On-site Sewage Management Assessment
Proposed Dwelling

Location:

1931 Coolamon Scenic Drive
Lot 6 DP 258075
Mullumbimby NSW

Byron Shire Council

Prepared for:

Jace O'Connor

Report No:

2022.1099

September 2022

HMC environmental consulting pty ltd

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RE: 1931 Coolamon Scenic Drive, Lot 6 DP 258075, Mullumbimby, NSW.

HMC Environmental Consulting Pty Ltd is pleased to present our revised 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.

Yours sincerely

Helen Tunks
(B.Env.Sc.)

Document Control Summary			
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Job No:	2022.1099		
Client:	Jace O'Connor		

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J. O'Connor	14.10.2022	Draft Issue A	Email	1 x pdf
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TABLE OF CONTENTS

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
OSMS	On-Site Sewage Management System
SDI	Sub-surface drip irrigation
TN	Total nitrogen
TP	Total phosphorus
TSS	Total suspended solids

1 INTRODUCTION

HMC Environmental Consulting Pty Ltd has been commissioned to prepare an on-site sewage management assessment for a proposed 3-bedroom dwelling located at 1931 Coolamon Scenic Drive, Lot 6 DP 258075, Mullumbimby, NSW, within Byron Shire Council. The property supports an existing small dwelling, to be replaced, and a separate structure to be used as an office/workshop. The existing structures are serviced by a Council approved on-site sewage management system (OSMS).

A site inspection was carried out by Taylah Richards of HMC on the 22nd August 2022. During the inspection, the site and soil characteristics were assessed in terms of wastewater treatment and disposal methods, along with the design and condition of the existing OSMS. The OSMS comprises a ~2400L concrete septic tank with failed effluent absorption trenches located approximately 20m upslope of an intermittent watercourse.

It is proposed to decommission the existing concrete septic tank and install an aerated wastewater treatment system (AWTS) with minimum 53% total nitrogen (TN) reduction. Effluent disposal is proposed through 500m2 of subsurface drip irrigation (SDI) throughout a newly planted orchard. The proposed OSMS land application area (LAA) is located on a south facing moderate-steep sloping ridgeline. Due to the slope of approximately 30%, a reduction in the recommended design irrigation rate (DIR) of 50% has been included in this design.

2 PROPOSAL

Proposal	Proposed 3 B/R dwelling & office
Property	1931 Coolamon Scenic Drive Lot 6 DP 258075 Mullumbimby NSW
Council Area/Approvals:	Byron Shire Council
Area of Property	1.76 ha (17600m2)
Water Supply	Non-reticulated roof water supply
Design Daily Hydraulic Load & Design Occupancy	575L/day 5 persons, proposed 3-bedroom dwelling Amenities within office/workshop are to be used by householders only Based on 115L/p/day wastewater design flow allowance as per Byron Shire Council OSMS Design Model
Water Saving Devices	Expected in proposed development

3 SUMMARY OF RECOMMENDED SEWAGE WORKS

On-site Sewage Management System
• Decommission existing concrete septic tank in accordance with NSW Health guidelines (Appendix 12) • Install an Aerated Wastewater Treatment System (AWTS) with NSW Health accreditation for nutrient reduction of >53% total nitrogen. • Install 500m2 of shallow ripped pressure compensating subsurface drip irrigation (SDI) within existing orchard. 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.

Table 1: Variation to Byron OSMS Design Model/Strategy

Byron Shire Council OSSM Design Model/Strategy Default	Change Displayed on Design Model/ Specification	Justification
• TN reduction 20%	• 53%	• Install an AWTS with NSW Health accreditation for nutrient reduction of >53% total nitrogen
• LAA sizing 220m2 Assumes 53% TN reduction	• LAA 500m2	• LAA increased to 500m2 due to slope risk • Steep slopes, 50% reduction in recommended DIR • Light Clay soil – Max DIR 3mm/day, reduced to 1.5mm/day
• 40m to intermittent watercourse	• 22m	• Achieves high risk when assessed by Table R1, AS/NZS1547:2012. • Low DIR, reduced risk of run-off • Secondary treatment with nutrient reduction of >53% TN

4 SITE & SOIL INVESTIGATION

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).

Inspected by	Taylah Richards
Date & Time of Inspection	Wednesday 8th June 2022. See Appendix 1 & 2 for site location, Appendix 8 for photos.
Weather	Weather – warm, rainfall recorded on morning of site inspection. BOM Stn 58040 Mullumbimby (Fairview Farm). ~12mm rainfall recorded for the fortnight preceding site inspection. ~89mm rainfall recorded for the month preceding site inspection.
Soil Type & Category	Soil Category 5 (Table 5.1 AS/NZS1547:2012) 0-200mm: Strongly structured Clay Loam 200-400mm: Moderately structured Light Clay 400-600mm: Weakly structured Medium Clay
Climate	Average Annual rainfall: 1515mm, Alstonville (1980 – 2001) Annual evaporation: 1000-1200mm/year Warm, temperate. High volume, seasonal rainfall typical of region.
Terrain	Upper slope
Slope & Drainage:	Steep slope ~30%, linear planar
Aspect & Shading	South-eastern aspect, shading expected from orchard growth
Ground cover/vegetation	Scattered fruit trees, grass cover between

4.1 Site Compliance

SITE CONSTRAINT/FEATURE	SETBACK DISTANCE/DESCRIPTION	Recommended (BSC, 2004)	COMPLYING
Setback to Boundary	3m to upslope property boundary	3m	YES
Setback to Watercourses	22m to intermittent watercourse	40m	**NO**
Setback to Water Bore	~60m upslope	>50m	YES
Reserve LAA	100% available		YES
Slope Gradient	~30% steeply sloping	<10%	**NO**
Slope Stability	Not mapped		YES
Flood Liability	Nil		YES
Aquaculture	Not mapped		YES
Water Catchment	Not mapped		YES

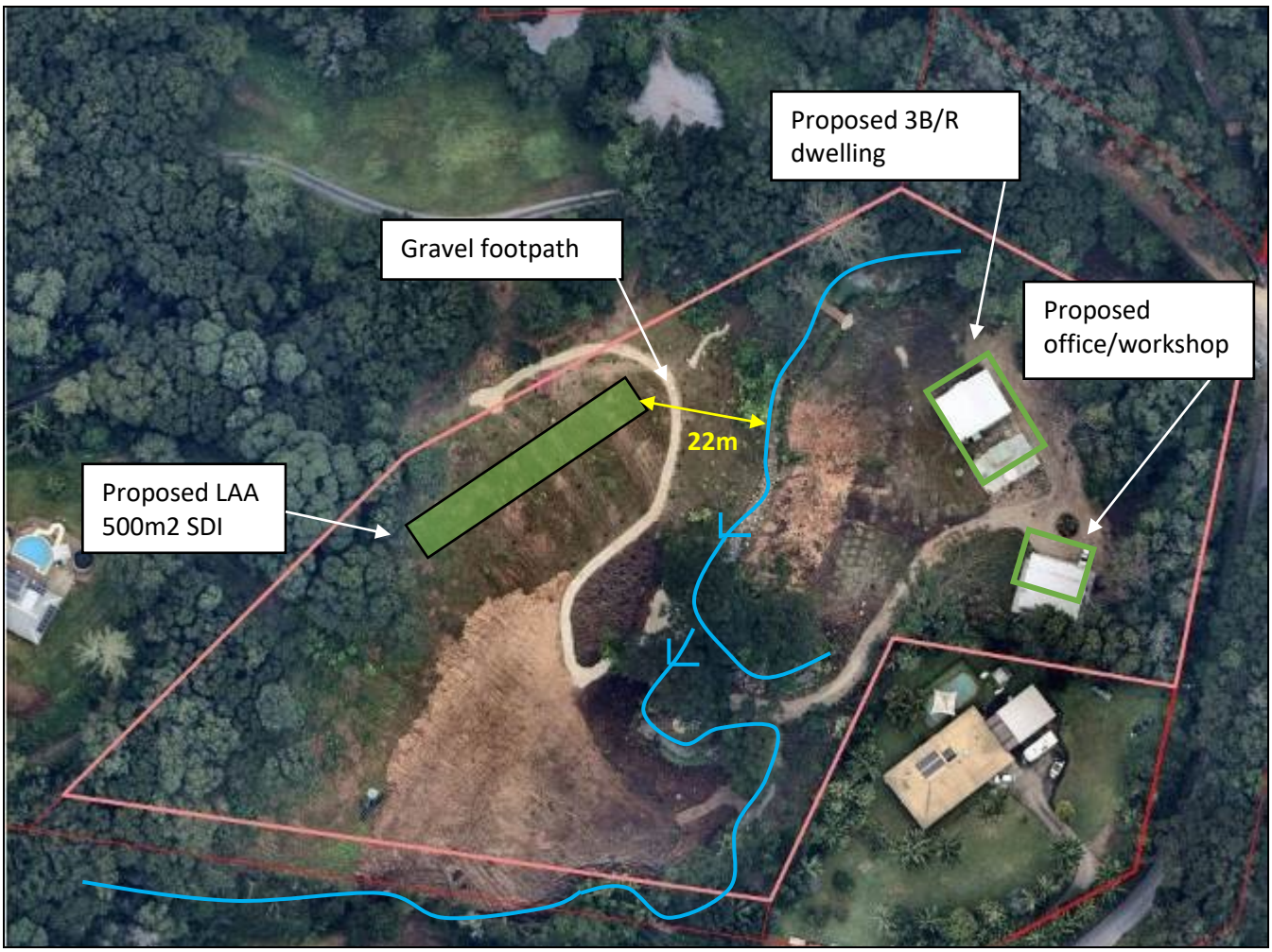


Figure 1: Site features and setback distance from Land Application Areas (Nearmap, July 2022).

4.2 Setback Distance Risk Assessment

The setbacks from the proposed on-site sewage management system for this residential development were adopted from the recommendations within the following guidelines:

- Byron Shire Council – Design Guidelines for On-site Sewage Management for Single Households (BSC,2004)
- AS/NZS1547: 2012

The proposed land application area does not comply with the recommended setback distances from land application areas (LAAs) as shown within Table 2 below.

Table 2: Recommendations for Minimum Setback Distances

Guideline Recommendations for Minimum Setback Distances		
Constraints	**BSC, 2004**	**AS/NZS1547:2012**
Surface Waters	40 metres from the nearest edge of intermittent watercourse	15-100m to surface waters
Driveways	6 meters from driveways	Not specified

A setback distance risk assessment, based on table R1 of the AS/NZS1547:2012, in relation to site constraints was carried out and is detailed in Appendix 6. The risk assessment conclusions are presented in Table 3 below. The proposed LAA lies approximately ~240m upslope of a property domestic groundwater bore (GW300724).

Table 3: Risk Assessment Results for Site Constraints

Site Constraint	**Setback Distance/Criteria Achieved**	**Average Risk Assessment Result (Appendix 6)**	**Mitigations**
Surface Waters	~22m to downslope intermittent watercourse	HIGH	• Low DIR achieved of 1.15mm/day • Secondary treated and disinfection of effluent with NSW health accreditation for nutrient reduction of >53% TN • Shallow subsurface effluent disposal with uniform pressure dosed application
Gravel footpath	3m downslope	LOW	• Suitable for pedestrian use only • Discourages pedestrian access to LAA • Proposed LAA within orchard, minimal pedestrian/vehicle access expected due to slope and density of plantings

5 LAND APPLICATION AREA SIZING AND DESIGN

5.1 Assessed Design Inputs

Model Used: Byron OSSM Design Model. Daily Time Step	
Climate Data	Alstonville Rainfall & Evaporation Record: 1/7/1980 – 30/6/2001
Design Occupancy	Proposed 3-bedroom dwelling & office/workshop/5 persons design occupancy
Wastewater Design Flow Allowance	115L/p/day
Wastewater Design Hydraulic Load	575L/day
Nitrogen (TN)	4.2 kg/person/year
TN System Nutrient Reduction	Secondary Effluent –53% reduction assumed by proposed AWTS with nutrient reduction
Maximum Design Irrigation Rate (DLR)	3mm/day (Table M1 AS/NZS1547:2012)
Proposed DIR	2.6mm/day (*BSC Design Model*)

5.2 Summary of Land Application Area Calculations

Analyte	**Land Application Area Minimum Requirement Hydraulic Load (Q) = 575L/day**	
	BSC OSSM Design Model	**LAA Method & Configuration**
Hydraulic Area	220m^2	Install 500m2 pressure compensated sub-surface dripperline ripped @100mm depth under lawn DIR = 575L/500m2 = 1.15mm/day
Nitrogen (TN)	85m^2	
Phosphorus (TP)	73m^2	
DIR (Q/LAA)	2.6mm/day	

No permeability tests were undertaken in the field. 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.

6 DISCUSSION/REASON FOR APPROVAL

The existing primary treatment system is failing with the resulting effluent plume discharging to the ground surface upslope of the intermittent waterway. The proposed OSMS of secondary treated effluent with final disinfection and nutrient reduction distributed through pressure compensating dripperline installed within the shallow topsoil layer will replace this failing system. The shallow subsurface effluent disposal is considered to be the most appropriate design due to the site constraints of steep slope and low permeability of the deeper subsoil. The location was chosen to maximise the distance to the intermittent watercourse and provide benefit to the orchard plantings.

Sub-soil absorption effluent disposal methods were not recommended due to the very low permeability rate of the subsoil and sloping land. The steep slope was mitigated by increasing the length of the flexible dripperline to achieve a wetted LAA of 500m2, therefore lowering the DIR .

7 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 continued occupation proposed 3 bedroom replacement dwelling.

DESIGN HYDRAULIC LOADING

- Proposed 3B/R dwelling
- Existing structure to be used as & office/workshop
- 5 persons occupancy assumed
- 575L/day

RECOMMENDED ON-SITE SEWAGE MANAGEMENT SYSTEM

Refer to Site Plan & irrigation detail in Section 7.1

- Decommission existing concrete septic tank in accordance with NSW Health guidelines (Appendix 12)
- Install an AWTS with NSW Health accreditation for nutrient reduction >53% TN :
  Accredited AWTS include:
  - ✓ Taylex ABS-NR Certificate No. AWTS 036/AWTS026. Expiry 31.12.2022.
  - ✓ Fuji Clean ACE 1200 Advanced Certificate No. STS-AWTS042. Expiry 31/12/2025,
  - ✓ OzziKleen RP10A+ Certificate No. AWTS014 Expiry 31/12/2026.

- Connect all sanitary drainage from to proposed AWTS

Land Application Area:

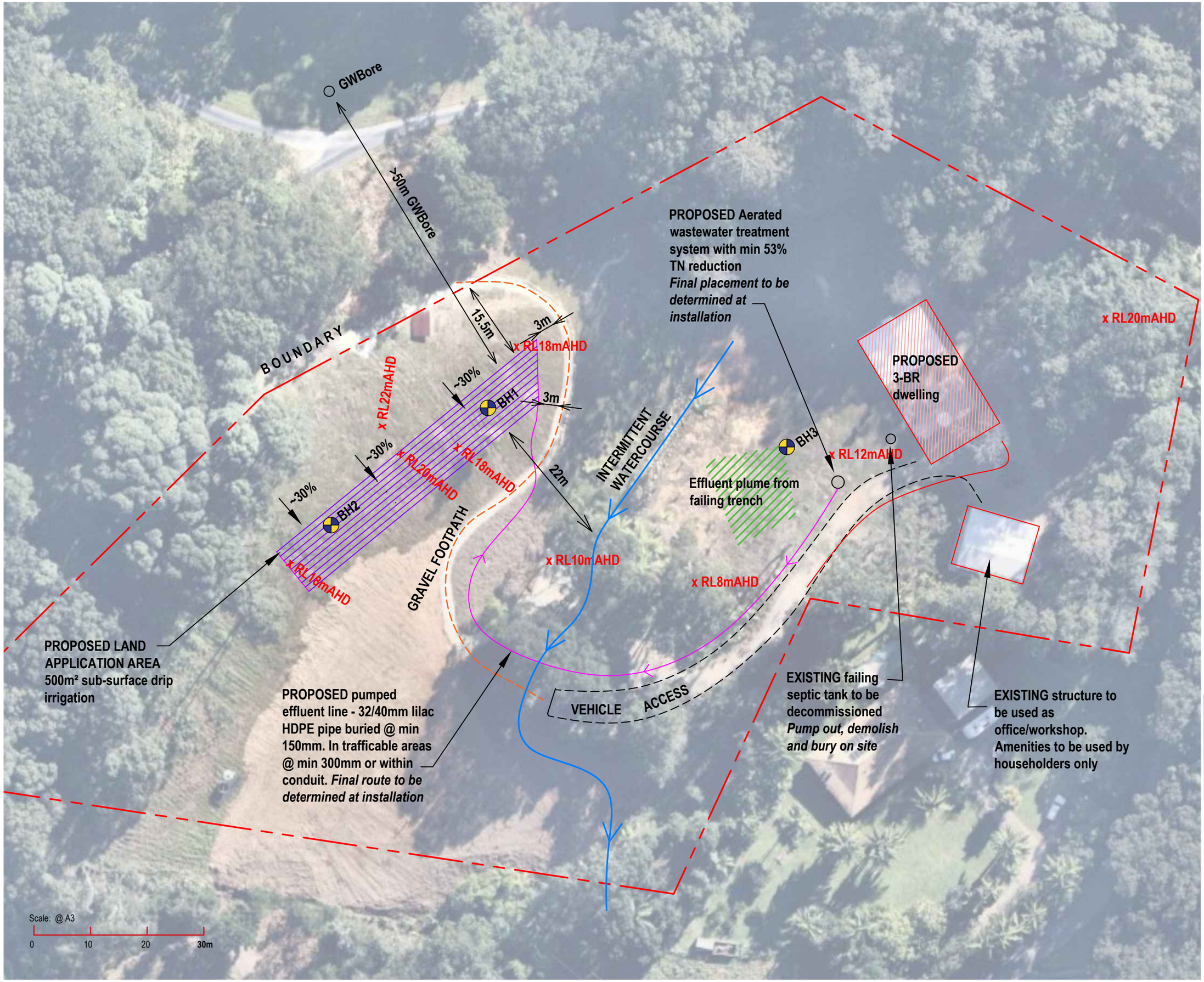
- Install 500m2 zone of shallow ripped pressure compensating subsurface drip irrigation (SDI) within native topsoil. Ensure a minimum 500 linear meters of dripperline is installed @ average 100mm depth and ~1m dripperline lateral spacing. Recommended dripline is Netafim Unibioline CNLXR 16mm.
- Install 32-40mm HDPE pipe, buried @ 150mm depth, to distribute effluent from AWTS to proposed Land Application Area (LAA).

OPERATION & MAINTENANCE

- 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.

7.1 Site Plan & Irrigation Design Section Detail

SEE FOLLOWING PAGES



ONSITE SEWAGE MANAGEMENT DESIGN LAND APPLICATION AREA (LAA)

SHEET 1 - PLAN

NEW COMPONENTS

- Aerated Wastewater Treatment System (AWTS) min 53% TN reduction
- 500m² sub-surface drip irrigation
- 100mm DWV PVC pipe
- Lilac HDPE pipe (buried)
- check valves
- flush valves
- flush trench
- air relief/vacuum breakers

All drainage work is to be undertaken by a licensed Plumber/Drainer
Plumber to check all levels on site and adjust layout where necessary

PROPOSED LAA HAS BEEN STAKED ON SITE - ALL OTHER LOCATIONS ARE GENERAL ONLY AND ARE TO BE CONFIRMED ONSITE

Job:	HMC2022.1099
Date:	October 2022
Version:	
Drawn:	KH
Base:	Nearmap 2022
Council:	Byron Shire Council

Lot 6 DP 258075
1931 Coolamon Scenic Drive
Mullumbimby

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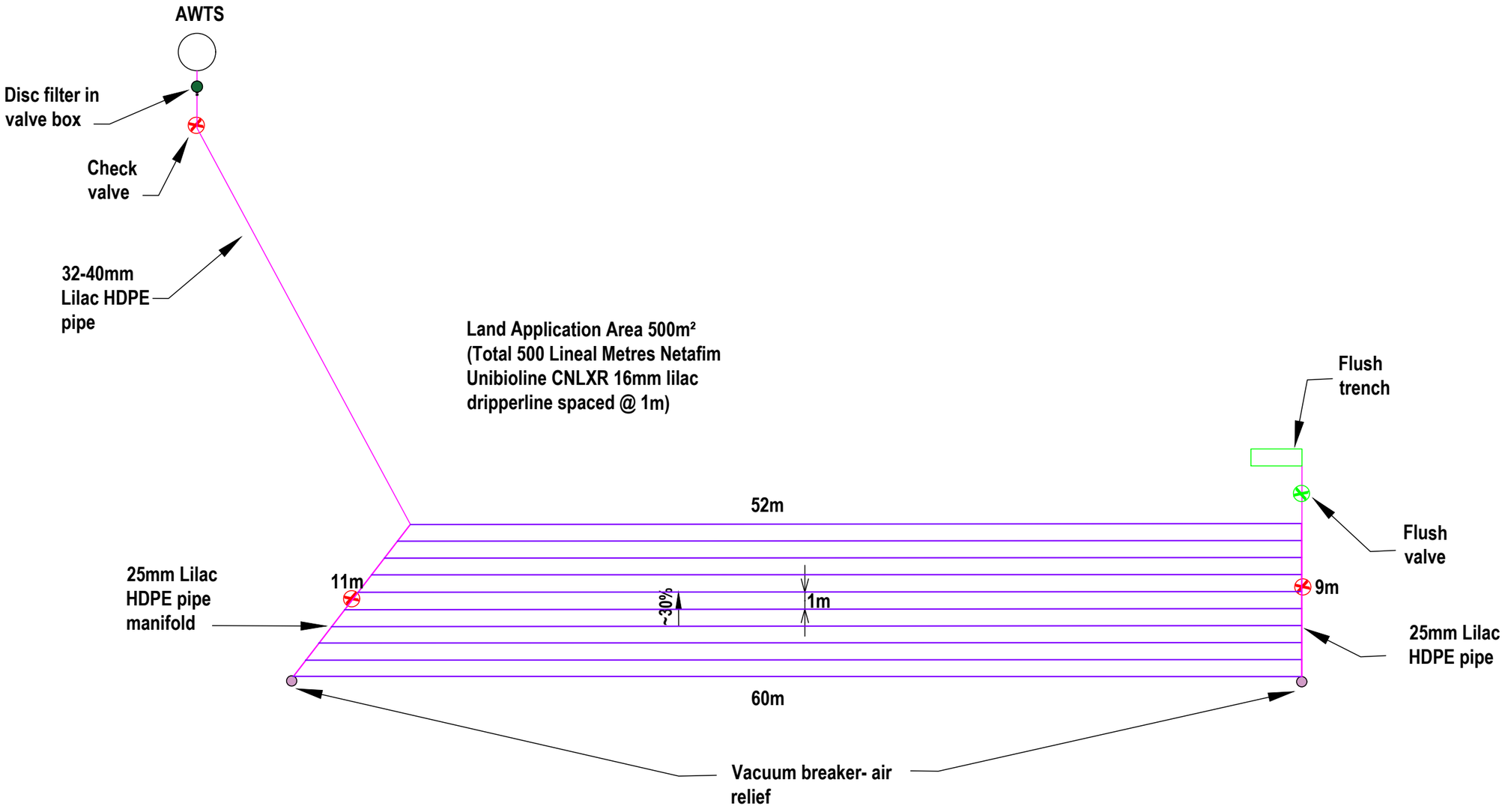

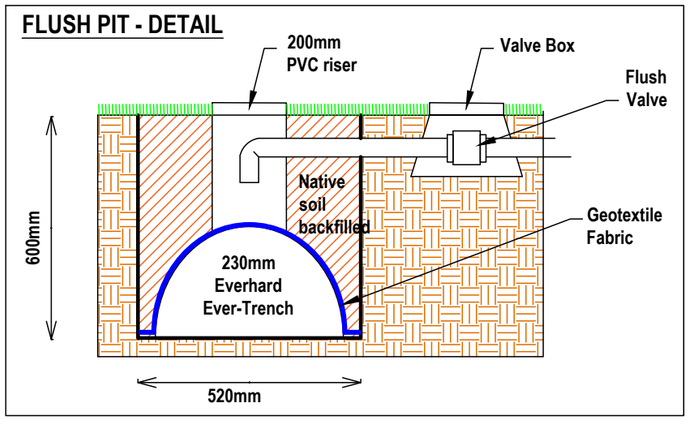

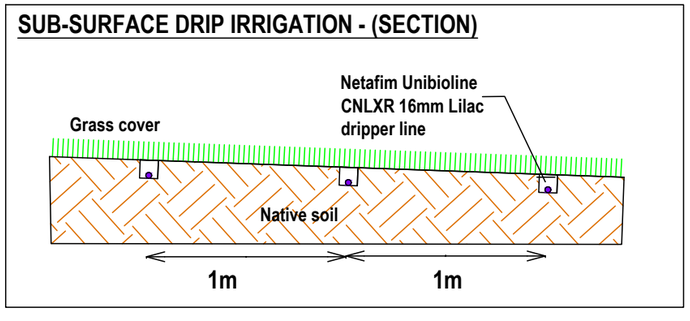

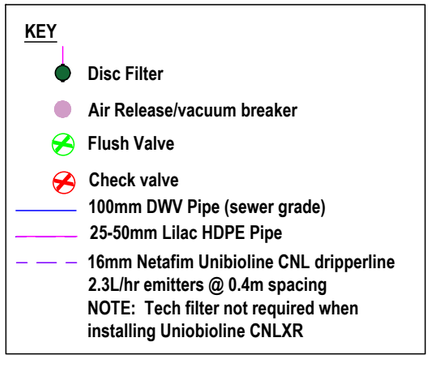

ONSITE SEWAGE MANAGEMENT DESIGN LAND APPLICATION AREA (LAA)

SHEET 2 - DETAIL

NEW COMPONENTS

- Aerated Wastewater Treatment System (AWTS) min 53% TN reduction
- 500m² sub-surface drip irrigation
- 100mm DWV PVC pipe
- Lilac HDPE pipe (buried)
- check valves
- flush valves
- flush trench
- air relief/vacuum breakers

All drainage work is to be undertaken by a licensed Plumber/Drainer
Plumber to check all levels on site and adjust layout where necessary

PROPOSED LAA HAS BEEN STAKED ON SITE - ALL OTHER LOCATIONS ARE GENERAL ONLY AND ARE TO BE CONFIRMED ONSITE

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8 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 assumes 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.

9 REFERENCES

References/legislation utilised in the preparation of report:

- Australian/New Zealand Standard AS 1547: 2012 - *On-site domestic wastewater management*, February 2012
- Byron Shire Council, "*On-site Sewage Management Strategy*", 2001.
- Byron Shire Council, " Design Guidelines for On-site Sewage Management for Single Households". 2004
- Byron Shire Council, "Information and Assessment Guide for owners of On-site Sewage Systems", 2006
- Martens & Associates P/L, On-site Sewage Management for Single Households. Standard Component Designs Prepared for North Coast Councils, ETA Design Final Draft, 25.3.2004.
- Morand, D.T., *Soil Landscapes of the Lismore-Ballina 1:100 000 Sheet*, 1994
- Munsell Soil Color Charts, GretagMacbeth, New Windsor, NY, USA, 2000.
- 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
- Rous Water Regional Water Supply, "Rous Water Onsite Wastewater Management Guidelines", June 2008.
- WaterNSW, "Designing and Installing On-site Wastewater Systems. A WaterNSW Current Recommended Practice", WNSW, 2019

10 APPENDICES

APPENDIX 1 Site Location

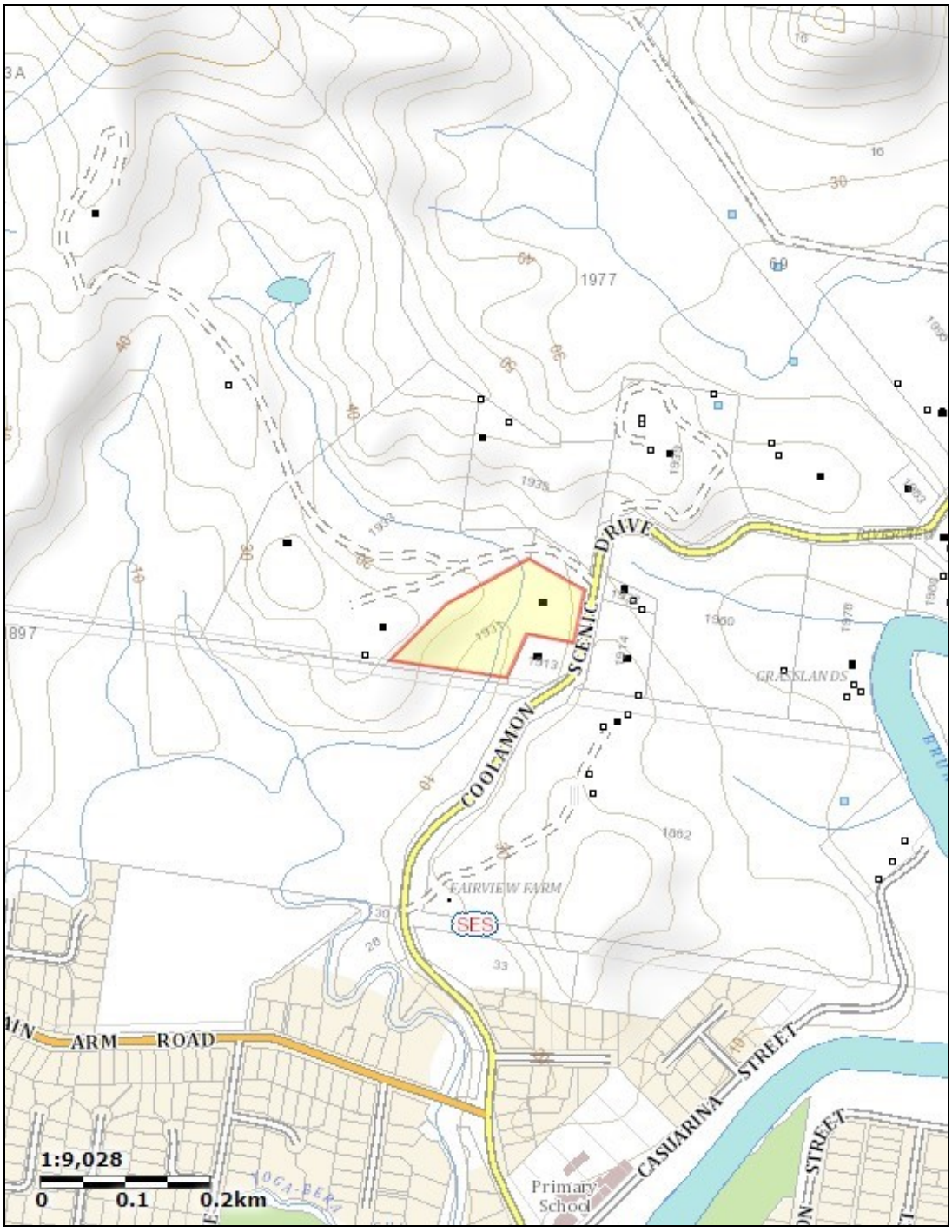


Figure 2: Site Location& property boundary, as shown in yellow (NSW LPI Viewer, SIX Maps)

APPENDIX 2 Property Boundary

Figure 3: Property Boundary (HMC GIS).

APPENDIX 3 LAA Modelling

SEE FOLLOWING PAGES

Byron OSMS Design Model *Version:* 2022.1099 - OSMS 1 -- AWTS + SSI.xlsm ***Period of Rainfall & Evaporation Record: 01/07/1980 - 30/06/2001***

Set Defaults

bedrooms / persons — STEP 1

 # persons (Grp 1) 5 — STEP 2

persons (Grp 2)

STEP 3: Buffer to permanent water / Buffer to intermittant water

STEP 4 — **Block size (m2)** 17600 / 22

Total Daily Flow (L/day) * 575

Daily Effluent Flow per person (L/day) 115

TN production per year (kg/year) 21.00

N prod. per capita (kg/person/yr) 4.20

TN reduced by all N loss (kg/year) * 7.90

N loss in treatment system (% reduction) 53%

N Plant Uptake rate (kg/ha/year) 200

Phosphorus in effluent (Ip) (kg/yr) * 3.00

P prod. per person per yr (kg/person/yr) 0.60

P uptake by plants (Hp) (kg/ha/yr) 10

P soil sorption (Ps) (kg/ha/m depth) 8000

STEP 10 — Water Table/ Bedrock Depth (m) **3.00**

Buffer to Water Table (Bwt) (m) 0.5

Time for accumulation of P(years) 50

Final area (m^2) **220**

Phosphorus area (m^2) 73

Water balance area (m^2) 220

Specific Crop Coeff.(grass=1.00) 1.00

% Effective Rainfall 65%

Percolation (mm/d) 4

Nitrogen Report

N plant uptake (kg/yr) 4.41

N load exceedence 0.00

N load percolated (kg/yr) 3.49

N released (perc+exceed.) (kg/yr) **3.49**

Enviro.N limit (kg/yr) **6.20**

Nitrogen area (m^2) **85**

Hydraulic area (m2) **220**

Total ETA trench area 213.47

ETA trench length (m) 18.73

Number of SSI laterals 10

beds/ total plus separating spaces: X,Y dimensions = 10.3m x 11.4m

Avg depth of root zone (m) 0.30

Effective porosity of root zone 0.34

Avail.Water Capacity (AWC) of root zone 0.13

Avg depth bluemetal (etc) in trench below root zone (m) 0.00

Effective porosity of bluemetal in trench below root zone 0.00

Default AWC of bluemetal in trench below root zone 0.00

Trench under root zone <-

Soil Moisture Holding Capacity: saturation & AWC (mm) 102.00 / 39.00

Permissible percentile exceedence 5.00%

SSI laterals pipe separation (m) 0.60

Minimum effluent application (mm/day/m^2) 2.61

Exceedence (L) 0.00000

94.52%

STEP 5 — **Daily effluent flow accord. water supply type**

- Reticulated supply (bore,spring,creek) 180L/p.d
- Reticulated + std. water saving devices 145L/p.d
- Roof water harvesting 140L/p.d
- Roof water harvesting + std. water sav. 115L/p.d

STEP 6 — Grp1 / Grp 2: Toilet, Bathroom, Laundry, Kitchen

Wastewater stream

% black to tot WW in a full system 32%

% black to tot WW in a full system: TN 70%

N loss in disposal bed (% reduction) 20%

wastewater in a full system: TP 40%

STEP 7 — **Treatment system**

- Septic (primary teatment only)
- AWTS
- Septic + single pass sandfilter (SPF)
- Septic + SPF, 25% septic return flow
- Septic + recirculating sandfilter
- Septic + reedbed

current Inlet BOD conc 250 mg/L

STEP 8 — **P soil sorption accord. soil type**

- "Alluvial"Soils 1 (dp,mu,my,te) 10,000 kg/ha/m
- "Alluvial"Soils 2 (cr) 2,000 kg/ha/m
- Red Basaltic Soils (bg,ca,co,el,ew,mb,ro,wo) 10,000 kg/ha/m
- Duplex Soils (ba, bi,bu,mi, ni) 8,000 kg/ha/m
- Podzol Soils (ab,bo,br,eb,fh,ki,ku,og,po,ty,wy) 1,000 kg/ha/m

STEP 9 — **Soil texture & structure beneath system**

- Gravels,Sands Ksat >3.0m/d
- Sandy loams - weakly structured Ksat >3.0m/d
- Sandy loams - massive Ksat 1.4 - 3.0m/d
- Loams - high/moderate structured Ksat 1.5 - 3.0m/d
- Loams - weakly structured or massive Ksat 0.5 - 1.5m/d
- Clay loams - high/mod structured Ksat 0.5 - 1.5m/d
- Clay loams - weakly structured Ksat 0.12 - 0.5m/d
- Clay loams - massive structured Ksat 0.06 - 0.12m/d
- Light clays - strongly structured Ksat 0.12 - 0.5m/d
- Light clays - moderately structured Ksat 0.06 - 0.12m/d
- Light clays - weak. structured or massive Ksat <0.06m/d
- Med. to heavy clays - strong. struct. Ksat 0.06-0.5m/d
- Med. to heavy clays - mod. structured Ksat <0.06m/d
- Med. to hvy clays - weak. struct. or massive Ksat<0.06m/d
- DISPERSIVE soil (Modified Emerson Aggregate test)

Wetted depth(m) 0.50

TN% removal 50.0%

Reed bed area (m2) 11.3

BOD target of 20mg/L is Current Outlet BOD reduction of 92.0% req. 90.0%

STEP 11 — **% Effective Rainfall**

- Mounded bed
- Level bed with grass

STEP 12 — **Soil texture in root zone**

- Coarse Sand
- Fine sand, Sandy loams
- Loams,Clay loams,Silt
- Clay (light,med,heavy)

Land Application Type — STEP 13: SSI / ETA

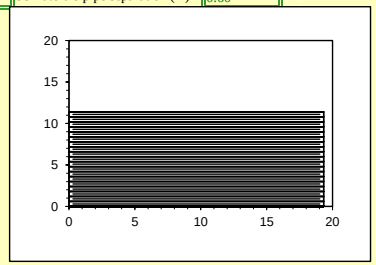
STEP 14: Calculate (or Cntl- q)

Lateral seepage width (m) 0.60

ETA trench separation 2.00

ETA bed separation 1.40

STEP 15: 2.00



19

Source: ASNZS1547:2000

Source: Jeppesen & Safley (1994) and Witt et al (1974)

Source: N prod/person/yr Aust., local & overseas studies (Davison 2002)

Source: Mourad (1994 soil units, SCU data in LCC 2000)

Source: P prod /person/yr Aust. & local studies (Davison, 2002)

Soil texture/structure Source ASANZ 1547(2000)

Source: LCC (1998)

Source: Dunne & Leopold (1978)

Source: Dunne & Leopold (1978)

Exceedence (mm)	Effluent Irrigation Rate (mm/day)	Actual Soil Moisture (mm)
2.000000	2.61	104.00
0.000000		
0.000000	0.00	0.40
30.085275	662.00	

Exceedence (mm)	Effluent Irrigation Rate (mm/day)	Actual Soil Moisture (mm)

APPENDIX 4 Soil Investigation

NSW DLWC 1:100,000 Soil Landscape Map (Morand, 1994)	Burringbar (bu) soil landscape (Expected) Red to Yellow Podzolics on mid to lower slopes
Geology	Metasediments of the Neranleigh Fernvale Group - shales, siltstones, sandstones, greywacke and agglomerates

Soil profile – BH1 & BH2 within proposed LAA							
Bore Hole No.	**Approx. Depth (mm)**	**Field Texture Determination (AS1547 Soil Category)**	**Structure**	**Colour Moist (MUNSELL)**	**pH**	**Coarse Fragments**	**Modified Emmerson Aggregate Test**
1	0- 200	Clay Loam Category 4	Strong	Dark Brown 10YR 3/3	5.5	Fine gravels <20%	Class 3
	200-400	Light Clay Category 5	Moderate	Strong Brown 7.5YR 5/6	5.5	Fine gravels <20%	Class 3
	400-600	Medium Clay Category 6	Weak	Strong Brown 7.5YR 5/6	5.0	Nil	Class 3
2	0- 200	Clay Loam Category 4	Strong	Dark Brown 10YR 3/3	5.5	Fine gravels <20%	Class 3
	200-400	Light Clay Category 5	Moderate	Strong Brown 7.5YR 5/6	5.5	Fine gravels <20%	Class 3
	400-600	Medium Clay Category 6	Weak	Strong Brown 7.5YR 5/6	5.0	Nil	Class 3
3 Existing LAA	0- 200	Sandy Loam Category 3	Strong	Dark Brown 7.5YR 3/2	6.0	Organic fragments, mulch cover	Class 3 Slake 2 (some slaking)
	200-700	Medium Clay Category 6	Massive	Brown + orange mottles 7.5YR 5/2	4.5	Fine gravels <20%	Class 4
Top dressing of the disposal area may be required, especially for the first 6-12 months due to settling of the soil. Topsoil should be of a loam to sandy loam texture with a neutral pH.							

APPENDIX 5 Modified Emersion Aggregate Test

As described within the *Design Guidelines for On-site Sewage Management for Single Households* (BSC, 2004).

Soil Class	**Description**
Class 1	Material disperses completely
Class 2	Aggregates disperse (clouds solution appreciably)
Class 3	Aggregates slake - smaller aggregates/particles fall off the original aggregate
Class 4:	No change to aggregate, therefore non-dispersive

APPENDIX 6 Setback Distance Risk Assessment

Table 4: 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 5: Site Constraint Risk Assessment

Item	Site/system feature	Constraint Scale Factors		Risk Level of Constraint
		Lower ⟷ Higher		
A	Microbial quality of effluent [3]	Secondary treatment	Primary treatment	Low-Secondary treatment with disinfection
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 value	High – Category 5 soils
D	Slope	0-6% (surface effluent application)	>10% (surface effluent application), >30% subsurface effluent application	High – Steep slopes
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	High – downslope to surface water
F	Drainage	Category 1 and 2 soils, gently sloping area	Category 6 soils, sites with visible seepage, moisture tolerant vegetation, low lying area	High – Category 6 subsoils
G	Flood potential	Above 1 in 20-year flood contour	Below 1 in 20-year flood contour	Low – Nil flood inundation within 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				**HIGH**

APPENDIX 7 Setback Guidelines

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)1**	**Site constraint items of specific concern (from table R2)1**
	Horizontal Setback Distance (m)	
Property Boundary	1.5-502	A, D, J
Buildings/houses	2.0->63	A, D, J
Surface Water4	15-100	A, B, D, E, F, G, J
Bore, Well5	15-50	A, C, H, J
Recreational areas (Children's play areas, swimming pools and so on)7	3-158,9	A, E, J
In-Ground water tank	4-1510	A, E, J
Retaining wall and Embankments, escarpments, cuttings11	3.0m or 45o angle from toe of wall (whichever is greatest)	D, G, H
	Vertical Setback Distance (m)	
Groundwater 5,6,12	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 may 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 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 1** **Lower ⟷ Higher** **Examples of constraint factors2**		**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,	Category 4 to 6 soils, permanent surface water <50m down	Surface water pollution hazard for low permeable soils, low lying or poorly

		low rainfall area	gradient, high rainfall area, high resource/environmental value6	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 6: Guidelines for Horizontal and Vertical Setback Distances (WaterNSW 2019)

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 7: Guidelines for Horizontal and Vertical Setback Distances (DLG, 1998)

System	Recommended Buffer Distances
All land application systems	100 metres to permanent surface waters (eg. River, streams, lakes etc.) 250 metres to domestic groundwater well 40 metres to other waters (eg. 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 22/08/2022	
Description: View NE and across slope showing existing septic tank to be decommissioned. Existing dwelling shown in distance.		

Photo No. 2	Date 08/06/2022	
Description: View SE from septic tank looking towards existing structure to be used as office building/workshop.		

Photo No. 3	Date 08/06/2022	
Description: View SW and downslope overlooking existing failed effluent disposal area located upslope of intermittent watercourse.		

Photo No. 4	Date 08/06/2022
Description: View N and across slope overlooking intermittent watercourse located downslope of dwelling.	

Photo No. 5	Date 08/06/2022
Description: View W and upslope from watercourse looking towards proposed dwelling location.	

Photo No. 6	Date 08/06/2022
Description: View overlooking bridge crossing intermittent watercourse.	

Photo No. 7	Date 08/06/2022
Description: View NE and across slope overlooking proposed LAA, located on grassed slope	

Photo No. 8	Date 08/06/2022
Description: View N and upslope overlooking proposed LAA.	

Photo No. 9	Date 08/06/2022
Description: Soil profile BH3 within existing effluent disposal area.