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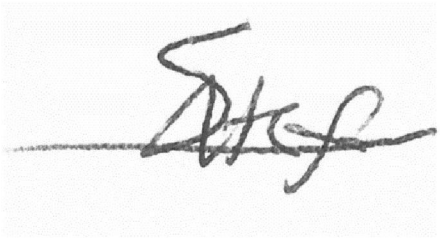
'ON-SITE WASTEWATER MANAGEMENT REPORT'

For:

168 Church Lane, Castlereagh

CLIENT:	Nick Borg
REFERENCE:	REF-18-6283-A
DATE:	14 June 2018



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Document Management				
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INTRODUCTION

EnviroTech Pty. Ltd. 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.

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

Scope of Works

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*

DESKTOP INFORMATION

Address	168 Church Lane, Castlereagh
Council	Penrith
Proposed Development	New dwelling
Intended Water Supply Source	Town water
Design Wastewater Allowance	150 L / day / person
Equivalent Population (Proposed Residence)	*Up to* 7 *people (*5 *Habitable Rooms)*
Design Wastewater Flowrate (Proposed Residence)	1050 *L / day*
Rainfall Station	067002 - Castlereagh
Evaporation Station	067019 - Prospect Reservoir

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'.

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%	Very Gently Inclined	Simple Slope	Linear	Planar	Very Low

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	Tree	Mid-High	Sparse	Open Woodland
B	Grass	Low	Mid-Dense	Open Grassland

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

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

Site & Soil Disturbance

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

None	Description:

Rocky Outcrops

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

None	Description:

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.

Site Feature	*Setback Range*	*Constraint Factors*	*Proposed Setback*
Dwellings	15	LOW	>15m
Property Boundaries & Buildings	3 – 6	LOW	>3m Upslope >6m Downslope
Overland Flow Path	40	MODERATE	40 m
Groundwater Well (GW017843)	250	LOW	147m

Domestic Groundwater Wells (GW017843)

The "Environment & Health Protection Guidelines: On-site Sewage Management for Single Households" (the silverbook) recommends the following buffer distances between land application areas and the following:

Domestic Groundwater Wells: > 250-m

Due to land availability these buffer distances are not attainable. The justification for the reduced buffer distance is as follows:

- 'Secondary-level' wastewater treatment is proposed via an AWTS. This presents a significantly lower pollution risk to groundwater than other primary treatment systems (e.g. a conventional septic tank).

- The proposed effluent application is situated on a gently-inclined slope (<10%) and therefore lateral seepage to the adjacent groundwater should be minimal.

- With regards to nutrients entering the groundwater, the land application area has been sized so that nutrient uptake (by vegetation and soil adsorption) exceeds nutrient application.

- The proposed AWTS effluent has a significantly lower pathogen concentration (measured as thermotolerant coliforms) of less than 30 cfu/100ml when compared to other primary treatment systems (e.g. conventional septic tank effluent is in the range of 10^5 - 10^7 cfu/100ml).

A Viral Die-Off calculation with conservative values was carried out for the site and a proposed setback of 7.4 m was calculated.

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 to place no major limitations to on-site wastewater management.

Figure 1. – Indicative landform of proposed EDA

SOIL ASSESSMENT

The location of the borehole excavated during the site inspection is shown on the attached site plan. Physical and chemical soil properties were recorded on a soil profile log (see attached). On each property two boreholes are performed, the first analyses soil features listed below, and the second serves a confirmatory borehole. If soil properties found in the two boreholes on site differ, then both samples 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

Erodability / Erosion Hazard

Soil erodability 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 erodability 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 erodability, vegetation cover and topography.

	Borehole 1	*Borehole 2*
Erodability	Low	Low
Erosion Hazard	Slight	Slight

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

Bore Hole 1:

Soil Horizon	Depth	Colour	Mottles	Coarse Fragments %	Texture	Structure
A	700	Brown	-	< 10	Loam	Massive
B1	1300	Brown	Orange	< 10	Clay Loam	Weak

Excavation terminated at: 1300 mm

Reason: Auger depth limit

Bedrock Depth: 1300 mm

Water Table Depth: >1300 mm

Surface Condition: Firm

Figure 2. – Soil sample from BH 1

Chemical Properties

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

Borehole 1

Horizon	*PH*	*EC_e (µS/cm)*
A	7.21	665
B1	7.14	720

(Hanna Instruments, HI 98129, Ref 29713)

Phosphorus Adsorption Capacity (kg / ha): 4000

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

Bore Hole 2:

Soil Horizon	Depth	Colour	Mottles	Coarse Fragments %	Texture	Structure
A	700	Brown	-	< 10	Loam	Massive
B1	1300	Brown	Orange	< 10	Clay Loam	Weak

Excavation terminated at: 1300 mm

Reason: Auger depth limit

Bedrock Depth: 1300 mm

Water Table Depth: >1300 mm

Surface Condition: Firm

Figure 3. – Soil sample from BH 2

Chemical Properties

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

Borehole 1

Horizon	*PH*	*EC_e (µS/cm)*
A	7.04	633
B1	6.55	722

(Hanna Instruments, HI 98129, Ref 29713)

Phosphorus Adsorption Capacity (kg / ha): 4000

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.

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.

ON-SITE WASTEWATER MANAGEMENT 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.

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 irrigation purposes.

Effluent Application:

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

1. Surface Fixed / Semi Fixed Spray Irrigation
2. Subsurface Drip Irrigation

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

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

+ Appendix E (Irrigation Descriptions & Standard Drawings)
+ Appendix F (Operation & Maintenance Guidelines).

<u>If Council prefers the client install one particular method of irrigation (i.e. only one of our recommended options be available to the client) then consultation between client and Council may be required.</u>

Effluent Application Area Sizing

A monthly nutrient balance and water balance were modelled to determine the minimum land application area with no wet weather storage requirements. The results were as follows:

Proposed Design Irrigation Rate (DIR):

Massive Structured Loam 4 mm / day (Table M1, AS 1547:2012)

Minimum Irrigation Areas:

Water Balance	Nitrogen Balance (Spray Irrigated on Slashed Grass)	Nitrogen Balance (Subsurface Irrigation Under Mown Lawn)	Phosphorus Balance (Spray Irrigated on Slashed Grass)	Phosphorus Balance (Subsurface Irrigation Under Mown Lawn
287m^2	972m^2	972m^2	**1223m^2**	1223m^2

Site Modifications Recommended

Nil.

RECOMMENDATIONS

- Installation of a NSW Health Accredited Aerated Wastewater Treatment System (AWTS) with capacity to treat the design flowrate (1050 L/d) 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 low-pressure effluent irrigation system. This area shall be designated for effluent application only.

- EnviroTech recommends all of the following irrigation types are suitable for installation on this site:

Irrigation System Type	*Minimum area Required*
Surface Fixed / Semi Fixed Spray	1223m^2
Subsurface Drip Irrigation	1223m^2

- Before choosing which type of irrigation system to install, the client must consider:
  + Appendix E (Irrigation Descriptions & Standard Drawings)
  + Appendix F (Operation & Maintenance Guidelines).

- 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 irrigation details (for example, accurate sprinkler and distribution line positioning within the proposed irrigation area), if required, may be determined in consultation with your plumber / irrigation installer.

- Each irrigation system must be installed within the proposed land application area shown on the site plan or within the 'available irrigation envelope' (if an envelope is shown on your site plan).

LIMITATIONS

Envirotech Pty Ltd has prepared this report for the exclusive use of our client, for this project only and for the purpose(s) described in the report. It should not be used for other projects or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of Envirotech, does so entirely at its own risk and without recourse to Envirotech for any loss or damage.

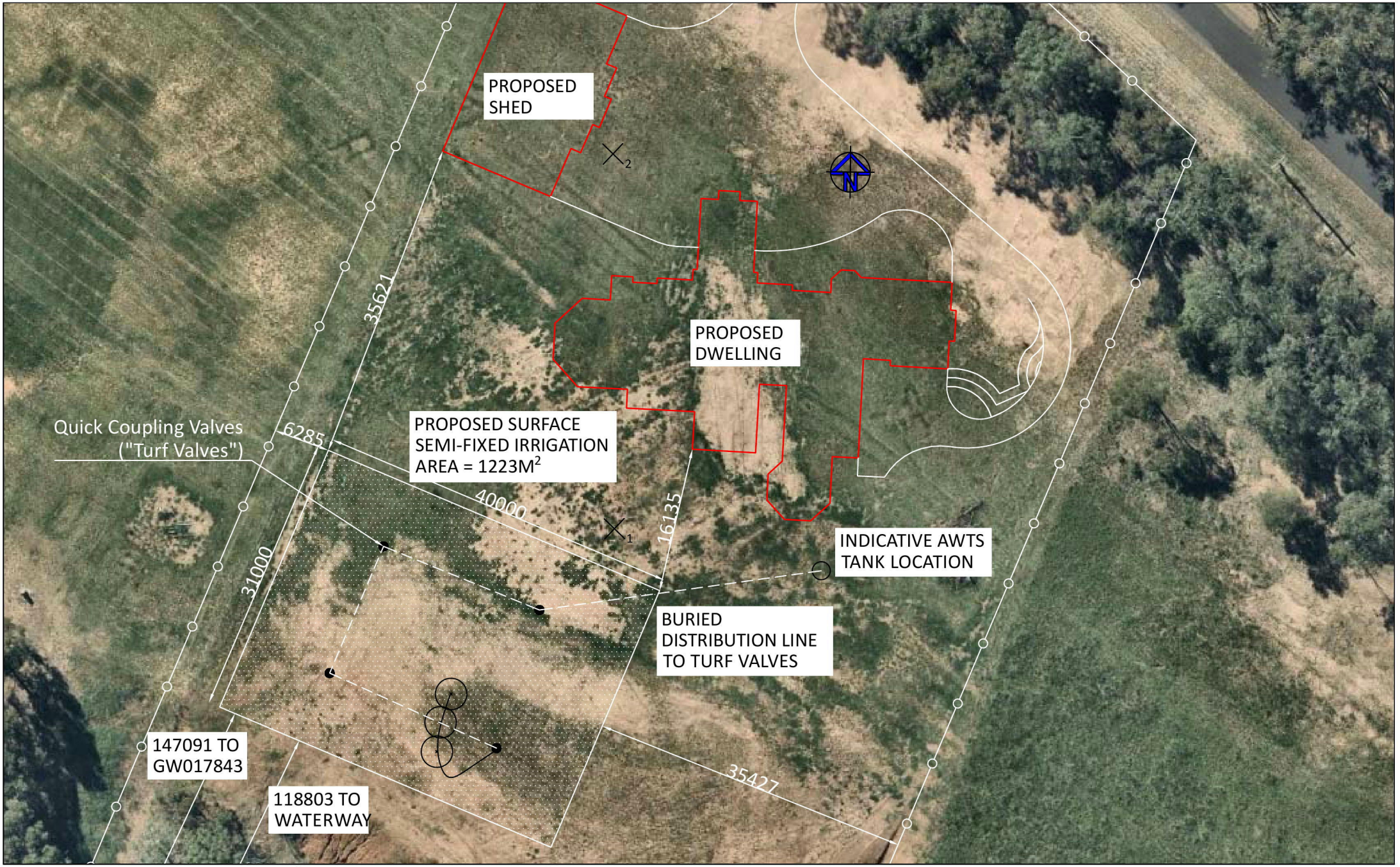
In preparing this report Envirotech has necessarily relied upon information provided by the client and/or their Agents. The results provided in the report are indicative of the sub-surface conditions only at the specific sampling or testing locations, and then only to the depths investigated and at the time the work was carried out. Under no circumstances can it be considered that these findings represent the actual state of the site at all points. Subsurface conditions can change abruptly due to variable geological processes and also as a result of anthropogenic influences. Such changes may occur after Envirotech's field testing has been completed.

Envirotech's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by Envirotech in this report may be limited by undetected variations in ground conditions between sampling locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

Should any site conditions be encountered during construction that vary significantly from those outlined and discussed in this report, Envirotech should be advised and a plan outlining the need for potential action developed accordingly.

This report must be read in conjunction with all of the attached notes and should be kept in its entirety without separation of individual pages or sections. Envirotech cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion given in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by Envirotech. This is because this report has been written as advice and opinion rather that instructions for construction.



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LEGEND:

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

TITLE: AWTS + SEMI-FIXED SURFACE IRRIGATION

CLIENT: BORG

PROJECT: 168 CHURCH LANE, CASTLEREAGH, NSW (PENRTITH LGA)

SHEET SIZE: A4

SCALE: 1:500 @ A4

SHEET: 1/1

DATE: 14/06/2018

PROJECT REF / DRAWING NUMBER: 18 6283

Viral Die-Off Calculation - Estimating Groundwater Setback Distance

(Cromer, Gardner & Beavers, 2001)

Climate Data - 067113 - Penrith Lakes AWS

Ground

Mean Temperature (˚C)(Yearly)	18.55

1. Calculated Time For Viral Die-off:

$$\frac{M_t}{M_0} = e^{-kt} \qquad \textit{and} \qquad k = \frac{T - 8.5}{20}$$

Ratio of Viral Concerntration (M_t/M_o)

Greywater	0.00001
Primary	0.0000001
Secondary	0.001

Time for Viral Die-Off Calculator

Parameter	Value	Parameter Discriptor
Treatment Level	Secondary	
T (˚C) (Max.)	18.55	Groundwater Tempreture (Max temp)
k (Max)	0.5025	First Order rate of Die-off
M_t/M_o	0.001	Dimsionless ratio of viral concentrations

t (days)(max)	13.7	Travel Time

2. Calculated Horizontal Setback Distance:

$$d_g = (t - \frac{d_v \times P}{K}) \div (\frac{P}{K \times i})$$

Parameter	Value	Parameter Discriptor
t (days)(max.)	13.7	Travel Time
d_v (m)	98	Vertical Distance (to water table)
P	0.2	Effective Porosity
K	2.5	Saturated Hydraulic Conductivity (permeability)
i (m / m)	0.1	Slope of Groundwater table

d_g (m)	7.383470843	Estimated Setback Distance

NUTRIENT BALANCES

1) Nitrogen Balance

- Design Wastewater Flowrate (L/d):	1050
- Effluent nitrogen concentration $(mg/L)_{1:}$	25
a) Surface Irrigation, perennial pasture:	
- Critical Total Nitrogen Loading Rate: $(mg/m^2/d)_{2:}$	27
- Minimum irrigation area $_{1\ (m2)}$	**972**
b) Subsurface Irrigaiton, mown lawn, clippings removed:	
- Critical Total Nitrogen Loading Rate: $(mg/m^2/d)_{3:}$	27
- Minimum irrigation area $_{2\ (m2)}$	**972**

2) Phosphorus Balance

- Design Wastewater Flowrate (L/d):	1050
- Effluent Phosphorus Concentration: $_{(mg/L)1}$	12
- Phosphorus Sorption Capacity $(_{kg/Ha})$	4000
a) Surface Irrigation, perennial pasture:	
- Critical loading rate $_{(mg/m2}$/day$)_2$	3
$P_{adsorbed\ (kg/Ha):}$	350
$P_{adsorbed\ (kg/m2):}$	0.04
$P_{uptake\ (slashed\ grass)\ (mg/m2)2}$	54750
$P_{uptake\ (slashed\ grass)\ (kg/m2)}$	0.05475
$P_{generated\ (kg)}$	230
Irrigation area required $_{(Pgenerated\ /\ (Padsorbed\ +\ Puptake):}$	
- Minimum irrigation area $_{1\ (m2):}$	**1223**
b) Subsurface Irrigaiton, mown lawn, clippings removed:	
- Critical loading rate $_{(mg/m2}$/day$)_4$	3
$P_{adsorbed\ (kg/Ha):}$	1333
$P_{adsorbed\ (kg/m2):}$	0.13
$P_{uptake\ (mown\ grass)\ (mg/m2)}$	54750
$P_{uptake\ (mown\ grass)\ (kg/m2)}$	0.0548
$P_{generated\ (kg)}$	230
Irrigation area required $_{(Pgenerated\ /\ (Padsorbed\ +\ Puptake):}$	
- Minimum irrigation area $_{2\ (m2)\ :}$	**1223**

1: Typical AWTS Effluent Nutrient Concentrations
2: Appendix 6, 'On-site Sewage Management for Single Households', (DLG, 1998)
3: (240 kg/Ha/year), Appendix 1 'Designing & Installing On-site Wastewater Systems' (SCA, 2013)
4: (30 kg/Ha/year), Appendix 1 'Designing & Installing On-site Wastewater Systems' (SCA, 2013)

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

Parameter	Symbol	Formula	Units	Value
Design Wastewater Flow	(Q)		L / day	1050
Design Soil Percolation Rate$_2$	(SPR)		mm / month	150
Nominated Irrigation Area$_1$	(A)		m2	235

Weather Station: Precipitation: 067084-Orchard Hills Treatment Works
Evaporation: 067019-PROSPECT RESERVOIR

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	99.80	85.60	74.90	42.40	42.30	32.80	20.80	17.80	28.60	42.00	59.70	56.50
Mean daily Evaporation	(E)		mm/day	5.5	4.7	3.9	2.9	2.0	1.6	1.7	2.5	3.6	4.4	5.0	5.6
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)	(E x C)	mm/month	119.4	92.1	84.6	52.2	31.0	21.6	21.1	34.9	59.4	88.7	105.0	121.5

Inputs	Symbol	Formula	Units	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Median Precipitation	(MP)		mm/month	99.8	85.6	74.9	42.4	42.3	32.8	20.8	17.8	28.6	42.0	59.7	56.5
Effluent Irrigation	(EI)	(Q x D / A)	mm/month	138.5	125.1	138.5	134.0	138.5	134.0	138.5	138.5	134.0	138.5	134.0	138.5
Inputs	(I)	(EI+MP)	mm/month	**238.3**	**210.7**	**213.4**	**176.4**	**180.8**	**166.8**	**159.3**	**156.3**	**162.6**	**180.5**	**193.7**	**195.0**
Outputs	**Symbol**	**Formula**	**Units**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**July**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Evapotranspiration	(ET)	(E x C)	mm/month	119	92	85	52	31	22	21	35	59	89	105	122
Design Soil Percolation Rate$_2$	(SPR)		mm / month	150	150	150	150	150	150	150	150	150	150	150	150
Outputs	(O)	(ET+SPR)	mm / month	**269**	**242**	**235**	**202**	**181**	**172**	**171**	**185**	**209**	**239**	**255**	**272**

Storage	(I - O)			-31	-31	-21	-26	0	-5	-12	-29	-47	-58	-61	-77
Cumulative Storage	(M)			0	0	0	0	0	0	0	0	0	0	0	0

Storage Requirement	(V)	Largest M	mm	0
		(VxA) / 1000	m^3	0

1: Nominated Irrigation Area to be greater than or equal to the minimum irrigation area determined in the nutrient balances

2: Based on AS1547:2012 Design Irrigation Rates x 4.3 weeks / month

APPENDIX E

Irrigation Descriptions & Standard Drawings

1. Surface Irrigation

1.1) Fixed Surface Spray Irrigation

A fixed spray irrigation system involves fixed and buried distribution lines, with a series of fixed sprinklers. Generally, pop-ups are the preferred type of sprinkler as they allow the area to be easily mowed without the risk of damaging sprinkler heads. The sprinklers should be spaced so as to evenly service the entire irrigation area. They should produce a coarse droplet to avoid spray drift, and have a plume height less than 400mm and a plume diameter of approximately 4m.

1.2) Semi-fixed Spray Irrigation

A semi-fixed surface spray irrigation system is recommended on preference to a simple 50m length of hose. This sort of system partially fixes the sprinklers to the irrigation are while still preventing effluent application outside of allowable areas. A typical set up might contain the following:

- A fixed and buried main distribution line(s) to transfer effluent from the tanks to the nominate irrigation fields.

- A series of take-off points (stand-pipes) spaced evenly within the irrigation fields. These take-off points may be quick release valves or any other type of vale as desired by the owners, or recommended by an irrigation expert. At least two take-off points should be provided per field and should be spaced at least 10m apart.

- A minimum of two flexible, moveable irrigation lines per field each having no less than three sprinklers on each line. These lines will be connected to the take-off points on the main line and will be easily detached and moved between the different take-off points.

In total the irrigation system would comprise of no less than six sprinklers. The moveable irrigation lines can be moved between the different take-off points to service different areas as required. The lines and sprinklers should be moved regularly to ensure even and widespread application of effluent throughout the entire irrigation area. The setup of the main distribution line and flexible lines should be designed to ensure that the recommended buffer distances described below are not compromised.

1.3) Surface Drip Irrigation

Surface drip irrigation involves laying pressure compensated drip lines or leaky pipe within garden beds, and covered mulch, pine bark or other surface covering. In larger garden beds several lines may be needed, and a series of manual or automatic switching valves should be used to select the desired area of irrigation. The irrigation design must ensure that relatively small areas of garden bed irrigation are not proportionally over-serviced.

The pipes and fittings shall be semi-flexible and robust (polyethylene complying with AS4130 and AS4129 are suitable. UPVC pipes and fittings and garden hoses and fittings are not suitable).

In-line strainers (150-200 mesh) shall be provided on the pump discharge to protect pipelines from any effluent solids carried over from the wastewater treatment unit into the irrigation lines and to facilitate systems servicing.

Inflow of surface and seepage water on to the land application area shall be controlled or prevented. A cut-off trench or diversion drain may be constructed, if necessary, upslope of the land application area to divert surface water and groundwater away from the irrigation area (see Figure 2).

A commissioning test may be carried out after all on-site components including the pump have been installed.

For spray irrigation the test would include checking the location and coverage achieved by the spray heads and adjusted to ensure even distribution over the design area.

The test should also involve checking the pumping main to ensure there are no leaks and air release valve is functioning.

The presence of buried pipes shall be indicated (e.g. using underground marking tape) or signage. Signs shall be prominently displayed with the words “Sewerage-effluent pipelines installed below. DO NOT DIG”.

An installation and commissioning report may be prepared to include the ‘as-built’ details following construction, the results of the construction inspections and the commissioning process. This report would be provided to the owner of the wastewater system and to the approval authority, if required.

2. Sub-surface Irrigation

Subsurface irrigation involves the installation of a series of parallel drip irrigation lines serviced by a common header line.

The dripper lines (generally 13-16mm diameter) shall be spaced to provide an effective even distribution of effluent over the whole of the design area (typically 1000mm spacing in clay soils and 600mm in sandy soils). The effluent is discharged below the surface but within the potential root zone of the vegetative cover (approximately 100mm below the ground surface).

Each dripper line comprises of pressure compensated emitters that are typically spaced at 0.6-1.0m along the line. A filter, vacuum breaker valves and flushing valves are installed to improve performance and longevity of the system.

The effluent filter (typically 150-200 mesh) should be cleaned about every two months. Vacuum breakers with surface boxes shall be provided to prevent ingress of soil into the irrigation lines under the effects of negative pipelines pressures. Irrigation lines should be flushed approximately yearly according to installer’s recommendations. This should be done during periods of fine weather when the threat of runoff is low.

The pipes and fittings shall be semi-fixed and robust (polyethylene complying with AS4130 and AS4129, or PVC Class 12 complying with as1477 are suitable for header and main pump pipelines).

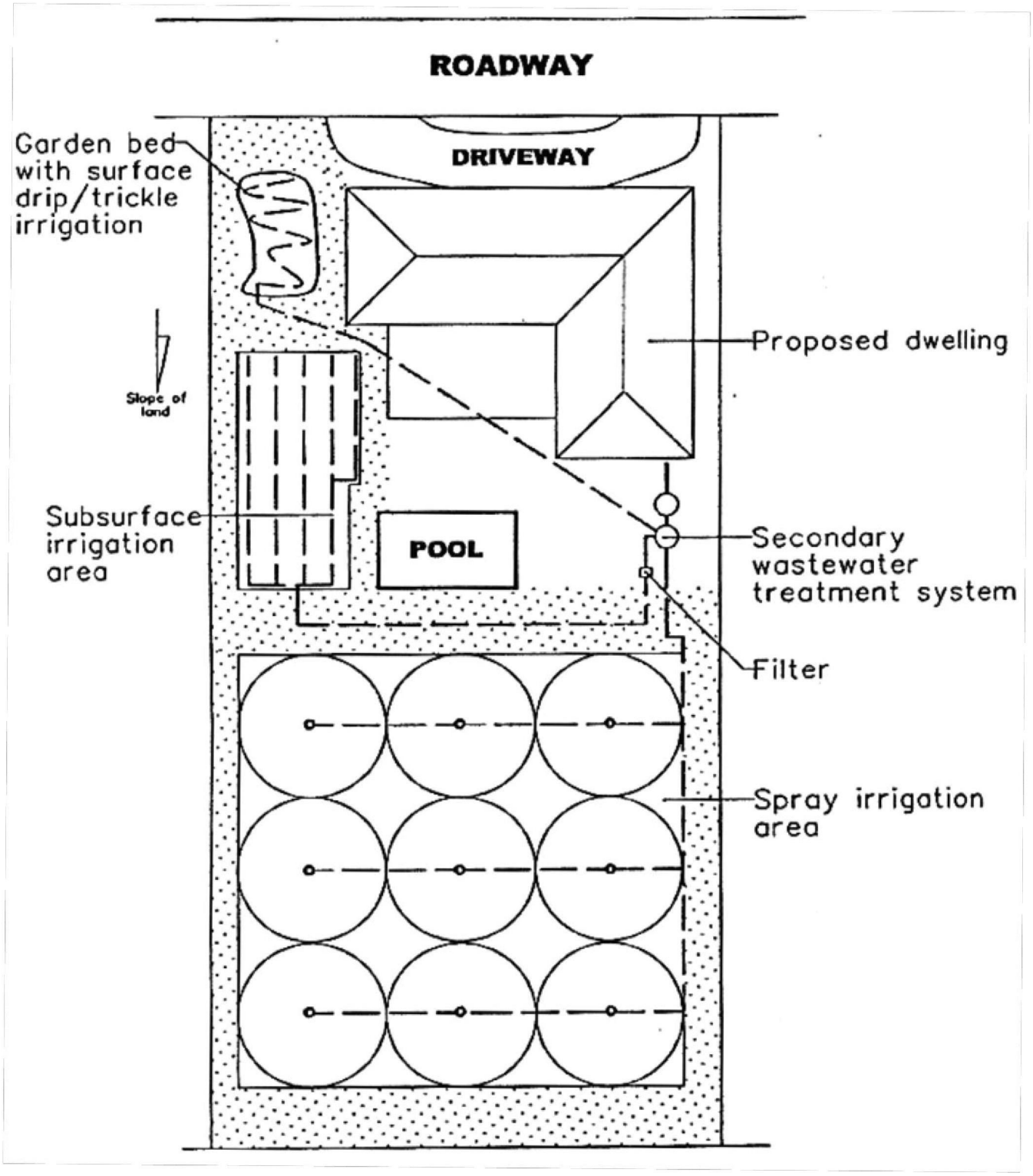
Inflow of surface seepage water onto the land application area shall be controlled or prevented. A cut-off trench or diversion drain may be constructed, if necessary, upslope of the land application area to divert surface water and groundwater away from the irrigation area. (See Figure 1).

A commissioning test may be carried out after all on-site components including the pump have been installed, but prior to covering the effluent dripper system. The test would check the effluent dripper system to ensure water flows uniformly from all perforations, that all flushing valves and other fittings are operating correctly and check the pumping main to ensure there are no leaks.

An installation and commissioning report may be prepared to include the 'as-built' details following construction, the results of the construction inspections and the commissioning process. This report would be provided to the owner of the wastewater system and to the approval authority, if required.

The irrigation area must not be subject to high traffic, to avoid compaction around emitters.

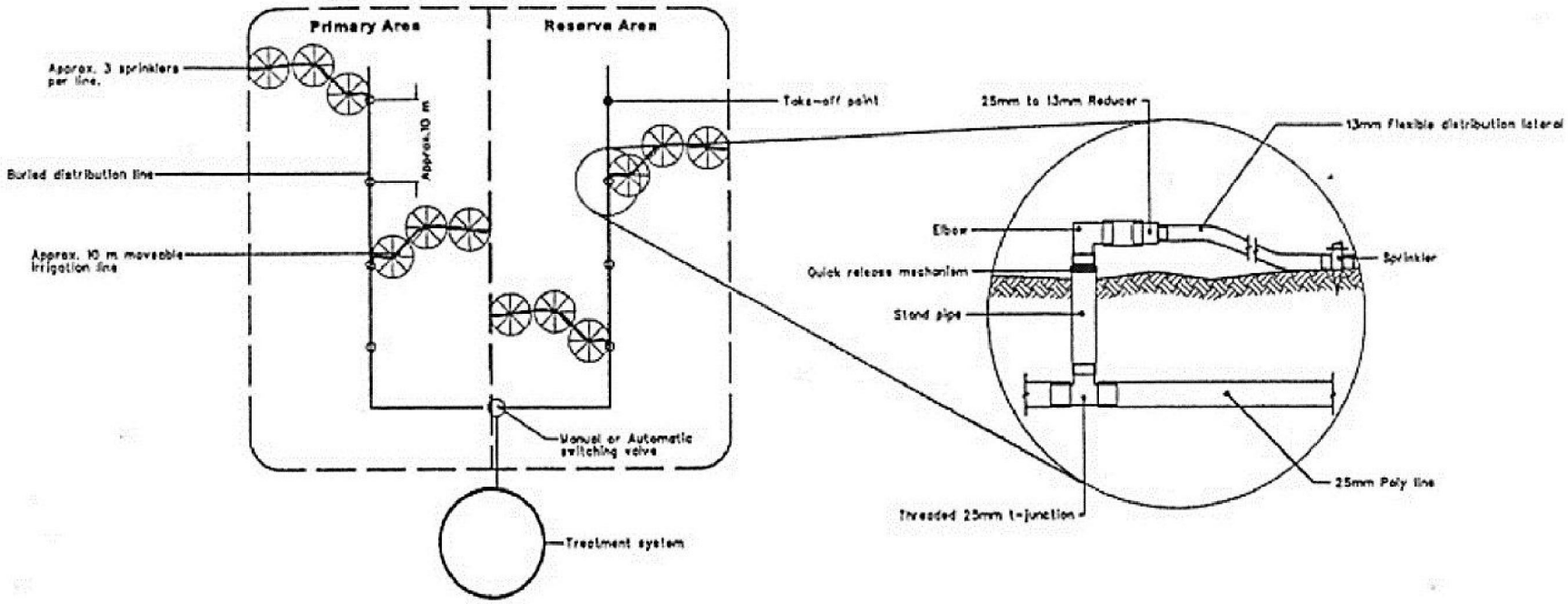
Standard Drawings SD1: Typical Irrigation Layout Overview



Note:

1. Surface-spray Irrigation (Refer to Standard Drawing SD-2)
2. Subsurface Irrigation (Refer to Standard Drawing SD-3)
3. Surface-drip Irrigation (Refer to Standard Drawing SD-2)

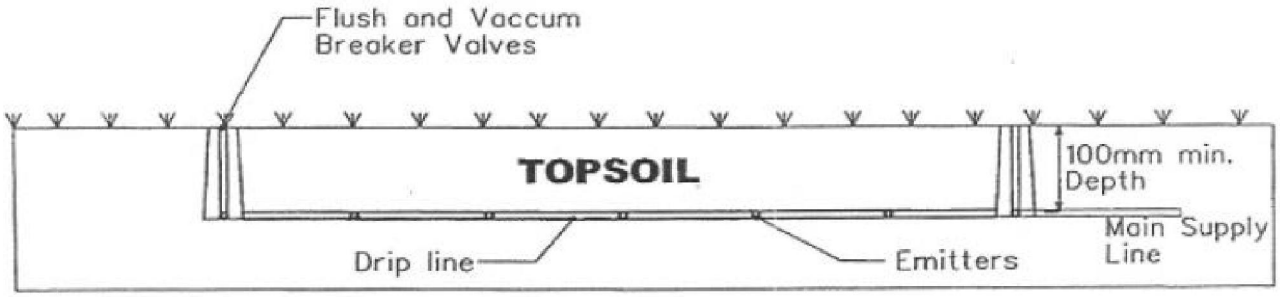
Standard Drawings SD2: Typical Surface-spray Irrigation

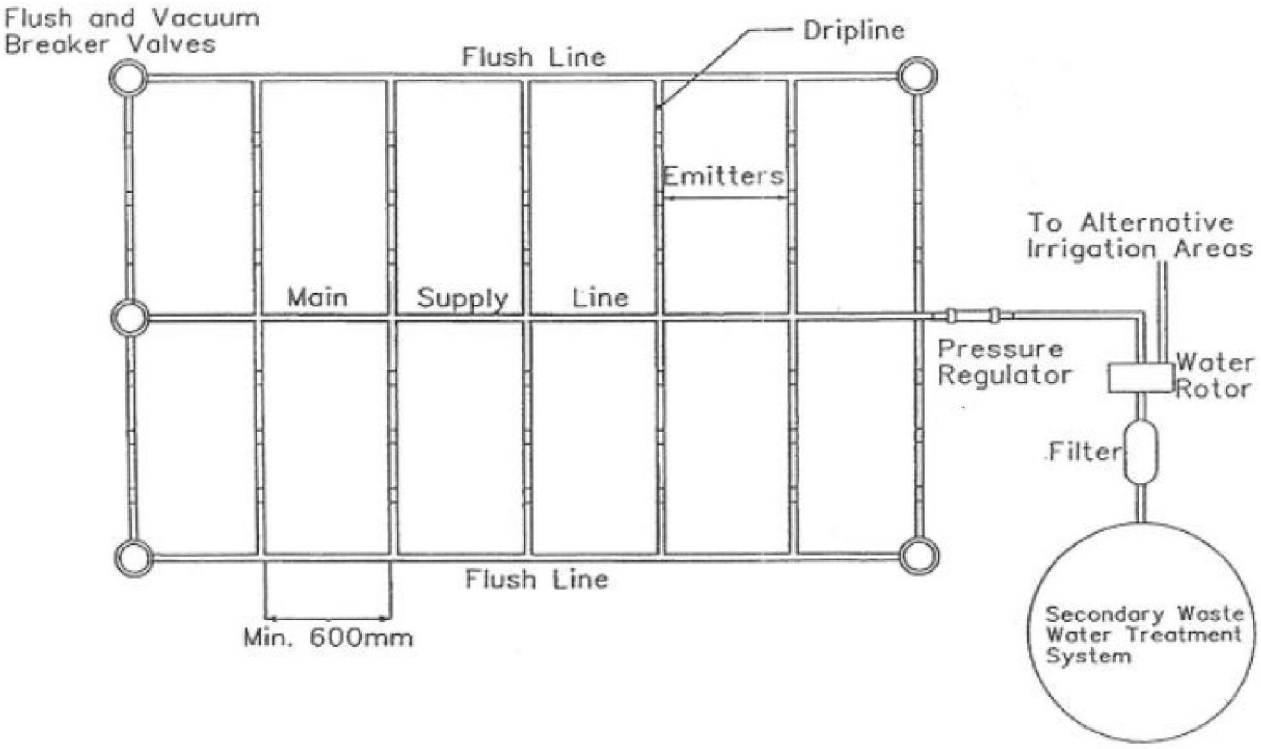


NOTES:-

1. Sprinklers shall be selected to provide a coarse droplet; the throw on sprinklers should not extend beyond designated disposal area/s
2. To avoid saturation and aid soil remediation of wastewater the owner shall ensure that movable sprinklers are periodically rotated
3. Avoid walking on disposal areas during irrigation to prevent compaction and human contact
4. Main distribution lines buried to approximately 100mm
5. The position of all take-off points and the length of moveable lines will be determined so that appropriate buffers are not compromised.

Standard Drawings SD3: Typical Subsurface Irrigation





NOTES:-

1. Drip line shall be either :
   (1) Low-pressure percolating pipe pressurised to no more than 70 kPa or as recommended by manufacturers.

   (2) Propriety drip feed pipe (eg. wasteflow) with emitters fixed inside the pipe and pressurised to manufactures recommendations. Commonly, 4.3 L/hr emitters are spaced 600mm along drip line.
2. Drip line depth and spacing : Buried to 100mm depth in which it will fall within rootzone of vegetative cover. Drip line laterals spaced 1m apart (may be subject to soil assessment) and main line 25mm PVC.
3. Flush and vacuum : fitted to prevent ingress of soil into the irrigation lines under negative pipeline pressure.
4. Filter : Grooved disk or screen filter (150-200 mesh) to remove sediment carried over from wastewater treatment unit.
5. Water rotor or manually operated lever action ball valve to distribute effluent to multiple irrigation areas (if required).
6. Marking : Buried pipes marked to AS/NZS 2648.1 with prominent signage "DO NOT DIG"

Appendix F: Operation and 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.

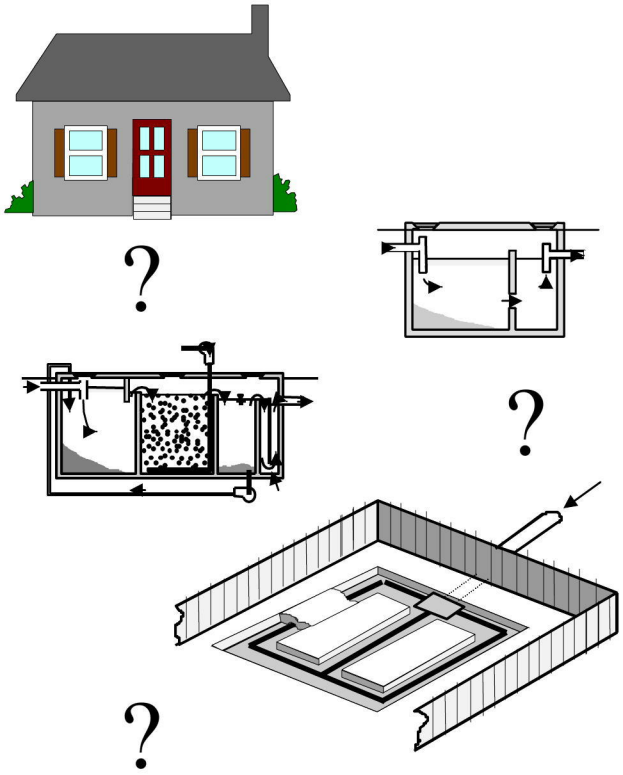
HELP PROTECT YOUR HEALTH AND THE ENVIRONMENT

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?

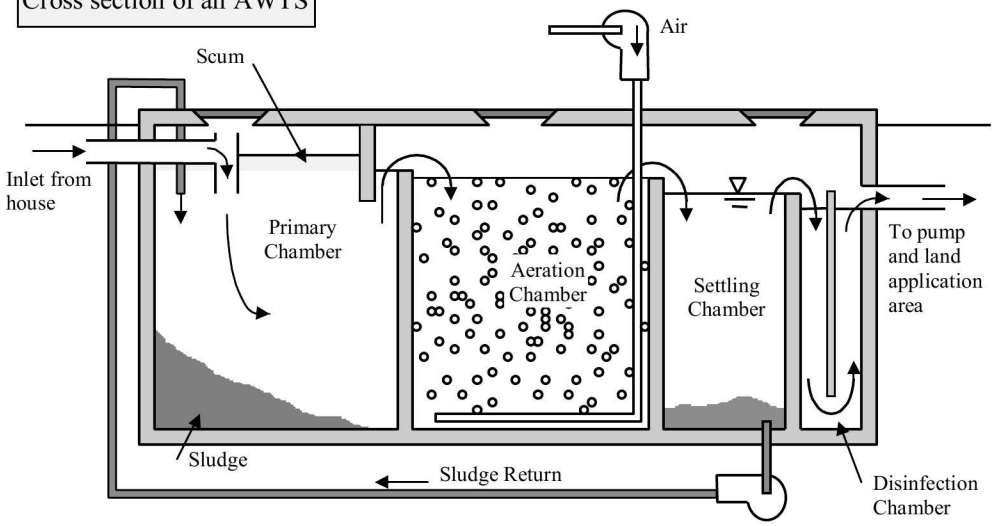
An AWTS is a purpose built system used for the treatment of sewage and liquid wastes from a single household or multiple dwellings.

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.

Cross section of an AWTS



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.

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

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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.

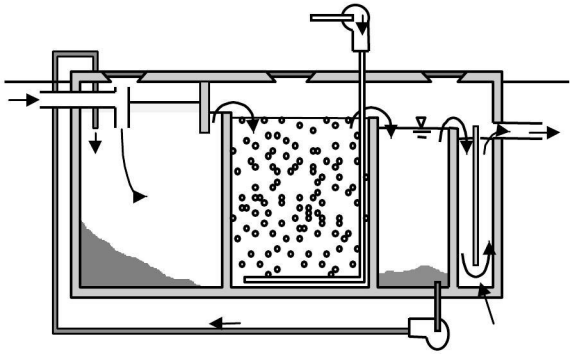
HELP PROTECT YOUR HEALTH AND THE ENVIRONMENT

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



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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?

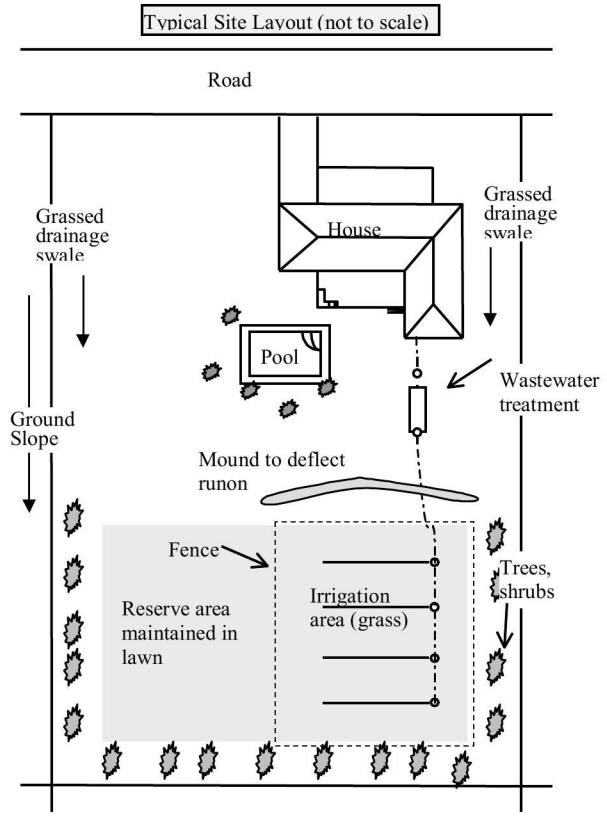
Treated wastewater applied to a land application area may be utilised or simply disposed, depending on the type of application system that is used. The application of the wastewater can be through a soil absorption system (based on disposal) or through an irrigation system (based on utilisation).

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:

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

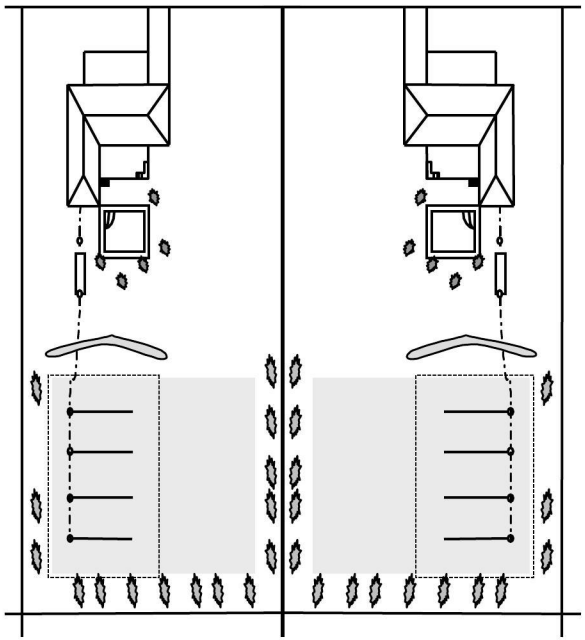
HELP PROTECT YOUR HEALTH AND THE ENVIRONMENT

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 G

Water Conservation

Whilst this report is based on AA rate plumbing fixtures, AA rate 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 900L to 750L per day:

- Dual flush 6/3L pan and cistern (average household savings of 93L / Day)[1]
- AAA rated shower heads to limit flows to 7L/min [1]
- AAA rate dishwasher (not more than 19L per wash cycle) [2]
- AAA rated washing machine (not more than 22L per dry kg of clothing) [2]

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 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 sage for septic systems. Avoid oil, paint, petrol, acids, degreasers, photography chemicals, cosmetic, lotions, pesticides and herbicides in the wastewater system. Even small amounts of these products can harm the performance of the onsite effluent management system.

1. Independent Pricing and Regulation Tribunal of NSW (1996), "water Demand Management: A Framework for Option Assessment'

2. Sydney Water Demand Management Strategy, 1995