Site and Soil Assessment for On-Site Effluent Management System

Assessment Site: Lot 101 DP 1241486
21 Shepherds Lane, Gulgong NSW 2852

Client: Tino & Lillian Mutyiri, 119 White Cirlce, Mudgee NSW 2850

(Our Reference: 29942-ER01a)

LIST OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

Appendix A – Water Balance Calculation
Appendix B –Laboratory Testing Results
Appendix C – Site Setback Requirements
Appendix D – Recommended Species List
Appendix E –Absorption Bed Concept Plans

Disclaimer

This report has been prepared solely for Tino & Lillian Mutyiri in accordance with the scope provided by the client and for the purpose(s) as outlined throughout this report.

Barnson Pty Ltd accepts no liability or responsibility for or in respect of any use or reliance upon this report and its supporting material by anyone other than the client.

Project Name:	Lot 101 DP1241486 21 Shepherds Lane, Gulgong NSW 2852
Client:	Tino & Lillian Mutyiri
Project No.	29942
Report Reference	29942-ER01a
Date:	6.09.2018
Revision:	A

Prepared by:	Reviewed by:
Jeremy Wiatkowski Geotechnical Technician	Nick Reardon Laboratory Manager

1.0 SYSTEM OVERVIEW

The following table provides a summary of the information for a sustainable onsite effluent management system proposed at Lot 101 DP1241486, 21 Shepherds Lane, Gulgong NSW 2852. The following sections of this report provide site specific details justifying the section type.

Table 1 : System Overview

Site Assessor	Jeremy Wiatkowski
Client	Tino & Lillian Mutyiri
Site Location	Lot 101 DP1241486 21 Shepherds Lane, Gulgong NSW 2852
No. of Bedrooms	4 Bedrooms
Water Source	Rainwater Water Supplied
Estimated Daily Flow (L/day)	600L/Day based on 5 people by at 120L/person/day
Tank Recommendation	Standard Septic Tank
Tank Capacity	As per section 6.3 the minimum size tank required is 3,000
Sub Soil Assessment Class	Field assessment and subsequent laboratory tests have classed the subsoil as category 4, as shown in section 3.5.
Sub Soil Recommended Hydraulic Loading mm/day (DIR/DLR)	Bed/trench systems in category 4 soils have a design-loading rate of 10mm/day. (Refer to Table 7)
Recommended Effluent Application Type	Due to the category 4 soil (clayey loam) it is recommended that an absorption bed be utilised to disperse onsite wastewater.
Effluent Design Criteria	*As per section 7.0 the minimum application area was determined by calculating the requirements of hydraulic loading. As shown 2 absorption bed of 15.0m long x 2.0m wide is required to dispose of the proposed hydraulic load.*

2.0 INTRODUCTION

2.1 Overview

Barnson Pty Ltd on behalf of Tino & Lillian Mutyiri has prepared this report for submission to Mid-Western Regional Council. This report provides direction for sustainable on-site effluent management for a 4-bedroom residence, on Lot 101 DP1241486, at 21 Shepherds Lane, Gulgong NSW (refer Figure 1).

2.2 Key References

The following key references were utilised as part of this assessment:

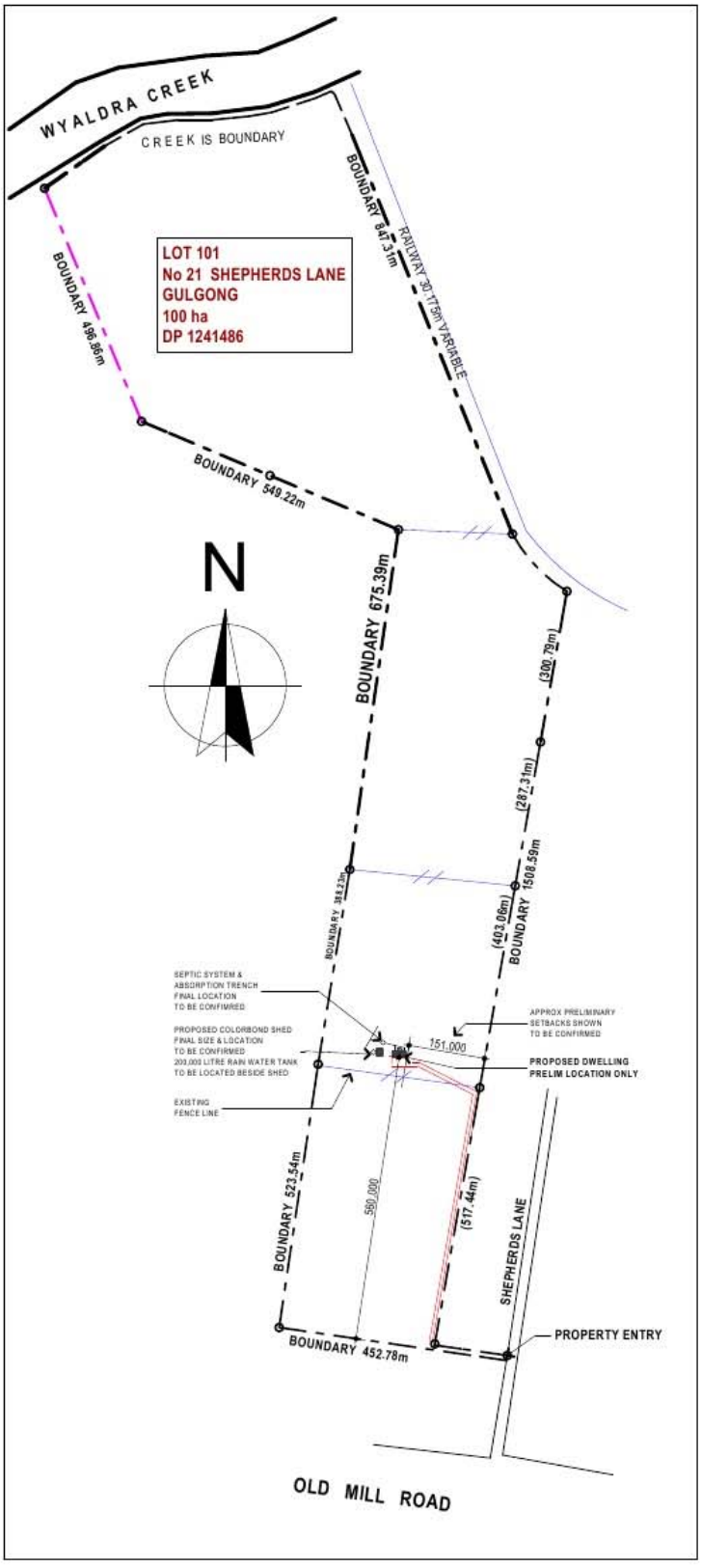
- AS/NZS 1547:2012. *On-site Domestic Wastewater Management;*
- NSW Government 1998. *On site Sewerage Management for Single Households* (The Silver Book/OSMSH);
- NSW Government 2000. *The Easy Septic Tank Guide.* Developed by Social Change Media for the NSW Department of Local Government;
- NSW Health, 2001. 'Septic Tank and Collection Well Accreditation Guidelines";
- Mid-Western Regional Council Local Environment Plan, 2012;
- Murphy B.W. & Lawrie J.W. 1998. *Soil Landscapes of the Dubbo 1:250 000 Sheet Report,* DLWC.
- Sydney Catchment Management Authority, 2012. *Designing and Installing On-Site Wastewater Systems;*

2.3 Disposal System

Figure 1 illustrates the site location.

The proposed effluent disposal system for this site is via a concrete septic tank into an absorption bed.

PRELIMINARY SKETCH PLAN ONLY



1 SITE PLAN - PRELIMINARY
1:10000

Figure 1 – Site Location Plan

PRELIMINARY SKETCH PLAN ONLY

DRAWING TO SCALE ON A3 SIZE SHEET FORMAT ONLY

BUILDING CLASSIFICATION: CLASS 1a	D.P. NUMBER: 1241486	CLIENT: T & L MUTYIRI
This drawing is subject to copyright and must not be reproduced or used without the written permission or consent of the author - Preferred Design & Drafting	SITE AREA: 100 ha	PROJECT: PROPOSED DWELLING
	DATE: 8.8.18	SITE ADDRESS: LOT 101 SHEPHERDS LANE GULGONG
	DRAWN MP	SHEET DESCRIPTION: SITE PLAN
	SCALE: 1:100, 1:200, UNO	ACCREDITED CHARTERED MEMBER OF BUILDING DESIGNERS AUSTRALIA - ACCREDITATION. No: 6077
	DRAWING No: 1 OF 6	PROJECT No: 113.18
	ISSUE A	

ISSUE	DATE	DESCRIPTION
A	8.8.18	PRELIMINARY SKETCH PLAN

Preferred Design & Drafting
30 Lewis Street
Mudgee NSW 2850
ph: 0263724397 Mob: 0429600160
email: marian@preferred-design.com.au
ACCREDITED CHARTERED MEMBER OF BUILDING DESIGNERS AUSTRALIA - ACCREDITATION. No: 6077

3.0 SITE AND SOIL EVALUATION

3.1 Site Evaluators Details

The following table provides an overview of the evaluator's particulars.

Table 2: Details

Name / Role	Jeremy Wiatkowski
Role/ Qualifications	Geotechnical Technician
Company	Barnson Pty Ltd
Company Address	1/36 Darling Street Dubbo NSW 2830
Contact Details	1300 BARNSON
Date of Assessment	6/9/2018

3.2 Site Information

The following table provides an overview of the site information.

Table 3: Site Particulars

Address/Locality	Lot 101 DP 1241486 Shepherds Lane, Gulgong NSW 2852
Local Government Area	Mid-Western Regional Council
Owner	Tino Mutyiri & Lillian Mutyiri
Developer/Builder	Owner/Builder
Block Configuration	Approximately 100ha
Intended Water Supply	Rainwater supplied
Intended Power Supply	Supplied
Local Experience	Care needs to be taken to minimise runoff and erosion. Systems commonly malfunction due to lack of ongoing maintenance. The system is to be inspected and maintained regularly in accordance with manufacturer details, Council requirements, and prescriptions identified in this report.

3.3 Desktop Assessment

The following information was obtained via desktop review of the site.

Table 4: Desktop Assessment Details

Climate Overview[1]		Annual Average Rainfall for Gulgong is 652.8mm. Warm summers with large evaporative deficit, cool winters with small evaporative deficit. The mean summer monthly rainfall (January) is 70.8mm. The mean winter rainfall (July) is 49.1mm. The mean monthly summer evaporation (January) is 175mm with evapotranspiration averaged at 90mm. The mean monthly winter evaporation (July) is 60mm with evapotranspiration averaged at 30mm.
Soil Landscape Reference[2]	Area has been mapped within the 'Craigmore" Landscape Group. Red Earths and Non-Calcic Brown Soils co-dominate the area.	
	Surface Conditions	Hardsetting
	Drainage	Moderately Well Drained
	Available water holding capability	Moderate to High
	Water table depth	>100cm
	Depth to bedrock	Very deep
	Flood hazard	High terrace above modern flood level
	Expected Nutrient deficiencies	Nitrogen, Phosphorous
	Soil Salinity	Low
	Erosion Hazard	Low
Underlying Geology[3]		*"Alluvial and riverine plain deposits of gravel, sand, silt and clay; claypans and outwash areas of black and red clayey silt and sand; coastal sand dunes and beach deposits".*
Groundwater Review		No water bores were identified within 500m of the proposed site, illustrated in **Figure 3.** The area is mapped as being groundwater vulnerable on the proposed lot as per the Mid-Western Regional Council LEP map GRV 005 **Figure 4.**

[1] Bureau of Meteorology online Climate Data website

[2] NSW Soil and Land Information System

[3]Dubbo Geological Map Sheet 1:250,000 SI 55-4

3.4 Groundwater Review

The following information was obtained via desktop review of available groundwater information in the local area. Information was obtained from the NSW Office of Water online groundwater-mapping tool. No water bores were identified within the general area of the allotment.

Table 5: Groundwater Review

Groundwater Bore Reference	Total Depth (m)	Water Bearing Zones (m)	Standing Water Level (m)	Yield (L/s)	Salinity Yield
N/a	N/a	N/a	N/a	N/a	N/a

Although no groundwater information was available, no water as encountered during the investigation so it not expected to pose a risk.

3.5 Surface Water Review

Site drains to a dam onsite approximately 900m north from the proposed application area.

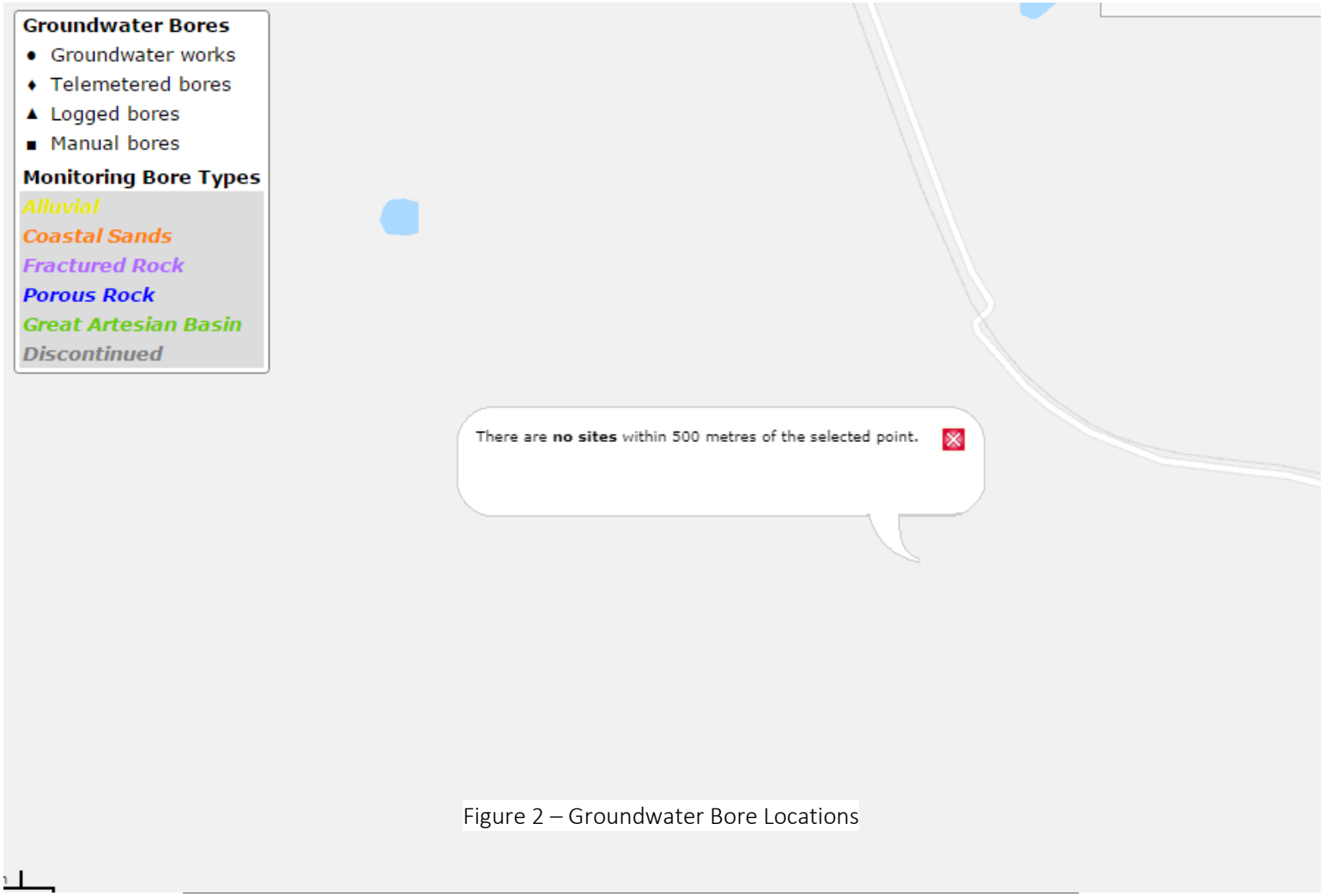


Figure 2 – Groundwater Bore Locations

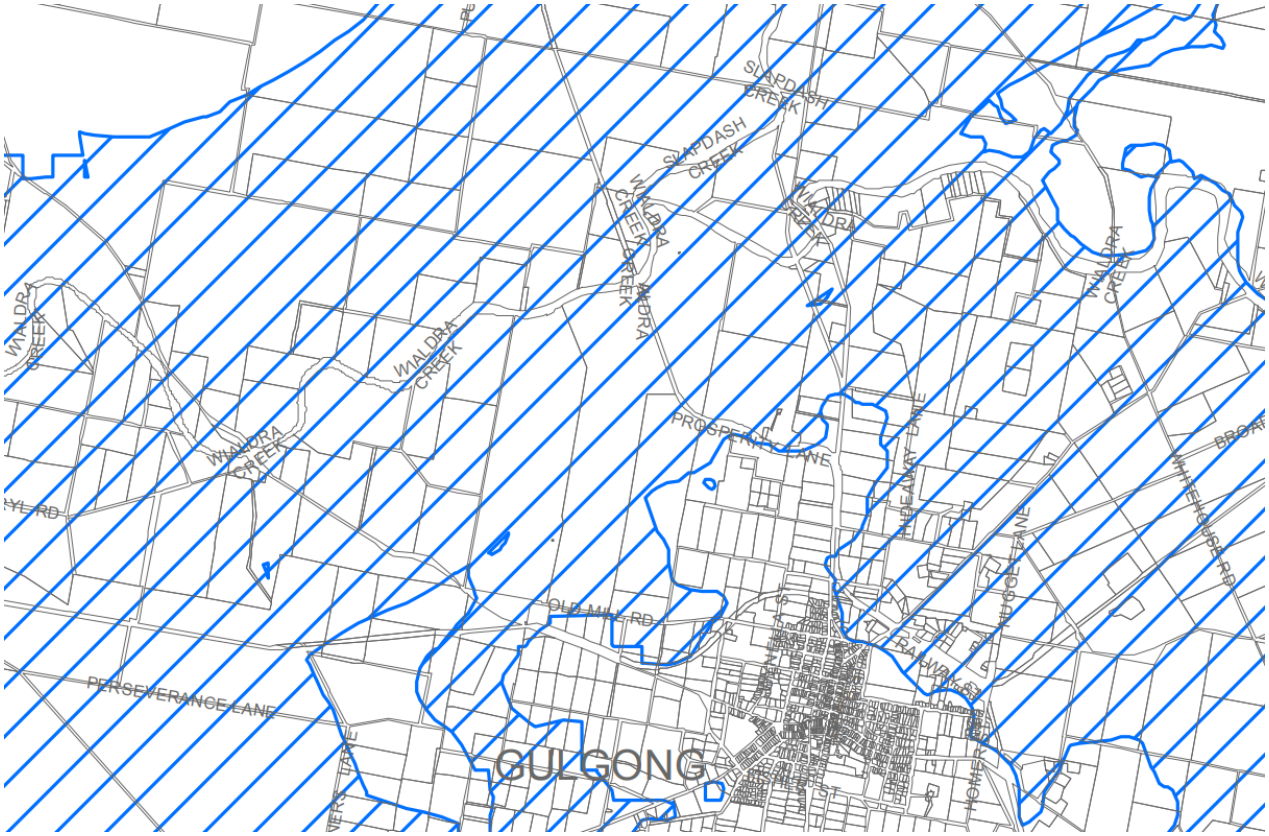


Figure 3 – Groundwater Vulnerability Map GRV_005

3.6 Field Assessment Information

The following table provides detail on the site assessment as well as the field and laboratory results.

Table 6: Site Assessment Details

Water Balance Attached		See *Appendix A*
Exposure		Good exposure.
Slope		Site has a slight slope to the north.
Elevation		Approximately 429m.
Run-On		None
Seepage		None
Erosion Potential		Low due to vegetation cover.
Site Drainage		Site drains to a dam located onsite approximately 900m from proposed application area.
Fill		None encountered
Surface rock/Outcrops		None encountered
Is there sufficient land area for:	Application system, including buffers	Yes
	Reserve application system	Yes

3.7 Soil Assessment

A soil sample was taken by client and returned to Barnson Pty Ltd for analysis on 28/08/2018. The client collected the sample to a depth of 800mm. Laboratory and results are provided at ***Appendix B***. Field assessment parameters were also obtained. The following table provides detail on both field and laboratory assessment results.

Table 7: Soil Assessment Details

Depth to bedrock or hardpan via field assessment		>1.5m
Depth to high soil water table via field assessment		>1.5m
Soil Analysis	pH – subsoil $CaCl_2$ (lab), subsoil	6.3
	Soil Colour – topsoil, subsoil (field)	Red Brown
	Emerson Test Result –subsoils (Lab)	4
	Soil Type (NATA Lab result) – subsoils	Sandy Clay
	Estimated Soil Category–topsoil, subsoil A, subsoil B,	4
	Structure massive, weak, high, moderate, strong (Field)	High/Moderately Structured
	Sub soil Permeability (from table 5.2 of AS 1547:2012)	0.5 -1.5 (k_{sat}) (m/d) (Infiltration is moderate)
	Recommended Hydraulic Loading for disposal system (from Table 5.2 of AS 1547:2012)	10mm per day (For effluent disposal beds/trenches)

4.0 SITE AND SOIL LIMITATION ASSESSMENT

The following two limitation tables are a standardised guide to the site and soil characteristics which may limit the suitability of the site for effluent disposal and which require attention through specific management practises. The tables have been reproduced from the NSW Government endorsed '*On-Site Sewerage Management for Single Households*' (1998), Tables 8 and 9. The highlighted categories represent site and soil conditions of the land covered in this report.

Table 8: Site Limitation Assessment

Site Feature	Relevant System	Minor Limitation	Moderate Limitation	Major Limitation	Restrictive Feature
Flood Potential	All land application systems	> 1 in 20 years		Frequent below 1 in 20 years	Transport in wastewater off site
	All treatment application systems	Components above 1 in 100 years		Components below 1 in 100 years	Transport in wastewater off site system failure
Exposure	All land application systems	High sun and wind exposure		Low sun and wind exposure	Poor evaporation transpiration
Slope %	Surface Irrigation	0-6	6-12	>12	Runoff, erosion potential
	Sub-surface irrigation	0-10	10-20	>20	Runoff, erosion potential
	Absorption	0-10	10-20	>20	Runoff, erosion potential
Landform	All systems	Hillcrests, convex side slopes and plains	Concave side slopes and foot slopes	Drainage plains and incised channels	Groundwater pollution hazard, resurfacing hazard
Run-on and upslope seepage	All land Application Areas	None-low	Moderate	High, diversion not practical	Transport of wastewater off site
Erosion potential	All land application systems	No sign of erosion potential		Indications of erosion e.g. rils, mass failure	Soil degradation and off-site impact
Site drainage	All land application systems	No visible signs of surface dampness		Visible signs of surface dampness, such as moisture-tolerant veg	Groundwater pollution hazard, resurfacing hazard
Fill	All systems	No fill	Fill present		Subsidence
Land area	All systems	Area available	Area not available		Health and pollution risk
Rock and rock outcrop	All land application systems	<10%	10-20%	>20%	Limits system performance
Geology	All land application systems	None		Major geological discontinuities, fractured or highly porous regolith	Groundwater pollution hazard

Table 9: Soil Limitation Assessment

Soil feature	Relevant system	Minor limitation	Moderate limitation	Major limitation	Restrictive feature
Depth to bedrock or hardpan (m)	Surface and sub-surface irrigation	> 1.0	0.5-1.0	< 0.5	Restricts plant growth
	Absorption	> 1.5	1.0-1.5	< 1.0	Groundwater pollution hazard
Depth to seasonal water table (m)	Surface and sub-surface irrigation	> 1.0	0.5-1.0	< 0.5	Groundwater pollution hazard
	Absorption	> 1.5	1.0-1.5	< 1.0	Groundwater pollution hazard
Permeability Category	Surface and sub-surface irrigation	2b, 3 and 4	2a, 5	1 and 6	Excessive runoff and waterlogging
	Absorption	3, 4		1, 2, 5, 6	Percolation
Coarse fragments %	All systems	0-20	20-45	>40	Restricts plant growth, affects trench installation
Bulk density (g/cc) SL L, CL C	All land application systems	< 1.8 < 1.6 < 1.4	> 1.8 > 1.6 >1.4		restricts plant growth, indicator of permeability
pH	All land application systems	> 6.0	4.5-6.0	-	Reduces plant growth
Electrical conductivity (dS/m)	All land application systems	<4	4-8	>8	Restricts plant growth
Sodicity (ESP)	Irrigation 0-40cm; absorption 0-1.2mtr	0-5	5-10	> 10	Potential for structural degradation
CEC mequiv/100g	Irrigation systems	> 15	5-15	< 5	Nutrient leaching
P sorption kg/ha	All land application systems	> 6000	2000-6000	< 2000	Capacity to immobilise P
Modified Emerson Aggregate Test – depressiveness	All land application systems	Classes 3-4	Class 2	class1	Potential for Structural degradation.

5.0 SYSTEM REQUIREMENTS

5.1 Mid-Western Regional Council Setback Requirements

The Mid-Western Regional Council 'On-Site Sewage Management Plan' (2008), provides recommended buffer distances. For this design, the following must be taken into consideration.

All Land Application Systems

- 80m to permanent surface waters (e.g. river, streams, lakes, etc.);
- 50m to domestic groundwater well on applicant's property and 200m to any groundwater well located on a neighbouring property;
- 40m to other waters (e.g. farm dams, intermittent waterways and drainage channels, etc.)

Absorption Systems

- 12m if area up-grade and 6m if area down gradient of property boundary;
- 6m if area is up-gradient and 3m if area is down gradient of swimming pools, driveways and building.

Absorption System Designs

- Bed lengths may vary depending on the number of bedrooms. However, the width will be 2.0m and the depth 450mm unless otherwise determined by the Council.

Other site setback requirement as per AS/NZS 1547:2012 are provided in **Appendix C.**

Actual siting of the effluent application area is the responsibility of the licenced plumber. The prescribed buffer areas/setbacks are to be adhered to.

5.2 Design Allowances – AS/NZS1547:2012 Table H1

In accordance with AS/NZS1547:2012 Table H1, the recommended design flow allowance for use in Australia, using on site roof water tank supply is 120L/person/day. Given the proposed residence is 4 bedrooms in total, the number of persons is calculated at 5.

6.0 SEPTIC TANK SELECTION AND CALCULATION

6.1 Silver Book/ NSW Health Guidelines

Primary effluent treated will be provided by a NSW Health accredited septic tank. The NSW Health '*Septic Tank and Collection Well Accreditation Guidelines*' (2001), set a sludge allowance of 1550L irrespective of the number of persons or which the septic tank is to be designed. It should be noted that in accordance with this guideline, a septic tank designed for a minimum of 5 persons needs to be de-sludge approximately every 4 years.

The general formula to calculate the minimum septic tank capacity in litres is:

$$S + (DF\ x\ N) = C$$

$$Sludge + (Daily\ Flow\ X\ No.of\ Persons) = Capacity\ of\ the\ tank$$

Residence - When DF = 120L/per person/per day and N =5, therefore DF x N =600L

$$1550L + 600L = 2150L$$

Table 2 in the NSW Health Guidelines provides a minimum of 2300L tank capacity.

6.2 AS/NZS 1547:2012 Requirements

A more conservative approach is outlined in AS/NZS1547:2012, Appendix J. A more conservative figure of 200L per person for all waste tanks is provided, giving a daily flow volume of 1000L for the residence. Therefore, a minimum capacity tank of 3,000L is required for a 4-bedroom residence with a design flow of <1000L. This conservative rate is to ensure that the unit has capacity to cope with peak discharge rates or for temporary or unusual overloads and includes no allowance for food waste disposal units. This tank design capacity also allows for the storage of sludge and scum at a rate of 80L/person/year. It should be noted that the higher cost of installing a larger septic tank may be offset by a reduced pump out frequency. Too frequent pump out removes microorganisms needed for degradation of wastewater solids. The longer pump out interval has beneficial implications for conservation of resources in that the volume of seepage requiring treatment and disposal can be reduced significantly.

6.3 System Recommendations

The following table provides details on the system selection.

Table 10: System Selection Details

Consideration of connection to centralised sewerage system	Distance to sewer	>5km
	Potential for future connection?	None planned
	Potential for reticulated water?	None planned
Expected Wastewater volume (litres/day)	Residence – 4-bedroom residence, potential occupancy of 5 people. Typical wastewater design flow is 120L/person per day in accordance with Table H3 of AS/NZS1547:2012 for households with full water reduction facilities, supplied by rain water supply. Therefore, 5 people at 120L per person per day gives a total load of 600L/day	
Type of Treatment system best suited	3,000L septic tank system– as per NSW Health accredited system - http://www.health.nsw.gov.au/environment/domesticwastewater/Pages/stcw.aspx with primary treated effluent to be distributed to an Absorption Bed	

Water conservation measures should be adapted to the greatest extent possible in the proposed residence, particularly in relation to the high water use activities of showering, clothes washing and toilet flushing. AAA rated plumbing appliances and fittings should be used. Measures including use of front loading washing machines, low volume shower roses and dual flush toilets can reduce water usage by 30-40%. Detergents low in phosphorous and sodium should be used as much as possible. Following these measures will ensure the greatest lifespan for this effluent treatment and disposal system.

7.0 EFFLUENT MANAGEMENT

Barnson Pty Ltd has analysed the proposed on site waste management system in accordance with the NSW Government endorsed *'Silver Book'* (1998) and the ANZ Standard 1547:2012 On-site Domestic Wastewater Management', with additional advice sought from the Sydney Catchment Management Authority '*Designing and installing On-site Wastewater Systems'* 2012 guideline. For this site, given the climate and soil constraints, absorption is considered the most appropriate effluent management device.

7.1 Hydraulic Loading Calculation

Given the proposed residence will be connected by rain water supply, the daily flow (Q) for the system is calculated as 600L/per day.

The required bed area shall be determined from the following relationship:

$$Length\ of\ Absorption\ Bed\ = (Q)\ /\ (DLR\ x\ W)$$

Proposed Residence

Where Q = 600L, DLR =10 mm/day (Table L1 AS 1577:2012 –conservative rate),

W (Width) = 2.0m

$$Length\ of\ Bed = \left(\frac{600}{10\ x\ 2.0m}\right)$$
$$= 30.0m$$

Therefore, from the above calculation, 2 x 15.0m long, 2.0m wide beds will be required for the proposed 4 bedroom residence.

7.2 Design Recommendations

Common failures of beds/trenches are often caused by poor installation practices. In addition to specifications outlined in AS/NZS 1547:2012, the following points should also be considered in the bed/trench design/construction which to meet the *minimum* dimensions of ***2 beds, 15.0m long and 2.0m wide with a minimum distance of 1.0m between beds. The maximum aggregate depth to be place should be 600mm.***

- Beds/trenches are to be built along the contour to ensure even distribution and avoid any section being over loaded;
- Avoid cutting beds into weakened ground;
- Construction is to take place during fine weather. If it rains beds are to be completely covered to protect them from rain damage;
- Where the beds/trenches are dug by an excavator in clay soils, the bed walls are to be scarified to remove any smearing caused by the excavator bucket;
- All distribution pipes and arches should be laid in accordance with the manufactures instructions;
- If two beds or more are utilised, ensure effluent is distributed evenly via a splitter box or sequencing valve or other appropriate method;
- All distribution pipes and arches should be laid in accordance with the manufactures instructions;
- Consideration can be given to using a pressure dosed system, which would allow for a better, more even distribution of effluent along the trench, and prolong trench life;
- Inspection ports shall be provided for the beds/trenches system. The inspection port shall be installed so as to facilitate monitoring of the effluent level in each trench;
- Trenches/Beds may be gravity fed or pressure dosed using pumps or dosing siphons;
- Vegetation cover must be well maintained to ensure strong growth for maximum update of transpiration. The surrounding landscape and vegetation must also be maintained to minimise shading and maximise exposure.
- The beds/trenches should be in an enclosed area, with and no exposed to vehicle movement or stock that can cause compaction and premature trench failure;
- The beds/trenches are to be constructed along the contour via laser levelling to ensure the base is exactly level;
- A diversion berm/bank/drain should be built upslope of the trench. This will reduce run on. A design sketch is provided at Appendix C.

8.0 RECOMMENDATIONS & CONCLUSIONS

As per the '*On-Site Sewerage Management for Single Households'* (1998) publication, stakeholders should be aware that all on site systems and components have a finite life and at some point will require replacement. Septic tanks and AWTS' generally require replacement every 25 years, whereas effluent disposal systems can have an expected life between 5-15 years. The owner is encouraged to obtain a copy of the NSW Government "The Easy Septic Guide" (2000) available from - http://www.olg.nsw.gov.au/sites/default/files/Easy-septic-guide.pdf

****As stated in AS1547-2012 section 5.5.3.4, a reserve application area of similar size to the current design should be considered as part of the risk management process to be available on a site for expansion or for resting of the land application system.*

The option provided in this report is a primary treatment septic fed into absorption beds. This is to be designed to accept the discharge from the wastewater treatment unit and it convey it securely and evenly to the land application area. The aim is to ensure uniform distribution of the effluent over the design area to help achieve effective aerobic/anaerobic decomposition within the soil. Typical design sketches for a bed/trench system as per AS 1547:2012 and *Design and Installation of On Site Wastewater Treatment (*2012) are provided at ***Appendix C.***

Installation instructions shall be provided by the manufacturer or designer. Barnson will not be liable for the incorrect installation and/or construction of the system unless when inspected by Barnson the installation and construction of the system holds true to the design featured in this report. Installation should be in accordance with the prescriptions within AS 1547:2012.

Barnson has not verified the accuracy or completeness of this data, except otherwise stated in this report. The recommendations for the proposed system as suggested in this report are based on historical data obtained for the area. Barnson will not be liable in relation to incorrect recommendations should any information provided by the client be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed.

The accuracy of geotechnical engineering advice provided in this report may be limited by unobserved variations in ground conditions across the site in areas between and beyond test locations and by any restrictions in the sampling and testing which was able to be carried out, as well as by the amount of data that could be collected given the project and site constraints.

These factors may lead to the possibility that actual ground conditions and materials behaviour observed at the test locations may differ from those which may be encountered elsewhere on the site.

If the sub-surface conditions are found to differ from those described in this report, we should be informed immediately to evaluate whether recommendations should be reviewed and amended if necessary.

Please do not hesitate to contact the undersigned if you have enquires regarding this report.

Yours Faithfully

Jeremy Wiatkowski
Laboratory Technician

Laboratory Manager

Appendix A – Water Balance Calculation

Barnson Job No	29942	
Location :	Shepherds Lane	

Design Wastewater Flow	Q	l/day	600
Design Loading Rate	R	mm/day	10

Climate Zone	3 C	*As per Soil Landscapes of Dubbo 1:250 000*
		Dropbox

1	2	3	4	5	6	7	8	9	
Month	Pan Evap E (mm)	Evapo Transpiration Et (ET=0.75E)mm	Rainfall R (mm)	Retained Rainfall Rr (Rr=0.75R) mm	DLR per Month mm	Disposal Rate (3-5+6) mm	Effluent applied per month L	Size of Area (8/7) m²	Days in Month
Jan	229	171.75	94	70.5	310	411.25	18600	45.227964	31
Feb	178	133.5	86	64.5	290	359	17400	48.467967	29
Mar	155	116.25	76	57	310	369.25	18600	50.372376	31
Apr	104	78	64	48	300	330	18000	54.545455	30
May	51	38.25	70	52.5	310	295.75	18600	62.890955	31
Jun	46	34.5	75	56.25	300	278.25	18000	64.690027	30
Jul	41	30.75	60	45	310	295.75	18600	62.890955	31
Aug	58	43.5	66	49.5	310	304	18600	61.184211	31
Sep	89	66.75	60	45	300	321.75	18000	55.944056	30
Oct	130	97.5	81	60.75	310	346.75	18600	53.640952	31
Nov	165	123.75	78	58.5	300	365.25	18000	49.281314	30
Dec	229	171.75	96	72	310	409.75	18600	45.393533	31
							Mean area	54.5m²	

Month	First Trial Area	Application Rate	Disposal Rate	mm	Increase in Depth of Stored Effluent	Depth of effluent for Month	Increase In Depth of Effluent	Computed	Reset if Et<0	Equiv Storage
Dec	60m²	310	409.75	-99.75	-332.5	0	-332.5	-332.5	0	0
Jan		310	411.25	-101.25	-337.5	0	-337.5	-337.5	0	0
feb		290	359	-69	-230	0	-230	-230	0	0
Mar		310	369.25	-59.25	-197.5	0	-197.5	-197.5	0	0
Apr		300	330	-30	-100	0	-100	-100	0	0
May		310	295.75	14.25	47.5	0	47.5	47.5	47.5	2850
Jun		300	278.25	21.75	72.5	47.5	120	120	120	7200
Jul		310	295.75	14.25	47.5	120	167.5	167.5	167.5	10050
Aug		310	304	6	20	167.5	187.5	187.5	187.5	11250
Sep		300	321.75	-21.75	-72.5	187.5	115	115	115	6900
Oct		310	346.75	-36.75	-122.5	115	-7.5	-7.5	0	0
Nov		300	365.25	-65.25	-217.5	0	-217.5	-217.5	0	0
Dec		310	409.75	-99.75	-332.5	0	-332.5	-332.5	0	0
Jan		310	411.25	-101.25	-337.5	0	-337.5	-337.5	0	0
Feb		290	359	-69	-230	0	-230	-230	0	0
Mar		310	369.25	-59.25	-197.5	0	-197.5	-197.5	0	0
Apr		300	330	-30	-100	0	-100	-100	0	0
May		310	295.75	14.25	47.5	0	47.5	47.5	47.5	2850

Estimated area of effluent drainfield	60m²
Maximum depth of stored effluent (must not exceed 350mm)	187.5mm
Trench dimensions width	2000mm
Length of trench required	30m
<20m lengths of trench	1.5

Trench Depth	450mm

Appendix B -Laboratory Testing Results

Material Test Report

Report Number:	**29942-1**
Issue Number:	1
Date Issued:	31/08/2018
Client:	Tino & Lillian Mutyiri
	119 White Circle, Mudgee NSW 2850
Contact:	Tino Mutyiri
Project Number:	29942
Project Name:	Site Classification and Septic Design
Project Location:	Lot 101 Shepherds Lane, Gulgong NSW
Work Request:	384
Sample Number:	D18-384B
Date Sampled:	28/08/2018
Sampling Method:	Sampled by Client
	The results apply to the sample as received
Material:	Red-Brown Sandy Clay

Barnson Pty Ltd
Dubbo Laboratory
16 L Yarrandale Road Dubbo NSW 2830
Phone: 1300 BARNSON
Email: nreardon@barnson.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Nick Reardon
NATA Accredited Laboratory Number: 9605

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	21		
Plastic Limit (%)	13		
Plasticity Index (%)	**8**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Linear Shrinkage (%)	4.5		
Cracking Crumbling Curling	None		

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**4**		
Soil Description	red brown sandy clay		
Nature of Water	distilled		
Temperature of Water (^{o}C)	16		

Appendix C – Site Setback Requirements

TABLE R1
GUIDELINES FOR HORIZONTAL AND VERTICAL SETBACK DISTANCES
(to be used in conjunction with Table R2)

Site feature	**Setback distance range** (m) (See Note 1)	**Site constraint items of specific concern** (from Table R2) (see Note 1)
	Horizontal setback distance *(m)*	
Property boundary	1.5 – 50 (see Note 2)	A, D, J
Buildings/houses	2.0 – > 6 (see Note 3)	A, D, J
Surface water (see Note 4)	15 – 100	A, B, D, E, F, G, J
Bore, well (see Notes 5 and 6)	15 – 50	A, C, H, J
Recreational areas (Children's play areas, swimming pools and so on) (see Note 7)	3 – 15 (see Notes 8 and 9)	A, E, J
In-ground water tank	4 – 15 (see Note 10)	A, E, J
Retaining wall and Embankments, escarpments, cuttings (see Note 11)	3.0 m or 45° angle from toe of wall (whichever is greatest)	D, G, H
	Vertical setback distance *(m)*	
Groundwater (see Notes 5, 6, and 12)	0.6 – > 1.5	A, C, F, H, I, J
Hardpan or bedrock	0.5 – ≥ 1.5	A, C, J

NOTES:

1 The overall setback distance should be commensurate with the level of risk to public health and the environment. For example, the maximum setback distance should be adopted where site/system features are on the high end of the constraint scale. The setback distance should be based on an evaluation of the constraint items and corresponding sensitive features in Table R2 and how these interact to provide a pathway or barrier for wastewater movement.

2 Subject to local regulatory rules and design by a suitably qualified and experienced person, the separation of a drip line system from an upslope boundary, for slopes greater than 5%, may be reduced to 0.5 m.

TABLE R1
GUIDELINES FOR HORIZONTAL AND VERTICAL SETBACK DISTANCES
(to be used in conjunction with Table R2) (continued)

3	Setback distances of less than 3 m from houses are appropriate only where a drip irrigation land application system is being used with low design irrigation rates, where shallow subsurface systems are being used with equivalent low areal loading rates, where the risk of reducing the bearing capacity of the foundation or damaging the structure is low, or where an effective barrier (designed by a suitably qualified and experienced person) can be installed. This may require consent from the regulatory authority.
4	Setback distance from surface water is defined as the areal edge of the land application system to the edge of the water. Where land application areas are planned in a water supply catchment, advice on adequate buffer distances should be sought from the relevant water authority and a hydrogeologist. Surface water, in this case, refers to any fresh water or geothermal water in a river, lake, stream, or wetland that may be permanently or intermittently flowing. Surface water also includes water in the coastal marine area and water in man-made drains, channels, and dams unless these are to specifically divert surface water away from the land application area. Surface water excludes any water in a pipe or tank.
5	Highly permeable stony soils and gravel aquifers potentially allow microorganisms to be readily transported up to hundreds of metres down the gradient of an on-site system (see R3, Table 1 in Pang et al. 2005). Maximum setback distances are recommended where site constraints are identified at the high scale for items A, C, and H. For reading and guidance on setback distances in highly permeable soils and coarse-grained aquifers see R3. As microbial removal is not linear with distance, data extrapolation of experiments should not be relied upon unless the data has been verified in the field. Advice on adequate buffer distances should be sought from the relevant water authority and a hydrogeologist.
6	Setback distances from water supply bores should be reviewed on a case-by-case basis. Distances can depend on many factors including soil type, rainfall, depth and casing of bore, direction of groundwater flow, type of microorganisms, existing quality of receiving waters, and resource value of waters.
7	Where effluent is applied to the surface by covered drip or spray irrigation, the maximum value is recommended.
8	In the case of subsurface application of primary treated effluent by LPED irrigation, the upper value is recommended.
9	In the case of surface spray, the setback distances are based on a spray plume with a diameter not exceeding 2 m or a plume height not exceeding 0.5 m above finished surface level. The potential for aerosols being carried by the wind also needs to be taken into account.
10	It is recommended that land application of primary treated effluent be down gradient of in-ground water tanks.
11	When determining minimum distances from retaining walls, embankments, or cut slopes, the type of land application system, soil types, and soil layering should also be taken into account to avoid wastewater collecting in the subsoil drains or seepage through cuts and embankments. Where these situations occur setback clearances may need to be increased. In areas where slope stability is of concern, advice from a suitably qualified and experienced person may be required.
12	Groundwater setback distance (depth) assumes unsaturated flow and is defined as the vertical distance from the base of the land application systems to the highest seasonal water table level. To minimise potential for adverse impacts on groundwater quality, minimum setback distances should ensure unsaturated, aerobic conditions in the soil. These minimum depths will vary depending on the scale of site constraints identified in Table R2. Where groundwater setback is insufficient, the ground level can be raised by importing suitable topsoil and improving effluent treatment. The regulatory authority should make the final decision in this instance. (See also the guidance on soil depth and groundwater clearance in Tables K1 and K2.)

TABLE R2

SITE CONSTRAINT SCALE FOR DEVELOPMENT OF SETBACK DISTANCES

(used as a guide in determining appropriate setback distances from ranges given in Table R1)

Item	Site/system feature	Constraint scale (see Note 1) LOWER ← → HIGHER Examples of constraint factors (see Note 2)		Sensitive features
A	Microbial quality of effluent (see Note 3)	Effluent quality consistently producing ≤ 10 cfu/100 mL *E. coli* (secondary treated effluent with disinfection)	Effluent quality consistently producing ≥ 10^6 cfu/100 mL *E. coli* (for example, primary treated effluent)	Groundwater and surface pollution hazard, public health hazard
B	Surface water (see Note 4)	Category 1 to 3 soils (see Note 5) no surface water down gradient within > 100 m, low rainfall area	Category 4 to 6 soils, permanent surface water <50 m down gradient, high rainfall area, high resource/environmental value (see Note 6)	Surface water pollution hazard for low permeable soils, low lying or poorly draining areas
C	Groundwater	Category 5 and 6 soils, low resource/environmental value	Category 1 and 2 soils, gravel aquifers, high resource/environmental value	Groundwater pollution hazard
D	Slope	0 – 6% (surface effluent application) 0 – 10% (subsurface effluent application)	> 10% (surface effluent application), > 30% subsurface effluent application	Off-site export of effluent, erosion
E	Position of land application area in landscape (see Note 6).	Downgradient of surface water, property boundary, recreational area	Upgradient of surface water, property boundary, recreational area	Surface water pollution hazard, off-site export of effluent
F	Drainage	Category 1 and 2 soils, gently sloping area	Category 6 soils, sites with visible seepage, moisture tolerant vegetation, low lying area	Groundwater pollution hazard
G	Flood potential	Above 1 in 20 year flood contour	Below 1 in 20 year flood contour	Off-site export of effluent, system failure, mechanical faults
H	Geology and soils	Category 3 and 4 soils, low porous regolith, deep, uniform soils	Category 1 and 6 soils, fractured rock, gravel aquifers, highly porous regolith	Groundwater pollution hazard for porous regolith and permeable soils
I	Landform	Hill crests, convex side slopes, and plains	Drainage plains and incise channels	Groundwater pollution hazard, resurfacing hazard
J	Application method	Drip irrigation or subsurface application of effluent	Surface/above ground application of effluent	Off-site export of effluent, surface water pollution

NOTES:

1 Scale shows the level of constraint to siting an on-site system due to the constraints identified by SSE evaluator or regulatory authority. See Figures R1 and R2 for examples of on-site system design boundaries and possible site constraints.

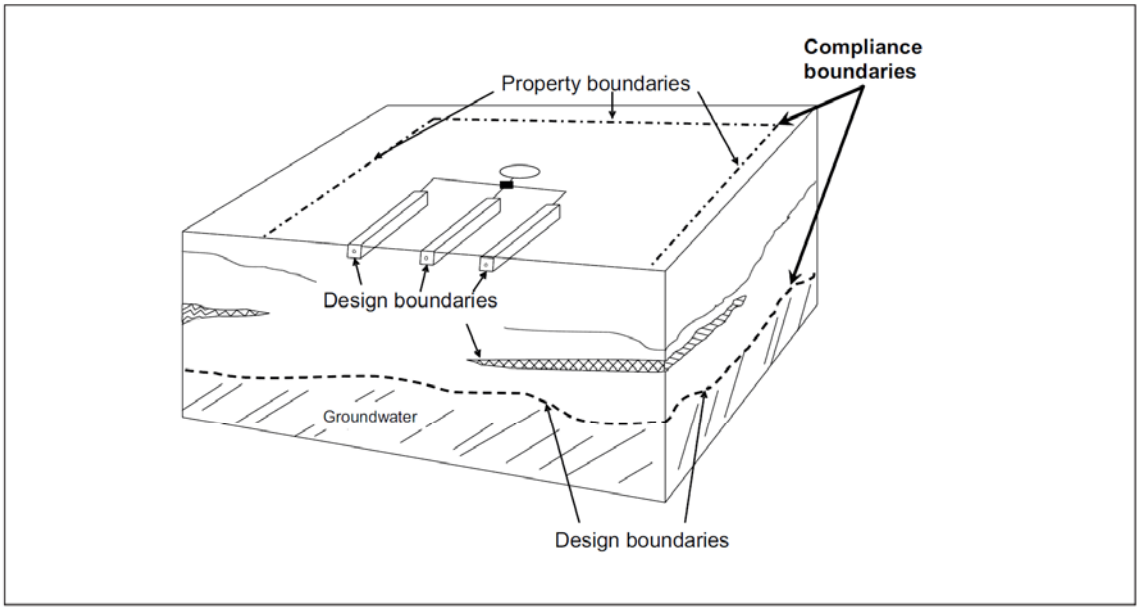
2 Examples of typical siting constraint factors that may be identified either by SSE evaluator or regulatory authority. Site constraints are not limited to this table. Other site constraints may be identified and taken into consideration when determining setback distances.

TABLE R2

SITE CONSTRAINT SCALE FOR DEVELOPMENT OF SETBACK DISTANCES

(used as a guide in determining appropriate setback distances from ranges given in Table R1) (continued)

3	The level of microbial removal for any on-site treatment system needs to be determined and it should be assumed that unless disinfection is reliably used then the microbial concentrations will be similar to primary treatment. Low risk microbial quality value is based on the values given in ARC (2004), ANZECC and ARMCANZ (2000), and EPA Victoria *(Guidelines for environmental management: Use of reclaimed water* 2003).
4	Surface water, in this case, refers to any fresh water or geothermal water in a river, lake, stream, or wetland that may be permanently or intermittently flowing. Surface water also includes water in the coastal marine area and water in man-made drains, channels, and dams unless these are to specifically divert surface water away from the land application area. Surface water excludes any water in a pipe or tank.
5	The soil categories 1 to 6 are described in Table 5.1. Surface water or groundwater that has high resource value may include potable (human or animal) water supplies, bores, wells, and water used for recreational purposes. Surface water or groundwater of high environmental value include undisturbed or slightly disturbed aquatic ecosystems as described in ANZECC and ARMCANZ (2000).
6	The regulatory authority may reduce or increase setback distances at their discretion based on the distances of the land application up or downgradient of sensitive receptors.



(Adapted from USEPA 2002)

FIGURE R1 EXAMPLE OF DESIGN AND COMPLIANCE BOUNDARIES FOR APPLICATION OF SETBACK DISTANCES FOR A SOIL ABSORPTION SYSTEM

Appendix D – Recommended Species List

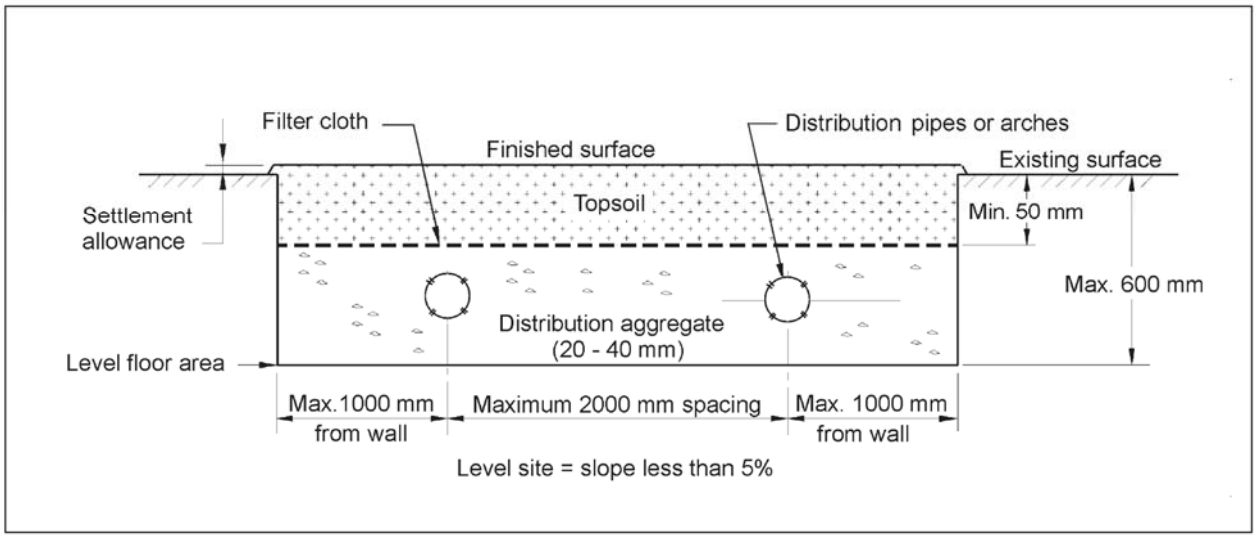
Vegetation Suitable for Land Application Areas

- *As per Appendix 7 of the Silver Book (1998) and the Upper Macquarie Catchment Revegetation Species List (CW CMA)*

Botanical Name	Common Name	Approx Height
Grasses		
Lomandra Longifolia	Spiny Headed Mat Rush	Up to 1m
Carex spp.	Sedges	Up to 1m
Poa spp.	Grasses	<30cm
Stipa spp.	Grasses/Herbs	<30cm
Shrubs		
Callistemon citrinus	Bottlebrush	1-3m

Other species such as Kikuyu may be suitable for use in this area. Consultation with Local Land Services is recommended.

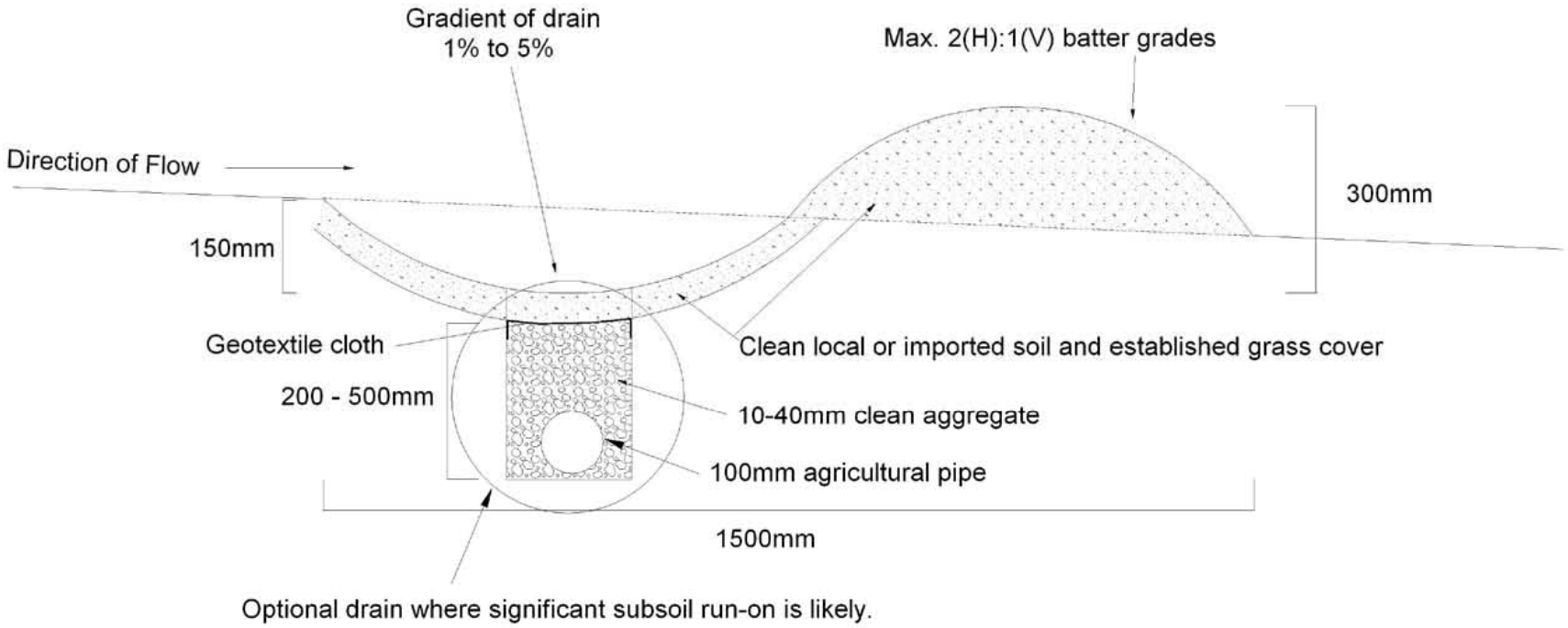
Appendix E -Absorption Bed Concept Plans



NOTE: LPED lines can be used instead of distribution pipes when dose loading effluent into beds.

FIGURE L5 CONVENTIONAL BED

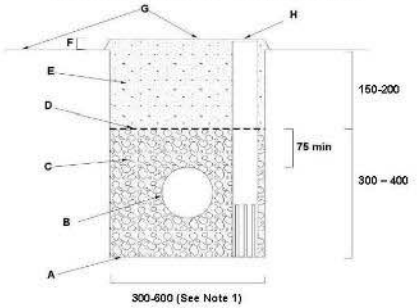
Cross Section: Upslope Diversion Drain



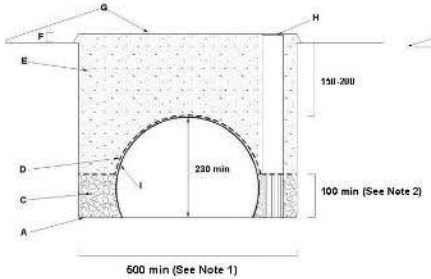
Standard Drawing 10A - Upslope Diversion Drain

(not to scale)

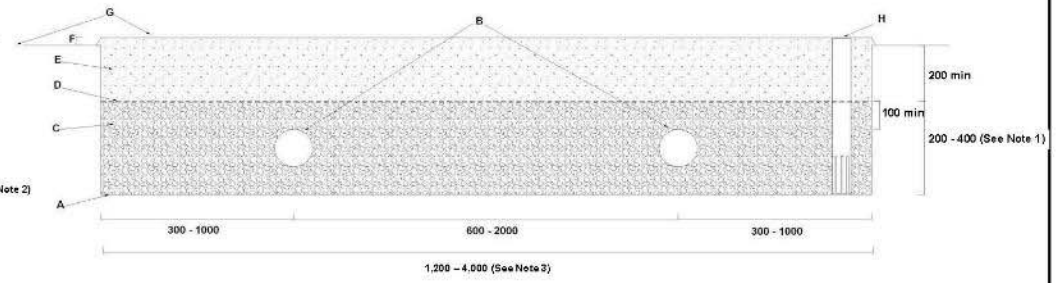
Cross Section: Piped Trench



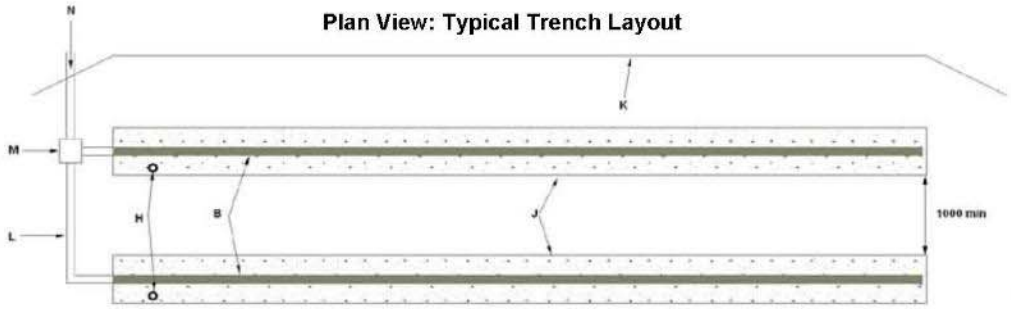
Cross Section: Arch



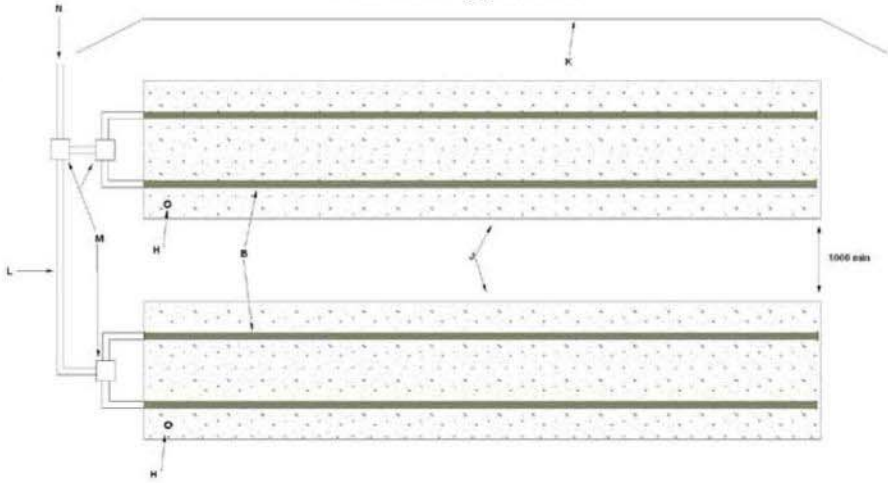
Cross Section: Conventional Piped Bed



Plan View: Typical Trench Layout



Plan View: Typical Bed



Absorption Trench / Bed

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 90-100 mm slotted PVC pipe.

C 20-40 mm distribution aggregate.

D Geotextile filter cloth.

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

F Allowance for settling after backfilling.

G Grass must be established across the construction area as soon as possible. Trench / bed surface must 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 Self supporting arch trench that complies with AS/NZS1547:2012.

J Trench / bed dimensions are an example only. The basal area of the land application area must be determined according to the procedures set out in AS/NZS1547:2012 and this document. 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. It is essential that effluent is distributed evenly to all units on a daily basis.

K Upslope stormwater diversion drain (see Standard Drawing No.9A for design detail). Subsoil drainage may be necessary on particular sites.

L 90-100 mm PVC gravity dosing pipe.

M Gravity splitter box to distribute effluent evenly between two to four separate trenches / beds. Should also be used to evenly dose multiple pipework within a single trench / bed.

N Gravity or pump fed effluent from treatment system.

Notes

1. Trenches should be a maximum of 600 mm (piped trench) or 1,000 mm (arch trench) wide. Optimum width will balance storage requirements against footprint and required trench length.
2. 100 mm of aggregate is the minimum depth. Depth can be increased to provide more storage if required, however, a minimum 150-200 mm of topsoil must exist above the top of the arch trench material. Alternative proprietary void / support materials are available to provide a substitute for both aggregate and arch trench.
3. Consideration should be given to maintaining a level base when determining an appropriate width.

   Gravity-fed beds are generally not suitable for sites with highly permeable soils due to difficulties in maintaining even distribution. Primary-treated effluent should not be dosed; effluent should at least be secondary-treated. Pressure dosing should be used in such soils.

Standard Drawing 10B - Absorption Trench / Bed

(not to scale)