ENVIRONMENTAL CONSULTING Pty Ltd

ONSITE SEWAGE MANAGEMENT ASSESSMENT

Proposed Boundary Adjustment

January 2024

Prepared for: John Tilton

Lot 8 DP 755685, Lot 1 DP 376131, Lot 1 DP 410859, Lot 1 DP 328107, Lot A DP 174886, & Lot 1 DP 364474
133-193 Dulguigan Road
Dulguigan

HMC Ref: 2023.616.1

RE: Lot 8 DP 755685, Lot 1 DP 376131, Lot 1 DP 410859, Lot 1 DP 328107, Lot A DP 174886, & Lot 1 DP 364474, 133-193 Dulguigan Road, Dulguigan

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.

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TITLE:	Onsite Sewage Management Assessment
PREPARED FOR:	John Tilton
HMC JOB NUMBER:	2023.616

DOCUMENT RECORD				
VERSION	DATE	PREPARED BY	CHECKED BY	ISSUED BY
Draft Issue A	18.12.2023	TR	HT	KH
Draft Issue B	8.01.2024	KH		
Final Issue A	11.01.2024	TR	HT	SV

DISTRIBUTION LIST	DATE	VERSION	COMMENTS
J. Tilton	20.12.2023	Draft Issue A	For Review
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J. Tilton		Final Issue A	For Lodgement

This report should be cited as 'HMC Environmental Consulting (2023). On-site Sewage Management Assessment, Proposed Boundary Adjustment, Lot 8 DP 755685, Lot 1 DP 376131, Lot 1 DP 410859, Lot 1 DP 328107, Lot A DP 174886, & Lot 1 DP 364474, 133-193 Dulguigan Road, Dulguigan, NSW. Report No. HMC2023.616.1.'

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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
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 an on-site sewage management (OSSM) assessment for a proposed boundary adjustment at Lot 8 DP 755685, Lot 1 DP 376131, Lot 1 DP 410859, Lot 1 DP 328107, Lot A DP 174886, & Lot 1 DP 364474, 133-193 Dulguigan Road, Dulguigan, within the Tweed Shire Council.

The proposed boundary adjustment will result in relocated boundaries and resizing of the existing 6 lots. Each adjusted lot will be larger than 2 hectares, with building envelopes nominated. A site inspection was carried out on 06/12/2023 by Helen Tunks, Mark Tunks, Taylah Richards of HMC. During the site inspection the site and soil characteristics were investigated to assess the feasibility of each lot to provide the essential service of sewage management for future dwellings.

An existing dwelling and OSSM system is located on current Lot 8 DP 755685 and comprises a septic tank with effluent disposal through 3 x ETA beds, recently installed with Council approval (SEP22/0088, HMC Design Report 2022.1000). This system was investigated and no signs of failure were observed. Reserve land application area is available within the proposed Lot 2 boundary and therefore the existing OSSM system is recommended to be retained for the purpose of this approval process.

The site constraints of slope and light clay subsoil guide the recommendations for effluent to be treated to minimum secondary quality with final disinfection to minimise risk to the environment. It is recommended that 400m^2 of shallow ripped subsurface drip irrigation fields under lawn grasses be installed within the nominated land application areas on the remaining 5 proposed lots, at the time of dwelling construction approval. 100% reserve land application areas remain available on all of the proposed lots and have been marked on the site plan provided in this report.

2. PROJECT INFORMATION

Table 1 - Project Information

Proposal	Proposed OSSM System Assessment	
Property	Lot 8 DP 755685, Lot 1 DP 376131, Lot 1 DP 410859, Lot 1 DP 328107, Lot A DP 174886, & Lot 1 DP 364474 133-193 Dulguigan Road Dulguigan	
Property Area	105 Ha 6 x EXISTING LOTS: Lot 8 DP 755685: existing dwelling Lot 1 DP 376131: Lot 1 DP 410859: Lot 1 DP 328107: Lot A DP 174886: Lot 1 DP 364474:	105 Ha 6 x PROPOSED LOTS: Lot 1: 53.5 Ha Lot 2: 19.19 Ha (existing dwelling) Lot 3: 2 Ha Lot 4: 1.65 Ha Lot 5: 1.72 Ha Lot 6: 22.36 Ha
Council Area/Approvals:	Tweed Shire Council	
Design Daily Hydraulic Load	720L/day Proposed dwelling sites, assumed 4-bedrooms Assumed 6 persons design occupancy @ 120L/p/day	
Water Saving Devices	Assumed in proposed dwelling	
Water Supply	Non-Reticulated Roof Catchment	

3. SUMMARY OF RECOMMENDED SEWAGE WORKS

Table 2 - OSSM Proposal for Future Dwellings on Lots 1,3,4,5,6.

Recommended On-Site Sewage Management System - Lots 1,3,4,5,6
• Install an Aerated Wastewater Treatment System (AWTS) with NSW Health accreditation for secondary treatment & disinfection of effluent Land Application Area: • Install 400m^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) • Construct an upslope surface water diversion bund & intercept drain to divert surface water run-on away from proposed LAA

Table 3 – Existing Dwelling on Proposed Lot 2

Recommended On-Site Sewage Management System - Lot 2
• Retain the existing septic tank. • Retain the existing 3 x ETA beds : each 2m x 20m x 0.45m. • No sewage works required for existing dwelling on proposed Lot 2.

Table 4 - OSSM Justification

Justification For Land Application Area
• Lot 2 presents gently sloping land within the existing land application area. The existing septic tank and ETA beds were installed less than 2 years ago, in accordance with Council approval. The system is currently operated under a current Section 68 Council Approval to Operate an On-site Sewage Management Facility. • Lots 1,3,4,5,6 are constrained by moderate to steep slopes, intermittent watercourses and low subsoil permeability. The site and soil constraints for effluent disposal require effluent to be treated minimum secondary quality with final disinfection to minimise risk to the environment. • The installation of the dripper lines via shallow ripping allows existing dense grass cover to remain in place. The pressure compensating dripper lines provides uniformity of distribution on varying elevations and is therefore the most appropriate land application method on sloping land.

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 5 - Site Conditions

Inspected by	Helen Tunks, Mark Tunks, Taylah Richards
Date & Time of Inspection	06/12/2023 See Appendix 1 for site location, Appendix 9 for photos.

Weather	Weather: Fine, hot, nil rainfall during site inspection. BOM Stn 58186 North Murwillumbah (Tweed River). ~5mm rainfall recorded the week preceding site inspection. ~116mm rainfall recorded the month preceding site inspection
Soil Type & Category	Soil Category 5 to 6 (AS/NZS1547:2012) BH1- 5– within proposed LAAs See Appendix 5 for soil investigation information.
Climate	Warm-temperate and high volume, seasonal rainfall typical of region.
Terrain	Ridge, upper to lower slopes
Slope & Drainage:	~15-25% Linear divergent
Aspect & Shading	Nil shading expected
Ground cover/vegetation	Existing Vegetation (Full cover), Grass/pasture/lawn 100% grass cover to be achieved
Site Constraints	Imperfectly drained soil High volume seasonal rainfall Setback to intermittent watercourse
Reserve LAA	100% available

4.2. SITE COMPLIANCE

Table 6 - Site Constraints

Site Constraints		Recommended	Complying?
Setback to Boundary	>6m to property boundary	3-6m (DLG, 1998)	YES
Setback to Watercourse	~25m to intermittent watercourse	15-100m (AS/NZS1547:2012)	NO
Setback to Water Bore	~170m to nearest registered domestic groundwater bore (GW300324)	15-50m (AS/NZS1547:2012) 100m (WaterNSW)	YES
Setback to Buildings & Site Features	3m to upslope building	2-6m (AS/NZS1547:2012)	YES
Reserve LAA	100% available		YES
Slope Gradient	~15-25%, moderate slopes	<10%	NO
Flood Liability	Nil flood inundation within proposed LAA	>1:20 year flood level contour	YES
Water Supply Catchment	Not mapped		YES

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
- Slope

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 7. The risk assessment conclusions are presented in Table 6 below.

Table 7 - Risk Assessment Results for Site Constraints

Site Constraint	Setback Distance/Criteria Achieved	Average Risk Assessment Result (Appendix 7)	Mitigations
Surface waters	~25m to downslope intermittent watercourse	LOW	• Secondary treated effluent with disinfection achieved within aerated wastewater treatment system (AWTS) with NSW Health accreditation. • The nutrient management area is maintained within the proposed LAAs • To remain conservative, a viral die-off calculation was performed to calculate the minimum required horizontal setback distance from a land application area to the nearest watercourse. The conservative estimate of pathogen die-off from the proposed land application areas has been calculated using a conservative permeability of 1.5mm/day (clay loam soil) and a 1m estimated vertical setback distance. The minimum horizontal distance has been calculated to be 6.23m using viral die-off calculations (Cromer, Gardner, & Beavers) as detailed in Appendix 10. A safety factor of 2 has been applied within the die-off model, to be conservative, increasing the calculated pathogen die-off to approximately 12.5m.
Slope	15-25%	N/A	• The recommended method of land application is shallow ripped subsurface drip irrigation under lawn grass • The installation of the dripper lines via shallow ripping allows existing dense grass cover over the deep soil to remain in place. The pressure compensating dripper lines provides uniformity of distribution on varying elevations. • The achieved DIR of 1.8mm/day complies with the recommended maximum for Medium Clay subsoils. • A monthly water balance is provided within this report to demonstrate that the hydraulic loading and retained rainfall can be contained within the topsoil layer of the proposed land application area.
CONCLUSION	AVERAGE RISK = LOW		Mitigations considered satisfactory given the constraints of the subject site the level of effluent treatment and distribution achieved with the proposed OSSM system.

5. SEWAGE TREATMENT SYSTEM

The site constraints described within this report result in the recommendation for future dwellings to be serviced by systems capable of treatment effluent to minimum secondary quality with final disinfection to minimise risk to the environment.

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 dripper line allows for the drip irrigation line to be installed on sloping land and still achieve uniform and controlled distribution of effluent.

Appendix 4 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 8 - Design Model

Model Used: Draft Richmond Tweed On-Site Regional Strategy (Alderson, 1999) Monthly Water Balance	
Climate Data	Tyalgum (1971-1984). Mean annual rainfall 1555mm
Structure	Dwelling, assumed 4-bedrooms
Design Occupancy	6 persons assumed
Wastewater Design Flow Allowance	120L/p/day
Wastewater Design Hydraulic Load	720L/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	Assumed ~8000 kg/ha/ based on field texture and work carried out by Morand, 1996
Maximum Design Irrigation Rate (DIR)	2mm/day for Medium Clay soils 3mm/day for Light Clay soils (Table 5.2, AS/NZS1547:2012)
Proposed DIR	1.8mm/day

Long Term Acceptance Rate	3mm/day (Monthly Water Balance)

6.2. SUMMARY OF MODELLING CALCULATIONS

Table 9 - Modelling Calculations Summary

Analyte	Minimum Recommended Land Application Area (LAA) Hydraulic Loading Rate (Q) = 720L/day	
	LAA Modelling Results	Proposed LAA Layout
Hydraulic Load	400m^2	Recommended 400m^2 subsurface drip irrigation filed ripped into the native soil @ ~100mm depth, under grass
Nitrogen (TN)	342m^2	
Phosphorus (TP)	86m^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 secondary treatment and pressure-compensated sub-soil distribution of effluent effectively reduces the risk of human exposure and run-off on the sloping land of the subject sites. The shallow ripped subsurface drip irrigation maximises the advantages of the significantly more permeable topsoil layer & established root zone and is therefore the most appropriate land application method to be used for future installations.

The conservative Design Irrigation Rate (DIR) of 1.8mm/day is less than the recommended maximum DIR for the underlying medium clay subsoil and is also considered appropriate to mitigate the slope, in combination with the recommended surface water controls.

A monthly water balance is provided within this report to demonstrate that the hydraulic loading and retained rainfall can be contained within the shallow topsoil layer of the proposed land application area without relying on the sub-soil clay layer.

The nominated land application areas comply with the minimum horizontal buffer distance as calculated within the viral die-off model (Appendix 10), further demonstrating site suitability.

Overall, the proposed systems are a conservative design, achieves an average medium risk of encroaching to surface waters. The site and soil assessment, and resulting system designs, demonstrate that the nominated land application areas and associated reserve areas are suitable for the future residential use.

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 the occupation of existing and future structures.

The subject site is therefore considered suitable for the proposed boundary adjustment in terms of on-site sewage management.

Table 10 - Recommendations

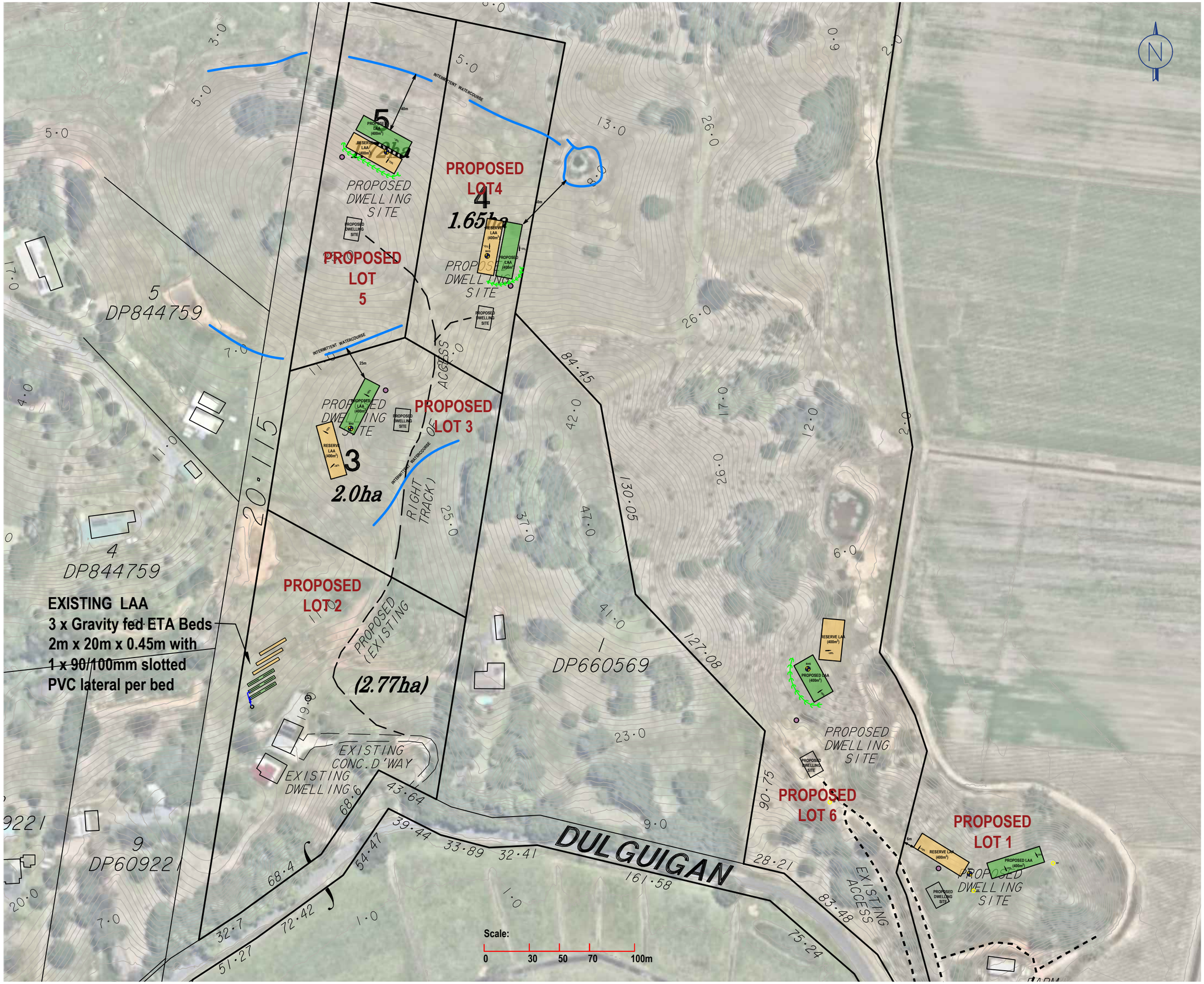
DESIGN HYDRAULIC LOADING	
• 720L/day • Non-Reticulated Roof Catchment	• Proposed Dwelling (4-bedrooms assumed) • 6 persons occupancy assumed
RECOMMENDED ON-SITE SEWAGE MANAGEMENT SYSTEM	
Refer to Site Plan & Detail Construction Design on following pages • Install an Aerated Wastewater Treatment System (AWTS) with NSW Health accreditation for secondary treatment & disinfection of effluent Land Application Area: • Install 400m^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) • Construct an upslope surface water diversion bund & intercept drain to divert surface water run-on away from proposed LAA	

8.1. SITE PLAN & SECTION DETAIL

ONSITE SEWAGE MANAGEMENT SITE CAPABILITY ASSESSMENT

SHEET 1 - PLAN

NOT FOR CONSTRUCTION



RECOMMENDED TREATMENT

- Aerated wastewater treatment plant (AWTS) with NSW Health accreditation for secondary treatment and disinfection

RECOMMENDED LAA

- 400m^2 shallow ripped subsurface drip irrigation under law
- 100% reserve LAA (400m^2)

KEY:

- Proposed LAA (400m^2)
- Reserve LAA (400m^2)
- AWTS (general location)
- Proposed upslope surface water diversion bund & intercept drain

ALL LOCATIONS ARE GENERAL ONLY AND ARE TO BE CONFIRMED ONSITE

Job:	HMC2023.616.1
DWG:	HMC2023.616.1
Date:	20.12. 2023
Version:	A
Drawn:	TR
Base:	Nearmap 2023
Council:	Tweed Shire Council

133-193 Dulguigan Road Dulguigan

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ONSITE SEWAGE MANAGEMENT SITE CAPABILITY ASSESSMENT

LOTS 1 & 6

SHEET 1 - PLAN

NOT FOR CONSTRUCTION

RECOMMENDED TREATMENT

- Aerated wastewater treatment plant (AWTS) with NSW Health accreditation for secondary treatment and disinfection

RECOMMENDED LAA

- 400m^2 shallow ripped subsurface drip irrigation under law
- 100% reserve LAA (400m^2)

KEY:

- Proposed LAA (400m^2)
- Reserve LAA (400m^2)
- AWTS (general location)
- Proposed upslope surface water diversion bund & intercept drain

ALL LOCATIONS ARE GENERAL ONLY AND ARE TO BE CONFIRMED ONSITE

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DWG:	HMC2023.616.1
Date:	18.12. 2023
Version:	A
Drawn:	TR
Base:	Nearmap 2023
Council:	Tweed Shire Council

133-193 Dulguigan Road Dulguigan

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ONSITE SEWAGE MANAGEMENT SITE CAPABILITY ASSESSMENT

LOTS 3, 4 & 5

SHEET 1 - PLAN

NOT FOR CONSTRUCTION

RECOMMENDED TREATMENT

- Aerated wastewater treatment plant (AWTS) with NSW Health accreditation for secondary treatment and disinfection

RECOMMENDED LAA

- 400m^2 shallow ripped subsurface drip irrigation under law
- 100% reserve LAA (400m^2)

KEY:

- Proposed LAA (400m^2)
- Reserve LAA (400m^2)
- AWTS (general location)
- Proposed upslope surface water diversion bund & intercept drain

ALL LOCATIONS ARE GENERAL ONLY AND ARE TO BE CONFIRMED ONSITE

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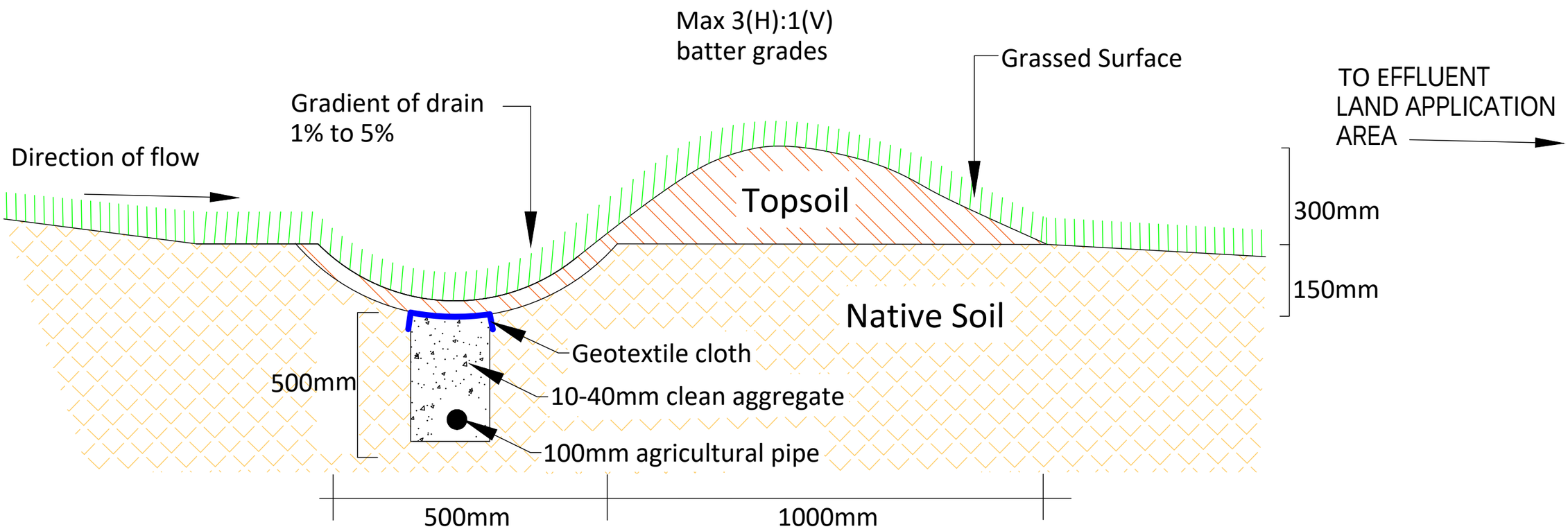
CROSS SECTION: DIVERSION DRAIN - (NOT TO SCALE)



Source: *Standard Drawing 12A*: Water NSW, 2019 - "Designing and Installing Onsite Wastewater Systems - A Water NSW Current Recommended Practice"

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DIVERSION DRAIN

HMC Ref: W:\DATA\business\Templates\HMC Templates\Drawing Templates\Master Drawing Templates\Diversion Bund

Date: September 2021
Revision Date:

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

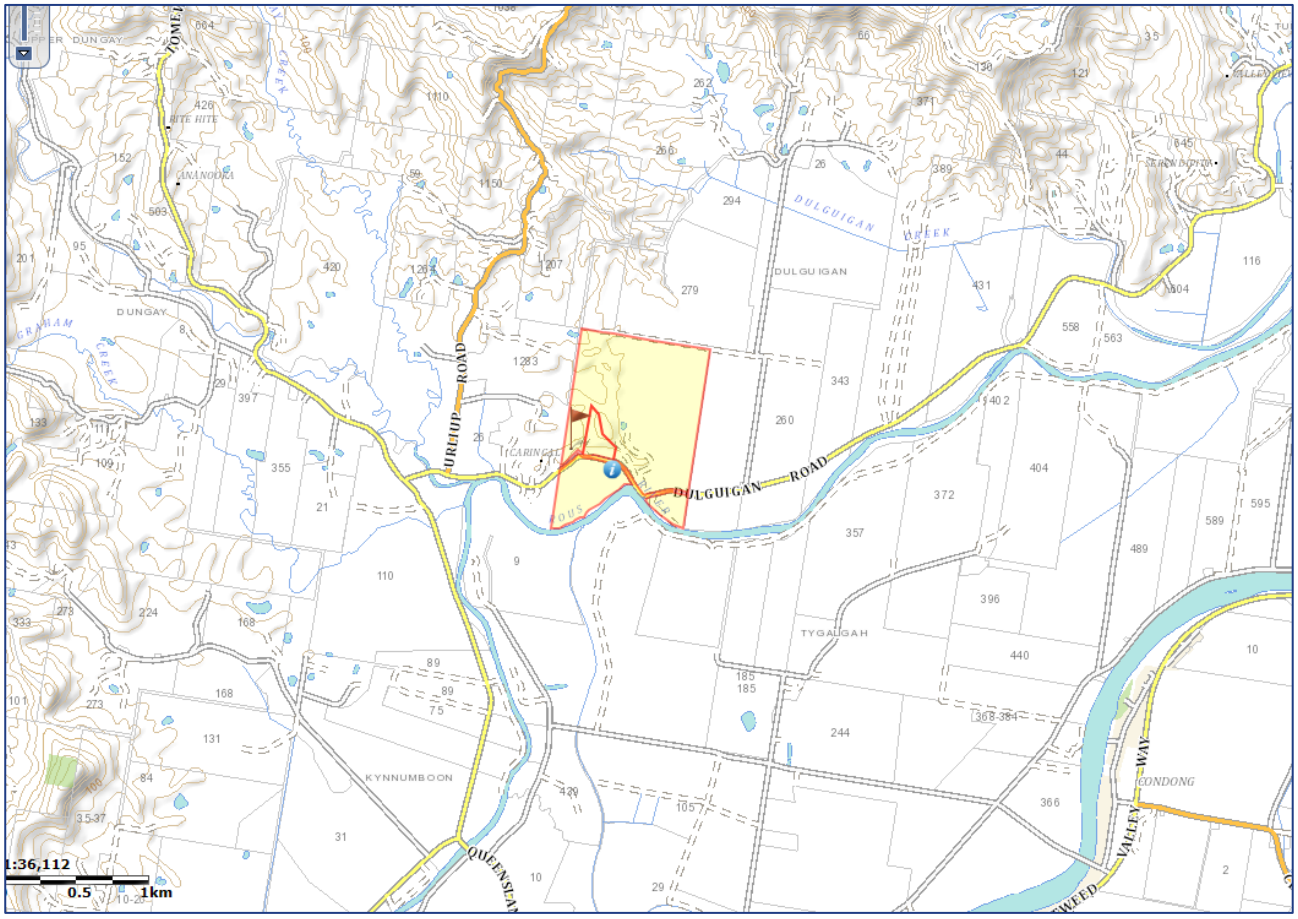


Figure 1 - Site Location (Source: NSW Spatial Viewer, Six Maps)

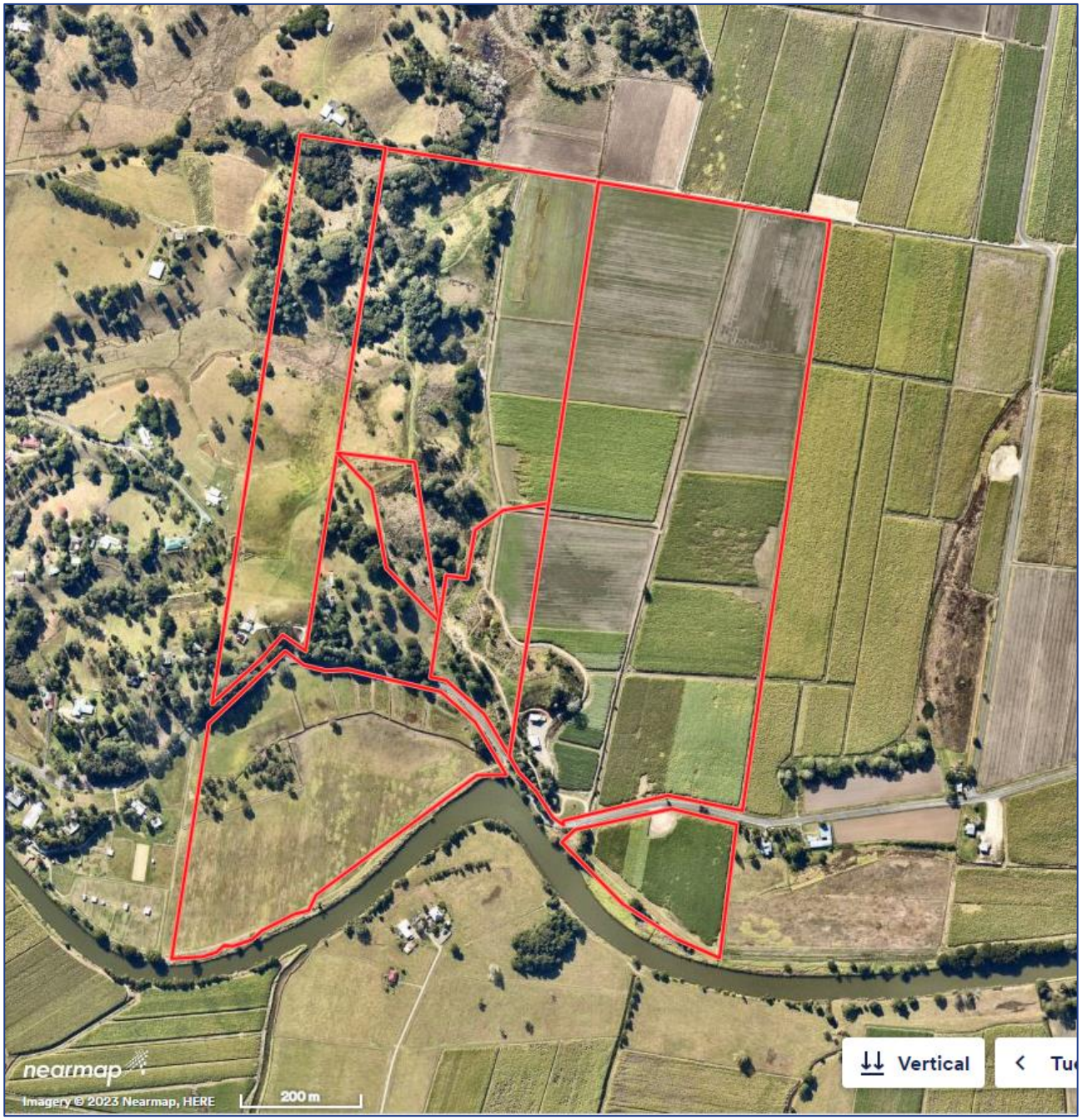
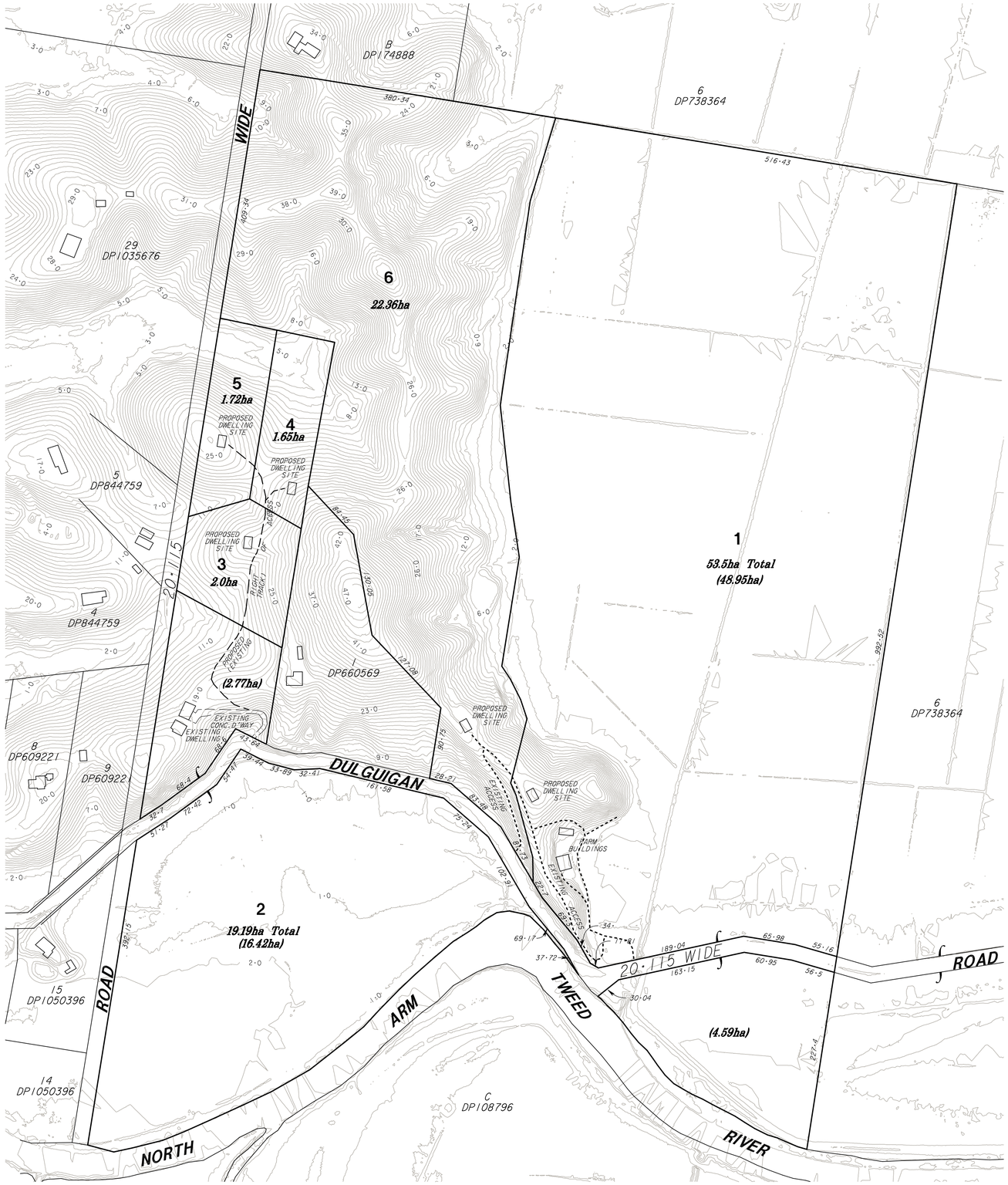


Figure 2 - Site Boundary (Source: Nearmap 2023)

APPENDIX 2- PROPOSED SUB-DIVISION PLAN

PRELIMINARY
ONLY
29/8/2023



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M.G.A.

PRELIMINARY
ONLY
29/8/2023

Revision | Chk

Client:

MR JOHN TILTON

IMPORTANT NOTES :

THE PROPOSED BOUNDARIES AS SHOWN HEREON ARE PRELIMINARY ONLY AND ARE SUBJECT TO FINAL DESIGN, LOCAL AUTHORITY APPROVAL AND REGISTRATION WITH NSW LAND REGISTRY SERVICES.

DIMENSIONS & AREAS SHOWN HEREON ARE SUBJECT TO FIELD SURVEY AND LOCAL AUTHORITY APPROVAL.

CONTOUR INTERVAL - 1m

CONTOURS HAVE BEEN DERIVED FROM NSW SPATIAL SERVICES 1m LIDAR DATA GATHERED APRIL 14.

PROPOSED SUBDIVISION PLAN

LOT 8 IN DP755685,
LOT 1 IN DP364474,
LOT 1 IN DP410859,
LOT 1 IN DP328107,
LOT 1 IN DP376131
& LOT A IN DP174886

DULGUIGAN ROAD
DULGUIGAN

Parish of BERWICK County of Rous

B & P SURVEYS
CONSULTING SURVEYORS
ACN 010117236
142 Murwillumbah Street
MURWILLUMBAH
NSW 2484 Australia
Telephone: (02)66721924
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www.bpsurveys.com.au
Offices Also At :
Nerang
Ph.(07)55960370
Tweed Heads
Ph.(07)55536311

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SCALE AT A1	Level DATUM	Drawn	Chk'd	F.Bk	L.Bk
1 : 3000	-	JPA		LS	-

REF. No.	DATE	DRAWING No./Size	Sheet	Of	Rev.
M31754	29/3/2023	25464 B	1	2	-

APPENDIX 3 - OSSM DESIGN MODEL & MONTHLY WATER

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:	John Tilton		
Site:	133-193 Dulguigan Road, DULGUIGAN		
Number of Persons	6	equivalent persons	
Daily Flow =	720	L/day	
Nitrogen Volume per year	22.8	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) =	8000	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 =	**86**	m^2	(based on P loading)
Hydraulic Area	400	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 =	4.5	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 =	12.45	mm	
Required permissible storage =	0.00	m^3	
Max cum stor =	4.98	m^3	

LAND APPLICATION AREA (LAA)

Client: John Tilton
Location: 133-193 Dulguigan Road, DULGUIGAN
File No. 2023.616.1

No. of Bedrooms: **4**
Water Supply: Non-reticulated
Water Saving: AAA

TABLE A1: SIZE OF AREA PER MONTH

(1) Month	Days in Month (n)	(2) Pan Evapoaration E (evap maps) mm	(3) Evapo-transpiration ET mm	(4) Rainfall R Mean mm	(5) Retained rainfall RR (Rr = 0.75R) mm	(6) Design Loading Rate (DLR) per month mm	(7) Disposal rate per month (5) - (3) + (6) mm	(8) Treated Effluent applied per month L	(9) Size of area (8)/(7) m2
Jan.	31	177	177.0	166.6	125.0	93	41.0	22320	545.1
Feb.	28	140	140.0	224.7	168.5	84	112.5	20160	179.2
Mar.	31	133	133.0	228.2	171.2	93	131.2	22320	170.2
Apr.	30	105	105.0	182.2	136.7	90	121.7	21600	177.6
May	31	84	84.0	158	118.5	93	127.5	22320	175.1
Jun.	30	72	72.0	188.8	141.6	90	159.6	21600	135.3
Jul.	31	84	84.0	107.4	80.6	93	89.6	22320	249.2
Aug.	31	109	109.0	75.3	56.5	93	40.5	22320	551.5
Sept.	30	132	132.0	69.2	51.9	90	9.9	21600	2181.8
Oct.	31	155	155.0	105.5	79.1	93	17.1	22320	1303.4
Nov.	30	162	162.0	115.1	86.3	90	14.3	21600	1507.9
Dec.	31	183	183.0	147.4	110.6	93	20.6	22320	1086.1
								AVERAGE:	**688.5**

TABLE A2: DEPTH OF STORED EFFLUENT

(1) Month		(2) First trial area LAA m2	(3) Application rate (8)/(2) mm	(4) Diposal rate /month (7) mm	(5) Nett Application rate (3) - (4) mm	(6) Increase in depth of stored effluen (5)/n mm	Depth of effluent for month (X - 1) mm	(7) Increase in depth of effluent + (6) mm	(8) Computed depth of effluent = month (X) mm
Jan.		400.0	55.8	145.1	-89	-498.6	0	-498.6	0.0
Feb.			50.4	55.5	-5.1	-28.4	0	-28.4	0.0
Mar.			55.8	54.9	0.9	5.3	0	5.3	5.3
Apr.			54.0	58.4	-4.4	-24.3	5.3	-24.3	0.0
May			55.8	58.5	-2.7	-15.1	0.0	-15.1	0.0
Jun.			54.0	20.4	33.6	187.7	0.0	187.7	187.7
Jul.			55.8	96.5	-40.7	-227.1	187.7	-227.1	0.0
Aug.			55.8	145.5	-89.7	-501.3	0.0	-501.3	0.0
Sept.			54.0	170.1	-116.1	-648.6	0.0	-648.6	0.0
Oct.			55.8	168.9	-113.1	-631.7	0.0	-631.7	0.0
Nov.			54.0	165.7	-111.7	-623.9	0.0	-623.9	0.0
Dec.			55.8	165.5	-109.7	-612.6	0.0	-612.6	0.0
								MAX:	**188**

CLIMATE DATA

Rainfall (mm)
Ballina Airport AWS: BOM Station No. 58198 (1961-1990)

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	166.6	224.7	228.2	182.2	158	188.8	107.4	75.3	69.2	105.5	115.1	147.4

Pan Evaporation (mm)
Alstonville (monthly)

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	177	140	133	105	84	72	84	109	132	155	162	183

No of days Per Month	Daily effluent	DLR
31	720	3
28	720	3
31	720	3
30	720	3
31	720	3
30	720	3
31	720	3
31	720	3
30	720	3
31	720	3
30	720	3
31	720	3
TOTAL	8640	

Porosity (n)	gravel	0.300	
	Sand	0.200	
	Clay	**0.179**	
	Clay Loam Tunnel	0.185	
	Trench	0.60	
Depth	Trench	450.0	mm
	Irrigation	**150.0**	**mm**

Pan Evaporation (mm)
Alstonville (monthly)

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	177	140	133	105	84	72	84	109	132	155	162	183
Ballina Airport AWS (ET)	140	95.1	90.90	88.7	68.5	62.6	63.7	82.8	93.8	118.8	156.5	156.4

APPENDIX 4 - 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 11 - 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 5 - SOIL INVESTIGATION

Table 12 - Soil Investigation

NSW DLWC 1:100,000 Soil Landscape Map (Morand, 1996)	**Billinudgel (bi) landscape:** Rolling hills on metamorphics of the Neranleigh-Fernvale Group. **Soils:** Deep, moderately well-drained Red Podzolic Soils on crests; moderately deep, moderately well-drained Yellow Podzolic Soils on slopes. **Geology:** Palaeozoic Neranleigh-Fernvale Group. Thinly bedded fissile shales, siltstones and sandstones with occasional more massive greywackes, volcanic tuffs, agglomerates, sandstones, and massive cobble conglomerates.

Soil Profile via hand auger within proposed LAA

See following page for soil profile information sheet.

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: 133-193 Dulguigan Road Dulguigan	Date: 14/12/2023
Soil Profile with hand auger within Proposed LAA		

BH1 - LOT 1	Depth	0-300	300-1000		
	**Structure**	Strong	Strong		
	Moisture	Moist	Moist		
	Coarse Fragments	Medium gravel	Nil		
	pH	5.0	5.0		
	Colour	7.5YR 3/2 Dark brown	10YR 6/4 light Yellowish Brown		
	Soil Category	Clay Loam, Category 4	Light Clay, Category 5		
	Modified Emerson Aggregate Test	Class 8 - No swelling	Class 3-6 - No dispersion		
	Ribbon Test				

BH2 - LOT 3	Depth	0-600	600-1000		
	**Structure**	Strong	Strong		
	Moisture	Moist	Moist		
	Coarse Fragments	Nil	Fine gravel, Few (2-10%)		
	pH	5.0	4.5		
	Colour	10YR 5/6 Yellowish Brown	2.5Y 5/6 light olive brown		
	Soil Category	Light Clay, Category 5	Light Clay, Category 5		
	Modified Emerson Aggregate Test	Class 8 - No swelling	Class 3-6 - No dispersion		
	Ribbon Test				

BH3 - LOT 4	Depth	0.200	200.600	600.1000	
	**Structure**	Moderate	Strong	Weak	
	Moisture	Dry	Moist	Dry	
	Coarse Fragments	Fine gravel, Common (10-20%)	Fine gravel, Very few (<2%)	Medium gravel, Coarse gravel, Many (20-50%)	
	pH	6.0	6.0	6.0	
	Colour	10YR 5/3 Brown	10YR 6/6 brownish yellow	10YR 6/8 Yellowish Brown	
	Soil Category	Clay Loam, Category 4	Medium Clay, Category 6	Light Clay, Category 5	
	Modified Emerson Aggregate Test	Class 8 - No swelling	Class 3-6 - No dispersion	Class 3-6 - No dispersion	
	Ribbon Test				

BH4 - LOT 5	Depth	0.350	350.1000		
	**Structure**	Weak	Strong		
	Moisture	Dry	Moist		
	Coarse Fragments	Fine gravel, Common (10-20%)	Nil		
	pH	5.0	5.0		
	Colour	10YR 4/4 Dark Yellowish Brown	5YR 5/8 Yellowish red		
	Soil Category	Clay Loam, Category 4	Light Clay, Category 5		
	Modified Emerson Aggregate Test	Class 8 - No swelling	Class 3-6 - No dispersion		
	Ribbon Test				

BH5 - LOT 6	Depth	0-150	150-1000		
	**Structure**	Strong	Strong		
	Moisture	Dry	Dry		
	Coarse Fragments	Nil	Fine gravel, Common (10-20%)		
	pH	6.0	6.0		
	Colour	10YR 5/4 Yellowish Brown	10YR 5/6 Yellowish Brown		
	Soil Category	Light Clay, Category 5	Medium Clay, Category 6		
	Modified Emerson Aggregate Test	Class 8 - No swelling	Class 3-6 - No dispersion		
	Ribbon Test				

APPENDIX 6 - 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 13 - 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 7 - SETBACK DISTANCE RISK ASSESSMENT

Table 14 - 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 15 - 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 6 soils High-25m to gully Low resource value Average: High
D	Slope	<30% subsurface effluent application	>30% subsurface effluent application	Low – <30% slopes exhibited
E	Position of land application area in landscape	Downgradient of surface water, boundary	Upgradient of surface water, boundary	High – downslope to gully
F	Drainage	Category 1 and 2 soils, gently sloping	Category 6 soils, seepage, low lying area	High – Category 6 soils
G	Flood potential	Above 1 in 20-year flood contour	Below 1 in 20-year flood contour	Low – nil flood inundation within proposed LAA
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				MEDIUM

APPENDIX 8 - SETBACK GUIDELINES

Table 16 - 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 17 - 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 18 - 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 19 - 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 9 - PHOTOGRAPHIC LOG

Photo No. 1	Date 06/12/2023
LOT 1	
Description: View east and across slope overlooking proposed LAA	

Photo No. 2	Date 06/12/2023
LOT 2	
Description: View north and across slope overlooking recently installed LAA	

Photo No. 3	Date 06/12/2023
LOT 3	
Description: View west and downslope overlooking proposed LAA	

Photo No. 4	Date 06/12/2023
LOT 4	
Description: View north and downslope overlooking proposed LAA	

Photo No. 5	Date 06/12/2023
LOT 5	
Description: View north-west and downslope overlooking proposed LAA	

Photo No. 6	Date 06/12/2023
LOT 6	
Description: View south-west and upslope overlooking proposed LAA	

APPENDIX 10 - 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