Wastewater Management: Site & Soil Evaluation & Disposal System Design

For Proposed Subdivision Development at: Lot 40 DP 882293 No. 698 Red Hills Road, Marulan

Prepared by:

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Signed:

Andrew Macloed
Director
SEEC

Document Certification

This report has been developed based on agreed requirements as understood by SEEC at the time of investigation. It applies only to a specific task on the nominated lands. Other interpretations must not be made, including changes in scale or application to other projects. The contents of this report are based on a professional appraisal of the conditions that existed at the time of our investigation. Where subsurface investigations have been done the results are only applicable to the specific sampling or testing locations and only to the depth(s) investigated. Because of natural geological variability, and/or because of possible anthropogenic influences, the subsurface conditions reported can change abruptly. Such changes can also occur after the site investigation. The accuracy of the conditions provided in this report is limited by these possible variations and influences and/or is limited by budget constraints imposed by others and/or by adequate accessibility.

Document Issue Table

Version	Date	Author	Reviewed	Notes
Draft A	13/09/2022	CB	LO	
01 Final	24/02/2023	CB	Client	
02 Final	11/11/2024	PB	Client	Relocation of the EMA, addition of the biodiversity zone.

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1 INTRODUCTION

Strategic Environmental and Engineering Consulting (SEEC) have been commissioned by Southern Cross Consulting Surveyors, on behalf of the property owner, to provide this Wastewater Site Assessment. It will accompany a development application for the proposed subdivision of Lot 40 DP 882293 No. 698 Red Hills Road, Marulan (Figure 1) into two rural allotments. The purpose of this report is to demonstrate that an Effluent Management Area (EMA) can feasibly be sited on each of the newly-created lots (Lots 1 and 2, shown in Figure 2). It does not provide details of a specific system to be used on a lot and must not be used by the purchasers of any of the proposed lots.

This study includes:

(i) Undertaking a site inspection and soil survey to assess the suitability of each proposed residential allotment for onsite effluent disposal;
(ii) Assessment of soil texture, depth, pH, electrical conductivity, dispersion potential and phosphorous sorption;
(iii) Discussion of suitable methods for treatment and land application of effluent;
(iv) Hydraulic modeling to determine the necessary size of EMAs;
(v) Preparation of a site plan showing conceptual EMAs;
(vi) A discussion of any special management initiatives; and,
(vii) Preparation of this written report for submission to Council.

The site and soil investigation is undertaken in accordance with:

(i) AS/NZS 1547: 2012 On-site Domestic Wastewater Management (Standards Australia / Standards New Zealand, 2012).
(ii) Environment and Health Protection Guidelines: Onsite Sewage Management for Single Households (Department of Local Government, 1998).
(iii) State Environmental Planning Policy Sydney Drinking Water Catchment (2011); and
(iv) WaterNSW (2019). *Designing and Installing On-Site Wastewater Systems. A WaterNSW Current Recommended Practice*

Figure 1: Existing Lot 40 DP 882293. Image provided by SIXMAPS (Accessed 2022) (NSW Spatial Services)

2 PROPOSED DEVELOPMENT

It is proposed to subdivide Lot 40 DP 882293, into two rural allotments (Figure 2). Proposed Lot 1 will be approximately 10 ha in size and proposed Lot 2 will be approximately 40.05 ha in size. Proposed Lot 2 will retain an existing dwelling and associated infrastructure.

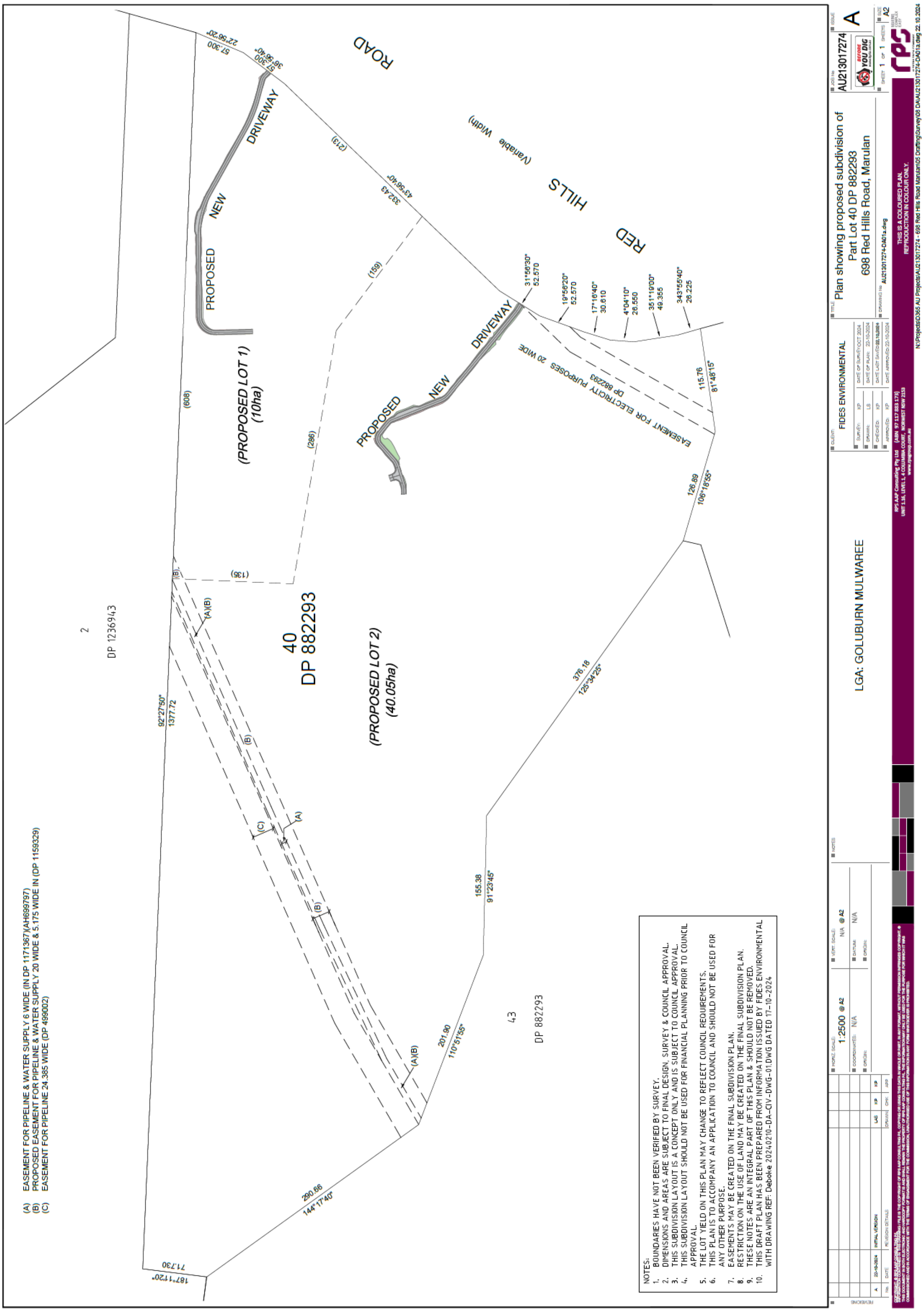

Figure 2: Proposed subdivision of Lot 40 DP 882293. Image provided by Fides Environmental, Planning & Development Management Services

ASSUMPTIONS AND LIMITATIONS OF THIS REPORT

The purpose of this report is to assess the feasibility to manage wastewater on both of the newly created Lots 1 and 2, thereby demonstrating for subdivision purposes that a new onsite wastewater system could theoretically be sited on each of those lots. This report does not provide details of a specific system to be used on a lot and must not be used by the purchasers of any of the proposed lots.

In assessing the feasibility to dispose of wastewater on each of the proposed Lots 1 and 2, we have assumed that developments on each would include:

- A new home, assumed to have five potential bedrooms;
- Shed; and
- Access driveway.

As this assessment relies on assumptions and is only a feasibility study, future purchasers of each of the new lots must not use this assessment when submitting a Development Application (DA). Future purchasers of each new lot must obtain their own site specific Wastewater Site Assessment specific to that lot, their proposed development and personal preferences.

At the time off assessment there was an existing dwelling on proposed Lot 2. Wastewater generated by the existing dwelling was being primary-treated in a septic tank and disposed via an absorption system (approximate location shown on Figure 4). For the purpose of this assessment we have assumed the existing dwelling wastewater infrastructure has a current approval to operate and shall remain onsite until such a time it is deemed no longer suitable for effluent management. SEEC have not assessed the existing system and this document does not approve that system for use. All calculations and sizing for a future wastewater management system on proposed Lot 2 have been conducting using current recommended best practice on the assumption that the existing wastewater management infrastructure will one day be replaced.

SEEC have not conducted any assessment into the feasibility of constructing a dwelling at these locations. Building envelopes shown in Figures 2 and 4 are indicative only and were provided by Southern Cross Consulting Surveyors.

3 SITE ASSESSMENT

3.1 Introduction

A site assessment was undertaken by Ciaran Bromhead of SEEC on 31 August 2022. The assessment was undertaken following Table 4 in the Environment and Health Protection Guidelines: Onsite Sewage Management for Single Households (Department of Local Government, 1998), which describes a rating system for onsite effluent management systems. Several possible site constraints are considered including, but not limited to:

(i) proximity to permanent or intermittent watercourses and farm dams;
(ii) landform, site gradient and drainage characteristics;
(iii) aspect and exposure;
(iv) extent of surface rock and outcrop;
(v) climate of the area;
(vi) existing vegetation;
(vii) soils (refer to Section 5); and
(viii) available land area.

The following sections provide a brief commentary on the levels of constraint for onsite effluent disposal across this site. The "Limitations" are based on the definitions in DLG (1998).

3.2 Location and General Site Conditions

Lot 40 DP 882293 is a rural lot located on the western side of Red Hills Road, Marulan (Figures 1 & 2). The property is bound by similar rural properties to the north, south, east and west. The existing topography in proximity to the building envelopes consists of upper to mid slopes where land in close proximity to the proposed building envelopes ultimately drains to the east. The site does not have access to reticulated water or sewer. As such effluent would need to be managed on-site.

At the time of inspection there was a residential dwelling located on the central portion of the existing lot. The site was vacant and was being used as grazing land for cattle.

3.3 Climate

Marulan experiences a temperate climate, with warm summers and cool winters. According to the Australian Bureau of Meteorology, nearby Marulan – George Street (Site No.70063) the median annual rainfall is 702 mm. There is no evaporation data for the town of Marulan however according to WaterNSW (2019) *Designing and Installing On-Site Wastewater Systems; A WaterNSW Current Recommended Practice* Marulan lies within Evaporation Zone 3 which experiences an average of 1,261 mm of evaporation per year. Rainfall is fairly evenly distributed across the year while evaporation is significantly greater in summer (Figure 3). This is considered a minor limitation to the application of treated effluent.

Table 1: Median monthly rainfall (Marulan – George Street) and evaporation (WaterNSW, 2019 Evaporation Zone 3)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Rain (mm)	55.6	55.2	52.0	34.8	31.2	45.6	31.2	33.3	38.5	47.0	52.6	53.0	702.0
Evap (mm)	187	145	124	79	51	34	39	61	88	123	146	185	1261

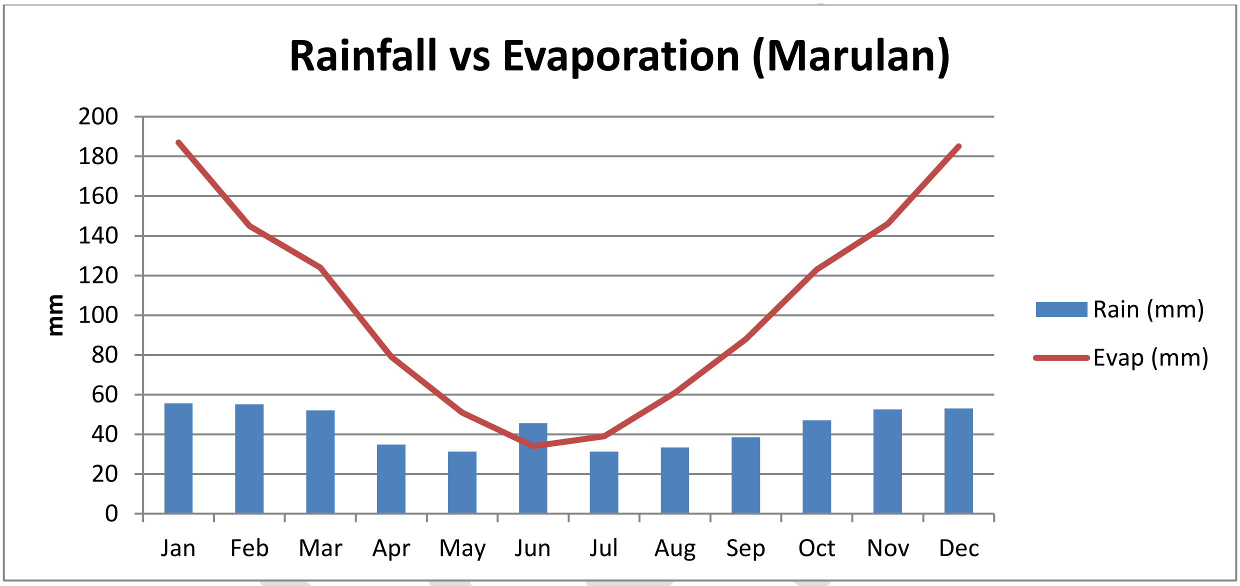

Figure 3: Graph showing Rainfall and Evaporation.

3.4 Flood Potential

While no formal flood study has been undertaken, all land identified as potentially suited to on-site effluent management appears to be well above any potential flooding. This is considered a minor limitation to the application of treated effluent.

3.5 Exposure

Land identified as potentially suited to on-site effluent management on both proposed lots is ultimately expected to be well exposed to sun and wind. This is considered a minor limitation to the application of treated effluent.

3.6 Slope

3.6.1 Lot 1

All land identified as potentially suited to on-site effluent management grades at 12-16% to the north-east. This is considered a major limitation where effluent is disposed of via surface irrigation and a moderate limitation where effluent is disposed via subsurface irrigation or absorption methods.

3.6.2 Lot 2

All land identified as potentially suited to on-site effluent management grades at 12-16% to the north-east. This is considered a major limitation where effluent is disposed of via surface irrigation and a moderate limitation where effluent is disposed via subsurface irrigation or absorption methods.

3.7 Stormwater Run-on

Some of the land identified as potentially suited to on-site effluent management might be subject to some degree of run-on. An upslope drain/berm could be required. This is considered a minor to moderate limitation to the application of treated effluent.

3.8 Proximity to Watercourses and Dams

There are numerous dams and drainage depressions affecting this site however all land identified as suitable for effluent management is located a minimum of 40 m from these features. This is considered a minor limitation to the application of treated effluent.

3.9 Surface Rock

There was significant surface rock outcropping identified onsite during our site investigation. This is considered a moderate limitation for the application of treated effluent. Areas of major surface rock outcropping have been avoided when siting the potential EMAs however it could not wholly be avoided. Depending on the final size and location of any future developments surface rock outcropping may have to be removed from within the EMAs. To mitigate the risks associated with surface rock outcropping subsurface irrigation is recommended on both proposed lots. Where rock outcropping cannot be removed, a suitable cover of topsoil (500 mm minimum) can be placed over the top of it before laying subsurface drip lines.

3.10 Groundwater Seepage

No areas of seepage or moisture tolerant vegetation were observed within the potentially suitable EMAs. This is considered a minor limitation to the application of treated effluent.

3.11 Groundwater

WaterNSW require that no onsite effluent disposal occur within 100 m of bores used for potable water supply. According to WaterNSW's ground water map there is a bore licensed for domestic use on this site (GW114693 License No. 10WA102334). Our onsite investigation identified this bore to be in proximity to the existing dwelling (Figure 4). Available information from WaterNSW's groundwater map showed the Standing Water Level (SWL) of this bore is approximately at 50 m depth. We have conducted a Viral Die Back Analysis (Appendix 5) which found viruses are likely to travel no more than 28 m downslope of their respective EMAs. To minimise the risk to groundwater the identified available EMA on proposed Lot 2 has been located over 28 m downslope from the groundwater bore.

Furthermore, any new wastewater management system installed on this site must be capable of achieving advanced secondary effluent.

3.12 Erosion Potential

No major erosion features were identified in close proximity to the identified available EMAs during our site inspection. This is considered a minor limitation to the application of treated effluent.

3.13 Fill

No unexpected fill was encountered during our investigation. This is considered a minor limitation to the application of treated effluent.

3.14 Vegetation

The suitability of the existing vegetation (if any) must be considered. The most common, and one of the most suitable, types of vegetation for effluent management is turf. Turf efficiently covers large areas and provides a good opportunity for evapotranspiration and nutrient uptake (particularly nitrogen). Some native vegetation, particularly that which has developed on poor sandy soils, will not respond well to nutrient-rich wastewater and, if possible, must be avoided or replaced with more suitable species. At the time of assessment we found the vegetation onsite to be semi-improved native pasture grass and scattered native trees where the available EMAs had a good cover of pasture grass. All nutrient modelling has been undertaken using the figures for un-managed lawn which is considered the conservative approach in Sydney's Drinking Water Catchment.

3.15 Land Availability

After summarising all of the above, particularly regarding buffer distances, land that is suitable for effluent management on site has been identified. We have found that more than enough land is suitable for effluent management via subsurface irrigation methods. Figure 4 identifies a 1,600 m^2 available EMA for each proposed lot. The available EMAs have been sited close to the indicative building envelopes, however they are not the only locations onsite where effluent management could occur.

Future owners would need to be considerate of their available (and required) EMAs when planning potential developments. As previously mentioned, future proponents would require a site specific Wastewater Site Assessment to suit their individual development and preferences.

4 SOILS AND GEOLOGY

4.1 Soil Landscape Mapping

The eSPADE mapping (accessed 2022), identifies all available EMAs are on the Gibraltar Rocks Soil Landscape.

4.2 Site Specific

Two Test Pits (TPs) were excavated by SEEC staff while on site. The soil profiles for each were similar consisting of:

TP 1

0-300 mm	Pedal brown fine sandy loam topsoil. 15-20 mm ribbon.
300-600 mm	Weakly pedal brown fine sandy clay loam. 30 mm ribbon. 10% coarse fragments. Refusal on rock.

TP 2

0-300 mm	Pedal brown fine sandy loam topsoil. 15-20 mm ribbon.
300-550 mm	Weakly pedal brown fine sandy clay loam. 30 mm ribbon. 10% coarse fragments.
550-600	Coarse yellow sand. Refusal on rock.

4.3 Soil Depth

Soil depth encountered in TPs 1 and 2 were approximately 600 mm in depth. This is considered a major limitation to the application of treated effluent via absorption methods however only a moderate limitation to the application of treated effluent via irrigation methods.

4.4 Soil Permeability

Soil permeability was not directly measured but can be inferred from the texture and depth. AS/NZS1547:2012 suggests that strongly pedal fine sandy clay loam (Category 4) subsoil has a Ksat of approx. 0.5-1.5 m/day.

4.4.1 Soil pH

The pH of a soil influences its ability to supply nutrients to vegetation. If the soil is too acidic or too alkaline vegetative growth could be inhibited. Soil investigations found the soils are non-acidic. This is unlikely to inhibit vegetation growth and is considered a minor limitation to the application of treated effluent.

4.5 Electrical Conductivity

The electrical conductivity of the soil relates to the amount of salts present. A high salt concentration would inhibit vegetative growth. Electrical conductivity has been measured in deciSemens per metre (dS/m). We have found the electrical conductivity of the soil is less than 4 dS/m. This is unlikely to inhibit vegetative growth and is considered a minor limitation to the application of treated effluent.

4.5.1 Emerson Aggregate Test (EAT)

The EAT is a measure of soil structural stability, dispersibility and susceptibility to erosion. It assesses the physical changes that occur to a single ped of soil when immersed in water - specifically whether it slakes and falls apart or disperses and clouds the water. SEEC have classified the subsoil as Class 3(2) which means that the soils show minor dispersion potential. This is considered a moderate limitation to the application of treated effluent. Ground disturbance must be minimised to only what is required for the safe and efficient installation of an onsite wastewater management system.

4.5.2 Phosphorus Sorption (P-Sorption)

A soil's capacity for sorbing (fixing) phosphorus is related to the texture and clay mineralogy. Generally, as clay content increases so does the P-sorption ability of the soil. According to WaterNSW's Neutral or Beneficial Effect (NorBE) tool the sites P-Sorption is 223 mg/kg

This represents a moderate ability to sorb phosphorus.

4.6 Soils Summary

The Test Pits and soil testing showed the soils at this site:

- Are relatively shallow (600 mm in depth).
- Are moderately drained; TPs generally revealed pedal sandy loam topsoil to weakly pedal fine sandy clay loam subsoil.
- Are non-acidic.
- Are non-saline.
- Show minor dispersion potential.
- Have a moderate ability to sorb phosphorus.

5 WASTEWATER MANAGEMENT

5.1 Design Wastewater Load

The Design Wastewater Load is calculated assuming a dwelling with five potential bedrooms (nine (9) Equivalent People (EP)) on each proposed lot with access to tank water supply. This equates to 900 L/day of wastewater generated on each proposed lot.

5.2 Proposed Wastewater Systems

For the purpose of this assessment SEEC have assumed that each lot will advance secondary-treat all wastewater generated in an Advanced Aerated Wastewater Treatment System (AWTS), or similar, before being disposed via subsurface irrigation (Appendix 3). This is the preferred approach in Sydney's Drinking Water Catchment.

The recommended wastewater management system has been based on the weakly pedal fine sandy clay loam (Category 4) subsoil encountered in TPs 1 and 2. Hydraulic modelling for zero storage (Appendix 1) requires a minimum EMA of 420 m². Nutrient modelling (Appendix 2) requires a minimum EMA of 822 m². An available EMA of 1,600 m² has been identified in close proximity to the indicative building envelops for both proposed lots.

It is required that all new developments within the Sydney drinking water catchment have a Neutral or Beneficial Effect (NorBE) on water quality. This is assessed using the NorBE assessment tool which includes a Wastewater Effluent Model (WEM). SEEC has undertaken an indicative WEM on this site and found that the WEM plume is expected to travel no more than 2.5 m downslope of any future EMA (Appendix 4).

Note: There has been several assumption made in the WEM. These assumptions have been made so the WEM can generate an effluent plume and we can check whether the plume is likely to cross an existing and/or proposed lot boundary. The results of the WEM show that a suitable EMA could feasibly be located on both proposed lots.

5.3 General Requirements for EMAs

5.3.1 Vegetative Cover

All deep rooted vegetation must be cleared from the proposed EMAs prior to commissioning so they have good exposure to sun and wind. The EMAs must be well vegetated (preferably with lawn grasses) before they are commissioned to reduce runoff and possible erosion and provide uptake of nutrients. Lawn grass is generally the most suitable form of vegetation but, at the time of inspection, the site had good covering of grasses suitable for effluent management.

5.3.2 Protection from Vehicles

Future owners should identify their EMA and ensure it is protected from vehicle access (fence it off if required).

5.3.3 Buffers

Buffers are required to EMAs from watercourses, drainage depressions, lot boundaries and the built environment. They vary depending on the level of pre-treatment and the relative position of the EMA to a given feature (Table 2):

Table 2: Required buffer distances as per the WaterNSW, 2019

	Surface Irrigation	Subsurface Irrigation
Buildings and retaining walls	6 - 15 m	2 m downslope or flat, 6 m upslope
Premise's boundaries, paths, drives and walkways, recreation areas	15 m	3 m downslope or flat, 4 m upslope
In-ground potable water tanks, in-ground swimming pools	4 m not to be located upslope	4 m not to be located upslope
Permanent and intermittent watercourses	100 m from high water level	100 m from high water level
Bore or well used for domestic consumption	100 m from high water level	100 m from high water level
Dams, drainage depressions, roadside drainage and stormwater improvement devices	40 m from high water level	40 m from high water level

5.3.4 Signs

A minimum 0f two Warning Signs must be installed along the edge of the EMA. The signs shall read "WARNING: RECLAIMED EFFLUENT/RECYCLED WATER, DO NOT DRINK, AVOID CONTACT" or similar. Lettering must be clearly visible from three meters away.

5.3.5 Water Saving Fixtures

In order to minimise wastewater generation on each of the proposed lots any new structure must incorporate full water reduction fixtures (three-star (min)). Full water reduction are 3/6 litre dual flush toilets, shower flow restrictors, aerator taps, front load washing machines, and flow/pressure control valves on all water use outlets.

5.3.6 Future Management

Council will require AWTSs be inspected every three months by a qualified person and the results of that inspection sent to council. It would also be the responsibility of the new owners to maintain the EMAs by ensuring effluent is distributed evenly over the entire area and that it is regularly mown.

Figure 4: Potential identified EMA locations and existing site features. This Figure is to be read with the accompanying report provided by SEEC

6 CONCLUSION

In conclusion, site and soil conditions on the proposed lots are considered suitable for on-site wastewater management via irrigation methods. Possible EMA locations have been identified on the plan in Figure 4.

It is assumed that future owners will install an Advanced AWTS to advance secondary-treat all wastewater generated by their developments. Secondary-treated effluent generated in the advanced AWTSs could then be disposed via subsurface irrigation. SEEC have identified 1,600 m² of available EMA on each proposed lot. Future owners may need to remove some surface rock in order to establish a suitable EMA on these sites. If rock cannot be removed a suitable cover of clean topsoil (500 mm minimum) will be required to cover the rock outcrop.

Ground disturbance must be minimised to only what is required for the safe and efficient installation of any proposed onsite wastewater management system to minimise the risk of erosion.

Given the conceptual nature of this assessment, it is expected that future proponents would require a *site specific* Wastewater Site Assessment to suit their individual development and preferences. Providing the general mitigation measures contained herein are adhered to the risk of pollution to receiving waters is minimal. As noted previously, this report assesses the theoretical feasibility to establish an EMA on each of Lots 1 and 2 and must not be relied upon by future purchasers of those lots.

7 REFERENCES

Cromer, W. C., Gardner, E. A. and Beavers, P. D. 2001. An improved viral die-off method for estimating setback distances.

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WaterNSW (2021). *Neutral or Beneficial Effect on Water Quality Assessment Tool CONSULTANTS AND CONSULTANT ADMINISTRATORS*

8 APPENDICES

8.1 Appendix 1 – Hydraulic Modelling for Zero Storage

Rainfall Station	Marulan (George Street)	
Evaporation Zone	3	
Wastewater Load	900	L/day
Design Irrigation Rate	3	mm/day
Land Area	420	sqm
Storage required:	0.0	cubic m

Month	Days in month	Median Precipitation (mm)	Evaporation (mm)	Crop Factor
Jan	31	55.6	187	0.8
Feb	28	55.2	145	0.8
Mar	31	52	124	0.8
Apr	30	34.8	79	0.8
May	31	31.2	51	0.7
Jun	30	45.6	34	0.6
Jul	31	31.2	39	0.6
Aug	31	33.3	61	0.6
Sep	30	38.5	88	0.7
Oct	31	47	123	0.8
Nov	30	52.6	146	0.8
Dec	31	53	185	0.8

INPUTS

	Median Precipitation (mm)	Effluent Irrigation (mm)	Inputs (mm)
Jan	55.6	66.43	122.03
Feb	55.2	60.00	115.20
Mar	52.0	66.43	118.43
Apr	34.8	64.29	99.09
May	31.2	66.43	97.63
Jun	45.6	64.29	109.89
Jul	31.2	66.43	97.63
Aug	33.3	66.43	99.73
Sep	38.5	64.29	102.79
Oct	47.0	66.43	113.43
Nov	52.6	64.29	116.89
Dec	53.0	66.43	119.43

OUTPUTS

	Evapotranspiration (mm)	Percolation (mm)	Outputs (mm)	Storage (mm)	Cumulative
Jan	149.6	93.00	242.60	-120.57	0.00
Feb	116	84.00	200.00	-84.80	0.00
Mar	99.2	93.00	192.20	-73.77	0.00
Apr	63.2	90.00	153.20	-54.11	0.00
May	35.7	93.00	128.70	-31.07	0.00
Jun	20.4	90.00	110.40	-0.51	0.00
Jul	23.4	93.00	116.40	-18.77	0.00
Aug	36.6	93.00	129.60	-29.87	0.00
Sep	61.6	90.00	151.60	-48.81	0.00
Oct	98.4	93.00	191.40	-77.97	0.00
Nov	116.8	90.00	206.80	-89.91	0.00
Dec	148	93.00	241.00	-121.57	0.00

8.2 Appendix 2 – Nutrient Modelling

Wastewater Volume	900 (L/day)
Vegetation in EMA	Lawn - Unmanaged
Limiting Soil in EMA	Clay Loams

Hydraulic Balance (AS/NZS1547:2012)

A=Q/DLR

Where:

A = Area (m^2)

Q = Wastewater Flow =	900	L/day	
DLR = Design Loading Rate =	3.5	mm/day	
Area Requred:			
A =	257	m^2 of	Irrigation

Nitrogen Balance (WaterNSW, 2021)

A = 3.65(C x Q) / Lx

Where:

A = Area (m^2)

C = Concentration of Nutrient =	30	mg/L	
Q = Wastewater Flow =	900	L/day	
Lx = Critical Loading Rate =	120	(Kg/ha/year)	
Area Required:			
A =	822	m^2 of	Lawn - Unmanaged

Phosphorus Balance (WaterNSW, 2021)

$A=3.65(CxQ)/U_R+0.2d(1-n_p)G_sX_{sorp}$ Basalt soils?

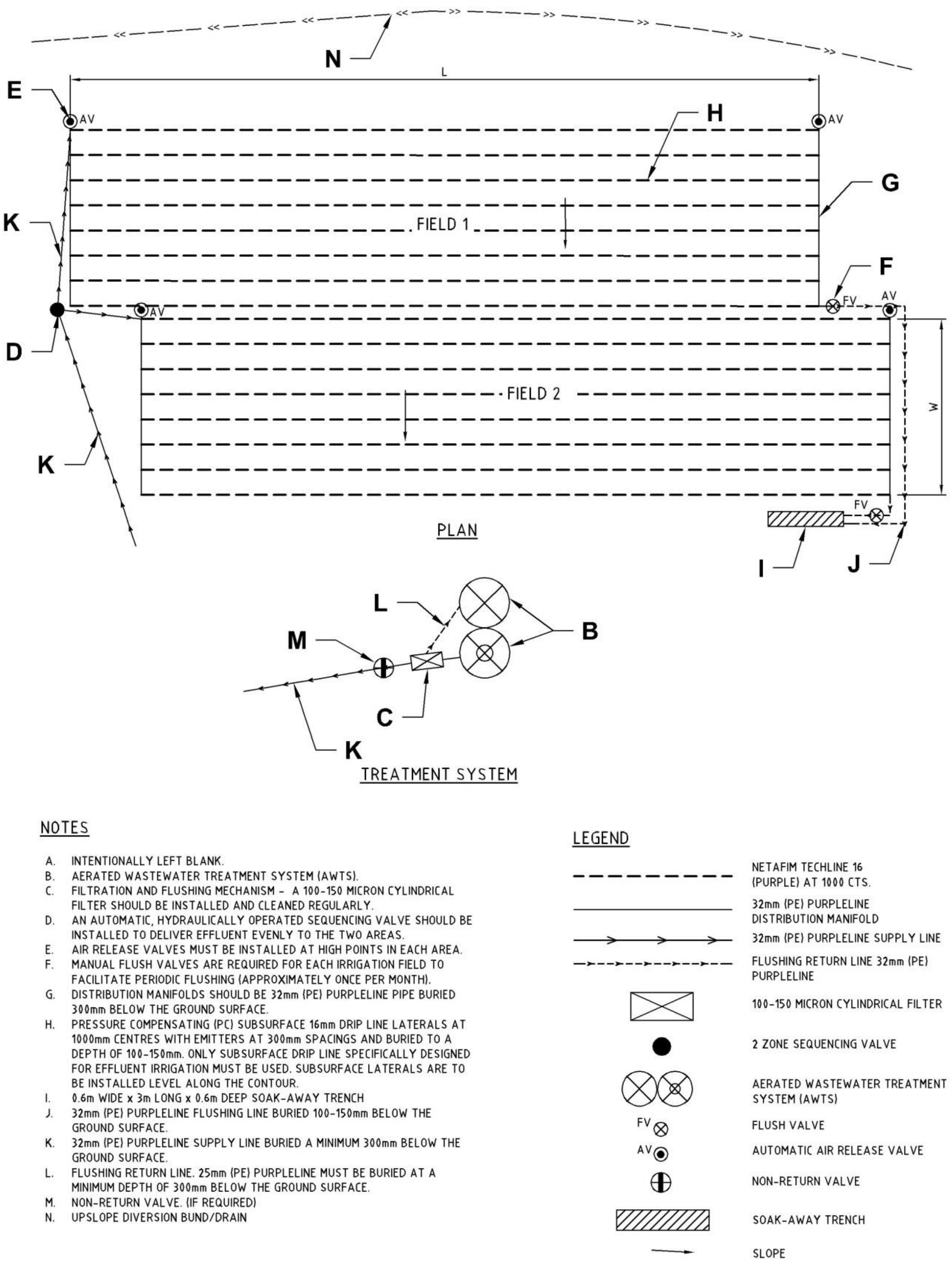
Where:

A = Area (m^2)

Wastewater Flow (Q) =	900	L/day	
Phosphorus Sorption (X_{sorp}) =	223	mg/kg	
Design Soil Depth (d) =	0.6	m	
Bulk Density =	1.66	g/cm^3	
Soil Specific Gravity ($G_{s)}$ =	2.65	g/cm^3	
P uptake (U_R) =	12	kg/ha/year	
Concentration of phosphorus =	12	mg/L	
Area Required:			
A =	699	m^2 of	Lawn - Unmanaged

Adapted from WaterNSW, 2019 and WaterNSW, 2021

8.3 Appendix 3 – Typical Detail of a Subsurface Irrigation Field



SUBSURFACE IRRIGATION

8.4 Appendix 4 – Neutral or Beneficial Effect (NorBE) Modelling

NorBE Assessment

WEM Summary

version 3

General Information

WEM model ID	**2604193**	Associated DA number	
Model description			
Consultancy	**SEEC**	Consultant	**cbromhead@seec.com.au**
Consultant reference number	**22000385**		
Council	**Goulburn Mulwaree**	Assessing officer	
Nominated lot	**40//882293**	Associated lots	
Development class	**New dwelling/dual occ <8bdrm unsewered**		
Date of model run	**9/12/2022 4:41:45 PM**		

Associated lots:

Lot	Section	Plan
40		882293

WEM Model Run Summary

Model run outcome **Satisfied**

Any of the sub-surface plumes reaches:

Lot boundary	**No**
Drainage depression	**No**
Top bank of watercourse	**No**
Another disposal field or onsite stormwater management system	**No**
Within 50m, and up gradient of,a licensed drinking water bore	**No**

Proposed Front End Design

Length (across slope)(m)	**40.0**	Width (up slope)(m)	**20.6**
Proposed area(m2)	**822.2**	Minimum Required area (m2)	**822.0**
Number of trenches	**0**		
Effluent volume proposed (l/day)	**900**		
Effluent volume calculated (l/day)	**900**		

WEM Model Inputs

Location

Easting	**9576249.677424**	Northing	**4338323.556654**
Slope (m/m)	**0.02561**	Slope is suitable based on site inspection (Applicable to some disposal systems on steep slopes)	**N/A**

Development

Development type	**Dwellings**	Development detail	**5 bedrooms**

WaterNSW

NorBE Assessment

WEM Summary

version 3

Water supply type	**Rainwater**	Spa Bath	**No**
Continuous system use	**Yes**		
Treatment system	**AWTS standard**	Disposal system	**Irrigation sub-surface**

Site

Lot size(m2)	**500000**		
Subject to severe frost	**No**	Bulk density(g/cm3)	**1.66**
Vegetation for nutrient uptake	**Lawn - unmanaged**	Phosphorus sorption (mg/kg)	**223**
Soil depth (to impermeable layer) (m)	**0.60**	Soil structure	**High/moderate**
Saturated hydraulic conductivity (Ksat)(m/day)	**0.62**		
Soil texture	**Clay loams**		

Effluent disposal risk factors

Depth to water table	**0.4 - 1.0**
Flood potential of disposal system	**Above 1 in 50 year ARI**
Landform score	**Hill crests, convex side slopes and plains**
Run-on and upslope seepage	**None-low, diversion possible**
Rock outcrops, scarp and bedrock	**< 5%**
Distance to drainage dpression	**> 50**
Distance to watercourses and water supply reservoirs	**> 120**
Distance to licenced drinking water bores	**> 150**

WEM Plume Map

No image of the plumes is available. This may be because the model has not yet been run or because no image was generated when the model ran.

WaterNSW


Legend :
Selected lots
Effluent management area
Phosphorus
Nitrogen
Faecal coliforms
Irrigation system area

8.5 Appendix 5 – Viral Die Back Analysis

SEEC

Viral Die Back Calculations (Cromer et al, 2001).
These calculations show the expected travel distance for pathogens in soils.

Inputs

Soil Type	Clay Loam		
Soil Porosity	25	%	
Soil Permeability	1.5	m/day	
Soil Thickness	0.6	m	
Gradient	19	%	
Winter Mean High Winter Temperature	12.5	degrees C	
Time to achieve log cycle reduction using Mag 2 Secondary Effluent	25	days	(see chart)
Predicted Travel Distance (m)	**28**	**m**	

Feature in proximity to EMA	Groundwater Bore
Achievable Buffer	100m

On-site '01. Armidale *W Cromer, E Gardner & P Beavers*

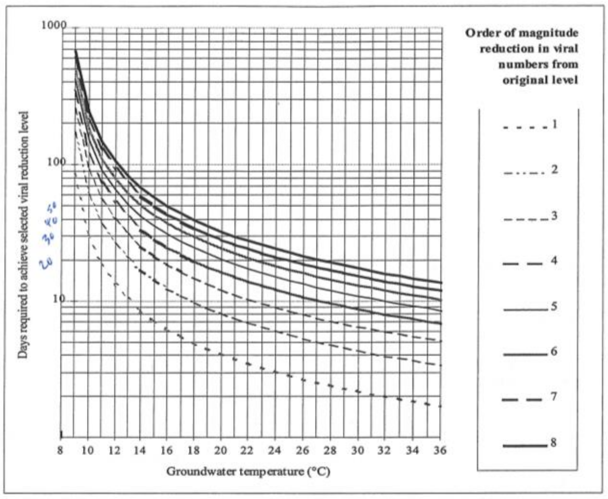


Figure 1. Relationship between Groundwater Temperature and Viral Die-Off Time for Various Order-of-Magnitude Reductions in Viral Numbers

3.2 Correcting Travel Time for Vertical Infiltration

The time required for groundwater to move a given distance in saturated material is described by a well-known form of Darcy's Law:

$$t = d.P / K.i \qquad \text{Eqn 2}$$

where

- t is the time (days) and d is the distance (m),
- P is the effective porosity of the soil (as a fraction; e.g. 0.2 instead of 20%),
- K is the saturated hydraulic conductivity (permeability) of the soil (m/day), and
- i is the groundwater gradient (as a fraction; e.g. 0.01 instead of 1 in 100).

Beneath an absorption trench or any similar land application area discharging wastewater to a uniform soil with a water table (Figure 2), the travel time for viral die-off is made up of two components:

- t_v, the time for wastewater to move vertically a distance d_v to a water table, and
- t_g, the time for wastewater to move a distance d_g with the groundwater.

The total distance is $d_v + d_g$ (of which only d_g is the setback distance). Similarly, the total travel time t is $t_v + t_g$, which can be expanded using Equation 2 to:

$$t = d_v.P/K + d_g.P/K.i \qquad \text{Eqn. 3}$$