ENVIRONMENTAL CONSULTING Pty Ltd

ONSITE SEWAGE MANAGEMENT ASSESSMENT

Site Feasibility Assessment for Dwelling Entitlement

January 2024

Prepared for: Scott Pearson

Lot 1 DP 818394
Clothiers Creek Road
Bogangar

HMC Ref: 2023.627.01

RE: Lot 1 DP 818394, Clothiers Creek Road, Bogangar

HMC Environmental Consulting Pty Ltd is pleased to present our report for On-site Sewage Management Assessment for the abovementioned site.

We trust this report meets with your requirements. If you require further information, please contact HMC Environmental Consulting directly on the numbers provided.

HMC ENVIRONMENTAL CONSULTING Suite 29, Level 2, 75-77 Wharf Street PO Box 311, Tweed Heads NSW 2485	Ph: 07 55368863 Email: admin@hmcenvironment.com.au ABN: 60 108 085 614

TITLE:	Onsite Sewage Management Assessment
PREPARED FOR:	Scott Pearson
HMC JOB NUMBER:	2023.627.01

DOCUMENT RECORD				
VERSION	DATE	PREPARED BY	CHECKED BY	ISSUED BY
Draft	20.12.2023	TR	SV	SV
Final	23.01.2024	TR	SV	SV

DISTRIBUTION LIST	DATE	VERSION	COMMENTS
S. Pearson, Newton Denny Chapelle	20.12.2023	Draft Issue A	For review
S. Pearson, Newton Denny Chapelle	23.01.2024	Final Issue A	Final

This report should be cited as 'HMC Environmental Consulting (2023). On-site Sewage Management Assessment, Site Feasibility Assessment for Dwelling Entitlement, Lot 1 DP 818394, Clothiers Creek Road, Bogangar, NSW. Report No. HMC2023.627.01.'

TABLE OF CONTENTS

LIST OF TABLES

ABBREVIATIONS

AWTS	Aerated Wastewater Treatment System
BOD_5	Biochemical oxygen demand over 5 day period
CFU	Colony forming unit
DIR	Design irrigation rate
DLR	Design loading rate
ETA	Evapo-Transpiration Absorption (ETA) ETA beds will be used in reference to the construction of shallow sub surface effluent disposal trenches that utilise the principles of evaporation, transpiration and absorption. The method of construction for the ETA bed referred to in this report is in accordance with a "Conventional Bed" provided in Figure L5 of AS/NZS 1547: 2012.
LAA	Land application area
LTAR	Long term acceptance rate
OSSM	On-Site Sewage Management
SDI	Sub-surface drip irrigation
TN	Total nitrogen
TP	Total phosphorus
TSS	Total suspended solids

1. INTRODUCTION AND SUMMARY

HMC Environmental Consulting Pty Ltd has been commissioned to prepare a site feasibility assessment for dwelling entitlement located at Lot 1 DP 818394, Clothiers Creek Road, Bogangar, within the Tweed Shire Council.

A site inspection was carried out on 01/12/2023 by Helen Tunks of HMC. During the site inspection the site and soil characteristics were assessed for wastewater treatment and disposal methods for the recommended OSSM system.

The property is large and exhibits minimal constraints for effluent disposal. This report contains hydraulic & nutrient modelling to show site feasibility for effluent disposal based on an assumed 4-bedroom, 6 persons design occupancy. Three suitable land application areas (LAAs) have been provided within this report.

The recommended treatment system is an Aerated Wastewater Treatment System (AWTS) for secondary treatment and disinfection. Effluent disposal is recommended through 500m^2 of shallow ripped subsurface drip irrigation under lawn. Adequate reserve land application area remains available on the large rural property, as provided on the site plan within this report.

2. PROJECT INFORMATION

Table 1 - Project Information

Proposal	Proposed OSSM System Assessment
Property	Lot 1 DP 818394 Clothiers Creek Road Bogangar
Property Area	6.10 Ha
Council Area/Approvals:	Tweed Shire Council
Design Daily Hydraulic Load	900L/day Assumed 4-bedroom dwelling 6 persons design occupancy @ 150L/p/day
Water Saving Devices	Assumed
Water Supply	Reticulated mains supply assumed

3. SUMMARY OF RECOMMENDED SEWAGE WORKS

Table 2 - OSSM Proposal

Recommended On-Site Sewage Management System
● Install an Aerated Wastewater Treatment System (AWTS) with NSW Health accreditation ● Ensure all sanitary drainage is connected to the proposed system. Land Application Area: ● Install 500m^2 of shallow ripped pressure-compensated subsurface drip irrigation (SDI) under lawn ● Recommended dripper line is Netafim Unibioline CNL 16mm @ average 100mm depth and 1m spacing. No tech filter is required with the Unibioline CNLXR (herbicide impregnated) dripline ● Install 32mm PE pipe, buried @ 150mm depth, to distribute effluent from AWTS to proposed Land Application Area (LAA)

Table 3 - OSSM Justification

Justification For Land Application Area
• The existing large rural property contains minimal site constraints for effluent disposal. Recommended LAAs achieve a minimum 40m buffer distance to intermittent watercourses & 10m to property boundaries • The recommended OSSM system provides secondary treatment and effluent disposal below ground via subsurface drip irrigation, minimising the risks to public health & the environment • The recommended shallow sub-surface drip irrigation (SDI) installed via ripping provides flexibility for installation within existing scattered trees and allows existing dense grass cover over the deep soil to remain in place. • The pressure compensating dripperlines provide uniformity of distribution on varying elevations and is therefore the most appropriate land application method on sloping sites.

4. LAND CAPABILITY – SITE & SOIL ASSESSMENT

4.1. SITE CONDITIONS

Should conditions vary from those described during any stage of installation HMC is to be notified to ensure the recommendations of this report remain valid or alternative recommendations be made. The information relates to the general site but more specifically to the proposed effluent land application area (LAA).

Table 4 - Site Conditions

Inspected by	Helen Tunks
Date & Time of Inspection	01/12/2023 See Appendix 1 for site location, Appendix 8 for photos.
Weather	Weather: Fine, hot. BOM Stn 58137 Kingscliff (Woram Place) ~45mm rainfall recorded the week preceding site inspection. ~280mm rainfall recorded the month preceding site inspection
Soil Type & Category	Soil Category 5 (AS/NZS1547:2012) BH1 – within recommended LAA See Appendix 4 for soil investigation information.
Climate	Warm-temperate and high volume, seasonal rainfall typical of region.
Terrain	Flat to middle slopes
Slope & Drainage:	~3 – 20%, generally level to moderate slopes Linear planar, convergent & divergent
Aspect & Shading	Northern aspect Partial shading expected
Ground cover/vegetation	Existing Vegetation (Full cover), Grass/pasture/lawn, Trees (scattered)
Site Constraints	Imperfectly drained soil High volume seasonal rainfall Setback distances to intermittent watercourses
Reserve LAA	100% available

4.2. SITE COMPLIANCE

Table 5 - Site Constraints

Site Constraints		Recommended	Complying?
Setback to Boundary	>10m to property boundary	3-6m (DLG, 1998)	YES
Setback to Watercourse	40m to dam	15-100m (AS/NZS1547:2012)	NO
Setback to Water Bore	>300m to nearest registered domestic groundwater bore	15-50m (AS/NZS1547:2012) 100m (WaterNSW)	YES
Setback to Buildings & Site Features	>3m	2-6m (AS/NZS1547:2012)	YES
Reserve LAA	100% available		YES
Slope Gradient	3-20%, gentle to moderate slopes	<30%	YES
Flood Liability	Nil flood inundation within recommended LAAs	>1:20 year flood level contour	YES
Water Supply Catchment	Not mapped		YES

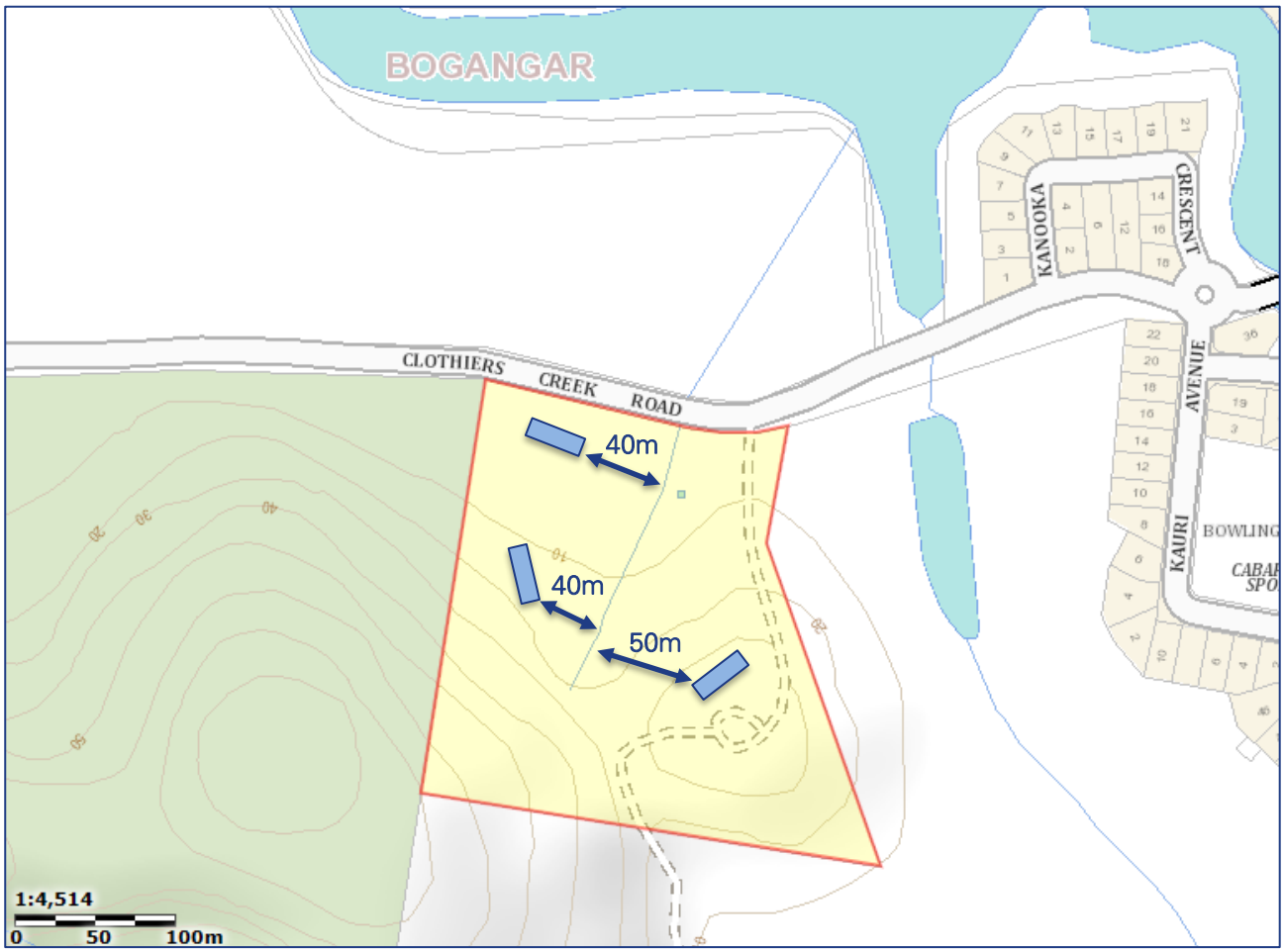


Figure 1: Site Features & Setback Distances from LAAs (Source: NSW Spatial Viewer, Six Maps).

4.3. SETBACK DISTANCE RISK ASSESSMENT

The setback distances adopted for this upgrade are those recommended within the following:

- Table R1, AS/NZS1547: 2012
- Environment & Health Protection Guidelines – On-site Sewage Management for Single Households (DLG et al. 1998)
- Environment & Health Protection Guidelines: On-site Wastewater Management Guidelines (DLG et al., Draft Review 2023)
- Water NSW, "Designing and Installing On-site Wastewater Systems", 2019

The following site features do not comply with the recommended setback distances from land application areas (LAAs) as mentioned in the above guidelines.

- Surface water

A setback distance risk assessment of the site constraints, based on Table R1 of AS/NZS1547:2012, was carried out and is detailed in Appendix 6. The risk assessment conclusions are presented in Table 6 below.

Table 6 - Risk Assessment Results for Site Constraints

Site Constraint	Setback Distance/Criteria Achieved	Average Risk Assessment Result (Appendix 6)	Mitigations
Surface waters	~40m to intermittent watercourse	LOW	• Secondary treated effluent with disinfection achieved within AWTS • Provides a significant reduction in risk to public health and the environment • The nutrient management area will remain within the recommended LAAs • Low DIR achieved • No vegetation removal required • To remain conservative, an estimate of pathogen die-off has been calculated using Cromer, Gardner & Beavers, "An Improved Viral Die-Off Method for Estimating Setback Distances". The calculations assume a conservative vertical separation distance to the watercourse of 1m & a permeability rating of 1.5mm/day for Light Clay soils exhibited. The pathogen die-off distance has therefore been calculated as 6.2m with a safety factor of 2, increasing the distance to approximately 12.5m (Appendix 9).
CONCLUSION	Mitigations considered satisfactory given the constraints of the existing lot and the effluent treatment and distribution achieved with the recommended OSSM system.		

5. SEWAGE TREATMENT SYSTEM

The effluent treatment considered to be most appropriate for the wastewater generated by the dwelling occupants is secondary treatment with final disinfection. This level of treatment enables the effluent to be distributed to the shallow topsoil zone via pressure compensated drip irrigation line under a lawn grass surface.

The pressure compensating nature of the emitters within the dripperline allows for the drip irrigation line to be installed on sloping land and still achieve uniform and controlled distribution of effluent. Appendix 5 provides the NSW Health guidelines for effluent quality suitable for shallow sub-surface drip irrigation. An Aerated Wastewater Treatment System (AWTS) with NSW Health accreditation would be a suitable system to provide this level of effluent treatment. Typical AWTS systems available locally can treat wastewater flows between 1200- 3000L per day.

6. LAND APPLICATION AREA SIZING AND DESIGN

6.1. ASSESSED DESIGN INPUTS

Table 7 - Design Model

Model Used: Draft Richmond Tweed On-Site Regional Strategy (Alderson, 1999)	
Climate Data	Tyalgum (1971-1984). Mean annual rainfall 1555mm
Structure	4-bedrooms
Design Occupancy	6 persons assumed
Wastewater Design Flow Allowance	150L/p/day
Wastewater Design Hydraulic Load	900L/day
Nitrogen (TN)	3.8 kg/person/year (Whelan & Titammis,1982)
TN System Nutrient Reduction	Secondary treatment ~55% reduction assumed in an AWTS with NSW Health accreditation
Vegetation Removal of TN	Conservative rate of 300 kg/ha/year. Note: Kikuyu up to 520kg/ha/year (NSW Agriculture 1997)
Phosphorus (TP)	0.6 kg/person/year (Geary & Gardner, 1996)
Vegetation Removal of TP	20 kg/ha/year (Myers et al 1994)
Phosphorus Adsorption	~10000 kg/ha/ based on field texture and work carried out by Morand, 1996
Maximum Design Irrigation Rate (DIR)	3mm/day for Light Clay soils (Table 5.2, AS/NZS1547:2012)
Proposed DIR	1.8mm/day
Comments	The proposed DIR is conservative for the Light Clay subsoils exhibited on the subject site.

6.2. SUMMARY OF MODELLING CALCULATIONS

Table 8 - Modelling Calculations Summary

Analyte	Minimum Recommended Land Application Area (LAA) Hydraulic Loading Rate (Q) = 900L/day	
	LAA Modelling Results	Recommended LAA Layout
Hydraulic Load	500m^2	500m^2 subsurface drip irrigation under lawn grass
Nitrogen (TN)	342m^2	
Phosphorus (TP)	69m^2	
DIR	1.8mm/day	

To provide a realistic assessment of permeability multiple tests are required. It is considered that the conservative loading rates based on soil texture (AS/NZS 1547:2012) are adequate for design inputs in this case for a domestic situation. The nutrient management area of 342m^2 will be contained within the proposed LAA.

7. DISCUSSION/REASON FOR APPROVAL

The recommended OSSM system achieves a reduced risk to public health and the environment by disposing of secondary treated effluent under dense, vigorously growing lawn grass. The DIR of 1.8mm/day is conservative for the light clay subsoil. The recommended effluent land application method of shallow ripped subsurface drip irrigation maximises the advantages of the existing established root zone.

Overall, the recommended system is a conservative design, maximises the advantages of the existing topsoil and achieves an average low risk of encroaching to surface waters.

The property presents minimal constraints for effluent disposal. Three available land application areas have been marked on the site plan, showing the site has capacity to support an on-site sewage management system with 100% reserve area available.

8. RECOMMENDATIONS

Based on the information presented in this report, it is considered that the recommendations listed below are sufficient to attain an acceptable level of environmental impact from the design wastewater flow generated by dwelling occupants.

Table 9 - Recommendations

DESIGN HYDRAULIC LOADING	
● 900L/day ● Assumed reticulated mains water supply	● Assumed 4-bedroom dwelling design ● 6 persons occupancy assumed

RECOMMENDED ON-SITE SEWAGE MANAGEMENT SYSTEM

Refer to Site Plan & Detail Construction Design on following pages

- Install an Aerated Wastewater Treatment System (AWTS) with NSW Health accreditation
- Ensure all sanitary drainage is connected to the proposed system.

Land Application Area:

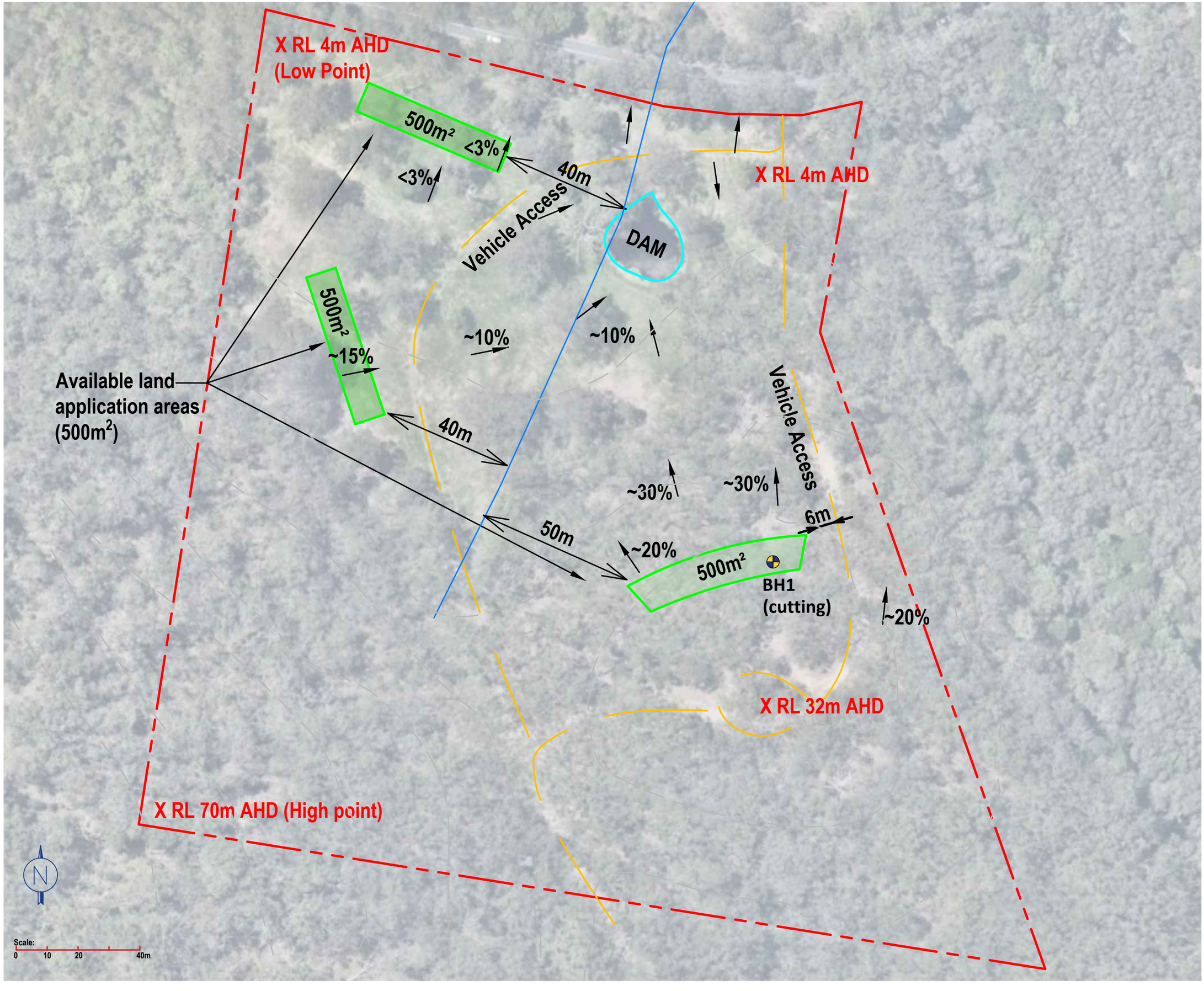
- Install 500m^2 of shallow ripped pressure-compensated subsurface drip irrigation (SDI) under lawn
- Recommended dripper line is Netafim Unibioline CNL 16mm @ average 100mm depth and 1m spacing. No tech filter is required with the Unibioline CNLXR (herbicide impregnated) dripline
- Install 32mm PE pipe, buried @ 150mm depth, to distribute effluent from AWTS to proposed Land Application Area (LAA)

OPERATION & MAINTENANCE

AWTS

- A contract with an authorised AWTS service agent for quarterly service inspections is to be current and remain current always during the operation of the system.
- The occupants are to practice water conservation and follow the chemical usage recommendations provided by the AWTS Manufacturer to maximise performance and longevity of the on-site sewage management system
- DO NOT ALLOW VEHICLES OR STOCK INCLUDING SLASHERS/TRACTORS TO ENTER THE EFFLUENT LAND APPLICATION AREA
- DO NOT DISPOSE OF DOWN THE DRAINS: Bleach, bleach-based products, whiteners, nappy soakers, and spot removers. Dispose of in the garden in an unused location
- DO NOT FLUSH DOWN THE SEPTIC SYSTEM: Hygiene products, condoms, tampons, sanitary napkins, disposable nappies, and cotton buds
- DO PRACTICE WATER CONSERVATION
- DO USE only the recommended amounts of disinfectants and cleaners. Biodegradable products for septic systems are recommended
- DO MOW the LAA to ensure that rainfall is shed from the surface

8.1. SITE PLAN & SECTION DETAIL



OSSM Site Feasibility
Available Land Application Areas (LAAs)

SHEET 1 - PLAN

Available Land Application Area (LAA) 500m²

ASSUMED COMPONENTS

- Aerated Wastewater Treatment System (AWTS) with NSW Health accreditation
- 500m² subsurface drip irrigation under grass

ALL LOCATIONS ARE GENERAL ONLY AND ARE TO BE CONFIRMED ONSITE

Job:	HMC2023.627
DWG:	HMC2023.627
Date:	December 2023
Version:	A - 20.12.2023
Drawn:	TR
Base:	Nearmap 2023
Council:	Tweed Shire Council

Clothiers Creek Road
Lot 1 DP 818394
Bogangar

HMC ENVIRONMENTAL CONSULTING Pty Ltd
HMC Environmental Consulting Pty Ltd
Tweed Heads NSW
0755368863
www.hmcenvironment.com.au
admin@hmcenvironment.com.au

9. LIMITATIONS

The information within this document is and shall remain the property of HMC Environmental Consulting Pty Ltd.
This document was prepared for the sole use of client and the regulatory agencies that are directly involved in this project, the only intended beneficiaries of our work. No other party should rely on the information contained herein without the prior written consent of HMC Environmental Pty Ltd and client. The report and conclusions are based on the information obtained at the time of the assessment. Your report is based on the assumption that the site conditions as revealed through selective point sampling are indicative of actual conditions throughout an area. This assumption cannot be substantiated until project implementation has commenced and therefore your report recommendations can only be regarded as preliminary.

Because a report is based on conditions which existed at the time of the subsurface exploration, decisions should not be based on a report whose adequacy may have been affected by time, natural processes and the activities of man. Changes to the subsurface, site or adjacent site conditions may occur subsequent to the investigation described herein, through natural processes or through the intentional or accidental addition of imported material, and these conditions may change with space and time.

The findings of this report are based on the objectives and scope of work outlined within. HMC performed the services in a manner consistent with the normal level of care and expertise exercised by members of the environment assessment profession. No warranties or guarantees, expressed or implied, are made. Subject to the scope of work, HMC's assessment is limited strictly to identifying typical environmental conditions associated with the subject property and does not include evaluation of any other issues. This report does not comment on any regulatory obligations based on the findings for which a legal opinion should be sought. This report relates only to the objectives and scope of the work stated and does not relate to any other works undertaken for the Client. All conclusions regarding the property area are the professional opinions of the HMC personnel involved with the project, subject to the qualifications made above.

While normal assessments of data reliability have been made by HMC, HMC assume no responsibility or liability for errors in any data obtained from regulatory agencies, or information from sources outside HMC's control, or developments resulting from situations outside the scope of this project.

10. REFERENCES

- Alderson, G. & Associates Pty Ltd, Draft Richmond Tweed On-site Regional Wastewater and Sewage Management Strategy, 1999 (OSSM Design Model)
- Australian/New Zealand Standard AS 1547: 2012 - *On-site domestic wastewater management*, February 2012
- Geary, P. and Gardner, T. *On-site disposal of effluen*t. Innovative Approaches to the On-Site Management of Waste and Water: A one day conference, Southern Cross University, Lismore NSW, 1996.
- Morand, D.T., *Soil Landscapes of the Lismore-Ballina 1:100 000 Sheet*, 1994
- NSW Department of Local Government, EPA (NSW), NSW Health, Land and Water Conservation and Department of Urban Affairs and Planning, *Environment & Health Protection Guidelines – On-site Sewage Management for Single Household*", February 1998
- WaterNSW," Designing and Installing On-site Wastewater Systems. A WaterNSW Current Recommended Practice", WNSW, 2019
- NSW Office of Water, "Commenced Water Sharing Plan for the Tweed River Area unregulated and alluvial water sources", October 2010
- Whelan, B.R. and Titammis, Z.V. Daily chemical variability of domestic septic tank effluent. *Water, Air and Soil Pollution* ***17***, 131-139

11. APPENDICES

See following pages

APPENDIX 1 SITE LOCATION

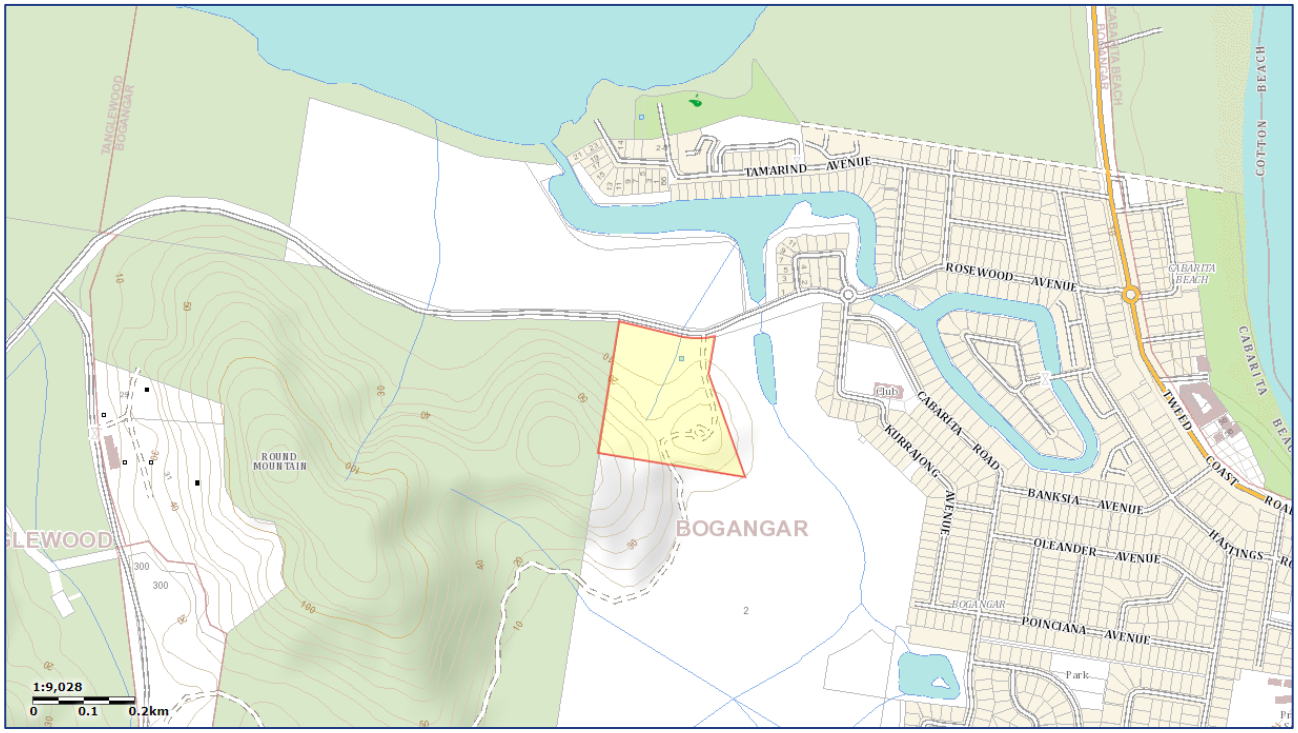


Figure 2 - Site Location (Source: NSW Spatial Viewer, Six Maps)

Figure 3 - Site Boundary (Source: Nearmap 2023)

APPENDIX 2 OSSM DESIGN MODEL

Daily Effluent Disposal Model using Boughton Water Balance Model - Tyalgum Greg Alderson & Associates Pty Ltd (LCC, Part C, 2007) Period of Rainfall & Evaporation Record: 01/01/1971 - 31/12/1984			
Client:	Scott Pearson		
Site:	Lot 1 DP 818394, Clothiers Creek Road, BOGANGAR		
Number of Persons	6	equivalent persons	
Daily Flow =	900	L/day	
Nitrogen Volume per year	22.80	kg/year	**3.80** kg N /p/year - See Table 7 & table 8
Denitrification reduce to	10.26	kg/year	55.00 % reduction rate
Plant Uptake rate (N) =	300	kg/ha/year	- See Table 6
Phosphorus in Effluent (Ip) =	3.6	kg/year	**0.6** kg P /person/year - see Table 11
P Uptake by plants (Hp) =	20	kg/ha/year	- P which is taken up by vegetation, Table 9
P sorption (Ps) =	10000	kg/ha/m depth	- soil sorption capacity, Table 10
Water Table Depth (Wtd) =	3	m	- measured depth to the water table at the disposal site
Buffer to W table (Bwt) =	0.5	m	- adopted buffer to be set above water table
Time for accumulation of P =	50.00	years	
Min. planted disposal area =	**342**	m^2	(based on N loading)
Min. planted disposal area =	**69**	m^2	(based on P loading)
Hydraulic Area	500	m^2	(ignored if less than Min. planted disposal area)
Crop factor =	1		See Table 3 and Section- B2.8
% Effective Rainfall =	75%		See Table 2
Drainage below root zone/ Percolation =	5	mm/day	- LTAR
% of storage depth at which percolation occurs =	50%		See Section–B2.3
Depth of topsoil/ Depth of trench =	0.45	m	
Available water/	0.179		Available water from Table 1 (m/m)
Soil Moisture Holding Capacity/ Trench storage =	80.55	mm	
Permissible days overflow =	20	days/year	
Minimum effluent application =	1.80	$mm/day/m^2$	
Max cum stor =	10.70	mm	
Required permissible storage =	0.00	m^3	
Max cum stor =	5.35	m^3	

APPENDIX 3 NUTRIENT LOADING

In consideration of nutrients such as nitrogen and phosphorus, a mass balance was used to estimate the application rate and long-term management of the on-site sewage management system based on effluent quality, wastewater volume and land application system, plant uptake, site and soil characteristics. In determination of LAA sizing regarding TN the following data was used.

Table 10 - Nitrogen Production Data

Study	Mean Annual Loading
Witt et al. 1974	2.2 kg/person/year
Whelan & Titammis 1982	3.8kg/person/year
Sarac, K et al 2001	4.0kg/person/year (based on 6 dwellings within tank)
Davison et al., 2002	4.2 kg/person/year (based on two dwellings within tank)
Patterson, R.A 2004	4.38 kg/person/year (using mean of 85.8mg/L^{-1} at 140L/person/day)
Mean of listed studies	3.73kg/person/year
Realistic annual loading rate based on above listed studies	**3.8 kg/person /year (as per Whelan & Titammis 1982)**

The mean of the above studies provides a TN of approximately 3.7kg/person/year therefore the previously quoted figure of 3.8kg/person/year by Whelan & Titammis, 1982, is considered realistic for this domestic installation

APPENDIX 4 SOIL INVESTIGATION

Table 11 - Soil Investigation

NSW DLWC 1:100,000 Soil Landscape Map (Morand, 1996)	**Burringbar (bu) landscape:** High rolling to steep hills on metamorphics of the Neranleigh-Fernvale Group. **Soils:** Shallow to moderately deep, moderately well-drained stony Grey Earths on crests and some slopes; deep, moderately well-drained Red Podzolic Soils on slopes of deeply weathered siltstone/mudstone/shale; shallow, poorly drained Yellow Podzolic Soils on slops of quartzite/phylitte; deep, moderately well-drained Red Earths on foot slopes/lower slopes; imperfectly drained stony Yellow Podzolic Soils on old coastline. **Geology:** Jurassic Neranleigh-Fernvale Group. Predominantly phyllitic siltstones and shales, slaty in part. Quartzites and siliceous sandstones and siltstones are also present. Greywacke and argillite may occur in places. Variant a – Steep to very steep slopes.

Soil Profile via hand auger within proposed LAA See following page for soil profile information
Modified Emerson Aggregate Test
As described by Robert Patterson Lanfax Labs Technical Note T14-1 (November 2014) *"The modified Emerson test can be reported and interpreted, with respect to domestic wastewater application as:* ***Class 1 -*** *Severe dispersion, maybe related to high sodicity which forces the clay particles apart in water. Amelioration with lime or gypsum may improve structural stability by increasing EC. Class 1 soils have a major limitation to wastewater application because of reduced permeability and potential to compact as the pores block.* ***Class 2 -*** *Moderate dispersion, may be related to high sodicity. Amelioration may be effective by increasing EC. Without amelioration, this class has a major limitation to wastewater application as for class 1.* ***Classes 3-6 -****Remoulding, and 1:5 soil:water suspension tests are irrelevant to wastewater assessment, but one can report the test results with degree of slaking as:* *Slake 1 (slight), slake 2 (moderate) or slake 3 (completely slumped). Slake 1, 2, or 3 – no limitation to wastewater application, but may benefit from additional organic matter for surface irrigated soils.* ***Classes 7 and 8 -*** *these soils are water stable but may swell (Class 7) or retain original size and shape (Class 8). Neither of these classes is a limitation to wastewater application."*

Soil Investigation record sheet	Address: Clothiers Creek Road Bogangar	Date: 14/12/2023
Soil Profile with hand auger within Proposed LAA		

BH1	Depth	0-400	400-1200		
	**Structure**	Massive	Strong		
	Moisture	Dry	Moist		
	Coarse Fragments	Fine gravel, Many (20-50%)	Fine gravel, Common (10-20%)		
	pH	6.0	6.0		
	Colour	10YR 4/4 Dark Yellowish Brown	10YR 4/4 Dark Yellowish Brown		
	Soil Category	Light Clay, Category 5	Light Clay, Category 5		
	Modified Emerson Aggregate Test	Class 8 - No swelling	Class 8 - No swelling		
	Ribbon Test				

APPENDIX 5 EFFLUENT TREATMENT

The method of land application chosen to suit the dwelling size and site will determine the treated effluent quality target criteria. The proposed secondary effluent treatment with disinfection is suitable for shallow sub-surface drip irrigation.

Table 12 - Recommended Final Use of Treated Effluent based on Treatment

Treatment	Standard	Recommended Final Use / Application
Primary Treatment (sewage or greywater) e.g., septic tank, greywater tank, wet composting closet	Solids separation and digestion- no effluent standard	Sub-soil at greater than 300mm depth below finished ground level e.g., absorption trenches, mounds, and evaporation-transpiration beds.
Secondary Treatment without Disinfection	• BOD < 20 mg/L • TSS < 30 mg/L • Service person performs compliance inspection and reports condition of land application system. • Local council develops risk	• Sub-soil > 300mm depth • Sub-surface (300 mm to 150 mm) • LPED • Shallow Sub-surface Drip Irrigation
Secondary Treatment with Disinfection	• BOD < 20 mg/L • TSS < 30 mg/L • E. coli <30 cfu/100mL	• Sub-soil > 300mm depth • Sub-surface (300 mm to 150 mm) • * LPED • Shallow sub-surface drip irrigation • Surface and spray irrigation (100 mm to above GL)
Advanced Secondary Treatment without Disinfection	• BOD < 10 mg/L • TSS < 10 mg/L • Service person performs compliance inspection and reports condition of land application system. • Local council develops risk	• Sub-soil > 300mm depth • Sub-surface (300 mm to ground level (no spray) • * LPED • ** Shallow Sub-surface drip irrigation
Advanced Secondary Treatment with Disinfection	• BOD < 10 mg/L • TSS < 10 mg/L • E. coli <10 cfu / 100mL	• Sub-soil > 300mm depth • Sub-surface (300 mm to 150 mm) • * LPED • ** Shallow sub-surface drip irrigation • Surface and spray irrigation (100 mm to above GL) • Greywater may be used for toilet flushing and washing machines

From NSW Health AdNote 4 (4 January 2017)
**Low Pressure Effluent Distribution (LPED) Irrigation Lines if installed in accordance with AS/NZS 1547:2012 On-site domestic wastewater management; Appendix M*
***Shallow sub-surface drip irrigation if installed in accordance with AS/NZS 1547:2012 On-site domestic wastewater management; Appendix M*

APPENDIX 6 SETBACK DISTANCE RISK ASSESSMENT

Table 13 - Site Features Not Achieving Maximum Setback Distances

Site Feature	Horizontal Setback Distance Range	Site Constraint Items
Surface waters	15-100m	A B D E F G J

Table 14 - Site Constraint Risk Assessment

Item	Site/system feature	Constraint Scale Factors Lower ◄——► Higher		Risk Level of Constraint
A	Microbial quality of effluent [3]	Secondary treatment	Primary treatment	Low-Secondary treatment in AWTS
B	Surface water	Category 1-3 soils >100m setback Low rainfall Low resource value	Category 4-6 soils <50m to surface water High rainfall High resource value	High - Category 5 soils High-40m to cane drain High resource value
D	Slope	<30% subsurface effluent application	>30% subsurface effluent application	Low – <30% slopes
E	Position of land application area in landscape	Downgradient of surface water, boundary	Upgradient of surface water, boundary	High – downslope to intermittent watercourse
F	Drainage	Category 1 and 2 soils, gently sloping	Category 6 soils, seepage, low lying area	Medium – Category 5 soils
G	Flood potential	Above 1 in 20-year flood contour	Below 1 in 20-year flood contour	Low – nil flood inundation within recommended LAAs
J	Application method	Drip irrigation or subsurface application of effluent.	Surface/above ground application of effluent.	Low-subsurface application under lawn
AVERAGE RISK LEVEL				
Surface waters				LOW

APPENDIX 7 SETBACK GUIDELINES

Table 15 - Setback Guidelines (Table R1)

Table R1 – AS/NZS 1547:2012 Guidelines for Horizontal and Vertical Setback Distances (to be used in conjunction with Table R2)		
Site Feature	**Setback Distance range (m)**	**Site constraint items of specific concern (from table R2)**
	Horizontal Setback Distance (m)	
Property Boundary	1.5-50	A, D, J
Buildings/houses	2.0->6	A, D, J
Surface Water	15-100	A, B, D, E, F, G, J
Bore, Well	15-50	A, C, H, J
Recreational areas (Children's play areas, swimming pools and so on)	3-15	A, E, J
In-Ground water tank	4-15	A, E, J
Retaining wall and Embankments, escarpments, cuttings	3.0m or 45o angle from toe of wall (whichever is greatest)	D, G, H
	Vertical Setback Distance (m)	
Groundwater	15-50	A, C, F, H, I, J
Hardpan or bedrock	0.5->1.5	A, C, J

Notes:
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 constrain 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.
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 0.5m.
Setback distances of less than 3m 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 tan effective barrier (designed by a suitably qualified and experienced person) can be installed. This may require consent from the regulatory authority.
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 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.
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 R2. 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.

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.
Where effluent is applied to the surface by covered drip or spray irrigation, the maximum value is recommended.
In the case of subsurface application of primary treated effluent by LPED irrigation, the upper value is recommended.
In the case of surface spray, the setback distances are based on a spray plume with a diameter not exceeding 2m or a plume height not exceeding 0.5m above finished surface level. The potential for aerosols being carried by the wind also needs to be taken into account.
It is recommended that land application of primary treated effluent be down gradient of in-ground water tanks.
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.
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 the 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 16 - Setback Guidelines (Table R2)

Table R2 - AS/NZS 1547:2012 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 Lower ⟷ Higher		Sensitive features
A	Microbial quality of effluent 3	Effluent quality consistently producing ≤106 cfu/100mL E.coli (for example, primary treated effluent)	Effluent quality consistently producing ≥106 cfu/100mL E.coli (for example, primary treated effluent)	Groundwater and surface pollution hazard, public health hazard
B	Surface water 4	Category 1 to 3 soils 5 no surface water down gradient within > 100m, low rainfall area	Category 4 to 6 soils, permanent surface water <50m down gradient, high rainfall area, high resource/environmental value6	Surface water pollution hazard for low permeable soils, low lying or poorly draining areas
C	Groundwater	Category 5 & 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)	>10% (surface effluent application), >30% subsurface effluent application	Off-site export of effluent erosion

E	Position of land application area in landscape 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, high 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:
Scale shows the level of constraint to sitting on 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.
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.
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)
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.
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).
The regulatory authority may reduce or increase setback distance at their discretion based on the distances of the land application up or downgradient of sensitive receptors.

Table 17 - Recommended buffer distances (Site Features)

Site Feature	Level of Effluent Treatment	Effluent Application Method	Buffer Distance (Minimum
Buildings, retaining walls	Primary	Subsoil	2.0m downslope and flat 6.0m upslope of the feature
	Secondary (disinfected)	Subsurface and surface irrigation	2 – 6m <3m only for drip irrigation on low rate
Premises boundaries, paths, and walkways, recreation areas	Primary	Subsoil	3.0m downslope or flat to the feature 6.0m upslope of the feature 15m to recreation areas if LPED irrigation
	Secondary (disinfected)	Subsurface irrigation	3.0m downslope or flat to the feature 4.0m upslope of the feature
		Surface irrigation	15m upslope or downslope of the feature
In ground potable water tanks In ground swimming pools	Primary	Subsoil	15m and downslope from water tank or pool
	Secondary (disinfected)	Subsurface and surface irrigation	4.0m and downslope Should not be upslope
Watercourse, lakes and water supply reservoirs	Primary	Subsoil	100m from high water level
	Secondary (disinfected)	Subsurface and surface irrigation	100m from high water level
Bore or well licensed for domestic consumption*	Primary	Subsoil	100m
	Secondary (disinfected)	Subsurface and surface irrigation	100m
Drainage depressions, farm dams and roadside drainage and lot scale stormwater quality improvement devices	Primary	Subsoil	40m from the high-water level
	Secondary (disinfected)	Subsurface and surface irrigation	40m from the high-water level
* If within 100 metres of a bore or well licensed for domestic consumption, a draw-down analysis is required using an appropriate methodology , such as Cromer, Gardner and Beavers, 2001 'An improved viral die-off method to estimate setback distances'. Domestic consumption is taken to mean for drinking, watering of edible plants etc.			

Table 18 - Recommended Buffer Distances (Effluent Disposal)

System	Recommended Buffer Distances
All land application systems	100 metres to permanent surface waters (e.g., River, streams, lakes etc.) 250 metres to domestic groundwater well 40 metres to other waters (e.g., Farm dams, intermittent waterways and drainage channels, etc.)
Surface spray irrigation	6 metres if area up-gradient and 3 metres if area down-gradient of driveways and property boundaries 15 metres to dwellings 3 metres to paths and walkways. 6 metres to swimming pools
Surface drip and trickle irrigation	6 metres if area up-gradient and 3 metres if area down-gradient of swimming pools, property boundaries, driveways and buildings
Subsurface irrigation	6 metres if area up-gradient and 3 metres if area down-gradient of swimming pools, property boundaries, driveways and buildings
Absorption System	12 metres if area up-gradient and 6 metres if area down-gradient of property boundary 6 metres if area up-gradient and 3 metres if area down-gradient of swimming pools, driveways and buildings

APPENDIX 8 PHOTOGRAPHIC LOG

Photo No. 1	Date 01/12/2023
Description: View west and across slope overlooking recommended LAA on northern property portion.	

Photo No. 2	Date 01/12/2023
Description: View north and across slope overlooking recommended LAA.	

Photo No. 3	Date 01/12/2023

Description: View west and across slope overlooking recommended LAA on southern portion of property

Photo No. 4	Date 01/12/2023

Description: View south and upslope overlooking intermittent watercourse (gully).

APPENDIX 9 VIRAL DIE-OFF MODELLING

Estimation of Pathogen Die-Off from Land Appplication Areas page 1

Based on a paper by W C Cromer, E A Gardner & P D Beavers, "An Improved Viral Die-Off Method For Estimating Setback Distances"

Step A - Equation 1: Determine days required for viral reduction

Formula: **Mt / Mo = e-kt**

Mt / Mo = is the dimensionless ratio of viral concentration in the groundwater t (Mt) and the viral concentration in the wastewater (Mo)

t = is the travel time (days) of the viruses in the groundwater

k = is the first order rate coefficient for the die-off rate of the organism and is the temperature- dependent variable (°C).

For treated effluent from a secondary treatment on-site system, Mt/Mo should be 0.001 (3 orders of magnitude reduction)
For primary treated effluent from a septic tank, Mt/Mo should be 0.0000001 (7 orders of magnitude reduction)
For raw wastewater, Mt/Mo should be 0.0000001 (7 orders of magnitude reduction)
For greywater, Mt/Mo should be 0.00001 (5 orders of magnitude reduction)

Input:	0.001	Mt / Mo (dimensionless ratio of viral concentration)
	14	T (groundwater temp °C)

Calculate k (14 – 8.5) / 20

k = **0.275**

Calcultae t Ln (Mt / Mo) / -k

Ln (0.0000001) / -0.275

t = **25.1**

An Improved Viral Die-Off Method For Estimating Setback Distances (W C Cromer, E A Gardner & P D Beavers)

Step B - Equation 2: Correcting Travel Time for Vertical Infiltration

The time required for groundwater (containing viruses) to move a given distance in saturated material:

Formula: **dg** = **(t - dv .P/K)/(P/K.i)**

dg = horizontal distance from effluent land application area to where virus die-off occurs (m)

dv = vertical distance to groundwater (m)

t = travel time (days)

P = porosity soil (fraction eg 0.3) - clay 40-70%, silt 35-50%, sand 25-50%, gravel 25-40%

K = permeability (m/day)

i = groundwater gradient (fraction eg 0.02 if slope of groundwater 1:50).

Input:	1	dv (vertical distance to the water table in metres)
	0.3	P1 (effective porosity of the soil - refer to "porosity" worksheet)
	0.3	P2 (effective porosity of the aquifer/soil of watertable
	1.5	K1 (saturated hydraulic conductivity in metres/day)
	1.5	K2 (saturated hydraulic conductivity in metres/day)
	0.05	i (groundwater gradient - the steeper, the more conservative the answer)

Calculate dg (t - dv .P/K)/(P/K.i)

dg = **6.23** metres

dg + safety factor (*2) = **12.5** metres