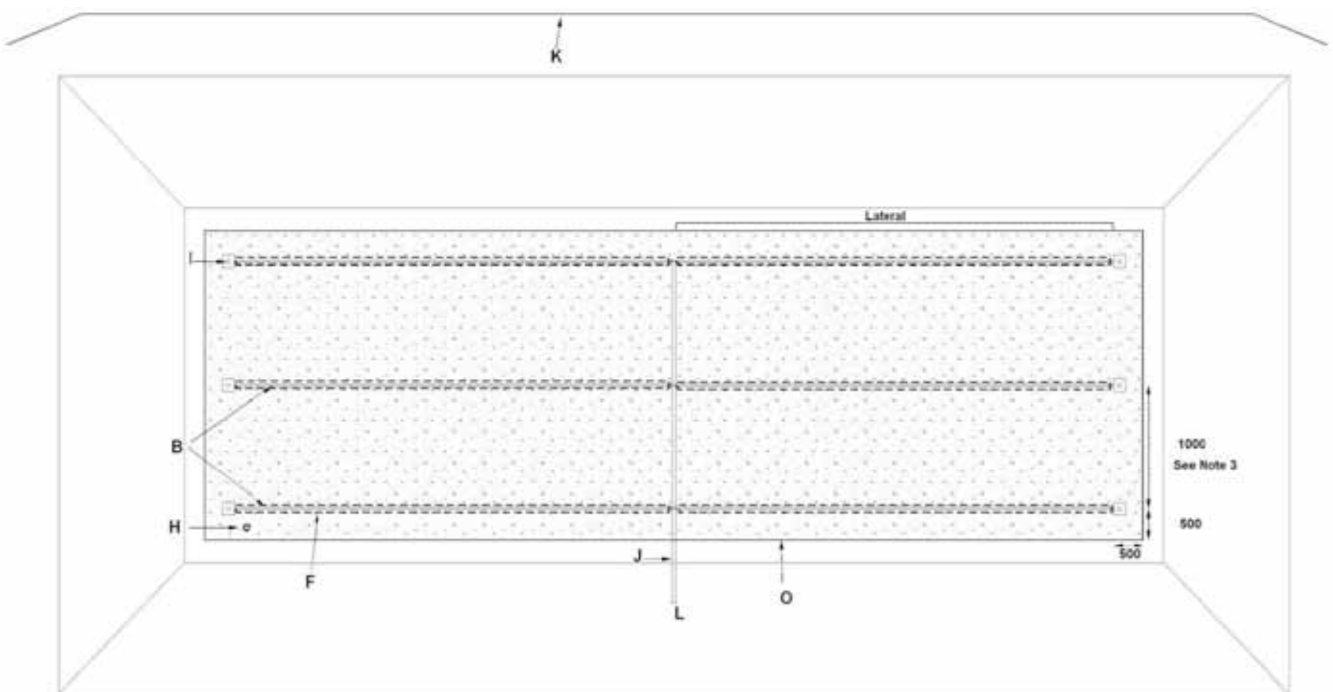
M The base of each absorption bed is to be raised to a height of 300 mm above the final ground surface (total bed height 700 mm). Compaction should be minimised when installing the bed. The fill must be a loam to sandy loam with minimal clay content.

N Prepare the site by clearing all shrubs, trees and boulders. Cut trees to ground level and then grind the stump out to a depth of 300 mm and backfill with permeable material such as the natural topsoil or sand (definitely not clay). Scarify the natural soils across the entire basal area to a minimum depth of 200 mm taking care not to compact the basal area in the process. This should extend to at least 1m beyond the perimeter.

O The bed dimensions shown are an example only. The basal area of the land application area must be determined based on the load and soil characteristics of the site. **A minimum bed length to width ratio of 3:1 must be adopted when developing individual designs and beds must be installed parallel to the site contours.** The location and orientation of the area should be based on a site by a suitably qualified person. The system may comprise a single bed or preferably multiple smaller beds.

P Batter slope 1(vertical):3 (horizontal) maximum.

Plan View



Note 1 The layout and dimensions used in this drawing are for general guidance only. The location, configuration and layout of individual beds will need to be determined on a site-specific basis. The purpose of this drawing is to illustrate a typical configuration and specify minimum system components.

Note 2 Consideration should be given to ensuring all beds have a level base when determining an appropriate width. The distribution manifold must also be level. Beds longer than 30 m will require specialist hydraulic design.

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