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APPENDIX H

Onsite Effluent Management Report

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DESIGN . PLAN . MANAGE

On-Site Effluent Management Report

Client: Narromine Shire Council

Site Address: 397 Craigie Lea Lane, Narromine, NSW 2821

14 August 2023

Our Reference : 40038-ER02_B

DISCLAIMER

This report has been prepared solely for Narromine Shire Council (the Client) in accordance with the scope provided 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.

Installation must be by a licensed plumber and Barnson will not be liable for the incorrect installation and/or construction of the system. Installation and construction of the system must hold true to the design recommendations presented in this report. Installation should be in accordance with the prescriptions within AS 1547:2012.

Unless otherwise stated in this report, Barnson has not verified the accuracy or completeness of the data retrieved from online databases and guidance documents. The recommendations for the proposed system as presented 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 the 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.

Project Name:	397 Craigie Lea Lane, Narromine, NSW 2821
Client:	Narromine Shire Council
Project Number:	40038
Report Reference:	40038 ER02_B
Date:	14/08/2023

Prepared by:	Reviewed by:
	
Nardus Potgieter **MSc(Chem) BSc(Hons)(Env.Tech.)** Senior Environmental Scientist	**Jeremy Wiatkowski** **AdvDip Laboratory Operations** Senior Laboratory Technician

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1. INTRODUCTION

1.1 Overview

This report has been prepared by Barnson Pty Ltd on behalf of Narromine Shire Council (the Client), in support of the industrial development of the property located at 397 Craigie Lea Lane, Narromine, NSW 2821 (hereafter referred to as the Subject Site).

The Subject Site is located approximately 7kms south of Narromine. Figure 1.1 presents a map indicating the location of the Subject Site. The site identified for the development is an area of approximately 95ha located in the north-eastern half of Lot 21 DP 592824, hereafter referred to as the Investigation Area. A site plan showing the proposed layout of the new development is attached as Appendix A.

As the property is not sewered, the proposed development will require on-site wastewater management.

The purpose of this report is to present the findings of a site inspection and geotechnical investigation undertaken of the Investigation Area in support of design recommendations for on-site wastewater management. The assessment evaluates the constraints of the Subject Site and Investigation area in order to inform the design and siting of a system or systems capable of accommodating wastewater effluent from the proposed new development.

1.2 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";
- Narromine Shire Council 'Development Control Plan (2011); Narromine Local Environmental Plan 2011;Murphy B.W. & Lawrie J.W. 1998. Soil Landscapes of the Dubbo 1:250 000 Sheet Report, DLWC.
- Sydney Catchment Management Authority, 2019. *Designing and Installing On-Site Wastewater Systems*
- NSW Government 2000. *Environmental Planning and Assessment Regulation*. Schedule 3 - Part 1: 29 Sewerage systems and sewer mining systems.

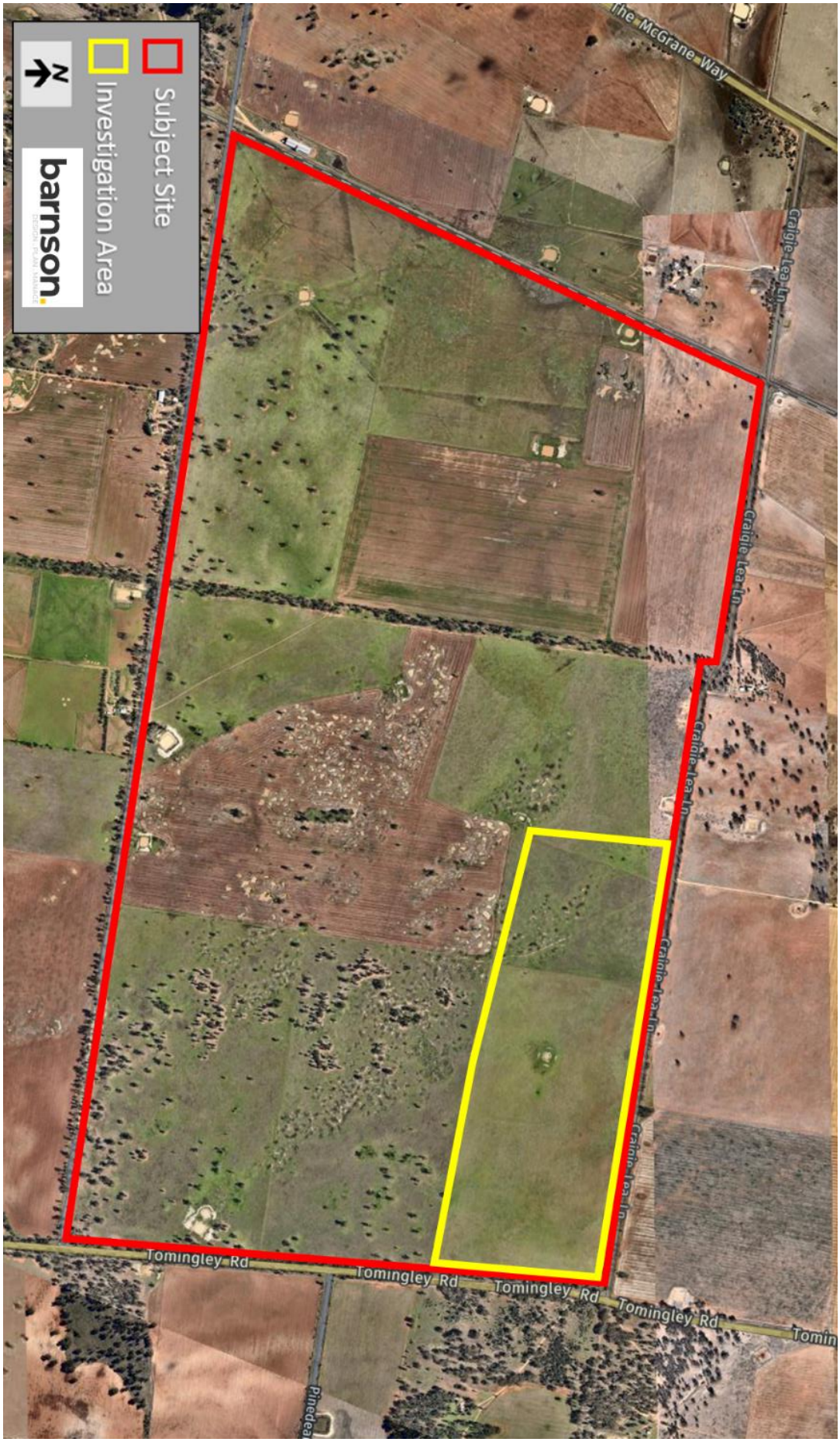

Figure 1.1: Location of the Subject Site and Investigation Area

1.3 System Requirements

1.3.1 Design Allowances

The purpose of this assessment is to evaluate the capabilities of the Investigation Area to accommodate on-site wastewater management. The evaluation considers the establishment of industrial facilities at each of the proposed lots accommodating offices and workshops. It is assumed that each facility has a small kitchen and ablution amenities providing water closet (toilet), urinal, basin and shower facilities to staff. The wastewater generated from the facilities is assumed to consist of grey and blackwater sewage effluent. Industrial effluent is not considered as part of this assessment.

For the purpose of this site capability assessment, it is assumed that wastewater from each of the proposed lots is reticulated to a central point where it is treated and the treated effluent disposed off. Although separate on-site wastewater treatment systems at each individual lot is possible, this option is not evaluated at this time.

In accordance with NSW Health 'Septic Tank and Collection Well Accreditation Guidelines' (2001), the recommended design flow allowance for factories and offices is 43L/person/day. Assuming each of the proposed lots will employ an average of 7 to 8 people the total staff compliment of the subdivision is assumed to be a maximum of 200 persons. The estimated daily maximum volume of wastewater generated for the development is then max 200 staff at 43L/person/day = 8,600L/day.

1.3.2 Narromine Shire Council Requirements

The Narromine Shire Council 'On-site Sewage Management Strategy' (2014) notes that Property owners are required to obtain an approval to install and operate a new system or to operate an existing system.

According to the strategy, a system of sewage management must be operated:

- in accordance with the relevant operating specifications and procedures (if any) for the sewage management facilities used for the purpose, and
- to allow the removal of any treated sewage (and any by- product of any sewage) in a safe and sanitary manner.

The strategy sets out to develop a way by which the requirements can be put into practice with minimum burden to Council and the community while achieving maximum benefits for the environment, public health and community amenity.

A risk management approach is applied, which allocate a low, medium or high risk rating to systems. Owners of low risk systems will not be required to renew their approval to operate. Owners of medium risk systems will consist of those systems with minor problems and be required to receive an inspection every three years, and owners of high risk systems will be required to renew their approval to operate and receive an inspection every two years.

A summary of the risk rating system is attached in Appendix B. Among the indicative criteria listed for each category, those relating to the medium-risk rating category have the most relation to the activity proposed at the Subject Site.

The Narromine Shire Council 'On-site Sewage Management Strategy' (2014) does not explicitely specify buffer distances for the on-site wastewater management system. However, the Narromine Shire Council 'Development Control Plan (DCP, 2011) (Chapter 5c Rural Development)' does list buffer distances as well as provide recommendations in regards to system selection The buffer distances recommended are as follows:

All Land Application Systems

- 100m to permanent surface waters (e.g. river, streams, lakes, etc.);
- 250m horizontal distance to a domestic groundwater well;
- 40m to other water bodies (e.g. farm dams, intermittent waterways and drainage channels, etc.)

Absorption Systems

- 12m if area up-grade and 6m if area down gradient of swimming pools, property boundaries, driveways and buildings;

Surface Spray Irrigation

- 6m if area up-gradient and 3m if area down-gradient of driveways and property boundaries;
- 15m to dwellings;
- 3m to paths & walkways;
- 6m to swimming pools;

Surface, Trickle & Subsurface Irrigation

- 6m if area up-gradient and 3m if area down-gradient of swimming pools, property boundaries, driveways and buildings;

The DCP further notes that when determining buffer distances, consideration should be given to:

- The type of land application system to be used;
- Surface and sub surface drainage pathways;
- Site factors – soil permeability, geology, vegetation buffering;
- Sensitive environments; and
- Development density.

In addition the DCP notes that

- Sanitary drainage must be disposed of to an effluent disposal field designed and constructed to the requirements of the relevant Australian Standard;
- The sewage management facility treatment disposal field is to be located, where possible, 500mm above the 1% AEP;

- Recommended buffer distances for On-site Sewerage Management Systems (septic tanks). (Local Government Environment and Health Protection Guidelines: on-site sewage management for single households 1998).
- Areas identified as medium or high groundwater vulnerability (according to the Narromine Local Environmental Plan 2011), require consideration of aerated or pump-out systems.

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

2. SITE AND SOIL EVALUATION

2.1. Site Evaluators Details

Table 2.1 provides an overview of the evaluator's particulars.

Table 2.1: Details

Name / Role	Nardus Potgieter
Role/ Qualifications	Environmental Scientist
Company	Barnson Pty Ltd
Company Address	Unit 4 108-110 Market St, Mudgee NSW 2850
Contact Details	Phone: 1300 BARNSON
Date of Assessment	14/08/2023

2.2. Site Information

Table 2.2 provides an overview of the site information.

Table 2.2: Site Particulars

Address/Locality	397 Craigie Lea Lane, Narromine, NSW 2821
Total Subject Site Area	Approx. 830ha
Investigation Area	Approx. 95ha
Local Government Area	Narromine Shire Council
Owner	Australian Rail Track Corporation
Intended Water Supply	Roof rainwater collection
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.

2.3. Site Parameters and Constraints

The following information (Table 2.3) was obtained via desktop review of the site.

Table 2.3: Desktop Assessment Details

Climate Overview[1]		Annual Average Rainfall for Narromine is 583.4mm. Warm summers with large evaporative deficit, cool winters with small evaporative deficit. The mean summer monthly rainfall (January) is 56.6mm. The mean winter rainfall (July) is 43.0mm. The mean monthly summer evaporation (January) is 254mm. The mean monthly winter evaporation (July) is 41mm.
Soil Landscape Reference[2]	The Subject Site is mapped within the three hydrogeological landscapes namely the 'Trangie, Terowie and Wyanga', with the Terowie and Wyanga landscapes covering the Investigation Area. In these landscapes, soils are described as comprises a range of unlithified materials including unconsolidated Quaternary alluvial and colluvial sediments and older Cenozoic sediments. The Investigation area mauilnly include alluvum which consist of gravel, sand, silt and clay.	
	Surface Conditions	Sandy but firm, coarse fragments are not evident. Clay in localised areas (gilgai)
	Drainage	Moderate
	Depth to bedrock	>150cm
	Flood hazard	Nil
	Soil Salinity	This unit is characterised by subsoil salinity rather than salt occurring throughout the soil profile.
	Erosion Hazard	Generally low to moderate erodibility. Highly erodible sodic soils occur throughout the landscape
	Urban Capability	Generally low limitations. Locally high limitations occur where dispersive soils with run-on and runoff pose problems for foundation and road stability.
Underlying Geology[3]		Soils have formed on Tertiary alluvium underlain by mudstone and sandstone of the Forbes group.

[1] Bureau of Meteorology online Climate Data website

[2] NSW Soil and Land Information System

[3] Narromine 1:250000

A portion of the Investigation Area is covered in a series of small mounds and depressions known as gilgai. The depressions seasonally fill with water and retains this water as a result of underlaying expanding clay soils. The area of the Investigation Area where the gilgai is most well observed is outlined in Figure 2.1.

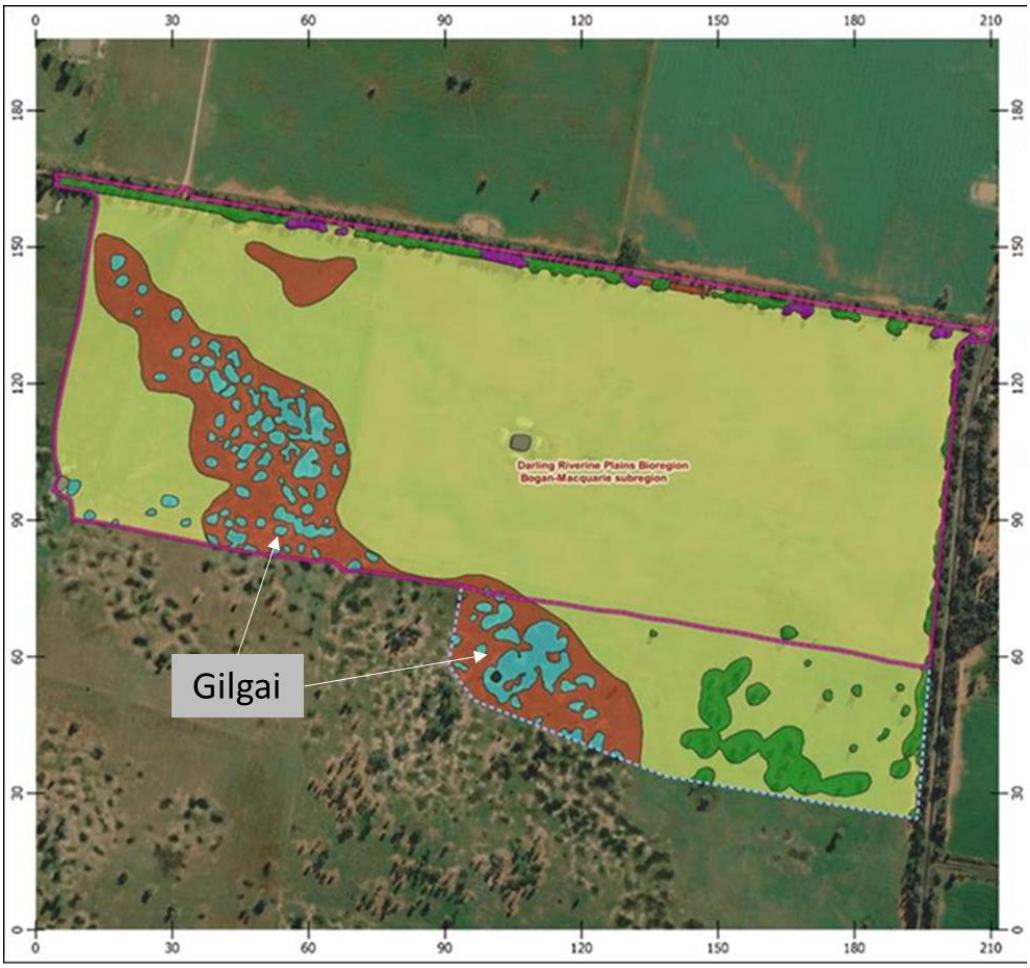

Figure 2.1: Aerial view of Investigation Area indicating location of gilgai.

The Subject Site is not shown as groundwater vulnerable on the Groundwater Vulnerability Map as published in the Narromine Local Environmental Plan (Narromine LEP, 2011). However, the western portion of the investigation area, covering portions of Lot1 and 2, are shown as containing terrestrial biodicersity values (see Figure 2.2) on the Terrestrial Biodiversity Map included in the Narromine LEP (2011).

The Subject Site is not shown as being affected by flooding on the Flood Planning Map included in the Narromine LEP (2011).

Figure 2.2: Environmentally sensitive land inside Investigation Area.

2.4. Groundwater Review

A review of existing groundwater bore records (WaterNSW, 2023) indicate 1 registered groundwater bore within the boundaries of the Subject Site (see Figure 2.3). The information recorded in the database for this bore (GW001565) and two more closest to the Subject Site (GW002441 and GW000306) indicate an average depth of between 89m and 112m deep. Only the on-site bore has data reported for depth of water bearing zones, indicating 50.3m, with standing water level of 42m and average yields 0.38L/s. According to the database all bores are used for stock.

The Subject Site falls outside the area mapped as groundwater vulnerable in the Narromine Local Environmental Plan (Narromine LEP, 2011). Based on the lithology of the area, aquifers are deep and unconfined with groundwater flow occurring vertically and laterally through fractures in bedrock. Most aquifers are isolated from surface by thick layers of clay with low hydraulic conductivity and transmissivity. High runoff rates occur on steeper slopes.

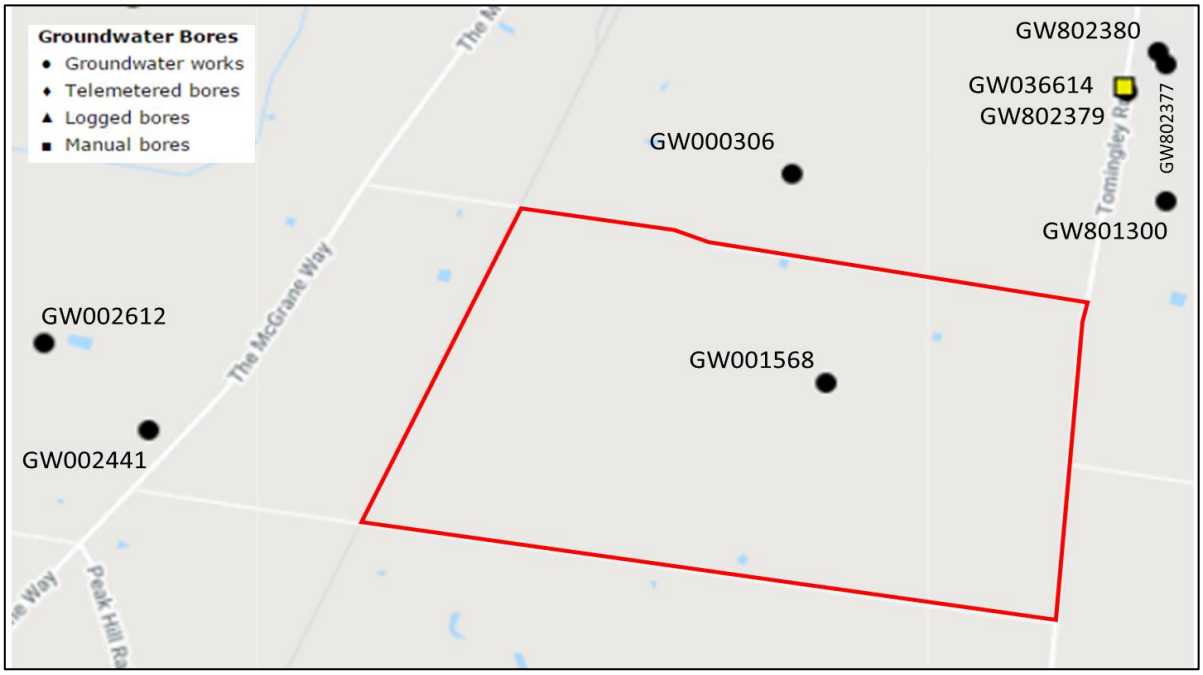

Figure 2.3: Groundwater bores near the Subject Site.

Source: WaterNSW All Goundwater Map, accessed 22/05/2023

The information recorded in the database for the groundwater bores indicates the depth of the bores reach final depths ranging from 61.0m to 85.0m. With a Standing Water Level (S.W.L) of 8m recorded for GW803397 and provided a Water Bearing Zone (W.B.Z) of 22.00m thick, starting at 9m. According to the database, the bores are utilised for domestic or stock watering purposes. Drillers logs record a layer of sticky clay from surface up to

Table 2.4 present details for GW01568 (on site bore) and GW000306 which is located at a distance of approximately 200m north-west of the Subject Site.

Table 2.4: Groundwater Review

Groundwater Bore Reference	Total Depth (m)	Water Bearing Zones (m)	Standing Water Level (m)	Yield (L/s)	Salinity
GW001568 Bore, On-Site Stock	89	50.3	42.7	0.38	no data
GW000306 Bore, 200m NW Unknown	94.4	no data	no data	no data	no data

NA - Information not provided in database

2.5. Surface Water

The closest natural water body is the Yellow Creek, which represents the main drainage for the area, at its closest point it is located approximately 200m to the south from the south-western corner of the Subject Site.

2.6. Topography

The Subject Site generally flat with a gentle slope from an elevated area near the south-eastern corner toward the west and north-west at less than 1%. The Investigation area sloes in the same general direction at less than 1%.

2.7. Field Assessment Information

A geotechnical investigation was undertaken of the Subject Site on 30/03/2023. Samples of soil was collected and submitted to the Australian Laboratroy Servicesd laboratory in Mudgee for analysis on 17/03/2023. Four soil samples were collected during the site investigation as per AS1289.1.2.1.6.5.3, two at a depth of 800mm and two at surface (0-150mm). The locations of the soil samples are indicated as A and B in Figure 2.4.

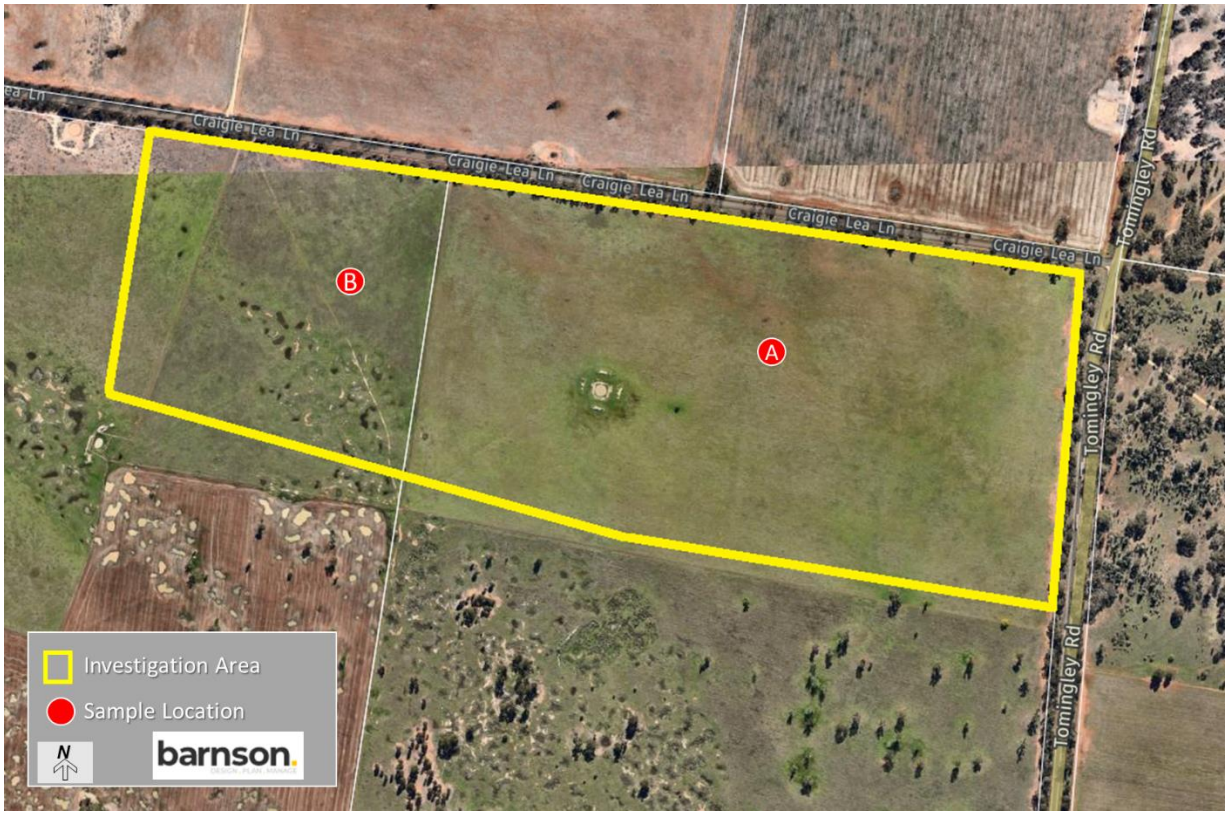

Figure 2.4: Location of soil samples

Laboratory results for the four samples are summarised in Table 2.5. Material test reports are provided at Appendix D. Field assessment parameters were also obtained.Table 2.6 provides detail

on the findings of the site assessment as well as the field and laboratory results. A bore log for geotechnical bores undertaken of the investigation area is attached as Appendix D in confirmation of the observed soil horizons.

Table 2.5: Soil Assessment Details

Depth to bedrock or hardpan via field assessment			>1.0m	
Depth to high soil water table via field assessment			>1.0m	
			Location A	Location B
	pH (1:5) (surface soil)		6.3	6.5
	Emerson Test Result	surface soil	2 (moderate dispersion)	1 (severe dispersion)
		sub-soil	2 (moderate dispersion)	2 (moderate dispersion)
	Electrical conductivity (µS/cm)		10	26
	Soil Classification,	surface soil	Clay: 20% Silt: 9% Fine sand: 37% Course sand: 31% Gravel: 3%	Clay: 13% Silt: 10% Fine sand: 35% Course sand: 34% Gravel: 8%
		subsoil	Clay: 27% Silt: 9% Fine sand: 32% Course sand: 30% Gravel: 2%	Clay: 35% Silt: 7% Fine sand: 26% Course sand: 26% Gravel: 6%
	Soil Category	-surface soil, -subsoil	4 (Silty Loam) 4 (Silty Clay Loam)	6 (Medium Heavy Clay) 6 (Medium Heavy Clay)
	Structure:	- surface soil, -subsoil	moderate structured moderate structured	
	Soil Particle Density (Clay/Silt/Sand) (g/cm^3)		2.57 – 2.59	2.47-2.61
	Exchangeable Sodium	- surface soil (%)	0.4	1.8
	Total Nitrogen as N	- surface soil (mg/kg)	340	1090
	Phosphate Sorption Capacity - surface soil (mg P sorbed/kg soil)		649	506
	Surface soil Permeability (from table 5.2 of AS 1547:2012)		0.5-1.5 (k_{sat}) (m/d) = 20.8-62.5 (mm/hr)	0.06-0.5 (k_{sat}) (m/d) = 2.5-20.8 (mm/hr) (Infiltration is moderate

	Sub soil Permeability (from table 5.2 of AS 1547:2012)	0.5-1.5 (k_{sat}) (m/d) = 20.8-62.5 (mm/hr)	0.06-0.5 (k_{sat}) (m/d) = 2.5-20.8 (mm/hr) (Infiltration is moderate
	Recommended Hydraulic Loading for drip or spray irrigation disposal system (from Table 5.2 of AS 1547:2012)	3.5 mm per day (conservative rate for spray irrigation)	2 mm per day (conservative rate for spray irrigation)
	Recommended Hydraulic Loading for trench or bed disposal system (from Table 5.2 of AS 1547:2012)	10mm per day (conservative rate for spray irrigation)	Absorption disposal of effluent not recommended

Table 2.6: Site Assessment Details

Water Balance Attached		See *Appendix E*
Exposure		Good exposure.
Slope		The site has a mild slope in a north-westerly direction.
Elevation		Approximately 247m.
Run-On		Minimal
Seepage		None
Erosion Potential		Soils are of moderate erodibility but erosion potential is low due to vegetation cover.
Site Drainage		The site is expected to drain in a north-westerly direction.
Fill		None encountered (see geotechnical investigation report)
Surface rock/Outcrops?		None encountered
Is there sufficient land area for:	Application system, including buffers in each proposed lot.	Yes
	Reserve application system	Yes

3. 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), Table 3.1 and Table 3.2. The highlighted categories represent site and soil conditions of the land covered in this report.

Table 3.1: 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 3.2: Soil Limitation Assessment (Location A)

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.

Based on the results presented in Table 3.2 and Table 3.3, the Emerson Class 1 and Class 2 dispersion properties of the sub-soil in both areas investigated represents a limitation to the application of absorption based effluent disposal at the Investigation Area. The limitation to wastewater application comes from reduced permeability and potential to compact as the pores block and the soil dries. Amelioration with lime or gypsum may improve the structural stability of the soil by increasing EC, and reducing ESP.

The cation exchange capacity measured represent a moderate limitation and refers to the ability of a soil to attract and hold cations by electrical attraction. A low CEC indicates that important plant nutrients such as calcium, magnesium and potassium may be leached with effluent irrigation and soil is likely to become more sodic.

Table 3.3: Soil Limitation Assessment (Location B)

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.

Other site characteristics present only minor limitations. Absorption as option for effluent management in this area may be considered with soil amelioration to prevent structural degradation. Surface irrigation as option for effluent management is recommended but soil nutrients may need to be supplemented to maintain vegetation.

4. TANK SELECTION AND CALCULATION

4.1. Silver Book/ NSW Health Guidelines

The '*On-Site Sewerage Management for Single Households*' (1998) guideline is based on the NSW Health guideline for septic tank and collection well capacity. Therefore, the calculation is the same.

Wastewater treatment can be provided by either a standard septic tank, producing primary treated effluent, or an Aerated Wastewater treatment System (AWTS), producing secondary or advanced secondary treated effluent. To treat the wastewater from all lots, either a large septic tank system may be considered or a wastewater collection well from which wastewater is transferred to an AWTS for treatment. The sections below present the capacities required for the different options.

4.2. Septic Tank

A septic tank is a waterproof tank usually located below ground level. Septic tanks provide preliminary treatment for the entire wastewater stream by allowing solids to settle to the base of the tank, and oils and fats to float to the top to form a scum layer. Anaerobic (in the absence of oxygen) bacterial digestion of the stored solids produces sludge, which accumulates in the bottom of the tank. Partly treated odorous effluent flows from the septic tank to either further on-site treatment, a common effluent system, a holding tank for pump out, or directly to a soil absorption system.

The required capacity of a septic tank is determined from the method prescribed in the NSW Health '*Septic Tank and Collection Well Accreditation Guidelines*' (2001). The guidelines set a sludge allowance of 1,550L for septic tanks irrespective of the number of persons or which the tank is to be designed.

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

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

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

Where a single septic tank system is considered for treatment of the wastewater from the entire development the design flow estimate for 200 persons at 43L/person per day is 8,600L (see Section 1.3.1), the required treatment capacity for the development is then calculated as:

$$1{,}550L + 8{,}600L = 10{,}150L$$

Where it is proposed to join two septic tanks together to form the one septic tank unit for a commercial installation, then two septic tanks with their partition walls removed shall be joined together such the capacity of the first septic tank has about twice the capacity of the second septic tank, and a combined capacity as calculated above. Both septic tanks must be fitted with inlet and outlet fittings and both septic tanks must have inspection and access openings and covers. Both septic tanks must be placed on a common concrete slab to ensure that there is no differential movement.

4.3. Collection Well

A collection well used for the collection of sewage effluent from the development prior to treatment is recommended to be sized at double the capacity calculated for the septic tank system. This is to provide a buffer for prolonged peak flow conditions or a delay in treatment of the collected wastewater. A minimum collection well capacity of 20,300L is recommended.

4.4. System Recommendations

Table 4.1 provides details on the system selection.

Table 4.1: System Selection Details

Consideration of connection to centralised sewerage system	Distance to sewer	>20km
	Potential for future connection?	None planned
	Potential for reticulated water?	None planned
Expected Wastewater volume (litres/day)	Industrial facility, potential occupancy of 200 persons (7 to 8 per lot). Typical wastewater design flow for offices and factories is 43L/person per day, assuming water closet, urinal, basin, shower and kitchen, in accordance with NSW Health 'Septic Tank and Collection Well Accreditation Guidelines' (2001). Therefore, 200 people at 43L per person per day gives a maximum total load of 8,600L/day. Minimum sewage effluent septic tank treatment capacity required for the entire development is recommended as a minimum of 10,150 litres. Wastewater collection capacity required prior to secondary AWTS treatment is recommended at 20,300L	
Type of Treatment system best suited	Accredited standard septic tank or Aerated Wastewater Treatment System. Accreditation of system as per NSW Health accreditation scheme https://www.health.nsw.gov.au/environment/domesticwastewater/Pages/stcw.aspx	

Water conservation measures should be adapted to the greatest extent possible in any effluent producing activity proposed for the Subject Site, particularly in relation to the high water use activities of showering and toilet flushing. AAA rated plumbing appliances and fittings should be used. Measures including use of 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 the recommended effluent treatment and disposal system.

5. 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 NSW Water '*Designing and installing On-site Wastewater Systems'* 2019 guideline as well as the Narromine Shire Council 'Sewage Management Plan'.

For this site, both irrigation and absorption are assessed as options for the management of the treated effluent. Due to the differences in the measured characteristics of the soil, the Investigation Area is considered in two areas. Calculations involving soil parameters are performed for each Area. Figure 5.1 present an outline of the two areas distinguished for the assessment.

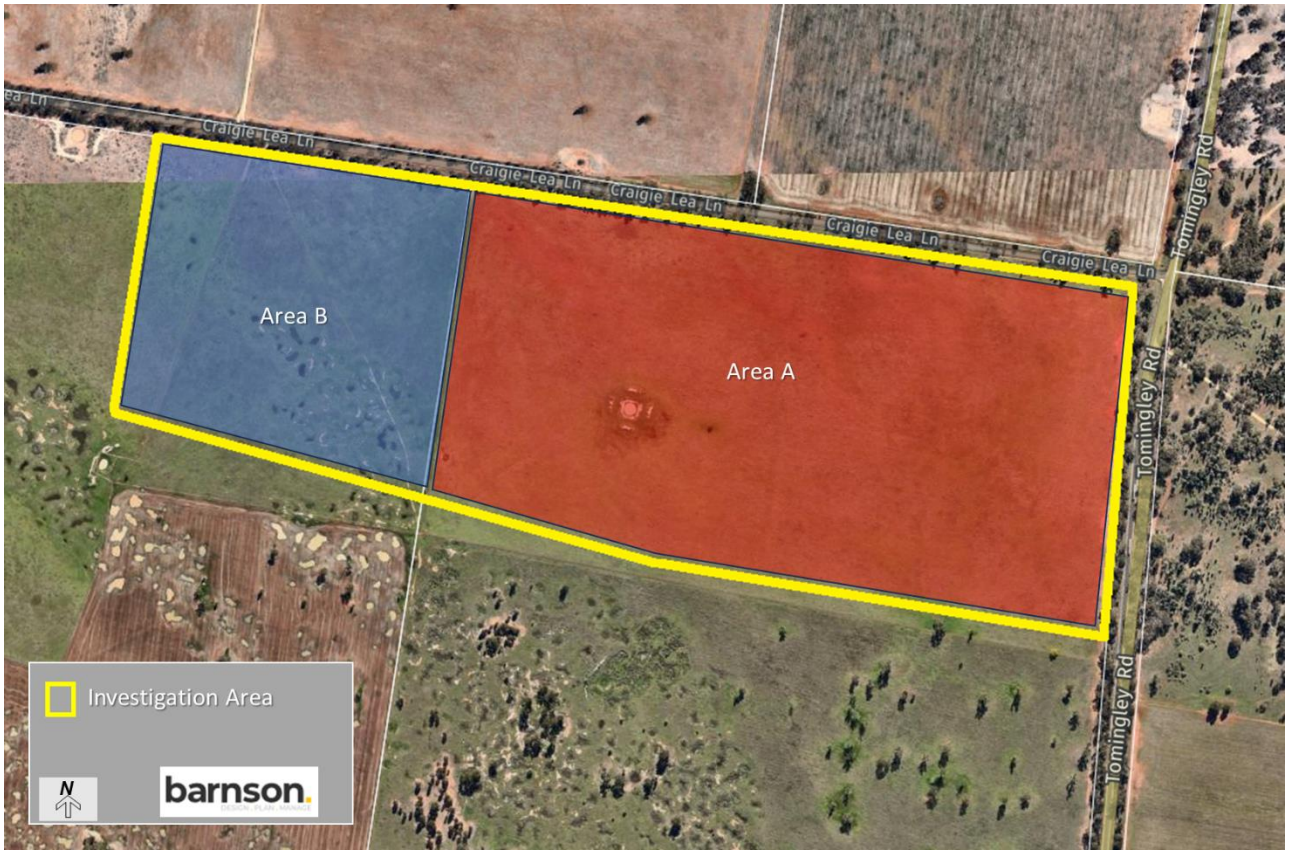

Figure 5.1: Different areas distinguished for the assessment.

In accordance with the Silver Book, the irrigation area for surface and subsurface irrigation must be the largest area calculated considering nutrient and liquid loading.

For calculation purposes, the nutrient balances assume a maximum effluent irrigation rate of 8600L per day.

5.1.1. Nitrogen Loading

The following formula is provided:

$$A = (C \times Q)/Ln$$

Where: A = land area (m^2)
C = concentration of nutrient (mg/L)
Q = treated wastewater flow rate (L/d)
L_n = critical loading rate of nutrient ($mg/m^2/d$)

It is appropriate to assume 20% loss by, denitrification. Given nitrogen has a nominal value of 37mg/L in secondary treated effluent, C = 25 X 0.8 = 20.0 mg/L.

In this case, Ln can be determined as 240kg/ha/yr. – this figure is obtained from Appendix 1 of the Sydney Catchment Management Authority 'Designing and installing On-site Wastewater Systems' 2019 guideline, for maintained lawn for the uptake of nitrogen.

Ln = 240kg/ha/yr. = 24000mg/m^2/year

Therefore

$$A = (20 \times 8{,}600 \times 365)/24{,}000$$

A= 2,615.8m^2

5.1.2. Phosphorus Loading

The general formula used to determine irrigation size based on Phosphorous loading is:

$$A = \ Pgenerated/(\ PAbsorbed\ +\ PUptake)$$

The nominal Phosphorus Sorption Capacity (mg/kg) measured for the two areas investigated is 649 mg/kg (Area A) and 506 mg/kg (Area B) respectively together with the nominal bulk density value of Clayey Loams being approximately 1.5g/cm^3 (nominal value as per *Interpreting soil results*), the Phosphorus sorption capacities were estimated to range between 9,750 kgP/ha and 7,500 kgP/ha.

Pgenerated = the amount of phosphorus generated over time, and is calculated as –

Pgenerated = total phosphorous (TP) concentration x volume of wastewater produced over 50 years

= TP X Q L/day X 365 days X 50years, where 10mg/L (concentration of phosphorous in treated sewage effluent as per the 'Silver book) and Q of 8600L/day

= 10 X 8600 X 365 X 50

= 1569.5kg

Where Pabsorbed = the amount of phosphorus that can be absorbed without leaching over 50 years. As per the 'Silver Book', this is typically 1/3 of the P sorption Value.

Area A	Area B
= PSorb X 1/3	
= 9,750kg/ha X 1/3	= 7,500kg/ha X 1/3
= 3,250.kg/ha	= 2,500.kg/ha
= 0.325kg/m^2	= 0.25kg/m^2

P_{Uptake} = the amount of P uptake by vegetation over 50 years.

For improved pasture, a phosphorous uptake value of 30 kg/ha/year will be used (as per SCA, 2019), which is equivalent to 0.0030kg/m^2/year.

Therefore, P Uptake = 0.0030 (kg/m^2/year) x 50 (years)

= 0.15kg/m^2

$$A = Pgenerated/(PAbsorbed + PUptake)$$

Where, Pgen = 1569.5kg Puptake = 0.15kg/m^2

For area A (Category 4 soil) PAbs = 0.325kg/m^2 , while for Area B (medium to heavy clay) PAbs = 0.25kg/m^2 the and

Considering phosphorous absorption, the irrigation area required in Area A = 3304.2m^2 and Area B = 3923.7 m^2.

5.1.3. Water Balance & Irrigation Area Size

The purpose of the water balance is to assess the sensitivity of the design to the various inputs and outputs of the system. An irrigation area too small will result in saturated soils for long periods. An irrigation area too large will result in poor dispersal of effluent over the area and during dry periods will result in vegetation dying.

A water balance for the area is attached as Appendix E. This balance utilises the 70th percentile monthly rainfall data as provided in the *Bureau of Meteorology* climate database. The water balance calculation utilised in this report is the minimum area method as per Table A6.2 of the *Silver Book.* Based on the average annual liquid loading, H (the amount of wastewater that maybe applied per year, is calculated as 1,344.8mm/year for Area A and 797.3mm/year for Area B. Therefore, using historical data, the land area required for irrigation in the two areas are:

$$A = 365 \times \frac{Q}{H}$$

A = land area (m^2)

Q = average treated wastewater flow rate (L/day) – 8,600L/day

H = average annual liquid loading (mm/yr.) –Area A 1,344.8 mm/year, Area B 797.3 mm/year

Area A	Area B
$A = \frac{365 \times 8600}{1{,}344.8}$	$A = \frac{365 \times 8600}{797.3}$
$=2{,}334m^2$	$= 3{,}937m^2$

Therefore, based on the Phosphorous Loading requirement, irrigation fields of 3,304m^2 is recommended for the disposal of secondary treated effluent in Area A, while the liquid loading rate calculation requires a minimum area of 3,937m^2 for irrigation effluent disposal in Area B.

5.2. Absorption Area Calculation

The area required for an absorption bed is determined from the following relationship:

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

Where Q = 860L, DLR = 10mm/day in Area A (Table L1 AS 1547:2012 –Conservative Rate),

W (Width) = 2m

$$Length\ of\ Bed = \left(\frac{8{,}600}{10\ x\ 2m}\right)$$

$$= 430m$$

Absorption beds are most effective in 20m lengths. From the above calculation, 21.5 x 20m long, 2m wide beds will be required to accommodate primary treated effluent generated from a septic tank system. Note this applies only to Area A. Absorption based effluent disposal is not recommended for Area B

6. CONCLUSIONS & RECOMMENDATIONS

6.1. Buffer Recommendations

With regard to buffer distances, the Investigation Area present no specific limitations other than potentially protected vegetation identified across Lots 1, 2, 4, 5, 6 and 7. Buffer distances to lot boundaries, roads and structures must be applied in accordance with the stipulations listed in Section 1.3.2.

The primary limitation for the Investigation Area is the presence of Category 6 clay soil in the areas comprising Lots 1 and 2. Absorption based effluent disposal is not recommended in the areas characterised by clay soil.

Buffer distances relevant to the Investigation Area are described in detail in Section 1.3.2, with further guidance from the Australian Standard AS/NZS 1547:2012) provided in Appendix C. Also included in Appendix C, is a site plan with the proposed location of an irrigation area, scaled to the recommended size and annotated with applicable buffer distances. This site plan is for illustrative purposes only and serves to demonstrate that siting of an applicable treated effluent disposal area is possible.

6.2. System Recommendations

6.2.1. General

- Calculation of the system requirements for on-site wastewater management of effluent generated from the proposed development was based on the assumption that up to 200 staff can be accommodated at the proposed subdivision. A maximum total daily flow of 8.600L was thereby estimated.
- Based on site specific measurements from samples of soil collected from the Investigation Area, two areas with different properties were identified. The assessment was conducted for each of the two areas.
- The system requirements derived from this assessment is that either a standard septic tank or an aerated wastewater treatment system (AWTS) may be used in Area A while only systems capable of producing secondary treated effluent is recommended for Area B.
- A standard septic tank treatment system must have a minimum of 10,150L wastewater capacity, with disposal of the primary treated effluent to absorption beds or trenches with a total absorption area of 860m^2
- It is recommended that an AWTS system include a surge tank of minimum 20,300L, from which the AWTS will pump the wastewater for treatment.
- Disposal of the secondary treated effluent is recommended to drip or spray irrigation fields, but absorption beds may be used in areas with more permeable soil (Area A).
- Drip or spray irrigation fields must be installed with a minimum area of 3,304m^2 in the area identified as Area A and 3,937m^2 in the area of the site where clay rich soils are present (identified as Area B).

- 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 AWTSs generally require replacement 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
- AS1547-2012 section 5.5.3.4, recommends that 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. Although a reserve application is not a requirement it is advised for consideration where the site allows for location of an additional area.
- It is recommended that a registered plumber be engaged to install the system, in accordance with the recommendations of this report.

6.2.2. Recommendations for Absorption Based Effluent Disposal

- Beds/trenches are not recommended for siting on soils of low permeability (e.g. Category 6);
- Beds/trenches are recommended 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 during construction 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 multiple beds 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 using 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 F.

6.2.3. Recommendations for Effluent Disposal Through Drip and Spray Irrigation

- Effluent can be dispersed by subsurface drip, surface drip or surface spray irrigation.
- Note that subsurface drip and surface drip irrigation offer advantages in utilising effluent for landscape planting, whilst sprays are effective on grassy areas.
- Drip and sub-surface irrigation lines require an in-line filter and a flush valve to guard against blockages. Treated effluent must be applied to vegetated areas and not bare ground.
- Records of maintenance carried out on the system should be kept by the property owners for at least 10 years.
- The area utilised for irrigation is to be protected from disturbances and will not be suitable for lawn growth, play areas and foot traffic. The area should be fenced off and protected from vehicles, livestock, domestic animals and children.
- Pasture grass cover of the area is recommended and should be slashed, removed and kept well maintained when it is greater than 10cm long. Shrub species can also be used in the land application area. Appendix G provides a list of species suitable for use as included in Appendix 7 of the *Silver Book.*
- The drip and spray effluent disposal area should be protected from potential run on and stormwater via an upslope diversion drain or beam. An example from the *Design and Installation of On Site Wastewater Treatment (*2019) guideline is provided at Appendix H.
- It is also critical to ensure an appropriate pump to adequately service the demands of the effluent application area is met.

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APPENDIX A

Site Plan

DIAL BEFORE YOU DIG
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THIS IS A DRAFT PLAN ONLY AND IS SUBJECT TO FINAL SURVEY

LEGEND (existing)

- CONSTRAINTS MAP - BLUEGRASS
- CONSTRAINTS MAP - HABITAT FEATURES
- CONSTRAINTS MAP - TECs FUTURE EXPANSION
- CONSTRAINTS MAP - TECs SUBJECT SITE

LEGEND (proposed)

- PROPOSED ROAD
- PROPOSED UNDERGROUND STORMWATER PIPE
- PROPOSED TABLE DRAIN
- PROPOSED GRATED STORMWATER PIT
- PROPOSED SEWER MAIN
- PROPOSED SEWER MANHOLE
- PROPOSED SEWER MAINTENANCE SHAFT
- PROPOSED WATERMAIN
- PROPOSED IN-GROUND HYDRANT
- PROPOSED STOP VALVE

PROPOSED OVERALL SITE PLAN

REDUCTION RATIO 1:2,500 @ A1
1:5,000 @ A3

SCALE 1:2500(A1)
0 50 100 150 200 250
SCALE 1:5000(A3)

ISSUED FOR REVIEW

barnson
DESIGN . PLAN . MANAGE

BARNSON PTY LTD

phone 1300 BARNSON (1300 227 676)
email generalenquiry@barnson.com.au
web barnson.com.au

Rev	Date	Description
A	31-08-2023	ISSUED FOR REVIEW

Project
CIVIL ENGINEERING DOCUMENTATION FOR NARROMINE FREIGHT HUB
Site Address
397 CRAGIE LEA LANE
NARROMINE NSW 2821
Client
NARROMINE SHIRE COUNCIL

Drawing Title
PROPOSED OVERALL SITE PLAN

Design DOS
Drawn JS
Check -
Original Sheet Size A1
Revision A

Certification

Project No 40038
Drawing No C03

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APPENDIX B

Narromine Sewage Management Plan

Narromine
SHIRE COUNCIL

ON-SITE SEWAGE MANAGEMENT STRATEGY

Adopted by Council 12 November, 2014

EXECUTIVE SUMMARY

In 1998 the New South Wales Government introduced regulatory reforms and guidelines to enable effective Council regulation and supervision of domestic sewage management facilities. Council regulates the installation and operation of sewage management systems under the Local Government Act 1993 and Regulations.

Property owners are required to obtain an approval to install and operate a new system or to operate an existing system. The Regulations specify the performance standards to be complied with by owners when operating a system of sewage management as follows:

A system of sewage management must be operated in a manner that achieves the following performance standards:

- *the prevention of the spread of disease by micro-organisms,*
- *the prevention of the spread of foul odours,*
- *the prevention of contamination of water,*
- *the prevention of degradation of soil and vegetation,*
- *the discouragement of insects and vermin,*
- *ensuring that persons do not come into contact with untreated sewage or effluent (whether treated or not) in their ordinary activities on the premises concerned,*
- *the minimisation of any adverse impacts on the amenity of the premises and surrounding lands,*
- *if appropriate, provision for the re-use of resources (including nutrients, organic matter and water).*

A system of sewage management must be operated:

- *in accordance with the relevant operating specifications and procedures (if any) for the sewage management facilities used for the purpose, and*
- *to allow the removal of any treated sewage (and any by-product of any sewage) in a safe and sanitary manner.*

The strategy sets out to develop a way by which the requirements can be put into practice with minimum burden to Council and the community while achieving maximum benefits for the environment, public health and community amenity.

The goals of the strategy are to:

- minimise the impact of systems on the environment;
- identify the location of all systems in the Shire area;
- establish a partnership between stakeholders to support continuing improvement of on-site sewage management;

- educate owners about on-site sewage management systems;
- ensure owners are aware of the need to maintain their on-site sewage management systems;
- ensure owners of installations are aware of the need to hold current approvals;
- implement a cost effective method of supervision of on-site sewage management systems;
- provide for charging of fees for registrations and inspection, if Council so chooses; and
- create links between this strategy and Council's strategic planning process.

The strategy proposes a risk management approach that will allocate a low, medium or high risk rating to systems. Owners of low risk systems will not be required to renew their approval to operate. Owners of medium risk systems will consist of those systems with minor problems and be required to receive an inspection every three years, and owners of high risk systems will be required to renew their approval to operate and receive an inspection every two years.

The legislative reforms were implemented in response to surveys which indicated on-site sewage management systems were failing to meet environmental and health protection standards. The hepatitis A outbreak linked to the consumption of oysters from Wallis Lake and the risk in settlement areas of the Murray Darling Basin from septic tank effluent being examples.

Narromine Shire is a medium rural shire in Western NSW. Its population is 6,850. The two main settlement areas of Narromine and Trangie are sewered, but the remaining areas of the Shire, including the village of Tomingley rely on on-site sewage management systems.

Council proposes to implement this strategy over a period of time using the existing staff resources of its Environmental Services Department.

All installations will be required to comply with the performance standards set out in the Regulation.

Council will implement an inspection regime to ensure that the objectives of this strategy are achieved.

Initial risk assessments will be completed by desktop assessment. A 5% random target group of installations will be inspected to verify the accuracy of those assessments.

The results of the inspection regime will be reported in Council's State of the Environment Report.

Council proposes to establish three categories of risk, which will be applied to installations, high, medium and low. Installations will be assessed against indicative criteria for each category.

Provision is made for reviews of risk assessments.

Provision is made for re-categorisation of systems to a lower category over a period of time.

Council will maintain records of all applications, approvals and exemptions.

As required, notices of renewal will be sent to owners of systems required to hold current approvals.

A monitoring program will be established to ensure the efficiency of the strategy. This will include inspection of systems, assessing the integration of the strategy with Council's other strategic planning processes and assessing the effectiveness of the strategy against its objectives and goals.

Activities undertaken in accordance with this strategy will be reported in Council's annual State of the Environment Report.

The strategy is to be the subject of ongoing review, at least in the early stages, and subsequently on setting the Integrated Planning and Reporting Framework documents.

DEFINITIONS

For the purposes of this strategy, the following definitions apply:

- Human waste storage facility means a device for holding or disposing of human waste, including a cesspit, septic tank, septic closet, water closet, chemical closet, humus closet and combustion closet.

- Operate a system of sewage management means hold or process, or re-use or otherwise dispose of; sewage or by-products of sewage (whether or not the sewage is generated on the premises on which the system of sewage management is operated). This includes:
    a) use artificial wetlands, transpiration mounds, trenches, vegetation and the like in related effluent application areas;

b) hold or process sewage that is to be subsequently discharged into a public sewer.

However, ***operate a system of sewage management*** does not include any of the following:

(a) any action relating to the discharge of sewage directly into a public sewer,

(b) any action relating to sewage or by-products of sewage after their discharge into a public sewer.

- Related effluent application area, in relation to a sewage management facility, means the area of land (if any):
  a) where it is intended to dispose of the effluent and any by-products of sewage from the facility, or
  b) to which the effluent and by-products are intended to be applied.

- Sewage includes effluent, being any matter or thing, whether solid or liquid or a combination of solids and liquids, which is of a kind that may be removed from a human waste storage facility, sullage pit or grease trap, or from any holding tank or other container forming part of or used in connection with a human waste storage facility, sullage pit or grease trap.

  Sewage management facility means:
  a) a human waste storage facility, or
  b) a waste treatment device intended to process sewage, and includes a drain connected to such a facility or device.

- The regulation means the Local Government (General) Regulation 2005.

1.0 INTRODUCTION

1.1 Legislative Changes

The requirement to obtain approval to operate sewage management systems is not a new concept. Council had the power under the orders provisions of the Local Government Act 1993 to require remedial work to be carried out on faulty sewage management facilities however, this power was reactive to problems and did not seek to ensure problems did not occur as a result of operation of such systems.

Clause 43 of the Local Government (General) Regulation 2005 prescribes the matters to be taken into consideration for approval to operate a system of sewage management. Likewise, Clause 26 of the Regulation prescribes the matters to accompany an application to install or construct sewage management systems. This means the owner of any land must obtain an approval of Council to install, construct or operate any on-site sewage management system(s) on their land.

1.2 Commencement

Systems, which were installed after 6 April 1998 could not be operated unless such approval had been obtained.

Systems installed before 6 April 1998 were able to continue to be operated until 30 June 1999 without an application having been lodged. However, after that date, the system could not be operated unless an application was lodged with Council. If an application for approval to operate had been lodged with Council by that date then the system could continue to be used until such time as the application is finally determined by Council.

2.0 OBJECTIVES

The objective of this strategy is to ensure that there is a system in place to provide oversight and control of on-site sewage management systems within the Shire. To achieve that objective, this strategy intends to ensure:

1. the protection of groundwater;
2. the protection of surface water;
3. the protection of land and vegetation;
4. the protection of public health and the prevention of public health risk;

5. the maintenance and improvement of community amenity;
6. the maximum re-use of resources consistent with other objectives.
7. the principles of ecological sustainable development, water cycle management and total catchment management are considered;
8. the implementation of a cost effective system of oversight in relation to sewage management facilities in the Council area.

3.0 GOALS

The goals of this strategy are to ensure that, by its implementation:

- the impacts of on-site sewage management facilities on the environment will be minimised;
- the location of all on-site sewage management facilities will be identified;
- a partnership will be developed between Council, householders and service agents to support continuing improvement of on-site sewage management;
- the owners of on-site sewage management facilities will be made aware of the type of systems installed on their premises at the time of inspection and of the limitations which may be placed on the operation of those systems;
- the owners of on-site sewage management facilities will be made aware of the need for ongoing maintenance and that they can be provided with the necessary information and support to ensure that their systems are maintained so that they meet the performance standards set out in the Regulation;
- a cost effective system of general performance assurance and supervision of on-site sewage management facilities is implemented;
- Council may recover all or part costs of implementation of this strategy by charging fees for the issuing of approvals in respect of facilities installed in high, medium and low risk locations;
- links will be created between this strategy, Council's Delivery Program and Operations Plan, State of the Environment Report and relevant planning instruments to facilitate the achievement of the objectives of this strategy and to ensure Council takes into account the issues related to on-site sewage management in its strategic planning process.

4.0 BACKGROUND

4.1 Legislation and Guidelines

On 9 March 1998 the Minister for Local Government announced new regulatory reforms and guidelines to enable more effective Council regulation and performance supervision of household septic tanks and other small on-site sewage management facilities.

The regulatory changes are included in the Local Government (General) Regulation 2005, which sets the legal framework through which the controls are to operate. The guidelines are entitled "Environmental Health & Protection Guidelines: On-site Sewage Management for Single Households"

4.2 Reasons for Legislation

The implementation of the reforms and the release of the guidelines were a response to a range of issues including:

- surveys in many areas had indicated that septic tanks and other on-site sewage management facilities were failing to meet environmental and health protection standards in all parts of NSW;
- the outbreak of hepatitis A linked to the consumption of oysters from Wallis Lakes was an indicator of the serious health risks involved;
- effluent from septic tanks posing risks in the Murray Darling Basin especially in settlement areas, areas discharging to slow flowing or discontinuous waterways and in areas, which rely on groundwater sources for water supply.

5.9 LOCATION AND CIRCUMSTANCES

5.1 Location

Narromine Shire Council has an area of 5224km2 located in central NSW and has a population of 6850.

5.2 Climate

Smith & Cooper (1996) provide the rainfall details for Trangie, dating from 1887 to 1996. These figures indicate that the region receives an annual mean rainfall of 480.9 millimetres (mm). Further to this, Smith & Cooper (1996) suggests that within the region the annual mean number of rain days is 79.9.

It should be noted however that Hoynes Wheeler & Co (1991) suggest that the annual rainfall in Narromine is higher than that of Trangie, due to more summer and spring rains. Unfortunately the data used by

Hoynes Wheeler & Co (1991) relates only to the period between 1965 and 1974.

Whilst there may be some variation between Narromine and Trangie rainfall, it is interesting to note, that Smith & Cooper's (1996) data indicates that during the early 1970's above average rainfall was experienced at Trangie. Therefore, as the Trangie data is averaged over 109 years of collection and not 9 years, the Narromine figures detailed by Hoynes Wheeler & Co (1991) may not be truly indicative of the regional annual rainfall. Hoynes Wheeler & Co (1991) do however suggest that rainfall in the region averages between 479 mm and 653 mm.

Smith & Cooper (1996) state that the mean evaporation at Trangie between the years 1968 an 1996 is 1940.6 mm. Further to this, at no time through the year does the monthly mean rainfall exceed the monthly mean evaporation. Smith & Cooper (1996) state that the lowest monthly evaporation mean of 52.5 mm is experienced in June. The monthly rainfall mean for June remains less than this, at 37.8 mm. Hoynes Wheeler & Co (1991) suggest that the average evaporation rates for the region are between 1890 mm and 1971 mm.

Smith & Cooper (1996) indicate that summers in the region are relatively hot, with an average monthly maximum temperature (between 1948 -1996) from December to February of 32.3°C, with a maximum peak through the day of approximately 43°C. The mean minimum temperature for the months of June to August is 3.9°C.

Mean relative humidity levels taken between 1948 and 1996, suggest higher levels are experienced in the region during the winter of between 76% and 83%. During summer, humidity drops to a mean between 48% and 50%. (Smith & Cooper, 1996)

5.3 Number of System Estimates

It is estimated that 650 to 900 systems are located within the shire.

5.4 Potential Problem Areas

5.4.1

- Small rural properties on the fringe of the Narromine and Trangie townships;
- Tomingley Village;
- Properties along the Macquarie River and other tributaries, creeks and water ways;
- Land Zoned RU4,RU5, and R5; and

- Systems located in areas of groundwater vulnerability as identified in Council's LEP mapping.

5.4.2 Council has not at this stage identified any other particular problem areas associated with on-site sewage management. The following situations however are identified as potential areas where problems may be identified:

1. Village areas where no reticulated sewage system is available;
2. Areas along the Macquarie River, creeks and tributary systems; and
3. Areas where significant numbers of small area subdivision have occurred or are likely to occur. This is particularly relevant to the creation of new rural residential zonings as a result of the Narromine Rural Residential Land Use Strategy and planning proposals currently being prepared and those going through the gateway process.

5.5 Linkages Between this Strategy and Council's Strategic Planning Process

5.5.1 The evaluation section of this strategy sets out the evaluation and reporting processes which would be used to ensure that this strategy is linked with Council's strategic planning and reporting processes, and updated on a regular basis.

5.5.2 Council's current land use and development controls are set out in the Narromine Local Environmental Plan 2011 and the Narromine Comprehensive Development Control Plan 2011. These controls can also be overridden or modified by any relevant Regional Environmental Planning Policies (REPP's) and State Environmental Planning Policies (SEPP's). Development Control Plans which may impact on issues related to on-site sewage management, are:

- Implementing buffer zones around sewage treatment systems;
- Control of development on flood prone lands in Narromine Shire; and
- Control of rural subdivision.

6.0 PROGRAMS

6.1 Requirements

Clause 47 of the Regulation provides temporary exemption for a period of three (3) months for a person who purchases (or otherwise acquires) land on which any sewage management facilities are installed. This applies after the date on which the land is transferred or otherwise conveyed.

Clause 48(e) of the Regulation provides exemption from the need for an approval in the following instances:
(i) under the authority of a licence in force under the *Protection of the Environment Operations Act 1997*, or
(ii) in a vessel used for navigation, or
(iii) in a motor vehicle that is registered within the meaning of the *Road Transport Act 2013* and is used primarily for road transport.

This also applies to the same instances to operate systems under Clause 48(f) of the Regulation.

6.2 Implementation Processes

The Implementation of the requirements will involve Council in the following:

- Requiring the lodgement of applications for approval in respect of all on-site sewage management systems in the Council area;
- Establishing a data base of all installations in the Council's area. A register is currently in place however, may only capture 50-60% of the total number of systems installed in the Shire;
- Carrying out a desktop audit of those applications received;
- Inspect a range of installations of different types and in different locations throughout the Council area. The initial target number of inspections will be 5% of all applications received;
- Ultimately all installations located in identified high and medium risk areas will be inspected;
- Use the information obtained from the above data to identify high, medium and low risk installations. These risks would be related to performance, design or location criteria;
- Requiring the owners of sewage management facilities to obtain approvals to operate. Such approvals may require the provision of statements to Council concerning:

    - the achievement of certain performance standards;

- proof of regular maintenance being provided to Council; or
- any other relevant issue;

- Requiring the upgrading of installations only where it is seen that those systems are incapable of meeting the performance standards set out in the regulation;
- The levying of fees in respect of applications for approvals to operate, only after the implementation of this strategy. Such fees are to be set annually in conjunction with Council's annual budget and would be advertised as required prior to formal adoption. Application fees will be no higher than that recommended by the Office of Local Government.

7.0 APPLICATIONS AND APPROVALS

7.1 Applications

All installations will continue to require approvals to operate. This means that owners will need to submit applications for approvals prior to the expiry of current approvals. Installations classified as low risk will be issued with approvals to operate which last for five years, subject to compliance with specified criteria and will not be subject to inspection. Those installations classified as medium risk will be issued with approvals to operate, which last for three years, subject to compliance with the specified criteria and will be subject to inspection. Those installations classified as high risk installations will be issued with approvals to operate which last for two years and will be subject to inspection. Information outlining the method of risk assessment and the associated inspection regime are set out in clauses 10 and 8 respectively.

7.2 Fees

Council has an obligation to its constituents to finance the various services it provides to the community. Unfortunately, this extends to the wide range of regulatory services Council is responsible for under State legislation and includes managing the regulation of on-site sewage management systems.

Council will therefore need to consider how it funds the regulation of the systems installed and operating in the Narromine local government area. In this regard, the following fee structure is proposed.

Application for approval to operate an on-site sewage management system -: N**o charge**

Assessment of applications to operate and categorise on-site sewage management systems -: **No charge**

Where inspections are required (first or additional), the following fee is proposed-: **$150 per inspection (inc GST)**

Any proposed fees will be set during the preparation of Council's annual estimates. Any fees proposed will be included in the required public participation process prior to adoption of Council's Delivery Program, annual Operational Plan plus rates and charges.

7.3 Performance Standards

Before approving any application to operate a system of sewage management, Council must be satisfied that the system when operating will achieve the following performance standards:

- the prevention of the spread of disease by micro-organisms,
- the prevention of the spread of foul odours;
- the prevention of contamination of water;
- the prevention of degradation of soil and vegetation;
- the discouragement of insects and vermin;
- ensuring that persons do not come into contact with untreated sewage or effluent (whether treated or not) in their ordinary activities on the premises concerned;
- the minimisation of any adverse impacts on the amenity of the premises and surrounding lands;
- if appropriate, provision for the re-use of resources (including nutrients, organic matter and water).

When considering any application for an approval to operate a system of sewage management, Council will take into account those issues raised in the publication, Environment & Health Protection Guidelines: On-site Sewage Management for Single Households and AS1547-2000.

7.4 Failure to Meet Performance Standard

It should be noted that where an installation, which is classified as low or medium risk, fails to operate in accordance with the performance standards of its approval, such installation would automatically be categorised as a high risk installation. This re-categorisation will not apply where the installation is maintained and repaired so that it again meets the performance standards within a period of twenty one (21) days of such failure.

8.0 INSPECTIONS

8.1 General

To support the implementation of this strategy, Council will implement an inspection regime to ensure that the objectives and goals of this strategy are achieved.

8.2 Initial Risk Assessment

When applications, for approval to operate on-site sewage management systems are received by Council, the initial risk assessment of those applications will be completed by way of a desk top assessment. An assessment will be made of the category of risk which will be allocated to each installation. This assessment will be made in accordance with the criteria set out in clause 10. Such assessment will utilise the information provided in the application and any other information which may be held in Council's property records and topographic maps.

The initial approvals to operate will only be issued after completion of that assessment and if Council is of the opinion that the performance standards set out in clause 7.3 can be achieved.

8.3 Site Inspections

To verify the general accuracy of those assessments a target group of 5% of those applications will be confirmed by site inspection.

8.4 Exemptions

Clause 48(e) of the Regulation provides exemption under certain circumstances. Refer to Cl 6.1 in this strategy.

8.5 Renewal Inspections

Applications for renewal of approvals to operate will be determined on the basis of random inspections of a minimum of 5% of applications received. Generally those random inspections will be weighted towards:

- installations in areas where previous inspections have indicated a history of system failure or operational problems; and
- on those types of systems, which previous inspections have indicated are prone to failure or operational problems.

8.6 Inspection and Reporting

Issues raised in Clauses 11.1, 11.2, 11.3 and 11.4 will be reported in Council's Annual State of the Environment Report.

9.0 EXEMPTIONS

9.1 Provision for Exemptions

Clause 47 of the Regulation provides temporary exemption for a period of three (3) months for a person who purchases (or otherwise acquires) land on which any sewage management facilities are installed. This applies after the date on which the land is transferred or otherwise conveyed.

Clause 48(e) of the Regulation provides exemption from the need for an approval in the following instances:
(i) under the authority of a licence in force under the *Protection of the Environment Operations Act 1997*, or
(ii) in a vessel used for navigation, or
(iii) in a motor vehicle that is registered within the meaning of the *Road Transport Act 2013* and is used primarily for road transport.

This also applies to the same instances to operate systems under Clause 48(f) of the Regulation.

On-site sewage management systems will be categorised into high, medium and low risk installations. Although all systems will be required to register, low risk systems may never have to be inspected unless a request is lodged with Council to do so.

9.2 Education

Council will implement a public education program and an inspection regime for systems of sewage management within the Council area. The education will be achieved by media publicity, direct mailing of information to owners and by addressing meetings of affected community groups where it is considered necessary.

9.3 Proposed Exemptions

It is Council's intention that installations, which are determined by Council as being in the low risk category, will not be required to be inspected unless a request is lodged with Council to do so. This exemption from inspection will continue to apply whilst the installation is

being maintained and operated in such a way that it achieves the performance objectives and standards set out in this strategy.

10.0 CATEGORIES OF RISK OF INSTALLATIONS

10.1 Categories of Risk

To allow implementation of this strategy all installations within the Shire will be categorised according to the degree of risk of each installation. In this regard three categories of risk with will be implemented ie; low, medium and high. This system will rank the installations in terms of their likely impact on the particular issues set out in the objectives of this strategy. The allocation of premises or installations to risk categories will depend upon an assessment, by Council staff, of the combined effects of all relevant issues related to an installation.

10.2 Indicative Risk Criteria

Set out below are the indicative criteria, which will be used by Council staff when making a risk assessment of installations. With particular installations, there may be other issues which may also be taken into account as part of the risk assessment process.

10.3 Low Risk Indicative Criteria

Low risk indicative criteria for an installation include the following matters. That the system is:

- operating in accordance with:
    - * the performance objectives of this strategy;
    - * any requirements of the manufacturer of any of the system's components,
    - * any conditions of accreditation imposed by the Director General of the Department of Health in respect of plans and designs for the sewage management facility;
    - * any conditions imposed by Council on any approval to install a system of sewage management.

      (In this respect it should be noted that Council is the authority for making the necessary determinations regarding the above issues.)
- located on a property with a total land area of at least 2 hectares
- located so that any part of the system is at least 10 metres from any property boundary;
- located so that any part of the system is 100 metres or more from any permanent surface waters;
- located where the soil in which the drainage field is located is not highly permeable allowing free flow of effluent which may

contaminate ground water, impact on neighbouring properties or impact on the environment.

- located so that any part of the system is at least 40 metres from any other waters (eg farm dams, intermittent water ways and drainage channels);
- not located in an area with a known high water table (less than 20 metres);
- not located within an area prone to flooding in a 1 in 100 year flood;
- a type of sewage management system which serves no more than 11 people; and
- not located within 1.5km of a public water supply bore.

NB. It should be noted that failure to comply with the performance criteria or any conditions of either the Department of Health or Council means that the classification of a system is immediately changed to high risk. This means that an approval to operate is then required.

10.4 Medium Risk Indicative Criteria

Medium risk indicative criteria for an installation include the following matters. That the installation is:

- operating in accordance with:
    * the performance objectives of this strategy;
    * any requirements of the manufacturer of any of the system's components;
    * any conditions of accreditation imposed by the Director General of the Department of Health in respect of plans and designs for the sewage management facility;
    * any conditions imposed by Council on any approval to install a system of sewage management.

      (In this respect it should be noted that Council is the authority for making the necessary determinations regarding the above issues.)
- located on a property with a total land area less than 2 hectares.
- located so that any part of the system is between 3 m and 10m from any property boundary;
- located so that any part of the system is between 50 metres and 100 metres from any permanent surface waters;
- located where the soil in which the drainage field is located is not highly permeable allowing free flow of effluent which may contaminate ground water, impact on neighbouring properties or impact on the environment.
- connected to a reticulated public water supply;

- located in an area with a known high water table (less than 15 metres);
- located within an area prone to flooding in a 1 in 20 year flood;
- a type of sewage management system which relies on mechanical or power driven parts to ensure its continued operation (eg AWTS, systems with collection wells whether with automatic pumps to on-site disposal areas, or pump out installations by tanker).
- Not located within 1.0km to 1.5km of public water supply bore;
- a type of sewage management system, which serves from 12 to 20 people.

NB. It should be noted that failure to comply with the performance criteria or any conditions of either the Department of Health or Council means that the classification of a system is immediately changed to high risk. This means that an approval to operate is then required.

10.5 High Risk Indicative Criteria

High risk indicative criteria for an installation include the following matters. That the installation is:

- not or, in the last three years has not operated in accordance with:
    * the performance objectives of this strategy;
    * any requirements of the manufacturer of any of the system's components;
    * any conditions of accreditation imposed by the Director General of the Department of Health in respect of plans and designs for the sewage management facility;
    * any conditions imposed by Council on any approval to install a system of sewage management.

      (In this respect it should be noted that Council is the authority for making the necessary determinations regarding the above issues.)
- located on a property with a total land area of less than 2 hectares;
- located on a property, which is located within zone R1, R5 or RU4 or is located within 100m of dwellings located on adjoining land;
- located so that any part of the system is less than 3 metres from any property boundary;
- located so that any part of the system is less than 50 metres from any permanent surface waters;
- located where the property has a boundary adjoining the Macquarie River, permanent creek or surface water;
- located where the soil in which the drainage field is located is highly permeable allowing free flow of effluent which may contaminate

ground water, impact on neighbouring properties or impact on the environment.

- located so that any part of the system is less than 25 metres from any other waters (eg farm dams, intermittent water ways and drainage channels);
- located in an area with a known high water table (less than 1 metre)
- a type of sewage management system which serves more than 20 people;
- within 1km of town or public water supply bore
- in order to protect town water supply, only AWTS's shall be installed within zone R1 where town sewer is not available.

11.0 REVIEW OF AND CHANGES TO CATEGORIES OF RISK

All systems categorised in accordance with this strategy will receive a bi-annual compliance statement (BCS). The owner is required to sign the BCS indicating that their on-site sewage management system is operating in accordance with the performance standards. Failure to return the BCS may result in Council recategorising the system to high risk.

11.1 Review of Categorisation

When an installation has been assessed and allocated to a category of risk by a member of Council's staff, any owner who believes that such allocation is not appropriate may apply to Council to have the risk assessment reviewed. Such a review may or may not involve the carrying out of a site inspection of the installation and may involve the payment of a fee to Council. The level of a fee, if any, for a risk assessment review will be determined annually by Council in conjunction with the fixing of its annual fees and charges.

12.0 RECORDS AND APPLICATIONS FOR RENEWAL

12.1 Records

Council will ensure that all applications received are recorded in a register and that details of the determination of those applications are also entered in the register. Such register will include full details: of,

- the applicant;
- the property concerned;
- the type of installation;
- the date of application;
- any site inspections;

- the determination of the application;
- the date of issue of any approval or refusal and any other relevant details.

This register may be kept in electronic format.

12.2 Notice of Renewal

Notification is to be sent, to each owner of land, in respect of which an approval to operate is issued, at least two months prior to the expiry date of their current approval. Such notification is to incorporate an application form for renewal and full details of the information required to be submitted with the new application. The appropriate renewal fee in accordance with Council's current schedule of fees and charges must accompany each renewal application.

13.0 EVALUATION OF IMPLEMENTATION OF THIS STRATEGY

13.1 Monitoring

The ongoing efficiency of this strategy will be evaluated by a monitoring program. This program will involve:

- the random inspection of sewage management facilities throughout the Council area. The program of inspections will commence in the first Operational Plan following adoption of this strategy by Council; and
- an assessment of the integration of this strategy with other Council strategic planning processes. These processes may include but are not limited to the Community Strategic Plan, Delivery Program, development planning, stormwater management planning and catchment management planning; and
- water and sewerage infrastructure planning; and
- an assessment of the effectiveness of this strategy in relation to the objectives and goals set out in clauses 2.0 and 3.0 and in relation to the resources required to implement the strategy.

On an annual basis Council may inspect 5% of all installations to determine whether they meet the performance standards set out in the Regulation. Where the inspections indicate that there is a general achievement of the performance standards then the random inspection rate may be decreased. If, on the other hand, the inspections reveal that a large number of installations are not meeting the performance standards then the rate of inspections will be increased.

The actual rate of inspections in any one year will be determined by Council's Director, Planning & Environmental Services after the annual State of the Environment Report has been considered. The % rate of inspection of installations may be varied according to the category of risk of installation (i.e. high, medium or low risk) and the particular risks attached to a particular category or type of installation as evidenced by Council's on-going inspection program.

13.2 Reporting

Council's annual State of the Environment Report will include details of:

- the results of the on-site sewage management inspection program;
- details regarding particular patterns of system failure related to either location criteria or system type;
- an assessment of the ongoing integration of this strategy with the other strategic planning processes of Council;
- the effectiveness of this strategy and its implementation measured against the objectives and goals set out in Clauses 2.0 and 3.0.

14.0 REVIEW OF THIS STRATEGY

This strategy is to be the subject of ongoing review. In the early stages of implementation it is intended that the content of the strategy will be reviewed by Council's Director, Planning & Environmental Services on an annual basis with any proposed changes to be publicly notified prior to formal consideration by Council. Ultimately, it is expected that the review process will stabilise and that reviews will occur every four years in the twelve month period after each general Council election.

In undertaking each review Council will take into account the information provided in Council's State of the Environment Reports and the results of any consultations with relevant Government Departments, the community generally and any local interest groups.

REFERENCE DOCUMENTS

During the preparation of this document the following documents have been used or are acknowledged:

Draft Water Quality Standards. Issued by the Environment Protection Authority.

Environment & Health Protection Guidelines: On-site Sewage Management for Single Households issued by Department of Local Government, Environment Protection Authority, NSW Health, NSW Dept of Land and Water Conservation and the Department of Urban Affairs and Planning.

ATTACHMENTS

1. Application form to operate an on-site sewage management system; and
2. Site assessment form for on-site sewage management systems.

Version Number	Created by	First Adopted	Resolution No.	Last Modified	Review Period
1	Director Planning & Environmental Services	12 November 2014	2014/383		2 Years

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APPENDIX C

Setback Requirements and Illustrative Buffer Plan

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.

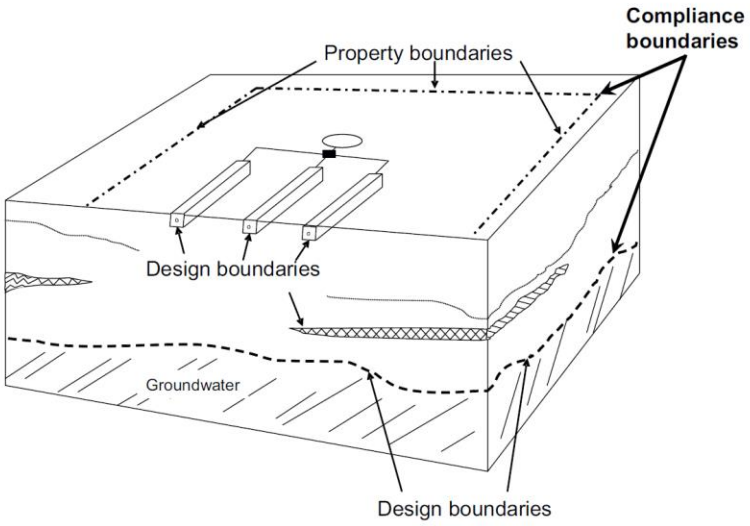
2 Examples of typical siting constraint factors that may be identified either by SSE evaluator or regulatory authority. Site constraints are not limited to this table. Other site constraints may be identified and taken into consideration when determining setback distances.

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.

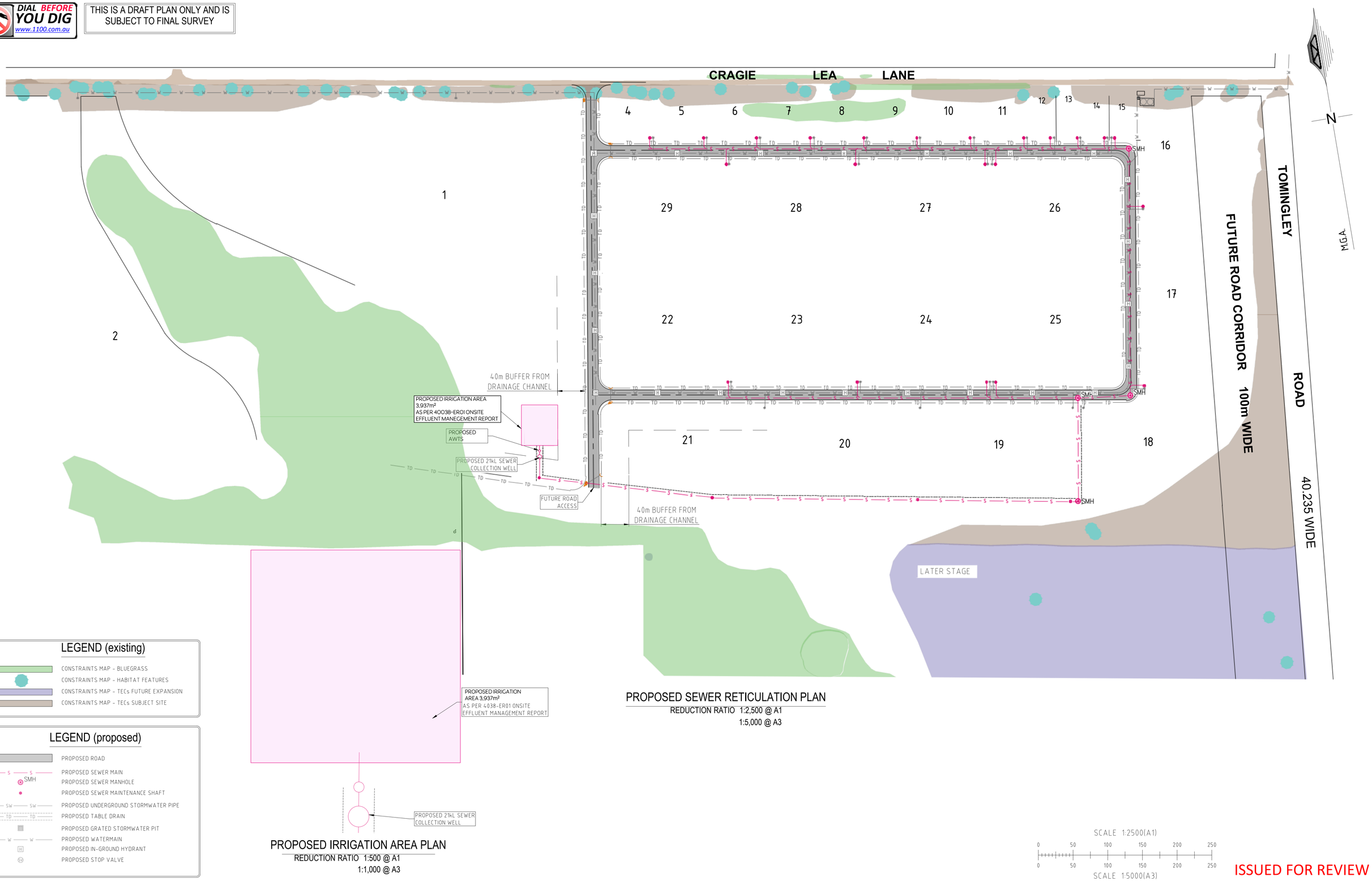


(Adapted from USEPA 2002)

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

DIAL BEFORE YOU DIG
www.1100.com.au

THIS IS A DRAFT PLAN ONLY AND IS SUBJECT TO FINAL SURVEY



LEGEND (existing)

- CONSTRAINTS MAP - BLUEGRASS
- CONSTRAINTS MAP - HABITAT FEATURES
- CONSTRAINTS MAP - TECs FUTURE EXPANSION
- CONSTRAINTS MAP - TECs SUBJECT SITE

LEGEND (proposed)

- PROPOSED ROAD
- PROPOSED SEWER MAIN
- PROPOSED SEWER MANHOLE
- PROPOSED SEWER MAINTENANCE SHAFT
- PROPOSED UNDERGROUND STORMWATER PIPE
- PROPOSED TABLE DRAIN
- PROPOSED GRATED STORMWATER PIT
- PROPOSED WATERMAIN
- PROPOSED IN-GROUND HYDRANT
- PROPOSED STOP VALVE

PROPOSED IRRIGATION AREA PLAN

REDUCTION RATIO 1:500 @ A1
1:1,000 @ A3

PROPOSED SEWER RETICULATION PLAN

REDUCTION RATIO 1:2,500 @ A1
1:5,000 @ A3

SCALE 1:2500(A1)
0 50 100 150 200 250

SCALE 1:5000(A3)
0 50 100 150 200 250

ISSUED FOR REVIEW

barnson
DESIGN . PLAN . MANAGE

BARNSON PTY LTD

phone 1300 BARNSON (1300 227 676)
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Rev	Date	Description
A	31-08-2023	ISSUED FOR REVIEW
X	14-12-2023	MARKUP

Project
CIVIL ENGINEERING DOCUMENTATION FOR NARROMINE FREIGHT HUB

Site Address
397 CRAGIE LEA LANE
NARROMINE NSW 2821

Client
NARROMINE SHIRE COUNCIL

Drawing Title
PROPOSED SEWER RETICULATION PLAN

Design	DOS	Original Sheet Size	A1
Drawn	JS		
Check	-	Revision	X

Certification

Project No 40038

Drawing No C21

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APPENDIX D

Soil Test Results and Borelogs

CERTIFICATE OF ANALYSIS

Work Order	: **ME2300735**	Page	: 1 of 13
Client	: **BARNSON**	Laboratory	: Environmental Division Mudgee
Contact	: Nardus Potgieter	Contact	: Mary Monds (ALS Mudgee)
Address	: Unit 4 108-110 Market Street MUDGEE NSW 2850	Address	: 1/29 Sydney Road Mudgee NSW Australia 2850
Telephone	: 0429 464 067	Telephone	: +61 2 6372 6735
Project	: Soil	Date Samples Received	: 17-Apr-2023 14:40
Order number	: ----	Date Analysis Commenced	: 18-Apr-2023
C-O-C number	: ----	Issue Date	: 27-Apr-2023 18:01
Sampler	: Nardus Potgieter (Client Sampler)		
Site	: ----		
Quote number	: SY/053/14		
No. of samples received	: 14		
No. of samples analysed	: 14		

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

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

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

Signatories

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

Signatories	*Position*	*Accreditation Category*
Aleksandar Vujkovic	Laboratory Technician	Newcastle - Inorganics, Mayfield West, NSW
Ankit Joshi	Senior Chemist - Inorganics	Sydney Inorganics, Smithfield, NSW
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Dian Dao	Senior Chemist - Inorganics	Sydney Inorganics, Smithfield, NSW
Edwandy Fadjar	Organic Coordinator	Sydney Inorganics, Smithfield, NSW
Edwandy Fadjar	Organic Coordinator	Sydney Organics, Smithfield, NSW

General Comments

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

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

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

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

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

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

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

- Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) per the NEPM (2013) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero, for 'TEQ 1/2LOR' are treated as half the reported LOR, and for 'TEQ LOR' are treated as being equal to the reported LOR. Note: TEQ 1/2LOR and TEQ LOR will calculate as 0.6mg/Kg and 1.2mg/Kg respectively for samples with non-detects for all of the eight TEQ PAHs.
- EP080: Where reported, Total Xylenes is the sum of the reported concentrations of m&p-Xylene and o-Xylene at or above the LOR.
- EP068: Where reported, Total Chlordane (sum) is the sum of the reported concentrations of cis-Chlordane and trans-Chlordane at or above the LOR.
- EP068: Where reported, Total OCP is the sum of the reported concentrations of all Organochlorine Pesticides at or above LOR.
- EP075(SIM): Where reported, Total Cresol is the sum of the reported concentrations of 2-Methylphenol and 3- & 4-Methylphenol at or above the LOR.
- EA058 Emerson: V. = Very, D. = Dark, L. = Light, VD. = Very Dark
- ED007 and ED008: When Exchangeable Al is reported from these methods, it should be noted that Rayment & Lyons (2011) suggests Exchange Acidity by 1M KCl - Method 15G1 (ED005) is a more suitable method for the determination of exchange acidity (H+ + Al3+).

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	CL-01 Surface Soil	CL-02 Surface Soil	CL-03 Surface Soil	CL-04 Surface Soil	CL-05 Surface Soil
			Sampling date / time	30-Mar-2023 00:00	30-Mar-2023 00:00	30-Mar-2023 00:00	30-Mar-2023 00:00	30-Mar-2023 00:00
Compound	CAS Number	LOR	Unit	ME2300735-001	ME2300735-002	ME2300735-003	ME2300735-004	ME2300735-005
				Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	**7.6**	**5.8**	**7.4**	**6.9**	**8.1**
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	<5	<5
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	**14**	**11**	**17**	**14**	**15**
Copper	7440-50-8	5	mg/kg	**6**	<5	**6**	**7**	**7**
Lead	7439-92-1	5	mg/kg	**6**	**5**	**6**	**7**	**7**
Nickel	7440-02-0	2	mg/kg	**5**	**3**	**5**	**7**	**7**
Zinc	7440-66-6	5	mg/kg	**8**	**5**	**7**	**9**	**9**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EP066: Polychlorinated Biphenyls (PCB)								
Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EP068A: Organochlorine Pesticides (OC)								
alpha-BHC	319-84-6	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
beta-BHC	319-85-7	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
gamma-BHC	58-89-9	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
delta-BHC	319-86-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Heptachlor	76-44-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Aldrin	309-00-2	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Heptachlor epoxide	1024-57-3	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
^ Total Chlordane (sum)	----	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
trans-Chlordane	5103-74-2	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
alpha-Endosulfan	959-98-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
cis-Chlordane	5103-71-9	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Dieldrin	60-57-1	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Endrin	72-20-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
beta-Endosulfan	33213-65-9	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
^ Endosulfan (sum)	115-29-7	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Endrin aldehyde	7421-93-4	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Endosulfan sulfate	1031-07-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	CL-01 Surface Soil	CL-02 Surface Soil	CL-03 Surface Soil	CL-04 Surface Soil	CL-05 Surface Soil
				Sampling date / time	30-Mar-2023 00:00	30-Mar-2023 00:00	30-Mar-2023 00:00	30-Mar-2023 00:00	30-Mar-2023 00:00
Compound	CAS Number	LOR	Unit		ME2300735-001	ME2300735-002	ME2300735-003	ME2300735-004	ME2300735-005
					Result	Result	Result	Result	Result
EP068A: Organochlorine Pesticides (OC) - Continued									
4.4`-DDT	50-29-3	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
Endrin ketone	53494-70-5	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Methoxychlor	72-43-5	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
^ **Sum of Aldrin + Dieldrin**	309-00-2/60-57-1	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
^ **Sum of DDD + DDE + DDT**	72-54-8/72-55-9/50-29-3	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
EP068B: Organophosphorus Pesticides (OP)									
Dichlorvos	62-73-7	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Demeton-S-methyl	919-86-8	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Monocrotophos	6923-22-4	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
Dimethoate	60-51-5	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Diazinon	333-41-5	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Chlorpyrifos-methyl	5598-13-0	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Parathion-methyl	298-00-0	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
Malathion	121-75-5	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Fenthion	55-38-9	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Chlorpyrifos	2921-88-2	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Parathion	56-38-2	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
Pirimphos-ethyl	23505-41-1	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Chlorfenvinphos	470-90-6	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Bromophos-ethyl	4824-78-6	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Fenamiphos	22224-92-6	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Prothiofos	34643-46-4	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Ethion	563-12-2	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Carbophenothion	786-19-6	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Azinphos Methyl	86-50-0	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthylene	208-96-8	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthene	83-32-9	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Fluorene	86-73-7	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Phenanthrene	85-01-8	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Anthracene	120-12-7	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Fluoranthene	206-44-0	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	CL-01 Surface Soil	CL-02 Surface Soil	CL-03 Surface Soil	CL-04 Surface Soil	CL-05 Surface Soil
				Sampling date / time	30-Mar-2023 00:00	30-Mar-2023 00:00	30-Mar-2023 00:00	30-Mar-2023 00:00	30-Mar-2023 00:00
Compound	CAS Number	LOR	Unit		ME2300735-001	ME2300735-002	ME2300735-003	ME2300735-004	ME2300735-005
					Result	Result	Result	Result	Result
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued									
Pyrene	129-00-0	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Benz(a)anthracene	56-55-3	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Chrysene	218-01-9	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(k)fluoranthene	207-08-9	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene	50-32-8	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
^ Benzo(a)pyrene TEQ (zero)	----	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
^ Benzo(a)pyrene TEQ (half LOR)	----	0.5	mg/kg		**0.6**	**0.6**	**0.6**	**0.6**	**0.6**
^ Benzo(a)pyrene TEQ (LOR)	----	0.5	mg/kg		**1.2**	**1.2**	**1.2**	**1.2**	**1.2**
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	10	mg/kg		<10	<10	<10	<10	<10
C10 - C14 Fraction	----	50	mg/kg		<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	mg/kg		<100	<100	<100	<100	<100
C29 - C36 Fraction	----	100	mg/kg		<100	<100	<100	<100	<100
^ C10 - C36 Fraction (sum)	----	50	mg/kg		<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	10	mg/kg		<10	<10	<10	<10	<10
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg		<10	<10	<10	<10	<10
>C10 - C16 Fraction	----	50	mg/kg		<50	<50	<50	<50	<50
>C16 - C34 Fraction	----	100	mg/kg		<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	mg/kg		<100	<100	<100	<100	<100
^ >C10 - C40 Fraction (sum)	----	50	mg/kg		<50	<50	<50	<50	<50
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg		<50	<50	<50	<50	<50
EP080: BTEXN									
Benzene	71-43-2	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	108-88-3	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	100-41-4	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	CL-01 Surface Soil	CL-02 Surface Soil	CL-03 Surface Soil	CL-04 Surface Soil	CL-05 Surface Soil
				Sampling date / time	30-Mar-2023 00:00	30-Mar-2023 00:00	30-Mar-2023 00:00	30-Mar-2023 00:00	30-Mar-2023 00:00
Compound	CAS Number	LOR	Unit		ME2300735-001	ME2300735-002	ME2300735-003	ME2300735-004	ME2300735-005
					Result	Result	Result	Result	Result
EP080: BTEXN - Continued									
ortho-Xylene	95-47-6	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
^ Sum of BTEX	----	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
^ Total Xylenes	----	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Naphthalene	91-20-3	1	mg/kg		<1	<1	<1	<1	<1
EP066S: PCB Surrogate									
Decachlorobiphenyl	2051-24-3	0.1	%		**96.6**	**122**	**113**	**111**	**125**
EP068S: Organochlorine Pesticide Surrogate									
Dibromo-DDE	21655-73-2	0.05	%		**74.1**	**94.5**	**86.5**	**94.0**	**88.6**
EP068T: Organophosphorus Pesticide Surrogate									
DEF	78-48-8	0.05	%		**61.4**	**53.2**	**50.0**	**61.0**	**64.6**
EP075(SIM)S: Phenolic Compound Surrogates									
Phenol-d6	13127-88-3	0.5	%		**79.9**	**82.1**	**76.9**	**76.2**	**77.0**
2-Chlorophenol-D4	93951-73-6	0.5	%		**81.8**	**86.6**	**79.8**	**78.9**	**79.4**
2.4.6-Tribromophenol	118-79-6	0.5	%		**54.2**	**61.8**	**47.6**	**44.0**	**43.8**
EP075(SIM)T: PAH Surrogates									
2-Fluorobiphenyl	321-60-8	0.5	%		**82.9**	**82.5**	**81.4**	**80.5**	**81.8**
Anthracene-d10	1719-06-8	0.5	%		**88.9**	**89.0**	**85.0**	**89.0**	**88.2**
4-Terphenyl-d14	1718-51-0	0.5	%		**84.2**	**83.4**	**80.2**	**81.0**	**79.9**
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	0.2	%		**110**	**125**	**119**	**120**	**116**
Toluene-D8	2037-26-5	0.2	%		**85.4**	**82.9**	**88.3**	**86.4**	**88.6**
4-Bromofluorobenzene	460-00-4	0.2	%		**84.3**	**89.4**	**87.7**	**87.7**	**85.8**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	CL-06 Surface Soil	CL-07 Surface Soil	CL-08 Surface Soil	CL-09 Surface Soil	CL-10 Surface Soil
			Sampling date / time	30-Mar-2023 00:00	30-Mar-2023 00:00	30-Mar-2023 00:00	30-Mar-2023 00:00	30-Mar-2023 00:00
Compound	CAS Number	LOR	Unit	ME2300735-006	ME2300735-007	ME2300735-008	ME2300735-009	ME2300735-010
				Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	**22.7**	**7.9**	**6.3**	**11.0**	**5.9**
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	<5	<5
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	**17**	**15**	**16**	**12**	**15**
Copper	7440-50-8	5	mg/kg	**15**	**5**	**6**	**8**	**6**
Lead	7439-92-1	5	mg/kg	**12**	**6**	**6**	**7**	**7**
Nickel	7440-02-0	2	mg/kg	**10**	**5**	**4**	**7**	**5**
Zinc	7440-66-6	5	mg/kg	**25**	**7**	**9**	**11**	**9**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EP066: Polychlorinated Biphenyls (PCB)								
Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EP068A: Organochlorine Pesticides (OC)								
alpha-BHC	319-84-6	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
beta-BHC	319-85-7	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
gamma-BHC	58-89-9	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
delta-BHC	319-86-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Heptachlor	76-44-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Aldrin	309-00-2	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Heptachlor epoxide	1024-57-3	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
^ Total Chlordane (sum)	----	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
trans-Chlordane	5103-74-2	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
alpha-Endosulfan	959-98-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
cis-Chlordane	5103-71-9	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Dieldrin	60-57-1	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Endrin	72-20-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
beta-Endosulfan	33213-65-9	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
^ Endosulfan (sum)	115-29-7	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Endrin aldehyde	7421-93-4	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Endosulfan sulfate	1031-07-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	CL-06 Surface Soil	CL-07 Surface Soil	CL-08 Surface Soil	CL-09 Surface Soil	CL-10 Surface Soil
				Sampling date / time	30-Mar-2023 00:00	30-Mar-2023 00:00	30-Mar-2023 00:00	30-Mar-2023 00:00	30-Mar-2023 00:00
Compound	CAS Number	LOR	Unit		ME2300735-006	ME2300735-007	ME2300735-008	ME2300735-009	ME2300735-010
					Result	Result	Result	Result	Result
EP068A: Organochlorine Pesticides (OC) - Continued									
4.4`-DDT	50-29-3	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
Endrin ketone	53494-70-5	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Methoxychlor	72-43-5	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
^ **Sum of Aldrin + Dieldrin**	309-00-2/60-57-1	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
^ **Sum of DDD + DDE + DDT**	72-54-8/72-55-9/50-29-3	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
EP068B: Organophosphorus Pesticides (OP)									
Dichlorvos	62-73-7	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Demeton-S-methyl	919-86-8	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Monocrotophos	6923-22-4	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
Dimethoate	60-51-5	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Diazinon	333-41-5	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Chlorpyrifos-methyl	5598-13-0	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Parathion-methyl	298-00-0	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
Malathion	121-75-5	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Fenthion	55-38-9	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Chlorpyrifos	2921-88-2	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Parathion	56-38-2	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
Pirimphos-ethyl	23505-41-1	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Chlorfenvinphos	470-90-6	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Bromophos-ethyl	4824-78-6	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Fenamiphos	22224-92-6	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Prothiofos	34643-46-4	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Ethion	563-12-2	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Carbophenothion	786-19-6	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Azinphos Methyl	86-50-0	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthylene	208-96-8	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthene	83-32-9	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Fluorene	86-73-7	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Phenanthrene	85-01-8	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Anthracene	120-12-7	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Fluoranthene	206-44-0	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5

Analytical Results

Sub-Matrix: SOIL
(Matrix: SOIL)

Compound	CAS Number	LOR	Unit	Sample ID	CL-06 Surface Soil	CL-07 Surface Soil	CL-08 Surface Soil	CL-09 Surface Soil	CL-10 Surface Soil
				Sampling date / time	30-Mar-2023 00:00	30-Mar-2023 00:00	30-Mar-2023 00:00	30-Mar-2023 00:00	30-Mar-2023 00:00
					ME2300735-006	ME2300735-007	ME2300735-008	ME2300735-009	ME2300735-010
					Result	Result	Result	Result	Result
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued									
Pyrene	129-00-0	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Benz(a)anthracene	56-55-3	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Chrysene	218-01-9	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(k)fluoranthene	207-08-9	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene	50-32-8	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
^ **Sum of polycyclic aromatic hydrocarbons**	----	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
^ **Benzo(a)pyrene TEQ (zero)**	----	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
^ **Benzo(a)pyrene TEQ (half LOR)**	----	0.5	mg/kg		**0.6**	**0.6**	**0.6**	**0.6**	**0.6**
^ **Benzo(a)pyrene TEQ (LOR)**	----	0.5	mg/kg		**1.2**	**1.2**	**1.2**	**1.2**	**1.2**
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	10	mg/kg		<10	<10	<10	<10	<10
C10 - C14 Fraction	----	50	mg/kg		<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	mg/kg		<100	<100	<100	<100	<100
C29 - C36 Fraction	----	100	mg/kg		<100	<100	<100	<100	<100
^ **C10 - C36 Fraction (sum)**	----	50	mg/kg		<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	10	mg/kg		<10	<10	<10	<10	<10
^ **C6 - C10 Fraction minus BTEX (F1)**	C6_C10-BTEX	10	mg/kg		<10	<10	<10	<10	<10
>C10 - C16 Fraction	----	50	mg/kg		<50	<50	<50	<50	<50
>C16 - C34 Fraction	----	100	mg/kg		<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	mg/kg		<100	<100	<100	<100	<100
^ **>C10 - C40 Fraction (sum)**	----	50	mg/kg		<50	<50	<50	<50	<50
^ **>C10 - C16 Fraction minus Naphthalene (F2)**	----	50	mg/kg		<50	<50	<50	<50	<50
EP080: BTEXN									
Benzene	71-43-2	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	108-88-3	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	100-41-4	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	CL-06 Surface Soil	CL-07 Surface Soil	CL-08 Surface Soil	CL-09 Surface Soil	CL-10 Surface Soil
				Sampling date / time	30-Mar-2023 00:00	30-Mar-2023 00:00	30-Mar-2023 00:00	30-Mar-2023 00:00	30-Mar-2023 00:00
Compound	CAS Number	LOR	Unit		ME2300735-006	ME2300735-007	ME2300735-008	ME2300735-009	ME2300735-010
					Result	Result	Result	Result	Result
EP080: BTEXN - Continued									
ortho-Xylene	95-47-6	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
^ Sum of BTEX	----	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
^ Total Xylenes	----	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Naphthalene	91-20-3	1	mg/kg		<1	<1	<1	<1	<1
EP066S: PCB Surrogate									
Decachlorobiphenyl	2051-24-3	0.1	%		114	110	121	110	103
EP068S: Organochlorine Pesticide Surrogate									
Dibromo-DDE	21655-73-2	0.05	%		73.7	90.8	92.6	108	133
EP068T: Organophosphorus Pesticide Surrogate									
DEF	78-48-8	0.05	%		70.9	67.1	53.8	98.4	70.8
EP075(SIM)S: Phenolic Compound Surrogates									
Phenol-d6	13127-88-3	0.5	%		83.7	78.3	81.9	76.5	81.1
2-Chlorophenol-D4	93951-73-6	0.5	%		86.2	81.1	84.6	76.5	82.6
2.4.6-Tribromophenol	118-79-6	0.5	%		66.7	53.0	57.2	46.8	47.1
EP075(SIM)T: PAH Surrogates									
2-Fluorobiphenyl	321-60-8	0.5	%		81.7	79.7	81.4	78.8	81.8
Anthracene-d10	1719-06-8	0.5	%		86.6	84.2	86.0	81.9	89.2
4-Terphenyl-d14	1718-51-0	0.5	%		81.5	79.2	80.4	79.4	87.1
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	0.2	%		102	104	120	119	120
Toluene-D8	2037-26-5	0.2	%		76.0	75.7	96.0	87.8	92.4
4-Bromofluorobenzene	460-00-4	0.2	%		79.2	77.1	106	86.7	101

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	CL-A-S Surface Soil	CL-A-D Sub-soil	CL-B-S Surface Soil	CL-B-D Sub-soil	----
			Sampling date / time	30-Mar-2023 00:00	30-Mar-2023 00:00	30-Mar-2023 00:00	30-Mar-2023 00:00	----
Compound	CAS Number	LOR	Unit	ME2300735-011	ME2300735-012	ME2300735-013	ME2300735-014	--------
				Result	Result	Result	Result	----
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	6.3	----	6.5	----	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	10	----	26	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	7.4	----	8.7	----	----
EA058: Emerson Aggregate Test								
Color (Munsell)	----	-	-	Dark Reddish Brown (5YR 3/4)	Dark Red (2.5YR 3/6)	Dark Grayish Brown (10YR 4/2)	Very Dark Grayish Brown (10YR 3/2)	----
Texture	----	-	-	Silty Loam	Silty Clay Loam	Medium Heavy Clay	Clay Loam	----
Emerson Class Number	EC/TC	-	-	2	2	1	2	----
EA150: Soil Classification - National Committee on Soil and Terrain (2009)								
Clay (<2 µm)	----	1	%	20	27	13	35	----
Silt (2-20 µm)	----	1	%	9	9	10	7	----
Fine Sand (0.02-0.2 mm)	----	1	%	37	32	35	26	----
Coarse Sand (0.2-2.0 mm)	----	1	%	31	30	34	26	----
Gravel (>2mm)	----	1	%	3	2	8	6	----
EA152: Soil Particle Density								
Soil Particle Density (Clay/Silt/Sand)	----	0.01	g/cm3	2.57	2.59	2.47	2.61	----
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	3.2	----	3.5	----	----
Exchangeable Magnesium	----	0.1	meq/100g	1.0	----	1.3	----	----
Exchangeable Potassium	----	0.1	meq/100g	0.8	----	1.0	----	----
Exchangeable Sodium	----	0.1	meq/100g	<0.1	----	0.1	----	----
Cation Exchange Capacity	----	0.1	meq/100g	5.0	----	5.8	----	----
Exchangeable Sodium Percent	----	0.1	%	0.4	----	1.8	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
^ Total Nitrogen as N	----	20	mg/kg	340	----	1090	----	----
EK072: Phosphate Sorption Capacity								
Phosphate Sorption Capacity	----	250	mg P sorbed/kg	649	----	506	----	----

Surrogate Control Limits

Sub-Matrix: SOIL		Recovery Limits (%)	
Compound	CAS Number	Low	High
EP066S: PCB Surrogate			
Decachlorobiphenyl	2051-24-3	39	149
EP068S: Organochlorine Pesticide Surrogate			
Dibromo-DDE	21655-73-2	49	147
EP068T: Organophosphorus Pesticide Surrogate			
DEF	78-48-8	35	143
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	63	123
2-Chlorophenol-D4	93951-73-6	66	122
2.4.6-Tribromophenol	118-79-6	40	138
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	70	122
Anthracene-d10	1719-06-8	66	128
4-Terphenyl-d14	1718-51-0	65	129
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	63	125
Toluene-D8	2037-26-5	67	124
4-Bromofluorobenzene	460-00-4	66	131

Inter-Laboratory Testing

Analysis conducted by ALS Brisbane, NATA accreditation no. 825, site no. 818 (Chemistry) 18958 (Biology).

(SOIL) EA058: Emerson Aggregate Test

Analysis conducted by ALS Newcastle, NATA accreditation no. 825, site no. 1656 (Chemistry) 9854 (Biology).

(SOIL) EA150: Soil Classification - National Committee on Soil and Terrain (2009)

(SOIL) EA152: Soil Particle Density

Analysis conducted by ALS Sydney, NATA accreditation no. 825, site no. 10911 (Chemistry) 14913 (Biology).

(SOIL) EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions

(SOIL) EP080/071: Total Petroleum Hydrocarbons

(SOIL) EP080: BTEXN

(SOIL) EP080S: TPH(V)/BTEX Surrogates

(SOIL) EP075(SIM)B: Polynuclear Aromatic Hydrocarbons

(SOIL) EP075(SIM)S: Phenolic Compound Surrogates

(SOIL) EP075(SIM)T: PAH Surrogates

(SOIL) EP068A: Organochlorine Pesticides (OC)

(SOIL) EP068B: Organophosphorus Pesticides (OP)

(SOIL) EP068T: Organophosphorus Pesticide Surrogate

(SOIL) EP068S: Organochlorine Pesticide Surrogate

(SOIL) EA055: Moisture Content (Dried @ 105-110°C)

(SOIL) EP066: Polychlorinated Biphenyls (PCB)

(SOIL) EP066S: PCB Surrogate

(SOIL) EG035T: Total Recoverable Mercury by FIMS

(SOIL) EG005(ED093)T: Total Metals by ICP-AES

(SOIL) EK062: Total Nitrogen as N (TKN + NOx)

(SOIL) EK072: Phosphate Sorption Capacity

(SOIL) EA002: pH 1:5 (Soils)

(SOIL) EA010: Conductivity (1:5)

(SOIL) ED007: Exchangeable Cations

Environmental Division
Mudgee
Work Order Reference
ME2300735

barnson

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CHAIN OF CUSTODY AND ANALYTICAL REQUEST

Job Number	40038	Date	17/04/2023
Laboratory	ALS Mudgee	Report to	Nardus Potgieter npotgieter@barnson.com.au
Sample Temperature on Receipt		Notes	
20 °C	Signature: mmorda		

Sample ID	Sample Description	Sample Date	Sample type	Analysis request					
				1	2	3	4	5	6
CL-01	Surface soil	30/03/2023	Soil	X					
CL-02	Surface soil	30/03/2023	Soil	X					
CL-03	Surface soil	30/03/2023	Soil	X					
CL-04	Surface soil	30/03/2023	Soil	X					
CL-05	Surface soil	30/03/2023	Soil	X					
CL-06	Surface soil	30/03/2023	Soil	X					
CL-07	Surface soil	30/03/2023	Soil	X					
CL-08	Surface soil	30/03/2023	Soil	X					
CL-09	Surface soil	30/03/2023	Soil	X					
CL-10	Surface soil	30/03/2023	Soil	X					
CL-A-S	Surface soil	30/03/2023	Soil		X	X	X	X	X
CL-A-D	Sub-soil	30/03/2023	Soil					X	X
CL-B-S	Surface soil	30/03/2023	Soil		X	X	X	X	X
CL-B-D	Sub-soil	30/03/2023	Soil					X	X

Analysis request		Method Code
1	TRH (C6-C40) / BTEXN / PAH / OC / OP / PCB / 8 Metals	S-16
2	pH plus EC (Saturated Paste) plus Exchangeable Cations and ECEC plus ESP	AG-1
3	P Sorption Capacity	EK072
4	Total Nitrogen as N*	EK062
5	Soil Classification by Particle Size Analysis (Sieve Hydrometer and SPD analysis to "Yellow Book" spec)	EA150H-Y
6	Emerson Aggregate Testing	EA058

Relinquished by / Affiliation	Accepted by / Affiliation	Date
/ Barnson	/ ALS Mudgee	17/04/2023 240

Barnson
1/36 Darling Street
NSW 2830
Telephone: 1300 BARNSON

BOREHOLE NUMBER 1

CLIENT Narromine Shire Council **PROJECT NAME** Pavement Investigation

PROJECT NUMBER 40860 **PROJECT LOCATION** 397 Craigie Lea Lane, Narromine NSW

DATE STARTED 30/3/23 **COMPLETED** 30/3/23 **R.L. SURFACE** _____ **EASTING** _____

DRILLING CONTRACTOR Barnson **SLOPE** 90° **NORTHING** _____

EQUIPMENT GT-10 Drill Rig **HOLE LOCATION** Borehole 1

HOLE SIZE 90mm **LOGGED BY** HC **CHECKED BY** NR

NOTES _____

Method	Samples	Depth (m)	Graphic Log	Classification Symbol	Material Description	Dynamic Cone Penetrometer Blows / 100mm	Additional Observations
Flight Auger & Tungsten Carbide (T.C) Bit		0			Sandy GRAVEL: brown: slightly moist: very dense: low plasticity	0 4 8 12 16 20 24 28 32	FILL
		0.1		ML	Sandy SILT: dark brown: slightly moist: hard: low plasticity	8	ALLUVIAL
		0.2		CL	Sandy Silty CLAY: brown-orange: slightly moist: hard: medium plasticity	10	ALLUVIAL
						7	
						10	
	Disturbed Sample CBR = 2.0%	0.5				10	
						7	
						6	
						6	
						6	
		1.0				10	
						8	
						7	
						9	
						10	
		1.5				12	

Borehole 1 terminated at 1.5m

BOREHOLE NUMBER 2

barnson.
Barnson
1/36 Darling Street
NSW 2830
Telephone: 1300 BARNSON

CLIENT Narromine Shire Council **PROJECT NAME** Pavement Investigation

PROJECT NUMBER 40860 **PROJECT LOCATION** 397 Craigie Lea Lane, Narromine NSW

DATE STARTED 30/3/23 **COMPLETED** 30/3/23 **R.L. SURFACE** **EASTING**

DRILLING CONTRACTOR Barnson **SLOPE** 90° **NORTHING**

EQUIPMENT GT-10 Drill Rig **HOLE LOCATION** Borehole 2

HOLE SIZE 90mm **LOGGED BY** HC **CHECKED BY** NR

NOTES

Method	Samples	Depth (m)	Graphic Log	Classification Symbol	Material Description	Additional Observations
Flight Auger & Tungsten Carbide (T.C) Bit		0			Sandy GRAVEL: brown: slightly moist: dense: low plasticity	FILL
		0.1		CL	Sandy Silty CLAY: brown-orange: slightly moist: very stiff to hard: medium plasticity	ALLUVIAL
	Disturbed Sample CBR = 4.5%	0.5				
		1.0				
		1.5				

Dynamic Cone Penetrometer Blows / 100mm

0 4 8 12 16 20 24 28 32

0: 7 7 7 8 10 9 7 7 8 8 10 12 12

Borehole 2 terminated at 1.5m

BOREHOLE / TEST PIT WITH DCP 40038-G01A-G10A.GPJ GINT STD AUSTRALIA.GDT 27/4/23

Barnson
1/36 Darling Street
NSW 2830
Telephone: 1300 BARNSON

BOREHOLE NUMBER 3

CLIENT Narromine Shire Council **PROJECT NAME** Pavement Investigation

PROJECT NUMBER 40860 **PROJECT LOCATION** 397 Craigie Lea Lane, Narromine NSW

DATE STARTED 30/3/23 **COMPLETED** 30/3/23 **R.L. SURFACE** _____ **EASTING** _____

DRILLING CONTRACTOR Barnson **SLOPE** 90° **NORTHING** _____

EQUIPMENT GT-10 Drill Rig **HOLE LOCATION** Borehole 3

HOLE SIZE 90mm **LOGGED BY** HC **CHECKED BY** NR

NOTES _____

Method	Samples	Depth (m)	Graphic Log	Classification Symbol	Material Description	Dynamic Cone Penetrometer Blows / 100mm	Additional Observations
Flight Auger & Tungsten Carbide (T.C) Bit		0			Sandy GRAVEL: brown: slightly moist: dense: low plasticity	10	FILL
		0.1		ML	Clayey SILT: pale brown: slightly moist: hard: low plasticity	10	ALLUVIAL
						7	
						7	
	Disturbed Sample CBR = 6%	0.5				8	
						8	
						9	
						10	
						9	
		1.0				9	
						7	
						10	
						12	
		1.5				12	

Dynamic Cone Penetrometer Blows / 100mm: 0 4 8 12 16 20 24 2832

Borehole 3 terminated at 1.5m

Barnson
1/36 Darling Street
NSW 2830
Telephone: 1300 BARNSON

BOREHOLE NUMBER 4

CLIENT Narromine Shire Council **PROJECT NAME** Pavement Investigation

PROJECT NUMBER 40860 **PROJECT LOCATION** 397 Craigie Lea Lane, Narromine NSW

DATE STARTED 30/3/23 **COMPLETED** 30/3/23 **R.L. SURFACE** _____ **EASTING** _____

DRILLING CONTRACTOR Barnson **SLOPE** 90° **NORTHING** _____

EQUIPMENT GT-10 Drill Rig **HOLE LOCATION** Borehole 4

HOLE SIZE 90mm **LOGGED BY** HC **CHECKED BY** NR

NOTES _____

Method	Samples	Depth (m)	Graphic Log	Classification Symbol	Material Description	Dynamic Cone Penetrometer Blows / 100mm	Additional Observations
Flight Auger & Tungsten Carbide (T.C) Bit		0			Sandy SILT: brown-orange	0 4 8 12 16 20 24 28 32	TOPSOIL
		0.1		ML	Clayey SILT: brown: slightly moist: very stiff to hard: low plasticity	6	ALLUVIAL
						6	
						7	
						8	
		0.5				8	
	Disturbed Sample CBR = 6%					10	
						6	
						6	
						7	
		1.0				9	
						10	
						12	
						12	
		1.5					

Borehole 4 terminated at 1.5m

barnson.
Barnson
1/36 Darling Street
NSW 2830
Telephone: 1300 BARNSON

BOREHOLE NUMBER 5

CLIENT Narromine Shire Council **PROJECT NAME** Pavement Investigation

PROJECT NUMBER 40860 **PROJECT LOCATION** 397 Craigie Lea Lane, Narromine NSW

DATE STARTED 30/3/23 **COMPLETED** 30/3/23 **R.L. SURFACE** **EASTING**

DRILLING CONTRACTOR Barnson **SLOPE** 90° **NORTHING**

EQUIPMENT GT-10 Drill Rig **HOLE LOCATION** Borehole 5

HOLE SIZE 90mm **LOGGED BY** HC **CHECKED BY** NR

NOTES

Method	Samples	Depth (m)	Graphic Log	Classification Symbol	Material Description	Dynamic Cone Penetrometer Blows / 100mm	Additional Observations
Flight Auger & Tungsten Carbide (T.C) Bit		0			Sandy SILT: brown	0 4 8 12 16 20 24 2832	TOPSOIL
		0.1		ML	Clayey SILT: brown: slightly moist: stiff to very stiff: low plasticity	1 4 3 3 7	ALLUVIAL
	Disturbed Sample CBR = 3.5%	0.5					
		0.6		ML	Clayey SILT: brown: slightly moist: hard: low plasticity	13 14 16 17	ALLUVIAL
		1.0					
		1.5					

Borehole 5 terminated at 1.5m

barnson.
Barnson
1/36 Darling Street
NSW 2830
Telephone: 1300 BARNSON

BOREHOLE NUMBER 6

CLIENT Narromine Shire Council **PROJECT NAME** Pavement Investigation

PROJECT NUMBER 40860 **PROJECT LOCATION** 397 Craigie Lea Lane, Narromine NSW

DATE STARTED 30/3/23 **COMPLETED** 30/3/23 **R.L. SURFACE** _____ **EASTING** _____

DRILLING CONTRACTOR Barnson **SLOPE** 90° **NORTHING** _____

EQUIPMENT GT-10 Drill Rig **HOLE LOCATION** Borehole 6

HOLE SIZE 90mm **LOGGED BY** HC **CHECKED BY** NR

NOTES _____

Method	Samples	Depth (m)	Graphic Log	Classification Symbol	Material Description	Dynamic Cone Penetrometer Blows / 100mm	Additional Observations
Flight Auger & Tungsten Carbide (T.C) Bit		0			Sandy SILT: brown	0 4 8 12 16 20 24 28 32	TOPSOIL
		0.1		ML	Clayey SILT: brown: slightly moist: stiff: low plasticity	5 5 5 4 7 9	ALLUVIAL
	Disturbed Sample CBR = 10%	0.5					
		0.7		ML	Sandy SILT: brown-orange: slightly moist: very stiff to hard: medium plasticity	10 9 12 14	ALLUVIAL
		1.0					
		1.5					

Borehole 6 terminated at 1.5m

barnson.
Barnson
1/36 Darling Street
NSW 2830
Telephone: 1300 BARNSON

BOREHOLE NUMBER 7

CLIENT Narromine Shire Council **PROJECT NAME** Pavement Investigation

PROJECT NUMBER 40860 **PROJECT LOCATION** 397 Craigie Lea Lane, Narromine NSW

DATE STARTED 30/3/23 **COMPLETED** 30/3/23 **R.L. SURFACE** _____ **EASTING** _____

DRILLING CONTRACTOR Barnson **SLOPE** 90° **NORTHING** _____

EQUIPMENT GT-10 Drill Rig **HOLE LOCATION** Borehole 7

HOLE SIZE 90mm **LOGGED BY** HC **CHECKED BY** NR

NOTES _____

Method	Samples	Depth (m)	Graphic Log	Classification Symbol	Material Description	Additional Observations
Flight Auger & Tungsten Carbide (T.C) Bit		0.1			Sandy SILT: brown	TOPSOIL
				ML	Clayey SILT: brown: slightly moist: very stiff to hard: low plasticity	ALLUVIAL
	Disturbed Sample CBR = 5.0%	0.5				
		1.0				
		1.5				

Dynamic Cone Penetrometer Blows / 100mm

0 4 8 12 16 20 24 28 32

0 1 5 5 6 6 9 12 10 12

Borehole 7 terminated at 1.5m

Barnson
1/36 Darling Street
NSW 2830
Telephone: 1300 BARNSON

BOREHOLE NUMBER 8

CLIENT Narromine Shire Council **PROJECT NAME** Pavement Investigation

PROJECT NUMBER 40860 **PROJECT LOCATION** 397 Craigie Lea Lane, Narromine NSW

DATE STARTED 30/3/23 **COMPLETED** 30/3/23 **R.L. SURFACE** _____ **EASTING** _____

DRILLING CONTRACTOR Barnson **SLOPE** 90° **NORTHING** _____

EQUIPMENT GT-10 Drill Rig **HOLE LOCATION** Borehole 8

HOLE SIZE 90mm **LOGGED BY** HC **CHECKED BY** NR

NOTES _____

Method	Samples	Depth (m)	Graphic Log	Classification Symbol	Material Description	Dynamic Cone Penetrometer Blows / 100mm	Additional Observations
Flight Auger & Tungsten Carbide (T.C) Bit		0			Sandy SILT: brown	0 4 8 12 16 20 24 28 32	TOPSOIL
		0.2		ML	Clayey SILT: brown: slightly moist: hard: low plasticity		ALLUVIAL
	Disturbed Sample CBR = 7%	0.5					
		1.0					
		1.2		CL	Sandy Silty CLAY: brown: slightly moist: hard: medium plasticity		ALLUVIAL
		1.5					

Borehole 8 terminated at 1.5m

BOREHOLE NUMBER 9

barnson.
Barnson
1/36 Darling Street
NSW 2830
Telephone: 1300 BARNSON

CLIENT Narromine Shire Council **PROJECT NAME** Pavement Investigation

PROJECT NUMBER 40860 **PROJECT LOCATION** 397 Craigie Lea Lane, Narromine NSW

DATE STARTED 30/3/23 **COMPLETED** 30/3/23 **R.L. SURFACE** **EASTING**

DRILLING CONTRACTOR Barnson **SLOPE** 90° **NORTHING**

EQUIPMENT GT-10 Drill Rig **HOLE LOCATION** Borehole 9

HOLE SIZE 90mm **LOGGED BY** HC **CHECKED BY** NR

NOTES

Method	Samples	Depth (m)	Graphic Log	Classification Symbol	Material Description	Dynamic Cone Penetrometer Blows / 100mm	Additional Observations
Flight Auger & Tungsten Carbide (T.C) Bit		0			Sandy SILT: brown	0 1	TOPSOIL
		0.2		ML	Clayey SILT: brown: slightly moist: hard: low plasticity	4 8 9 9 10 12 15	ALLUVIAL
	Disturbed Sample CBR = 2.5%	0.5					
		1.0		CL	Sandy Silty CLAY: brown: slightly moist: hard: medium plasticity		ALLUVIAL
		1.5					

Dynamic Cone Penetrometer Blows / 100mm: 0 4 8 12 16 20 24 2832

Borehole 9 terminated at 1.5m

Barnson
1/36 Darling Street
NSW 2830
Telephone: 1300 BARNSON

BOREHOLE NUMBER 10

CLIENT Narromine Shire Council **PROJECT NAME** Pavement Investigation

PROJECT NUMBER 40860 **PROJECT LOCATION** 397 Craigie Lea Lane, Narromine NSW

DATE STARTED 30/3/23 **COMPLETED** 30/3/23 **R.L. SURFACE** _____ **EASTING** _____

DRILLING CONTRACTOR Barnson **SLOPE** 90° **NORTHING** _____

EQUIPMENT GT-10 Drill Rig **HOLE LOCATION** Borehole 10

HOLE SIZE 90mm **LOGGED BY** HC **CHECKED BY** NR

NOTES _____

Method	Samples	Depth (m)	Graphic Log	Classification Symbol	Material Description	Dynamic Cone Penetrometer Blows / 100mm	Additional Observations
Flight Auger & Tungsten Carbide (T.C) Bit		0			Sandy SILT: brown	0 4 8 12 16 20 24 2832	TOPSOIL
		0.2		ML	Clayey SILT: brown: slightly moist: very stiff to hard: low plasticity	1 3 3 5 7 10 12 16	ALLUVIAL
	Disturbed Sample CBR = 2.5%	0.5					
		1.0		CL	Sandy Silty CLAY: brown: slightly moist: hard: medium plasticity		ALLUVIAL
		1.5					

Borehole 10 terminated at 1.5m

barnson.

APPENDIX E

Water and Nutrient Balances

Barnson Job No	40038	
Location :	Narromine	

Design Wastewater Flow	**Q**	**l/day**	8600
Design Loading Rate	**R**	**mm/day**	10

Climate Zone	2 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**	**uent applied per mo (L)**	**Size of Area (8/7) m²**	**Days In Month**
Jan	226	169.5	75	56.25	310	423.25	266600	629.8877732	**31**
Feb	173	129.75	78	58.5	290	361.25	249400	690.3806228	**29**
Mar	140	105	73	54.75	310	360.25	266600	740.0416378	**31**
Apr	91	68.25	83	62.25	300	306	258000	843.1372549	**30**
May	53	39.75	75	56.25	310	293.5	266600	908.3475298	**31**
Jun	41	30.75	78	58.5	300	272.25	258000	947.6584022	**30**
Jul	38	28.5	78	58.5	310	280	266600	952.1428571	**31**
Aug	51	38.25	73	54.75	310	293.5	266600	908.3475298	**31**
Sep	81	60.75	64	48	300	312.75	258000	824.940048	**30**
Oct	114	85.5	76	57	310	338.5	266600	787.5923191	**31**
Nov	155	116.25	72	54	300	362.25	258000	712.2153209	**30**
Dec	216	162	73	54.75	310	417.25	266600	638.9454763	**31**
							Mean area	798.6m²	

Month	First trial area	Application rate	Disposal rate	mm	Increase in Depth of Stored Effluent	th of Effluent for Mo	Increase in Depth of Effluent	Computed	Reset if Et<0	Equiv Storage
Dec	860m²	310	417.25	-107.25	-357.5	0	-357.5	-357.5	0	0
Jan		310	423.25	-113.25	-377.5	0	-377.5	-377.5	0	0
feb		290	361.25	-71.25	-237.5	0	-237.5	-237.5	0	0
Mar		310	360.25	-50.25	-167.5	0	-167.5	-167.5	0	0
Apr		300	306	-6	-20	0	-20	-20	0	0
May		310	293.5	16.5	55	0	55	55	55	47300
Jun		300	272.25	27.75	92.5	55	147.5	147.5	147.5	126850
Jul		310	280	30	100	147.5	247.5	247.5	247.5	212850
Aug		310	293.5	16.5	55	247.5	302.5	302.5	302.5	260150
Sep		300	312.75	-12.75	-42.5	302.5	260	260	260	223600
Oct		310	338.5	-28.5	-95	260	165	165	165	141900
Nov		300	362.25	-62.25	-207.5	165	-42.5	-42.5	0	0
Dec		310	417.25	-107.25	-357.5	0	-357.5	-357.5	0	0
Jan		310	423.25	-113.25	-377.5	0	-377.5	-377.5	0	0
Feb		290	361.25	-71.25	-237.5	0	-237.5	-237.5	0	0
Mar		310	360.25	-50.25	-167.5	0	-167.5	-167.5	0	0
Apr		300	306	-6	-20	0	-20	-20	0	0
May		310	293.5	16.5	55	0	55	55	55	47300

Estimated area of effluent drainfield	860m²
Maximum depth of stored effluent (must not exceed 350mm)	302.5mm
Bed/Trench dimensions	2000mm
Length of bed/trench required	430m
<20m lengths of bed/trench	21.5

Trench Depth	450

Phosphours Balance

Job Number 40038

Phosphorus Sorption capacity - calculated to a depth of 1m if possible

Weighted pSorb from lab results - as per SCA pg 203

Soil Depth	pSorption (mg/	pSorption/soil layer
0-20	250	5000
20-40	420	8400
40-70	560	16800
70-100	580	17400

Weighted Psorp = Column C/thickness

Weighted Psorp = 650 mg/kg

OR USE Psorption Uptake values for soil type as per Appendix 1 of SCA pg 207

BULK Density - use the following, unless determined by lab/field (SCM pg, 207)

Soil Type	g/cm3
Sandy Soil	1.8
Fine sandy loam*	1.6
Intermediate	1.5
clay	1.3

*Interpruting soil test results

Need to calculate the pSorption of the soil in kg/ha, using the bulk density and Weighted Psorb mg/kg

Note - use top 1m of the soil

1 hecatre = 10,000m2

Therefore in the top 1m of soil = 10,000m2 X 1m X Bulk density

15000 tonnes/hectare of soil (update with Bulk density)

Convert tonnes to kg 15000000 kg

Therefore the pSorption is value mg/kg X kg of soil you have

9750000000 mg/hectare

Convert mg/ha to kg/ha	9750

Irrigation Area = $P_{generated}$ / ($P_{absorbed}$ + P_{uptake})

$P_{generated}$ = total phosphorus (TP) concentration x volume (V)of wasewater produced in 50 years

TP = 12mg/L (from Sydney Catchment Management Authority, 2019. Designing and Installing On-Site Wastewater Systems)

V = Q x 365 days x 50 years, where Q is daily flow L/d

Q L/day =	8600	
$P_{generated}$ =	1569500000	mg
Convert to kg	1569.50	kg

$P_{absorbed}$ = in soil is between 1/4 and 1/2 of the the phosphorus sorption capacity, therefore in accordance with the silver book, use 1/3

Is value x 1/3 =	3250	kg/ha
convert to kg/m2	0.325	kg/m2

P_{uptake} = the amount of vegetation uptake over 50 years

Is value from SCA pg207 X 365 days X50 years

Value (kg/ha/year) 30 (choose from SCM Appendix 1 for maintained lawn)

Convert to mg/m2/day 8.21373 (using conversion factor from per year to per day)

Therefore total = amount mg/m2/day X 365 days X 50 years

Which is 149900.532

Convert to kg/m2 0.14990 kg/m2

Irrigation Area = $P_{generated}$ / ($P_{absorbed}$ + P_{uptake})

$P_{generated}$ =	1569.50	
$P_{absorbed}$ =	0.325	
P_{uptake} =	0.1499	
Irrigation Area =	3304.9	m2

Minimum Area Method Water Balance an Wet Weather Storage Calculations

Barnson Job No	40038		
Location :	Narromine		

Design Wastewater Flow	**Q**	**l/day**	8600
Design Percolation Rate	**R**	**mm/day**	3.5

Climate Zone	2 C	*As per Soil Landscapes of Dubbo 1:250 000* **Dropdown Box**

Paramter	**Symbol**	**Formula**	**Units**	**Jan**	**Feb**	**Mar**	**April**	**May**	**June**	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Total**
Days in Month	**(D)**	**n/a**	**days**	**31**	**28**	**31**	**30**	**31**	**30**	**31**	**31**	**30**	**31**	**30**	**31**	**365**
Precipitation (70th percentile)	**(P)**	**n/a**	**mm/month**	75	78	73	83	75	78	78	73	64	76	72	73	898
Evaporation	**(E)**	**n/a**	**mm/month**	226	173	140	91	53	41	38	51	81	114	155	216	1379
Crop Factor (as per Silver Book)	**(C)**	**n/a**	**n/a**	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Outputs																
Evapotranspiration	**(ET)**	**E X C**	**mm/month**	158.2	121.1	98	63.7	37.1	**28.7**	26.6	35.7	56.7	79.8	108.5	151.2	965.3
Percolation	**(B)**	**(R/7)xD**	**mm/month**	108.5	98.0	108.5	105.0	108.5	105.0	108.5	108.5	105.0	108.5	105.0	108.5	1277.5
Outputs		**(ET +B)**	**mm/month**	266.7	219.1	206.5	168.7	145.6	133.7	135.1	144.2	161.7	188.3	213.5	259.7	2242.8
Inputs																
Precipitation (70th percentile)	**(P)**	**n/a**	**mm/month**	75	78	73	83	75	78	78	73	64	76	72	73	898
Possible Efflient Irrigation	(W)	**(ET + B) -P**	**mm/month**	191.7	141.1	133.5	85.7	70.6	55.7	57.1	71.2	97.7	112.3	141.5	186.7	**1344.8**
Actual Effluent Production	(I)	**H/12**	**mm/month**	112.1	112.1	112.1	112.1	112.1	112.1	112.1	112.1	112.1	112.1	112.1	112.1	112.1
Inputs		**(P +I)**	**mm/month**	187.1	190.1	185.1	195.1	187.1	190.1	190.1	185.1	176.1	188.1	184.1	185.1	1010.1
Storage	(S)	**(P+I) - (ET+B)**	**mm/month**	-79.6	-29.0	-21.4	26.4	41.5	56.4	55.0	40.9	14.4	-0.2	-29.4	-74.6	
Cumulative Storage	(M)	**n/a**	**mm**	0.0	0.0	0.0	26.4	67.8	124.2	179.2	220.0	**234.4**	234.2	204.7	130.1	

Note - H = sum of W

Irrigation Area	**(L)**	**365 x Q/H**	**m²**	**2334.2**
Storage	**(v)**	**Largest M**	**mm**	**234.4**
		(V xL)/1000	**m³**	**547.1**

Phosphours Balance

Job Number 40038

Phosphorus Sorption capacity - calculated to a depth of 1m if possible

Weighted pSorb from lab results - as per SCA pg 203

Soil Depth	pSorption (mg/	pSorption/soil layer
0-20	250	5000
20-40	420	8400
40-70	560	16800
70-100	580	17400

Weighted Psorp = Column C/thickness

Weighted Psorp = 500 mg/kg

OR USE Psorption Uptake values for soil type as per Appendix 1 of SCA pg 207

BULK Density - use the following, unless determined by lab/field (SCM pg, 207)

Soil Type	g/cm3
Sandy Soil	1.8
Fine sandy loam*	1.6
Intermediate	1.5
clay	1.3

*Interpruting soil test results

Need to calculate the pSorption of the soil in kg/ha, using the bulk density and Weighted Psorb mg/kg

Note - use top 1m of the soil

1 hecatre = 10,000m2

Therefore in the top 1m of soil = 10,000m2 X 1m X Bulk density

15000 tonnes/hectare of soil (update with Bulk density)

Convert tonnes to kg 15000000 kg

Therefore the pSorption is value mg/kg X kg of soil you have

7500000000 mg/hectare

Convert mg/ha to kg/ha	7500

Irrigation Area = $P_{generated}$ / ($P_{absorbed}$ + P_{uptake})

$P_{generated}$ = total phosphorus (TP) concentration x volume (V)of wasewater produced in 50 years

TP = 12mg/L (from Sydney Catchment Management Authority, 2019. Designing and Installing On-Site Wastewater Systems)

V = Q x 365 days x 50 years, where Q is daily flow L/d

Q L/day =	8600	
$P_{generated}$ =	1569500000	mg
Convert to kg	1569.50	kg

$P_{absorbed}$ = in soil is between 1/4 and 1/2 of the the phosphorus sorption capacity, therefore in accordance with the silver book, use 1/3

Is value x 1/3 =	2500	kg/ha
convert to kg/m2	0.250	kg/m2

P_{uptake} = the amount of vegetation uptake over 50 years

Is value from SCA pg207 X 365 days X50 years

Value (kg/ha/year) 30 (choose from SCM Appendix 1 for maintained lawn)

Convert to mg/m2/day 8.21373 (using conversion factor from per year to per day)

Therefore total = amount mg/m2/day X 365 days X 50 years

Which is 149900.532

Convert to kg/m2 0.14990 kg/m2

Irrigation Area = $P_{generated}$ / ($P_{absorbed}$ + P_{uptake})

$P_{generated}$ =	1569.50	
$P_{absorbed}$ =	0.250	
P_{uptake} =	0.1499	
Irrigation Area =	3924.7	m2

Minimum Area Method Water Balance an Wet Weather Storage Calculations

Barnson Job No	40038		
Location :	Narromine		

Design Wastewater Flow	**Q**	**l/day**	8600
Design Percolation Rate	**R**	**mm/day**	2

Climate Zone	2 C	*As per Soil Landscapes of Dubbo 1:250 000* **Dropdown Box**

Paramter	**Symbol**	**Formula**	**Units**	**Jan**	**Feb**	**Mar**	**April**	**May**	**June**	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Total**
Days in Month	**(D)**	**n/a**	**days**	**31**	**28**	**31**	**30**	**31**	**30**	**31**	**31**	**30**	**31**	**30**	**31**	**365**
Precipitation (70th percentile)	**(P)**	**n/a**	**mm/month**	75	78	73	83	75	78	78	73	64	76	72	73	898
Evaporation	**(E)**	**n/a**	**mm/month**	226	173	140	91	53	41	38	51	81	114	155	216	1379
Crop Factor (as per Silver Book)	**(C)**	**n/a**	**n/a**	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Outputs																
Evapotranspiration	**(ET)**	**E X C**	**mm/month**	158.2	121.1	98	63.7	37.1	**28.7**	26.6	35.7	56.7	79.8	108.5	151.2	965.3
Percolation	**(B)**	**(R/7)xD**	**mm/month**	62.0	56.0	62.0	60.0	62.0	60.0	62.0	62.0	60.0	62.0	60.0	62.0	730.0
Outputs		**(ET +B)**	**mm/month**	220.2	177.1	160.0	123.7	99.1	88.7	88.6	97.7	116.7	141.8	168.5	213.2	1695.3
Inputs																
Precipitation (70th percentile)	**(P)**	**n/a**	**mm/month**	75	78	73	83	75	78	78	73	64	76	72	73	898
Possible Efflient Irrigation	(W)	**(ET + B) -P**	**mm/month**	145.2	99.1	87.0	40.7	24.1	10.7	10.6	24.7	52.7	65.8	96.5	140.2	**797.3**
Actual Effluent Production	(I)	**H/12**	**mm/month**	66.4	66.4	66.4	66.4	66.4	66.4	66.4	66.4	66.4	66.4	66.4	66.4	66.4
Inputs		**(P +I)**	**mm/month**	141.4	144.4	139.4	149.4	141.4	144.4	144.4	139.4	130.4	142.4	138.4	139.4	964.4
Storage	(S)	**(P+I) - (ET+B)**	**mm/month**	-78.8	-32.7	-20.6	25.7	42.3	55.7	55.8	41.7	13.7	0.6	-30.1	-73.8	
Cumulative Storage	(M)	**n/a**	**mm**	0.0	0.0	0.0	25.7	68.1	123.8	179.7	221.4	235.2	**235.8**	205.7	132.0	

Note - H = sum of W

Irrigation Area	**(L)**	**365 x Q/H**	**m²**	**3937.0**
Storage	**(v)**	**Largest M**	**mm**	**235.8**
		(V xL)/1000	**m³**	**928.3**

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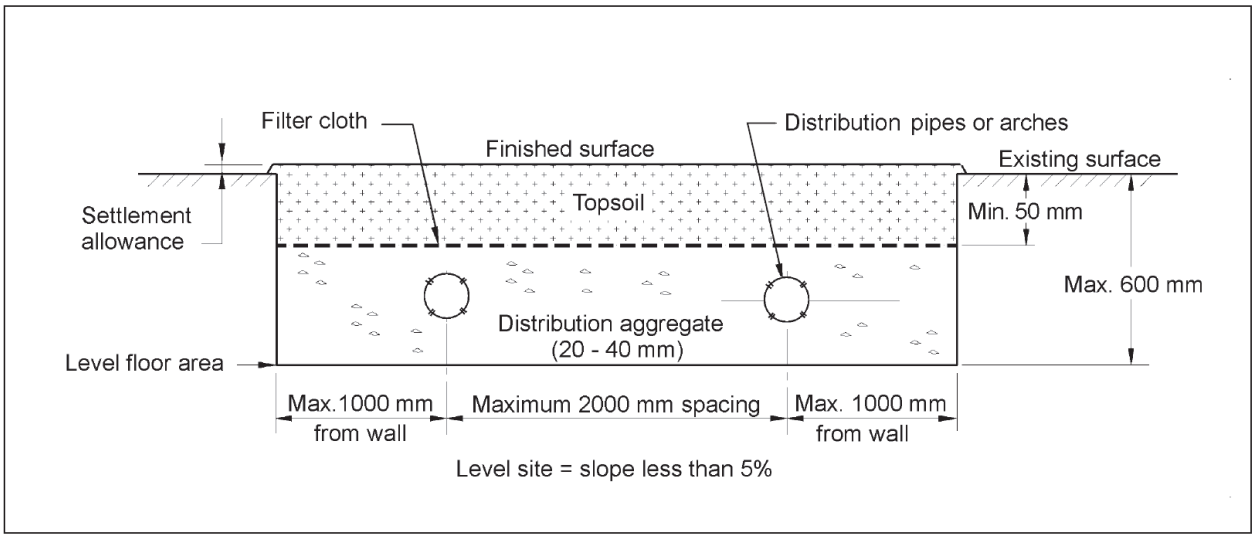
APPENDIX F

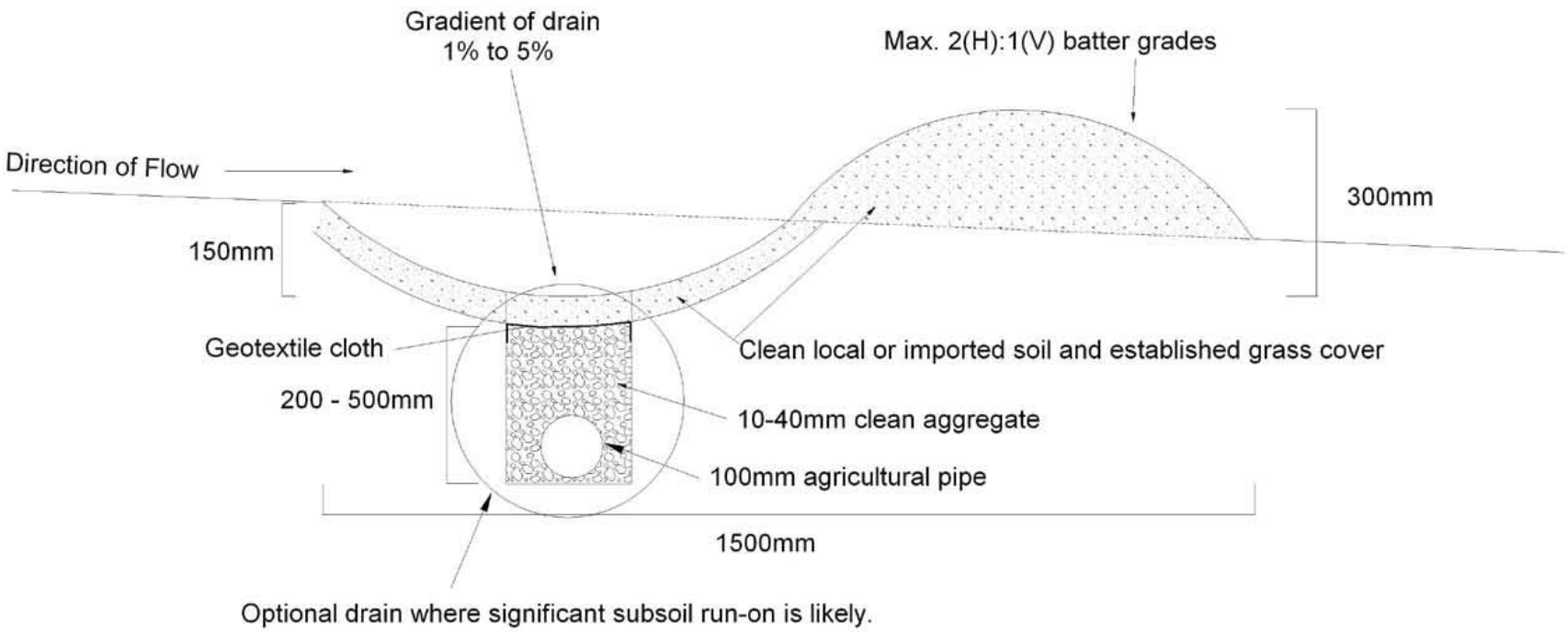
Concept Design Sketches – Absorption System



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

FIGURE L5 CONVENTIONAL BED

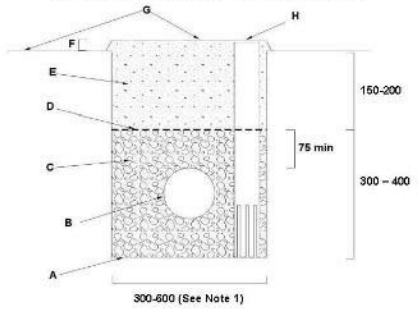
Cross Section: Upslope Diversion Drain



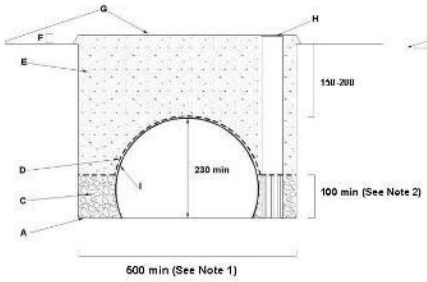
Standard Drawing 10A - Upslope Diversion Drain

(not to scale)

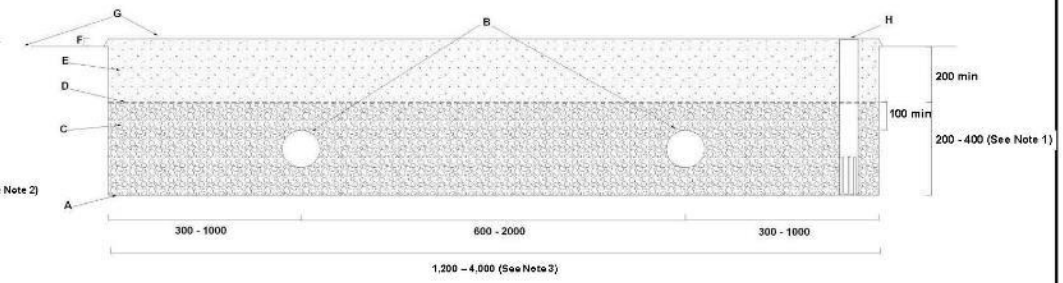
Cross Section: Piped Trench



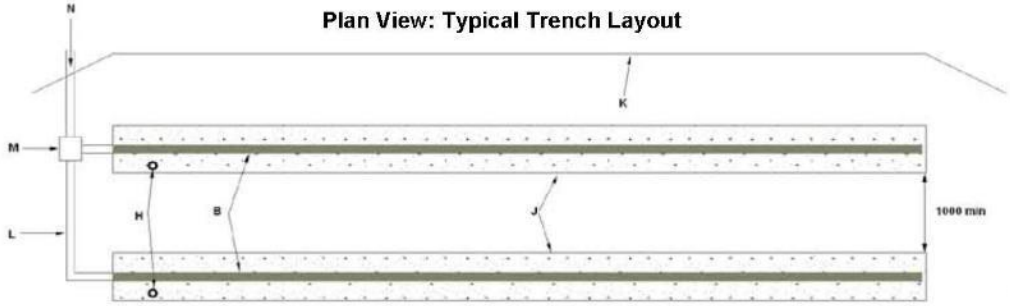
Cross Section: Arch



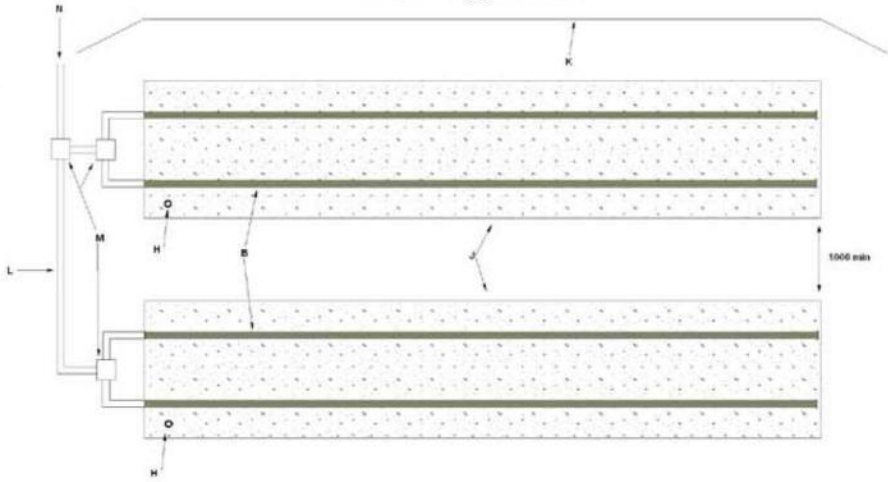
Cross Section: Conventional Piped Bed



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)

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APPENDIX G

Species List

APPENDIX 7

VEGETATION SUITABLE FOR LAND APPLICATION AREAS

Botanical Name	Approximate Height	Common Name or Variety
Grasses		
Carex spp.		
Lomandra longifolia		
Microlaena stipoides		
Oplismenus imbecillis		
Pennisetum alopecuroides	40 - 80 cm	Available as lawn turf
Poa lab		
Stipa spp.		
Ground cover/ climbers		
Hibbertia scandens		Snake vine
Hibbertia stellaris		
Isotoma fluviatalis	Prostrate	
Kennedia rubicunda	Climber	Dusky coral pea
Scaevola albida		
Scaevola ramosissima		
Veronica plebeia		
Viola hederacea		Native violet
Sedges/ grasses/ small plants		
Anigozanthus flavidus	2m	Kangaroo Paw
Baumea acuta		
Baumea articulata	Sedge	
Baumea juncea	Sedge	
Baumea nuda	Sedge	
Baumea rubiginosa	Sedge	
Baumea teretifolia	Sedge	
Blandfordia grandiflora	30-90cm	Christmas Bell
Blandfordia nobilis	30-90cm	Christmas Bell
Brachyscome diversifolia	Clump	Native Daisy
Carex appressa	Sedge	
Cotula coronopifolia	10-20cm	Waterbutton
Crinum pedunculatum	<2m	Swamp Lily
Cyperus polystachyos	Sedge	
Dianella caerulea	Low plant	Blue Flax Lily
Epacris microphylla	50cm -1m	
Ferns		
Gahnia spp.	Tall Grass	
Juncus spp.	0.5 m Rush	
Lobelia trigonocaulis	5-10cm	
Lomandra spp.	Grass	
Patersonia fragilis		Native Iris
Patersonia glabrata		Native Iris
Patersonia occidentalis		Native Iris
Ranunculus graniticola	5cm	
Restio australis	Reed	
Restio tetraphyllus	1m	
Sowerbaea juncea	Sedge	Rush Lily
Tetratheca juncea	<30cm	
Xyris operculata	<1m	Tall Yellow Eye

Botanical Name	Approximate Height	Common Name or Variety
Shrubs		
Agonis flexuosa nana		
Baekea linifolia	1 - 2.5 m	
Baekea utilis	1-2.5 m	
Baekea virgata	< 4 m	
Banksia aemula	1 - 7 m	
Banksia robur	0.5 - 2 m	
Bauera ruboides	0.5 - 1.5 m	
Callistemon	2 - 3 m	Burgundy
Callistemon	2 - 4 m	Eureka
Callistemon	3 - 4 m	Harkness
Callistemon	3 - 4.5 m	Kings Park Special
Callistemon	2 - 3 m	Mauve Mist
Callistemon	1 - 2.5 m	Red Clusters
Callistemon	2 - 3 m	Reeves Pink
Callistemon citrinus	50 - 80 cm	Austraflora Firebrand
Callistemon citrinus	2 - 4 m	Splendens
Callistemon citrinus	60cm – 1m	White Ice
Callistemon linearis	1 - 3 m	
Callistemon macropunctatus	2 - 4 m	
Callistemon pachyphyllus	2 - 3 m	
Callistemon pallidus	1.5 - 4 m	
Callistemon paludosus	3 - 7 m	
Callistemon pinifolius	1 - 3 m	
Callistemon rigidus	1.5 - 2.5 m	
Callistemon salignus	3 – 10m	
Callistemon shiresii	4 - 8 m	
Callistemon sieberi	1.5 - 2 m	
Callistemon sieberi	50 - 80 cm	Austraflora Little Cobber
Callistemon subulatus	1 - 2 m	
Callistemon viminalis	1 - 2 m	Captain Cook
Callistemon viminalis	5 - 10 m	Dawson River
Callistemon viminalis	3 - 5 m	Hannah Ray
Callistemon viminalis	50 cm - 1 m	Little John
Callistemon viminalis	1.5 - 2 m	Rose Opal
Callistemon viminalis	2 - 3 m	Western Glory
Goodenia ovata	1 - 1.5 m	
Hibiscus diversifolius	1 - 2 m	Swamp hibiscus
Kunzea capitata	1 - 2 m	
Leptospermum flavescens	< 2 m	Tea-tree
Leptospermum juniperinum	1 m	Tea-tree
Leptospermum lanigerum	1 - 2 m	Woolly tea-tree
Leptospermum squarrosum	< 2 m	Tea-tree
Melaleuca alternifolia	4 - 7 m	
Melaleuca decussata	1 - 2 m	Cross-leaved honey myrtle
Melaleuca lanceolata	4 - 6 m	
Melaleuca squamea	1 - 2 m	
Melaleuca thymifolia		

Botanical Name	Approx Height	Common Name or Variety
Trees		
Acacia elongata	> 2 m	
Acacia floribunda	2 - 4 m	Gossamer wattle
Agonis flexuosa	5 - 6 m	Willow myrtle
Allocasuarina diminuta	1.5 m	
Allocasuarina paludosa	0.5 - 2 m	
Angophora floribunda	Large tree	
Angophora subvelutina	Large tree	
Callicoma serratifolia	< 4m	
Casuarina cunninghamiana	10 - 30 m	River she-oak
Casuarina glauca	6 - 12 m	Swamp oak
Elaeocarpus reticulatis	Large tree	Blueberry ash
Eucalyptus amplifolia	Large tree	
Eucalyptus botryoides (coastal areas)	10 - 30 m	
Eucalyptus camaldulensis (west of ranges)	15 - 20 m	River red gum
Eucalyptus deanei	Large tree	Blue Mountains blue gum
Eucalyptus elata	Large tree	River Peppermint
Eucalyptus grandis	10 - 20 m	Flooded gum
Eucalyptus longifolia	20 m	Woollybutt
Eucalyptus pilularis	30 - 40 m	Blackbutt
Eucalyptus punctata	< 35 m	Greygum
Eucalyptus robusta	20 - 30 m	Swamp mahogany
Eucalyptus saligna (coastal)	30 - 50 m	Sydney blue gum
Eucalyptus tereticornis	30 - 40 m	Forest red gum
Eucalyptus viminalis (ranges)	20 - 40 m	Ribbon gum
Acmena smithii	10 - 20 m	Lilli pilli
Flindersia australis	< 40 m	Native teak
Hymenosporum flavuum	3 - 6 m	Native frangipani
Melaleuca armillaris	3 - 4 m	Bracelet honey myrtle
Melaleuca decora	4 - 7 m	
Melaleuca ericifolia	6 m	
Melaleuca halmaturorum	4 - 6 m	
Melaleuca hypericifolia	2 - 3 m	
Melaleuca linariifolia	4 - 8 m	Snow in summer
Melaleuca quinquenervia	5 - 7 m	Broad paperbark
Melaleuca squarrosa	6 m	
Melaleuca stypheloides	6 - 15 m	
Melia azedarach	15 - 20 m	
Pittosporum spp.		
Syzgium paniculatum	8 - 10 m	Bush cherry
Tristania laurina	5 - 15 m	Kanuka
Viminaria juncea	2 - 3 m	Golden spray

Source: Australian Plants Society

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APPENDIX H

Concept Design Sketches – Irrigation System

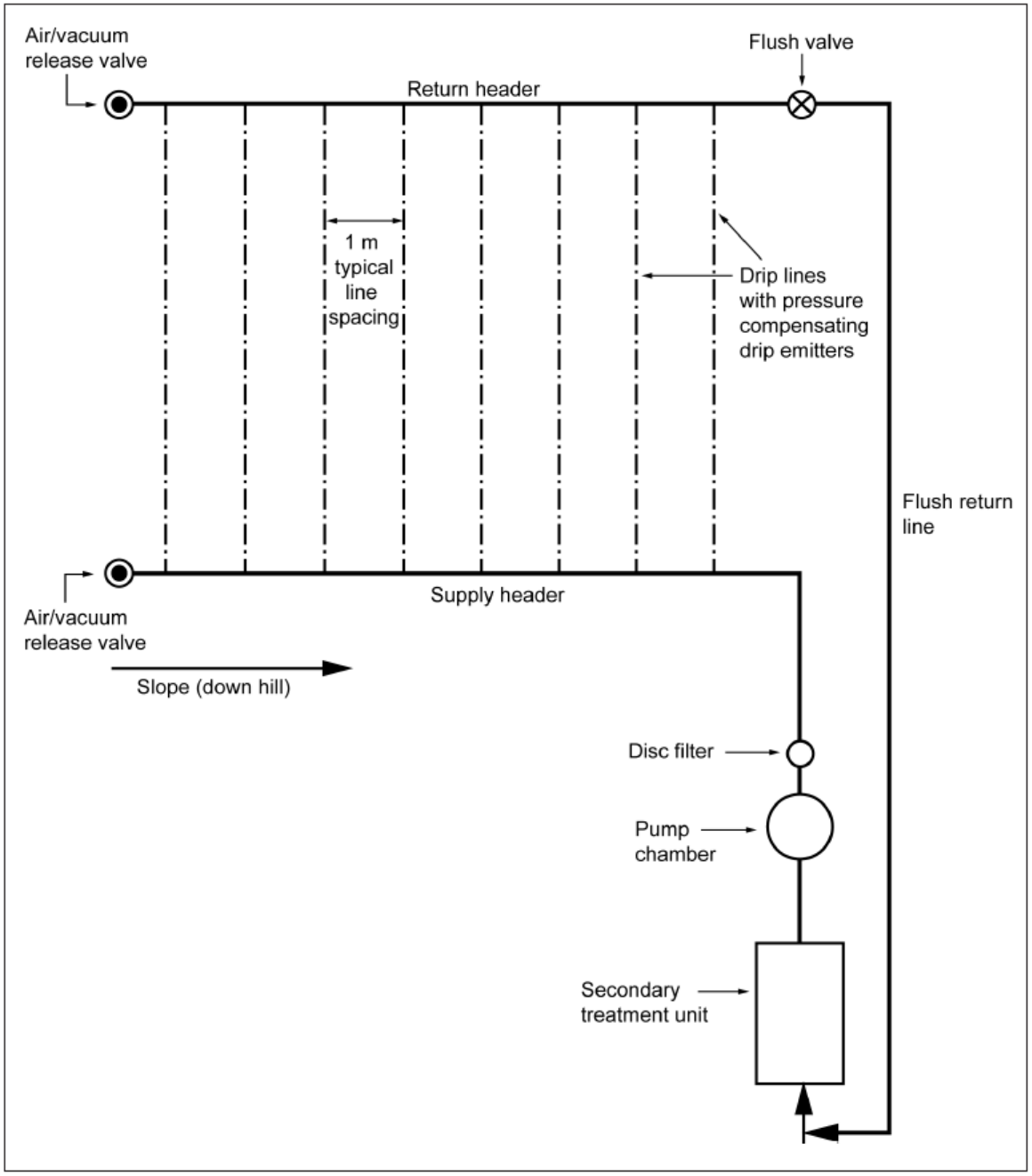


FIGURE M1 DRIP IRRIGATION SYSTEM – EXAMPLE LAYOUT OF COMPONENTS

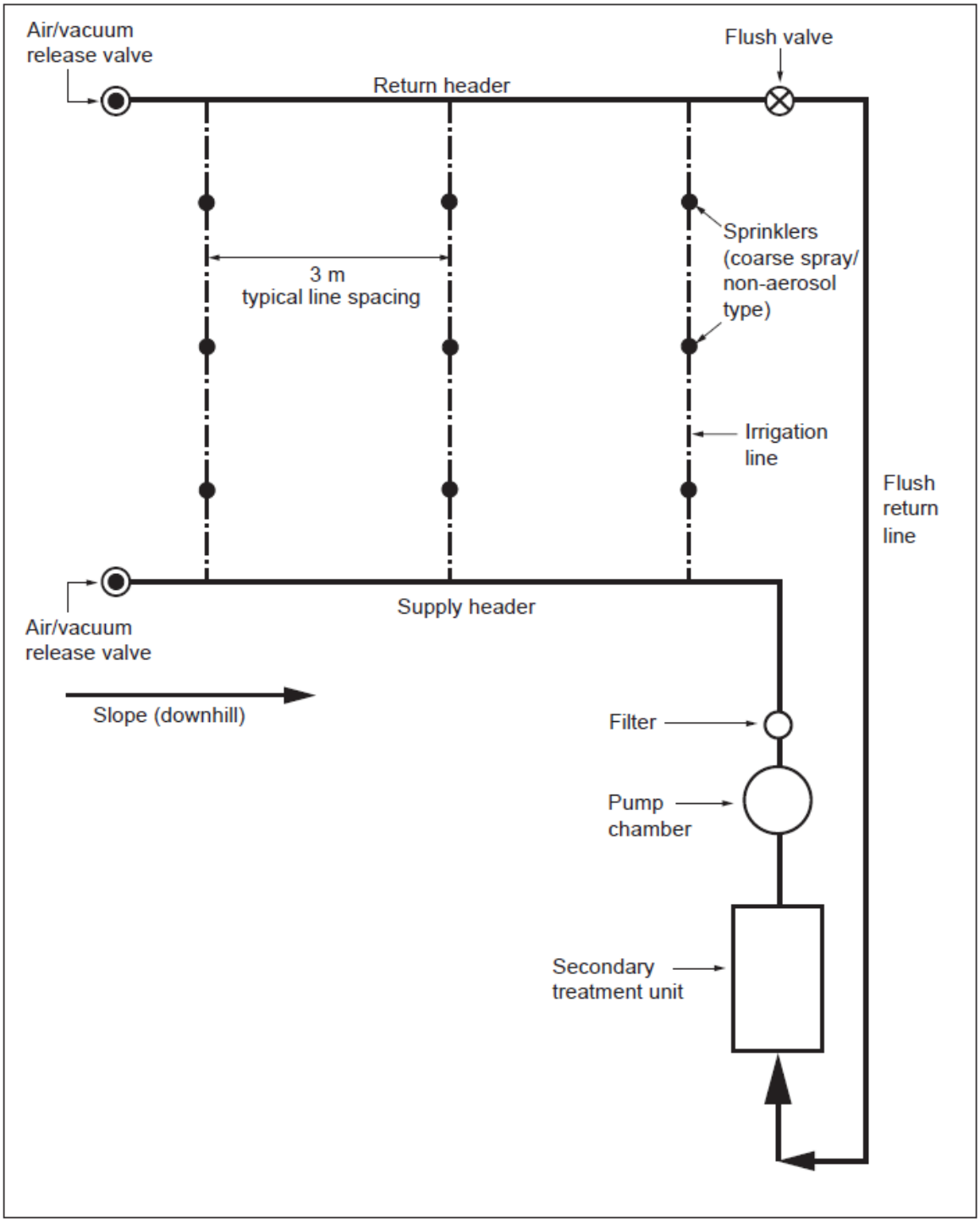
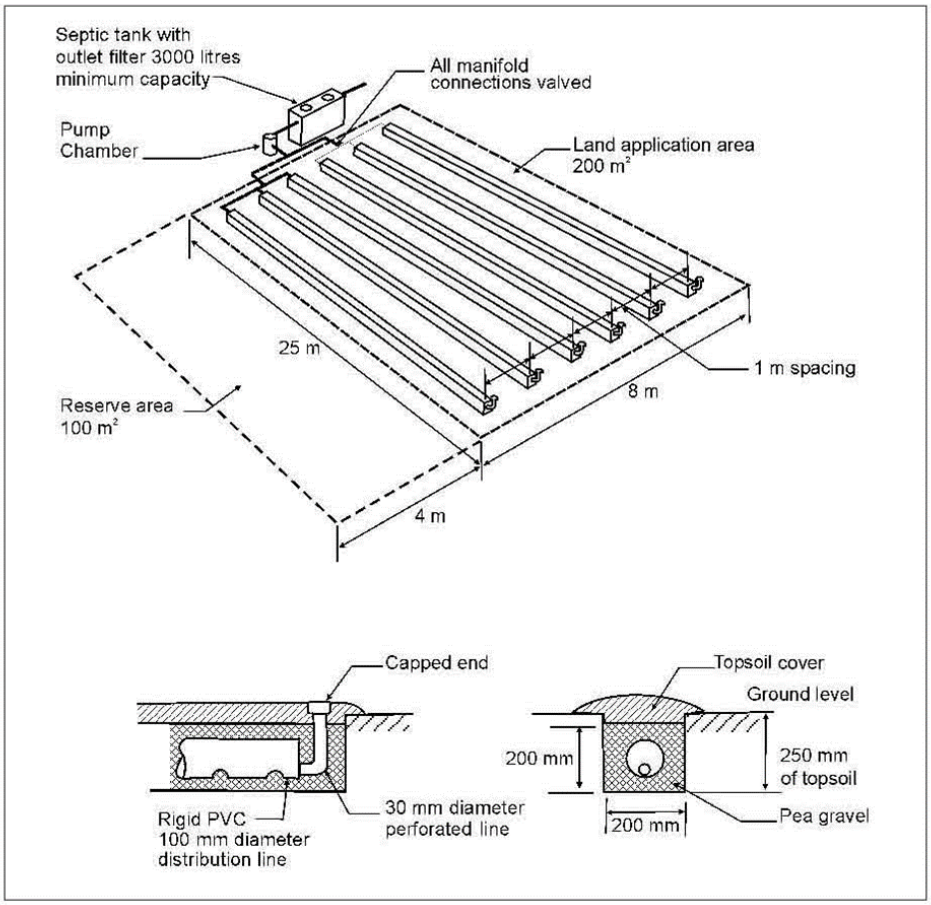


FIGURE M2 SPRAY IRRIGATION SYSTEM – EXAMPLE LAYOUT OF COMPONENTS



NOTES:

1 Example system sized for 700 L/d and DIR of 3.5 mm/d in soil Category 3 (see Table M1).

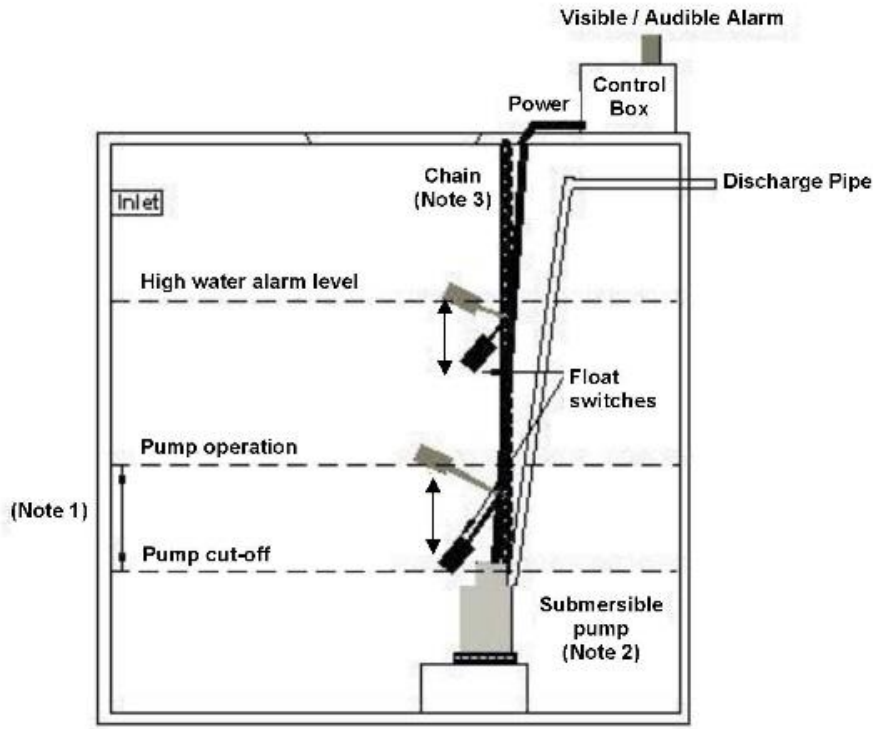
2 Preferred dosing method is by a 6-way automatic sequencing valve.

3 Good quality topsoil to 250 mm depth is required.

4 Flexible 100 mm diameter corrugated drainage line can be used in place of rigid PVC.

5 Distribution aggregate of 10 mm to 15 mm size can be used in place of pea gravel.

FIGURE M3 SHALLOW SUBSURFACE LPED IRRIGATION – EXAMPLE SYSTEM



Notes

1 The depth of effluent pumped within each cycle of the float switch (ie the depth between pump Cut-off and Operation) is calculated by:

depth of pumped effluent (m) x basal tank area (m^2) x 1,000 = discharge volume (litres per pump cycle).

This volume must match the hydraulic capabilities of the receiving component based on flow rate and total dynamic head.

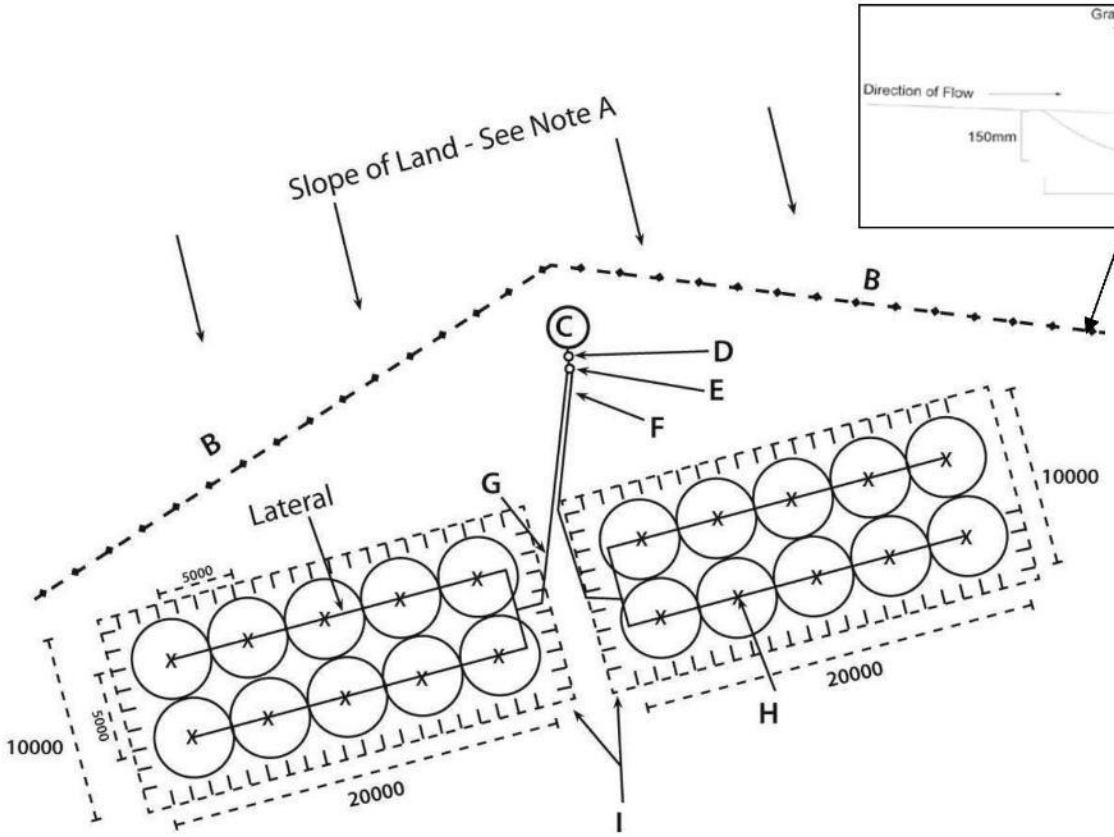
2 Submersible pump used as an example only. The pump will need to be selected based on the specific task. It may be a centrifugal pump or vortex pump depending on the type of effluent being pumped and the hydraulic characteristics of the system. It may sit on top of the tank and draw effluent from the tank.

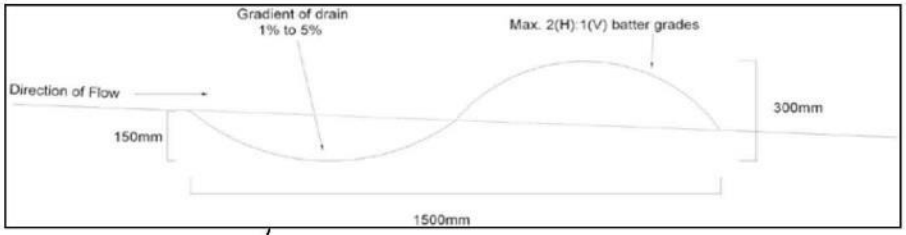
3 Submersible pumps must not be removed from a tank by their power cord. Heavier pumps may require the installation of a solid steel bar configuration according to manufacturer's specifications.

4 Cumulative storage must be assessed carefully to ensure that the pump well is large enough to buffer peak loads without the level exceeding that at which the high level alarm is triggered. The pump well should be sized to ensure that the volume of storage in the pump well reaches the low-level cut-off depth at least once every week.

Standard Drawing 12B - Demand Dose Pump well

(not to scale)





Surface Irrigation Area Construction

A Slope should not exceed 7% over the irrigation area. Landscaping may be required where appropriate.

B An earth bank diversion drain should be constructed upslope of the area to divert stormwater run-on if this is appreciable (see Inset A and Standard Drawing No.12B).

C Secondary treatment system (with disinfection) – the irrigation pump must provide adequate head at the highest sprinkler in the irrigation system at a flow rate that matches the output of the system. This figure will vary when alternative sprinklers are used - check with council and the supplier that alternative sprinklers are acceptable. A full hydraulic design should be carried out on each system.

D A 100-150 micron cylindrical filter should be installed prior to the sequencing valve and cleaned regularly.

E An automatic, hydraulically operated sequencing valve should be installed to deliver effluent evenly to the two (or more) areas. If preferred the valve can be set up to deliver effluent to the four laterals independently.

F In situations where the irrigation areas are above the pump well non-return valves should be installed.

G The effluent distribution pipe from the tank to the irrigation area should be buried a minimum of 300 mm below the ground surface. The manifold and laterals within the effluent irrigation area should be 25 mm polyethylene pipe buried 100-150 mm below the ground surface. Exact layout will depend on individual circumstances. Lateral and sprinkler spacing is typically 5 m.

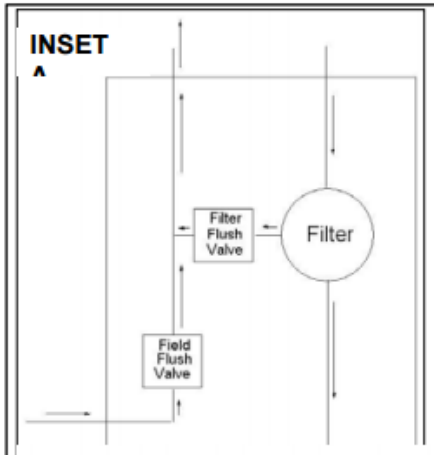
H Standard design based on use of typical heavy droplet rotary sprinklers with design throw radius 2 m, height 400 mm, flow rate 0.05 L/s and operating pressure of 80-100 kPa. Some pop-up and/or gear driven models may have different characteristics. Approval will be at the discretion of council.

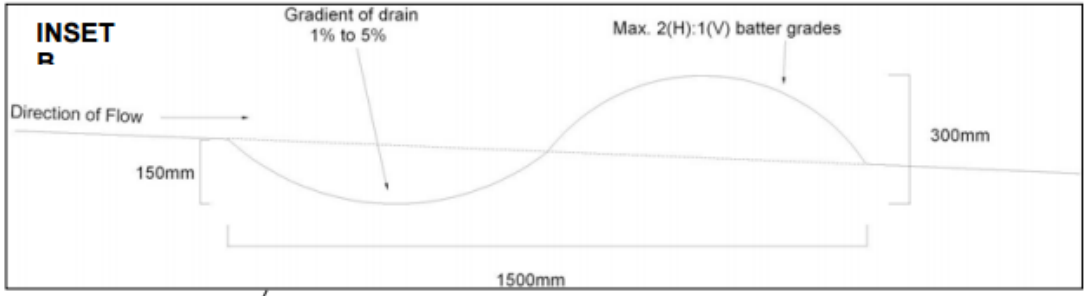
I Irrigation areas can be either landscaped garden beds or lawn areas. The irrigation area should be planted with species appropriate for effluent irrigation (see the 'Silver Book', Department of Local Government, 1998).

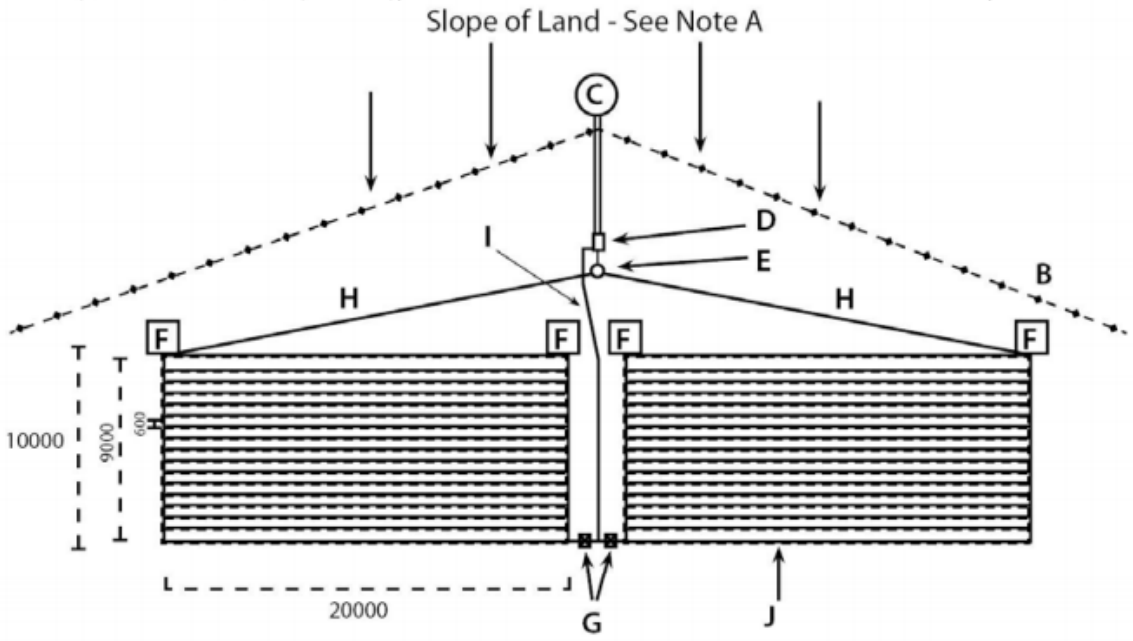
This standard design has been based on a generic area of 400m^2 for irrigation based on typical conditions. It does not eliminate the need for a site and soil evaluation to be carried out or any additional consideration of site specific issues. It should be used as a generic guide only.

Standard Drawing 12C - Surface Irrigation of Effluent

(not to scale)







This standard design has been based on a generic area of 400 m² for irrigation based on typical conditions. It does not eliminate the need for a site and soil evaluation to be carried out or any additional consideration of site specific issues. It should be used as a generic guide only.

Subsurface Irrigation Area Construction

A Design for relatively uniform slope. Additional design work may be required where slope exceeds 12% or if system is to be installed over undulating ground.

B An earth bank diversion drain must be constructed upslope of the area to divert stormwater run-on if this is appreciable (see Inset B and Standard Drawing No.13A).

C Secondary treatment system – the irrigation pump must provide a *minimum* 20 m head and a flow rate that matches the design output of the selected dripline. Flow rate will vary depending on emitter spacing, flow rate and lineal metres of line. A full hydraulic design must be carried out. Each area should be capable of discharging a minimum of 80 L/min.

D Filtration and flushing mechanism (see Inset A) – a field flush valve must be installed on the return line to facilitate periodic flushing to the treatment tank. An additional filter flush valve should be installed downstream of the field flush valve. A 100-150 micron cylindrical filter should be installed and cleaned regularly. Where there are potential problems in returning irrigation field flush back to the treatment tank, a small (approximately 3 m x 0.6 m) absorption area sited below the effluent irrigation area can be used to accommodate the flushed effluent.

E An automatic, hydraulically operated sequencing valve should be installed to deliver effluent evenly to the two areas.

F Air release valves must be installed at high points in each area. Additional air release valves may be required in undulating terrain.

G Check valves are required for each irrigation field to facilitate periodic flushing.

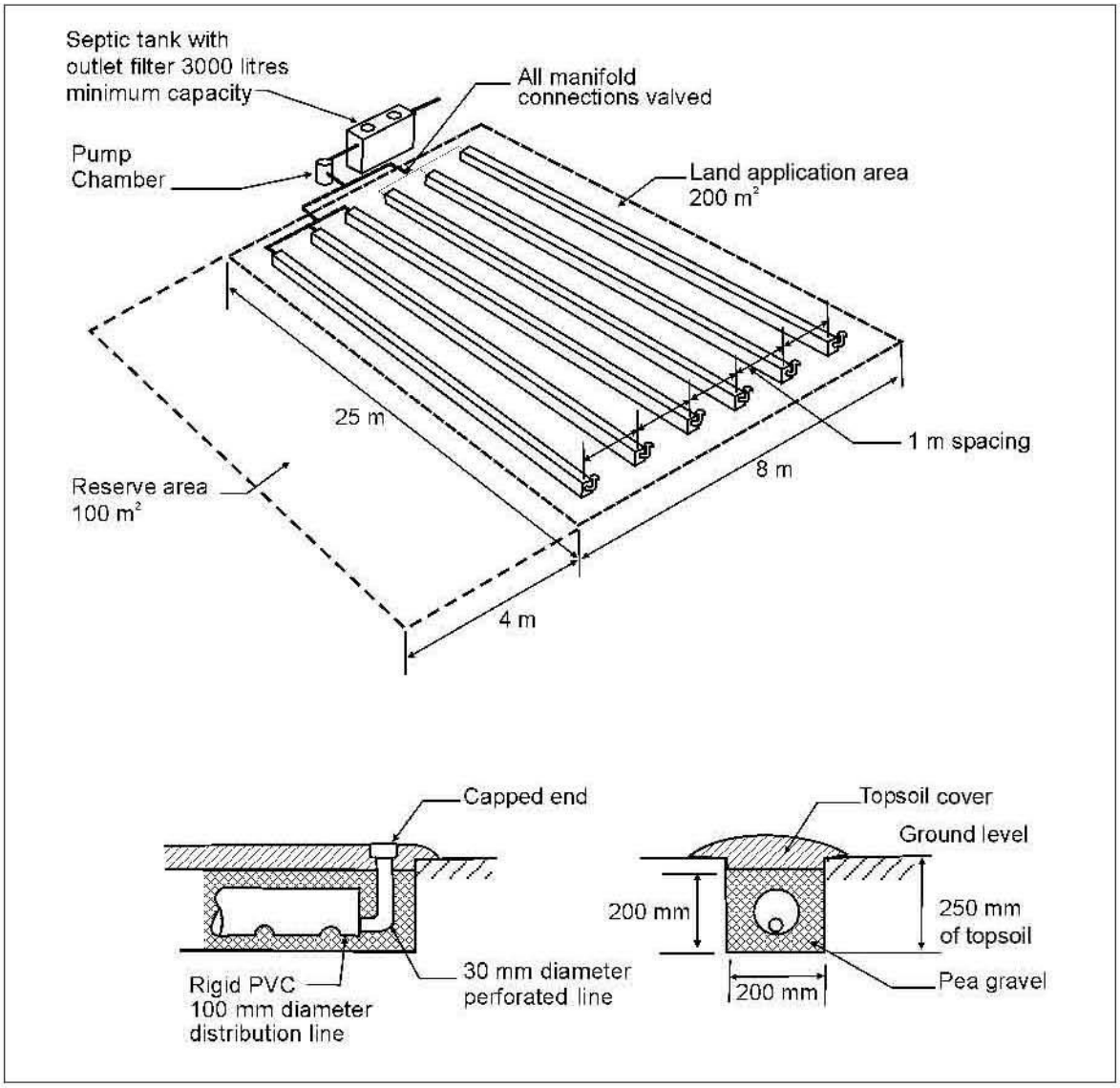
H Distribution manifolds should be 25 mm uPVC or polyethylene pipe buried 300 mm below the ground surface.

I Flushing return manifold should be 25 mm uPVC or polyethylene pipe buried 100-150 mm below the ground surface within the irrigation area. Outside this area, the pipe must be buried at a minimum of 300 mm depth.

J Pressure compensating (PC) subsurface drip line laterals (typically 16 mm) with emitters and laterals at approximately 600 mm spacings (maximum 1,000 mm spacings) and buried to a depth 100-150 mm. Only subsurface dripline specifically designed for effluent irrigation must be used.

Standard Drawing 13B - Subsurface Effluent Irrigation

(not to scale)



NOTES:

1 Example system sized for 700 L/d and DIR of 3.5 mm/d in soil Category 3 (see Table M1).

2 Preferred dosing method is by a 6-way automatic sequencing valve.

3 Good quality topsoil to 250 mm depth is required.

4 Flexible 100 mm diameter corrugated drainage line can be used in place of rigid PVC.

5 Distribution aggregate of 10 mm to 15 mm size can be used in place of pea gravel.

FIGURE M3 SHALLOW SUBSURFACE LPED IRRIGATION – EXAMPLE SYSTEM