



ENVIRONMENTAL CONSULTING Pty Ltd

ON-SITE SEWAGE MANAGEMENT CAPABILITY ASSESSMENT

**Proposed S.455 Modification of Approved
Community Title Subdivision**

January 2026

Prepared for: McAuleys Developments Pty Ltd

**Lot 8 DP 589795
53 McAuley's Lane
Myocum NSW**

HMC Ref: 2025.1928

RE: Lot 8 DP 589795, 53 McAuley's Lane, Myocum, NSW.

HMC Environmental Consulting Pty Ltd is pleased to present our revised On-site Sewage Capability Assessment Report for the above-mentioned site.

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

HMC ENVIRONMENTAL CONSULTING Suite 29, Level 2, 75-77 Wharf Street PO Box 311, Tweed Heads NSW 2485		Ph: 07 55368863 Email: admin@hmcenvironment.com.au ABN: 60 108 085 614
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PREPARED FOR:	McAuleys Developments Pty Ltd	
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Enquiries should be addressed to HMC Environmental Consulting Pty Ltd

EXECUTIVE SUMMARY

HMC Environmental Consulting Pty Ltd has been commissioned by McAuleys Developments Pty Ltd, to prepare an On-site Sewage Capability Assessment for the Proposed S.455 Modification of Approved Community Title Subdivision of Lot 8 DP 589795, 53 McAuley's Lane, Myocum, NSW, within Byron Shire Council.

The community title subdivision was approved under DA 10.2023.454.1 on 26 June 2025, and that this amendment is to satisfy Condition #2 and to modify the consent to reinstate Lot 38.

The site is currently largely grazing land with pasture grass cover. There is an existing rendered brick veneer dwelling existing on the property which will remain as part of the proposal on Lot 25. A detached weatherboard shed is located west of this dwelling which will be demolished. A weatherboard secondary dwelling located on the northern boundary will also be demolished, as well as existing fencing and cattle yards (see Figure 2).

The lots to be created are a minimum of 3224m² in size, ranging up to 9093m². The locations of the house sites, land application areas (LAA) and reserve LAAs are shown in this On-site Sewage Capability Assessment Report to justify lot size feasibility.

Site & Soil Investigation:

HMC staff carried out site walkover and soil investigations on 30th of October 2020 including obtaining drone footage, the excavation of 9 test pits and sampling of the exposed soil profiles. Laboratory analyses for soil chemistry were carried out to determine site limitations in terms of effluent land application. The results do not present any absolute constraints to on-site sewage management for the individual lots.

The soil profiles recorded for the majority of the test pits were deep Krasnozems (BH2, BH4, BH6, BH7, BH8 & BH9), within the area mapped as a Wollongbar soil landscape (Morand, 1994). Light to medium clay subsoils from 400mm depth were observed within the lower elevations at BH1, BH3 & BH5, within the area mapped as a Burringbar soil landscape (Morand, 1994).

Two gully systems are located on the site discharging eastwards and are classified as 1st order streams. The northern gully has been modified with a dam wall and the resulting upstream catchment is classified as a 2nd order stream. Additional minor drainage lines traverse the property (see Figure 3). These are to be intercepted with swales and piped underground as part of the engineered stormwater management system, in accordance with the proposed civil works plan.

Off-site gullies are also protected by a 30m buffer to the effluent land application areas and a 40m buffer to second order streams.

The recommended finished surface of all effluent land application areas is 100% lawn grass cover and to be further protected from stormwater run-on by installation of upslope water controls at time of installation.

On-site Sewage Management System Design:

The soil profiles across the site were recorded Clay Loam & Light Clay, overlying medium soils at depths ranging from 400mm- 1m. Given the topography & soil profile, the most suitable effluent land application method is considered to be pressure-compensated shallow sub-surface drip irrigation (SDI) to enable effluent distribution within the upper soil layers with minimal disturbance.

Secondary effluent treatment with final disinfection via mechanical Aerated Wastewater Treatment Systems (AWTS) is therefore recommended for all lots. The AWTS and SDI will maximise effluent quality and minimise soil disturbance and target the more permeable surface topsoil for effluent distribution.

Reserve Land Application Area :

The chemical or physical properties of the imported and native soils within the land application areas are not expected to be impacted in the long term by the shallow uniform distribution of the high-quality effluent, therefore the nominated effluent land application areas remain suitable for future installation of duplicated or replacement systems.

To provide a conservative approach to lot layout for this subdivision level assessment, additional reserve land application areas of 50% are nominated and are to remain free from permanent structures.

Land Application Area Modelling:

In accordance with Council's OSSM Guidelines (BSC, 2023) for subdivision applications, the soil was characterised, and the lot layout and density were justified by sizing the land application areas (LAAs) on the most limiting lots. A water balance and nutrient mass balance BSC OSSM Design Model for a four-bedroom dwelling serviced by a non-reticulated water supply was used for model inputs.

A deep drainage rate of maximum 3mm/day, suitable for Light Clay soils of Category 5, was therefore used to conservatively size all of the land application areas for the subdivision level assessment.

The land application area modelling results for the smallest lot (3100m²) and the least permeable Light Clay soil encountered on the site is provided to show that 450m² of land application area (LAA) is satisfactory on sites of up to 20% slope, based on a DIR of 1.6mm/day. In contrast, the larger lots within the deeper, more permeable Clay Loam soils would need less area, and this modelling is also presented to demonstrate the conservative approach taken to justify lot density for the subdivision.

Slope Mitigation:

The slope mitigation was addressed using the Design Irrigation Rate reduction recommended in Table M2 of AS1547:2012. The land application areas were sized on the soil and lot size and then adjusted for lots on steeper land. As a result, The adopted DIR for the land application areas on slopes of 20-30% is a low 1.2mm/day

Alternative On-site Sewage Management System:

This report does not preclude alternative treatment or effluent land application methods, provided there is a site and soil investigation, and merit-based assessment carried out at the time of dwelling construction and/or system installation approval stage. Final locations and sizing and make/model of system will be determined at the time of these future single lot development applications, as limited by the setbacks and the size and location of the dwellings.

Conclusion:

This report concludes that, based on the information presented, the proposed land application areas are based on a conservative design approach and enable practical and sustainable on-site sewage management solutions within the proposed new lot boundaries.

The report demonstrates that there no absolute site and soil limitations on the proposed lots which cannot be overcome by on-site sewage management design at time of development application assessments for future dwellings.

It is considered the site is suitable for the subdivision development in terms of on-site sewage management (OSSM).

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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
ETA	Evapo-Transpiration Absorption (ETA) ETA beds will be used in reference to the construction of shallow sub surface effluent disposal trenches that utilise the principles of evaporation, transpiration, and absorption. The method of construction for the ETA bed referred to in this report is in accordance with a "Conventional Bed" provided in Figure L5 of AS/NZS 1547: 2012.
LAA	Land application area
LTAR	Long term acceptance rate
OSMS	On-Site Sewage Management System
OSSM	On-Site Sewage Management
SDI	Sub-surface drip irrigation
TN	Total nitrogen
TP	Total phosphorus
TSS	Total suspended solids

1. INTRODUCTION

HMC Environmental Consulting (HMC) has been engaged by McAuleys Developments Pty Ltd to provide an On-site Sewage Assessment for a Proposed S.455 Modification to Approved Community Title Subdivision located at Lot 8 DP 589795, No.53 McAuleys, Lane, Myocum NSW.

The proposed development includes the subdivision of the existing lot into 39 residential lots and a residual community lot, associated earthworks, tree removal, and construction of roadways and services. A community building, tennis court and ancillary shed are proposed to be constructed on the community lot.

Figure 1 provides the site location approximately 3.5km west of Tyagarah Beach and Nature Reserve. The seweraged villages of Brunswick Heads and Mullumbimby are located less than 3km northeast and northwest of the site.

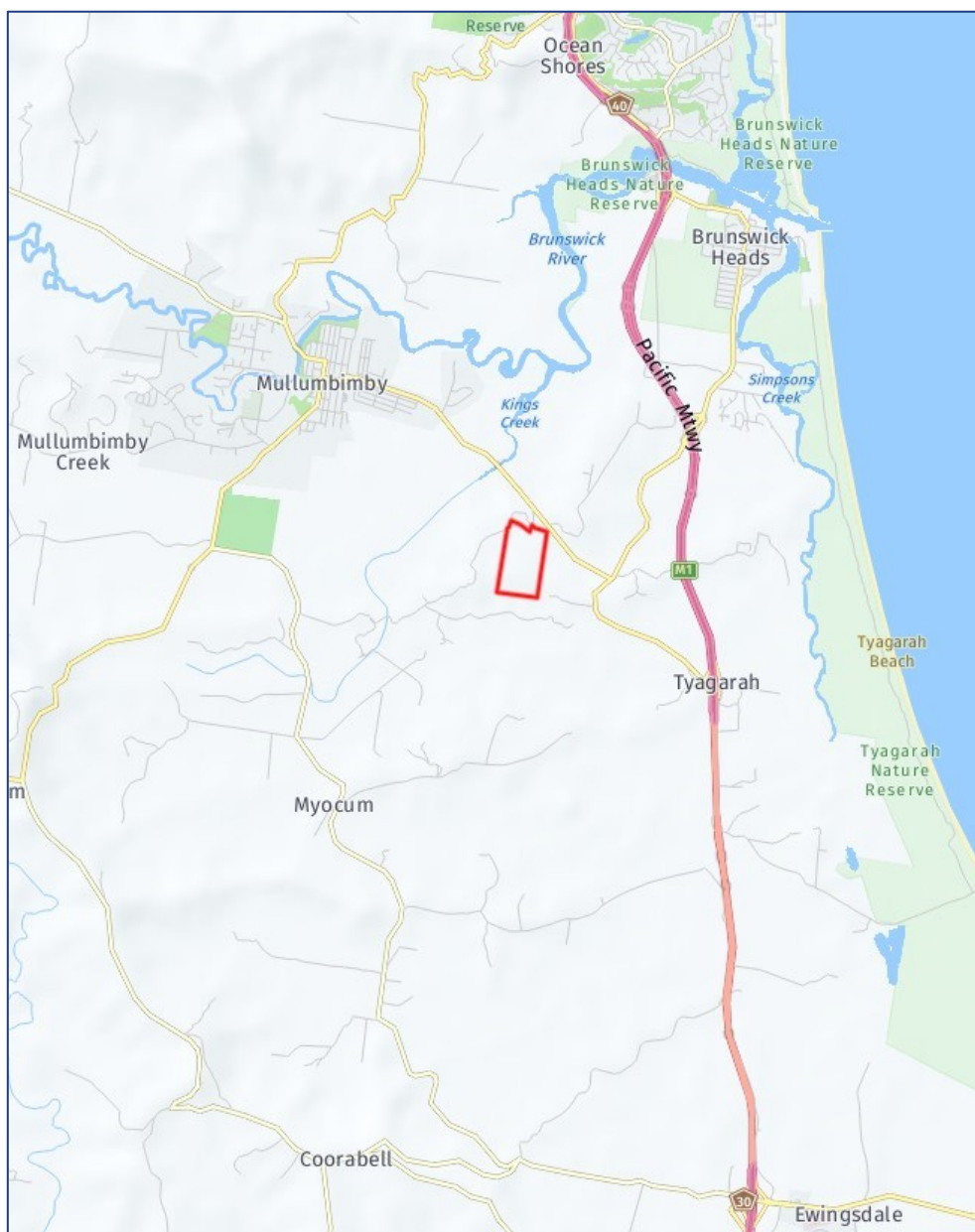


Figure 1 Site Location (Source: Nearmap, 2022)

The site is currently largely grazing land with pasture grass cover. An existing rendered brick veneer dwelling existing on the property will remain as part of the proposal. A detached weatherboard shed is located adjacent west to the dwelling which will be demolished along with the weatherboard secondary dwelling located on the northern boundary, as well as existing fencing and cattle yards.

A site walkover was carried out on the 30 October 2020 by HMC Environmental Consulting, and drone aerial photography was obtained. The site and soil were assessed for on-site wastewater disposal limitations, including soil investigation of nine (9) test pits, excavated by machine. Six (6) samples representative of the exposed profiles were submitted for laboratory analysis for effluent disposal analyses (Environmental Analytical Laboratory, Southern Cross University, Lismore).

The soils of the site are generally moderately well drained and present minimal constraint to effluent land application. The proposed effluent land application method is recommended to be shallow sub-surface pressure-compensated drip irrigation, to maximise the benefits of the higher permeability of the upper soil layers.

The sloping land and the existing gullies and watercourses present the main constraints to on-site sewage management. The proposed effluent land application areas are located to provide the required buffer between effluent land application area and identified streams. In summary the setbacks achieved are as follows:

- 30m from effluent application areas to the nearest surface water of the dam and 1st Order stream
- 40m from effluent application area to the 2nd Order stream is 40m.

An existing small drainage line in the west of the site, discharging northwards, is to be infilled and converted to an underground piped catchment discharging northwards creating suitable effluent land application areas for Lots 35-38.

An off-site dam located to the west of Lot 37 is connected to a first order stream and is 30m downslope of the nearest proposed EAA.

A viral die-off calculation was performed to calculate the minimum required horizontal setback distance from the proposed EAA to the nearest groundwater bore or watercourse. The conservative estimate of pathogen die-off assumes a permeability rate of 3mm/day and high porosity soil. The estimate has been calculated to be 12.5m using viral die-off calculations (Cromer, Gardner, & Beavers) as detailed in Appendix 9. A safety factor of 2 has been applied within the die-off model, to be conservative, increasing the calculated pathogen die-off to approximately 25m. The recommended 30m horizontal buffer distance from the effluent land application area on Lot 38 to the dam and 1st Order stream is therefore considered suitable.

The high rainfall of the region requires appropriate stormwater management. The proposed lot layout incorporates a series of stormwater drainage swales, gully pits and pipes to ensure incident rainfall is not directed onto any effluent land application area. Figure 2 provides an aerial view of the site features.

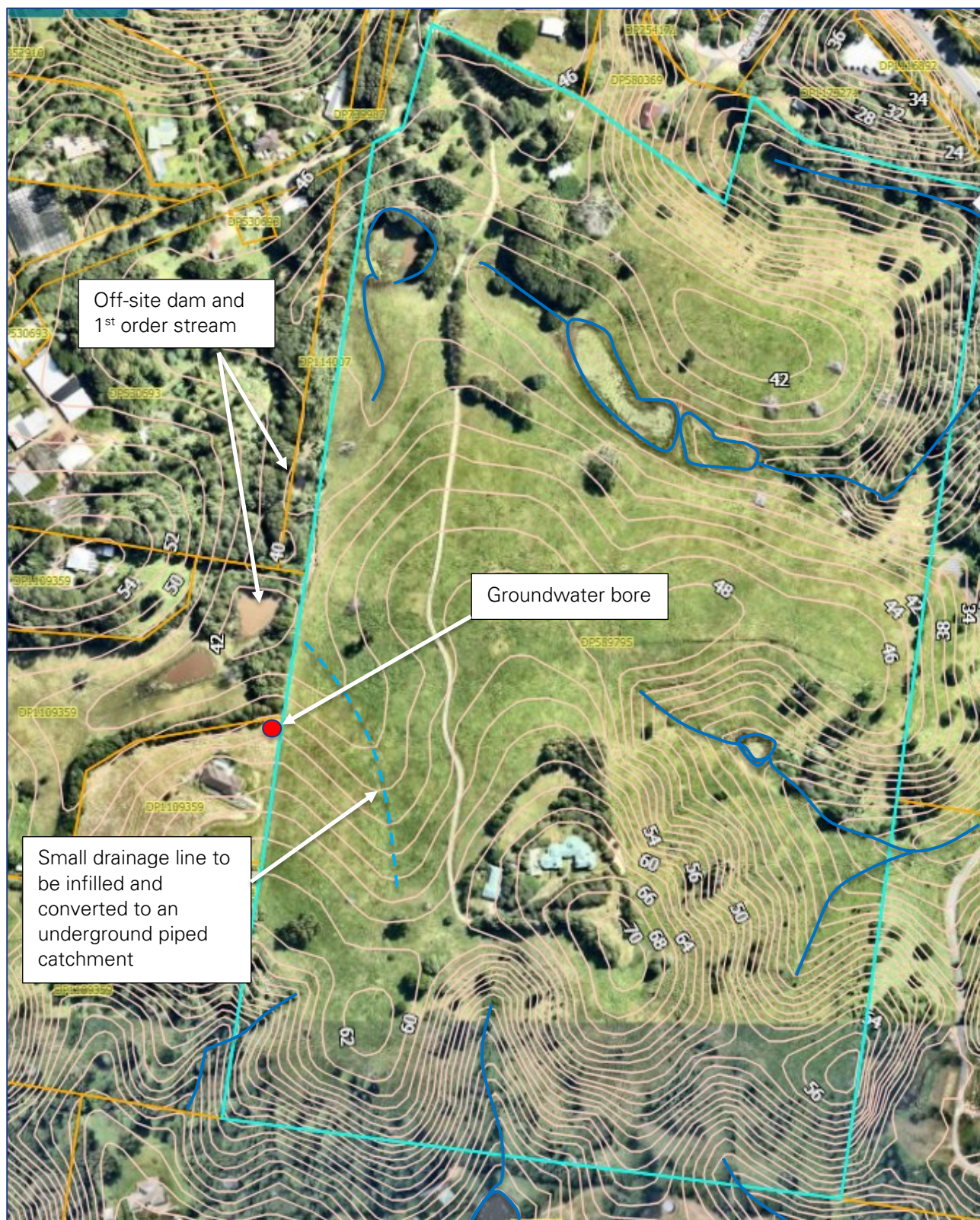


Figure 2 Property Boundary showing site features (Source: Nearmap, 2023)

2. PROJECT INFORMATION

Table 1 - Project Information

Proposal	Subdivision
Property	55 McAuleys Lane, Myocum NSW Lot 8 DP 589795
Property Area	34.95 Ha
Proposed Lot Size	Minimum 3224m ² Maximum 9513m ² + parent lot of 15.66Ha
Council Area/Approvals:	Byron Shire Council
Regulatory Authority & Guidelines:	Byron Shire Council Byron Shire Council On-site Sewage Management Strategy 2023 Byron Shire Council On-site Sewage Management Guidelines 2023 Australian Standard 1547:2012 On-site Domestic Wastewater Management
Design Daily Hydraulic Load	720L/day Assumed 4-bedroom dwellings 6 persons design occupancy @ 120L/p/day
Water Saving Devices	Recommended as standard in new dwellings. Recommend Minimum WELS 3-star rating on fixtures Recommend Minimum 6/3L dual flush toilets.
Water Supply	Non-reticulated roof water catchment supply
Protection of Surface Water Quality Setback Distances	30m buffer to 1st Order stream (dry gully) & dam 40m buffer to 2nd Order stream (intermittent watercourse) 100m buffer to 3rd order stream (permanent watercourse) - Upslope swales and stormwater controls to minimise run-on - Piped stormwater & infilling for natural drainage lines within setback.

3. SUMMARY OF RECOMMENDED SEWAGE MANAGEMENT

Table 2 – Summary of On-site Sewage Management System (OSMS) Design

On-Site Sewage Management System Recommendations per Lot
Effluent Treatment per Lot - Minimum secondary effluent quality + final disinfection to be achieved. - Installation of an Aerated Wastewater Treatment System (AWTS) with NSW Health accreditation for total nitrogen reduction of 53% or greater Land Application Areas per Lot: - Up to 20% slope: 450m² + 225m² reserve land application area 20-30% slope: 600m² + 300m² reserve land application area - Installation of shallow sub-surface pressure-compensated drip irrigation - Lots 35- 38 stormwater piping and infilling of natural drainage lines to provide suitable effluent land application area. Suitable finish for effluent land application requires: Minimum 300mm deep topsoil, any fill to be uncompacted, finished with grassed surface over exposed soil Alternative Solutions: This report does not preclude alternative treatment or effluent land application methods, provided there is an individual site and soil investigation, and merit-based assessment carried out at the time of dwelling construction and/or system installation approval stage. Final locations and sizing and make/model of

system will be determined at the time of these future single lot development applications, as limited by the size and location of the dwellings, and the assessed relevant site constraints.

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 3 - Site Conditions

Inspected by	H. Tunks & T. Richards
Date & Time of Inspection	30/10/2022 See Figure 1 for site location, Appendix 1 for photos.
Weather	Weather – Warm, dry. Nil rainfall during site inspection. Rainfall totalling 52mm for the week preceding site inspection and a total of 75mm for the preceding month (BOM Stn 58007 Byron Bay, Jacaranda Drive).
Soil Profile Summary: Soil Texture Soil Category (AS/NZS1547:2012)	Clay Loam- Light Clay topsoils from 400mm to 1m depth overlying Medium Clay subsoils Assumed moderately structured Light Clay Soil, Category 5 for the purpose of subdivision site suitability and lot layout justification. Refer to Appendix 4 for detail soil profile information
Design Irrigation Rate Long Term Acceptance Rate	Maximum DIR of 3mm/day Maximum LTAR (Percolation) of 4mm/day
Slope & Drainage:	Land Application Areas sized to mitigate slope in accordance with AS1547:2012 Table M2 10-20% slope mitigation DIR reduced to 1.6mm/day (20-30% slope mitigation DIR reduced to 1.2 mm/day Linear planar to waxing divergent in shape. Moderate drainage
Total Phosphorous	Measured P Sorption = 11145kg/ha/m – 12123kg/ha/m
Soil Chemistry	Exchangeable sodium percentage (ESP) 3.7 – 4.4 Effective Cation Exchange Capacity (ECEC) 45-52 cmol+/kg Refer to Appendix 8 for laboratory results.
Climate	Warm-temperate and high volume, seasonal rainfall typical of region.
Terrain	Ridge - mid to lower slopes
Shading	Minimal shading expected
Ground cover/vegetation	Pasture grass and scatted low stature vegetation throughout proposed LAAs. 100% grass cover to be achieved as finished LAA surface.
Stormwater Run-on/ Seepage Run-on	Stormwater run-on expected. Individual upslope diversion bunds and intercept drains recommended at installation stage for each Land Application Area Existing natural drainage lines to be infilled and piped (Lots 35 -38) Roadside stormwater swales and gully pits provided to manage local incident rainfall throughout site. See Stormwater Concept Plan by Ardill Payne & Partners in separate submission.

4.2. SITE COMPLIANCE FOR EFFLUENT LAND APPLICATION AREAS

Table 4 - Site Constraints

Site Constraints	Available Per Lot	Recommended (BSC, 2023 and AS1547:2012)	Complying?
Setback to Boundary	3m up & across slope 6m downslope	3-6m	YES
Setback to Watercourse	No major watercourse on site Not mapped Water Supply Catchment Buffer (BSC Rural Land Use Strategy) catchment 30m to 1 st order stream 40m to 2 nd order stream	40m to intermittent waterways, dry gullies 100m to permanent watercourses, rivers, creeks, wetlands	YES
Setback to Water Bore	>50m to domestic groundwater well/bore	50m	YES
Setback to Future Buildings & Site Features	3m to upslope building, swimming pool or driveway 6m to downslope building, swimming pool or driveway	3-6m	YES
Setback Underground Water Tanks	>15m to in-ground water tanks		YES
Reserve LAA	50% available	50% -Clause 8.13, BSC, 2023	YES
Slope Gradient	10-20% DIR Reduction 20% 20-30% DIR Reduction 50% -	<30% Table M2 & R2 (AS1547)	YES
Flood Liability	LAA and building envelopes >1:100-year flood level contour	LAA >1:20 year flood level contour	YES
Slope Stability, Mass Movement	Not mapped		YES
Water Supply Catchment	Not mapped		YES
Aquaculture	Not mapped		YES

5. LAND APPLICATION AREA SIZING AND DESIGN

5.1. MODELLING DESIGN INPUTS & SETBACK MITIGATION

Table 5 - Design Model Assumptions for Lot Feasibility Assessment

Model Used: Lismore CC On-site Wastewater Model (Single Rural Households) OSmodel300614.xls Printed 12-7-2023	
Design Occupancy	Up to 6 persons in 4-bedroom dwelling
Wastewater Design Flow Allowance	120L/p/day assumed as conservative
Groundwater Table	3m assumed depth
Wastewater Design Hydraulic Load	720L/day per dwelling
Effluent Quality	Secondary treated effluent + final disinfection as provided in locally available Aerated Wastewater Treatment Systems, accredited by NSW Health.

Design Irrigation Rate (DIR) Long Term Acceptance Rate (LTAR)	- Maximum DIR of 3mm/day and - Maximum LTAR (Percolation) of 4mm/day - Assumes moderately structured Light Clay <i>N.B. No permeability tests were undertaken in the field. It is considered that the conservative loading rates based on soil texture (AS/NZS 1547:2012) are appropriate for design inputs for the proposed residential subdivision</i>
Slope	50% reduction in DIR (1.6mm/day) applied for all lots on steep slopes (20-30%) . 20% reduction in DIR (1.2mm/day) applied for all remaining lots on gentle to moderate slopes (up to 20%) 85% retained rainfall assumed in modelling to remain conservative
Lot Size	Minimum 2995m ² adopted to conservatively justify lot layout feasibility
Nitrogen Removal	Minimum 53% Total Nitrogen reduction provided in AWTS
Phosphorous Adsorption	Conservate rate of 10000kg/ha/m adopted. Laboratory assessments recorded Mapped as Wollongbar soil landscape (Morand, 1994)
Reserve Land Application Area	Minimum 50% reserve land application area per Lot is provided based on secondary. Based on secondary treated effluent and pressurised distribution via sub-surface dripperline. Reserve LAAs are to remain free from permanent structures. As per BSC OSSM Guidelines 2023. The chemical and physical properties of the native soil are not expected to be impacted permanently by the shallow uniform distribution of the high-quality effluent via dripperline, The soils within the nominated effluent land application areas remain suitable for future installation of duplicated or replacement systems, supporting the reduction of the 100% reserve LAA recommendation. As per C5.5.3.4, AS/NZS1547:2012, the 100% requirement for reserve land application areas is normally applied to septic tank units and conventional trench disposal. The improved secondary treated wastewater treatment and pressurised shallow drip irrigation justifies a reduced reserve LAA on this site.

5.2. LAND APPLICATION AREA SIZING – FUTURE SINGLE LOT DEVELOPMENTS

Table 6 - Modelling Calculations Summary

Analyte	Subdivision Lot Layout Assumed 4 bedroom future dwellings 6 person Design Occupancy	
	LAA Modelling Results*	Recommended Minimum Effluent Land Application Area Per Lot
Wastewater Flow	720L/day	Slopes up to 20%: DIR Reduction 20% 450m² + Reserve LAA: 225m² - Total 675m² Slopes 20 to 30%: DIR Reduction 50% 600m² + Reserve LAA: 300m² - Total 900m²
Hydraulic Load	364m ²	
Nitrogen (TN)	412m ²	
Phosphorus (TP)	71m ²	
Design Hydraulic Load	720L/day	
Deep drainage rate	4mm/day	
Design Irrigation Rate	3mm/day	Maximum – Category 5 Light clay soils Slopes up to 20%: DIR Reduction minimum 20% Slopes 20 to 30%: DIR Reduction minimum 50%
Proposed DIR	1.6mm/day	
Proposed DIR	1.2 mm/day	

6. ON-SITE SEWAGE MANAGEMENT SYSTEM DESIGN

6.1. SUITABLE EFFLUENT TREATMENT

The effluent treatment considered to be most appropriate for the wastewater generated by the future dwelling occupants is secondary treatment with final disinfection and demonstrated nutrient reduction. 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 secondary treatment system type considered suitable for all lots is an Aerated Wastewater Treatment System (AWTS) with current NSW Health accreditation, capable of reducing Total Nitrogen by minimum 53%. Typical AWTS systems available locally can treat wastewater flows between 1200- 3000L per day.

6.2. LAND APPLICATION METHOD

The land application method considered suitable is pressure compensated sub-surface drip irrigation. The pressure compensating emitters within the dripper line allows for the installation within sloping and/or filled land and achieve uniform and controlled distribution of effluent.

As part of the stormwater management, infilling of the drainage line on Lots 35- 37 is proposed, ancillary to construction of swales and underground pipe system. Any fill material applied to the native soil within the effluent land application area should remain uncompacted and be finished with minimum 300mm topsoil layer with 100% grass cover.

The installation of pressure compensated dripperline within fill material is an accepted and common practice and often is required to improve soil health, permeability and increase vertical and overland setback distances. It is acknowledged that effluent disposal via a trench system would not be suitable, and it is for this reason that the pressure compensated dripperline fields are recommended as standard on these lots subject to civil works and to safeguard dwelling sites.

See LAA locations and construction details in On-site Sewage Management Capability Assessment Plan and Typical Land Application area Section & Detail, as provided in this report.

7. RECOMMENDATIONS

Based on the information presented in this report, it is considered that the site is suitable to provide the essential service of sewage management to the future dwellings on the proposed lots, and to attain an acceptable level of environmental impact from the sewage generated by occupation of the future dwellings.

The locations of the land application areas are typical only to demonstrate lot size suitability.

Table 7 – Recommendations for Subdivision Approval

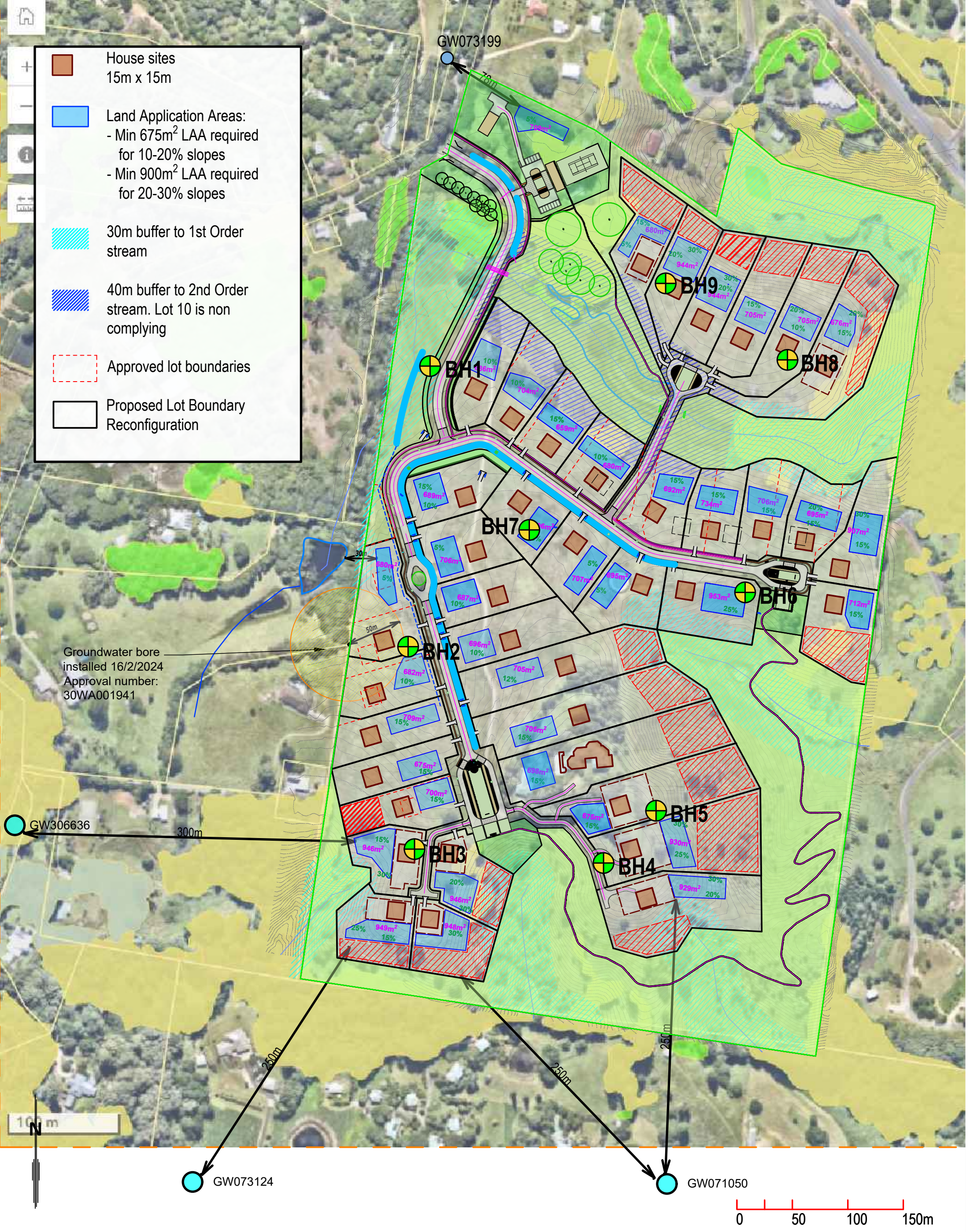
ASSUMED DESIGN HYDRAULIC LOADING PER LOT
● Up to 720L/day ● Non-reticulated roof water catchment ● Up to 6 persons design occupancy This report does not preclude larger design occupancies provided the on-site sewage management design is based on a site and soil investigation at single lot development stage.
SUITABLE ON-SITE SEWAGE MANAGEMENT SYSTEM FOR FUTURE DWELLINGS
Refer to the plans on the following pages: Sheet 1 – Site Plan Sheet 2 – Typical Land Application Area Section and Detail Sewage Treatment: ● Install an Aerated Wastewater Treatment System (AWTS) with NSW Health accreditation for TN and TP reduction This report does not preclude alternative sewage treatment provided the on-site sewage management design is based on a site and soil investigation at single lot development stage. Land Application Areas: ● For slopes up to 20% provide 450m² primary LAA per lot + 50% Reserve = TOTAL 675m² ● For slopes 20 to 30% provide 600m² primary LAA per lot + 50% Reserve = TOTAL 900m² ● Maintain 30m buffer to 1st order stream and off-site dam ● Maintain 40m buffer to 2nd order stream ● Install shallow ripped pressure-compensated subsurface drip irrigation (SDI) @ 150mm depth at average lateral spacing of 1m The location and sizes of the land application areas in the OSSM subdivision report are provided to demonstrate lot size suitability and remain subject to a site and soil investigation at single lot development stage. This report does not preclude alternative land application methods provided the on-site sewage management design is based on a site and soil investigation at single lot development stage. Stormwater/ Management: ● Infilling and piping of the natural drainage line traversing Lots 35-37. ● Underground piping of stormwater within roadside stormwater swale to minimise catchment of incidental rainfall where land application areas are less than 30m upslope. ● Stormwater swales and piping to be installed at Civil Works stage to manage stormwater (refer to Stormwater Concept Layout by Ardill Payne & Partners)

7.1. ON-SITE SEWAGE MANAGEMENT SYSTEM PLANS

See following pages:

Sheet 1 – On-site Sewage Management Capability Plan

Sheet 2 – On-site Sewage Management Capability - Typical Land Application Area Section and Detail



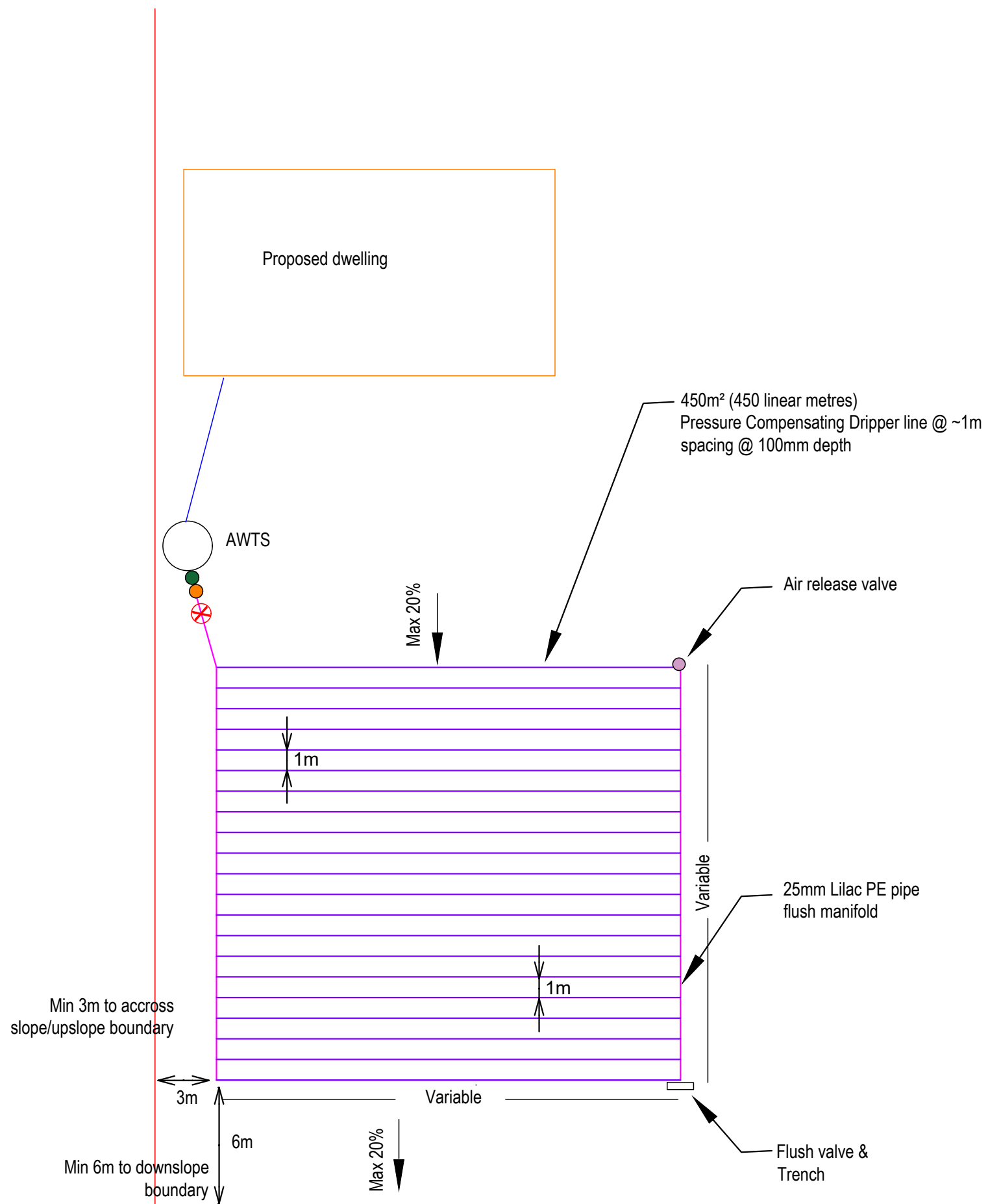
On-Site Sewage Capability Plan

**ON-SITE SEWAGE
MANAGEMENT
CAPABILITY
ASSESSMENT PLAN**

**- TYPICAL LAND
APPLICATION AREA**

**SECTION AND
DETAIL**

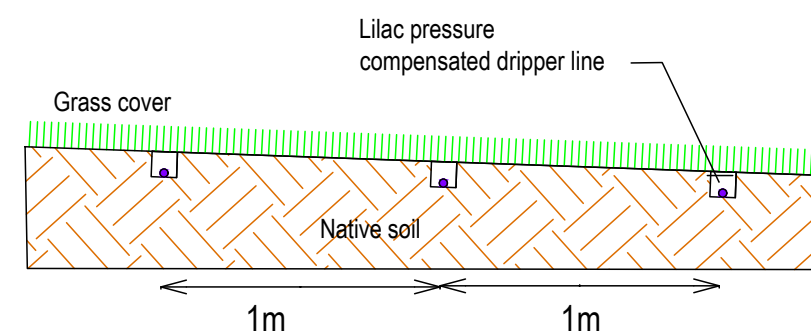
**NOT FOR
CONSTRUCTION**



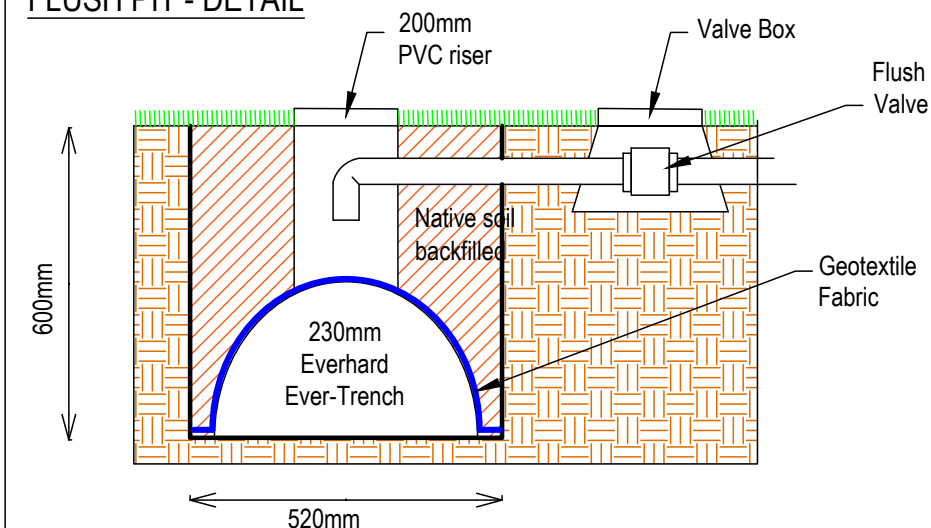
KEY

- Tech Filter
 - Disc Filter
 - Air Release/vacuum breaker
 - Flush Valve
 - Check valve
 - 100mm DWV Pipe (sewer grade)
 - 32mm Lilac PE Pipe
 - 25mm Lilac PE Pipe
 - Lilac pressure compensated dripperline
- NOTE: Tech filter not required when installing Uniobioline CNLXR

SUB-SURFACE DRIP IRRIGATION - (SECTION)



FLUSH PIT - DETAIL



Job: HMC2023.320.01
DWG: HMCDDWG2023.320.1
Date: November 2023
Version: B - 3/11/2023
Drawn: KH
Base:
Council: Byron Shire Council

Lot 8 DP 589795
53 McAuleys Lane
Myocum NSW



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

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 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.

9. REFERENCES

- Byron OSSM Design Model (On-site Sewage Management System Design Model Excel version 3.xls)
- Byron Shire Council – On-site Sewage Management Strategy (BSC, 2023)
- Byron Shire Council – On-site Sewage Management Guidelines (BSC, 2023)
- Rous Water On-site Wastewater Management Guidelines, 2008
- AS/NZS 1547: 2012 On-site Domestic Wastewater Management
- NSW Environment and Health Protection Guidelines – On-Site Sewerage and Wastewater Management for Single Households (Dept. of Local Government et al, 1998)
- Morand, D. Soil Landscapes of Lismore - Ballina 1:100000 Sheet Map and Report NSW Department of Land and Water Conservation, 1994
- Munsell Soil Color Charts (2000), Gretag Macbeth, New Windsor, NY, USA.
- Hazelton & Murphy, "Interpreting Soil Test Results – What Do All the Numbers Mean", CSIRO, 2007
- eSPADE V2.0 NSW Office of Environment and Heritage
<https://www.environment.nsw.gov.au/eSpade2WebApp>

10. APPENDICES

See following pages

APPENDIX 1 - MODELLING



Byron OSMS Design Model

Version: Medium Clay + Small Lot

Period of Rainfall & Evaporation Record: 01/07/1980 - 30/06/2001

Set Defaults

STEP 1 **# bedrooms (Grp 1)** **4** **# bedrooms (Grp 2)** **20**

STEP 2 **Block size (m²)** **2995**

STEP 3 **Buffer to permanent water** **20** **Buffer to intermittent water** **20**

STEP 4 **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 5 **Wastewater stream**

Grp1 ☒ Toilet ☐ Toilet
☒ Bathroom ☐ Bathroom
☒ Laundry ☐ Laundry
☒ Kitchen ☐ Kitchen

STEP 6 **Treatment system**

Septic (primary treatment only)
 AWTs
 Septic + single pass sandfilter (SPF)
 Septic + SPF, 25% septic return flow
 Septic + recirculating sandfilter
 Septic + reedbed

STEP 7 **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 8 **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. or massive Ksat < 0.06m/d
 DISPERSIVE soil (Modified Emerson Aggregate test)

STEP 9 **% Effective Rainfall**

Mounded bed
 Level bed with grass

STEP 10 **Soil texture in root zone**

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

STEP 11 **Land Application Type**

SSI
 ETA
 Lateral seepage width
 SSI laterals pipe separation (m)

STEP 12 **Calculate (or Cntl- q)**

STEP 13 **ETA bed separation** **1.40**

STEP 14 **ETA bed separation** **1.40**

STEP 15 **ETA bed separation** **1.40**

Final area (m²) **404** **Nitrogen area (m²)** **404** **Hydraulic area (m²)** **283**

Phosphorus area (m²) **71**

Water balance area (m²) **404**

☒ Specific Crop Coeff.(grass=1.00) **1.00**

% Effective Rainfall **65%**

Percolation (mm/d) **4**

Avg depth of root zone (m) **0.30** **Effective porosity of root zone** **0.37** **Avail. Water Capacity (AWC) of root zone** **0.15**

Avg depth blue metal (etc) in trench below root zone (m) **0.00** **Effective porosity of blue metal in trench below root zone** **0.00** **Default AWC of blue metal in trench below root zone** **0.00**

Soil Moisture Holding Capacity: saturation & AWC (mm) **111.00** **45.00**

Permissible percentile exceedence **5.00%** **SSI laterals pipe separation (m)** **2.00**

Minimum effluent application (mm/day/m²) **1.78**

Exceedence (L) **0.00000**

Exceedence (%) **94.92%**

Effluent Irrigation Rate **1.78** **Actual Soil Moisture** **112.78**

Exceedence (mm) **1.781281** **Exceedence (mm)** **0.000000** **Exceedence (mm)** **0.000000** **Exceedence (mm)** **19.854558**

Effluent Irrigation Rate **1.78** **Actual Soil Moisture** **112.78**

Exceedence (mm) **1.781281** **Exceedence (mm)** **0.000000** **Exceedence (mm)** **0.000000** **Exceedence (mm)** **19.854558**

Effluent Irrigation Rate **1.78** **Actual Soil Moisture** **112.78**

Exceedence (mm) **1.781281** **Exceedence (mm)** **0.000000** **Exceedence (mm)** **0.000000** **Exceedence (mm)** **19.854558**

Byron OSMS Design Model

Version: Clay Loam + Large Lot

Period of Rainfall & Evaporation Record: 01/07/1980 - 30/06/2001

Set Defaults

STEP 1 **# bedrooms (Grp 1)** **4** **# bedrooms (Grp 2)** **20**

STEP 2 **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 3 **Block size (m²)** **9513**

STEP 4 **Wastewater stream**

Grp1 ☒ Toilet ☒ Bathroom ☒ Laundry ☐ Kitchen

Grp2 ☐ Toilet ☐ Bathroom ☐ Laundry ☐ Kitchen

STEP 5 **Treatment system**

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

STEP 6 **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 7 **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. or massive Ksat < 0.06m/d
DISPERSIVE soil (Modified Emerson Aggregate test)

STEP 8 **% Effective Rainfall**

Mounded bed ☐
Level bed with grass ☐

STEP 9 **Soil texture in root zone**

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

STEP 10 **Water balance area (m²)** **285**

STEP 11 **Water balance area (m²)** **71**

STEP 12 **Water balance area (m²)** **285**

STEP 13 **Water balance area (m²)** **71**

STEP 14 **Water balance area (m²)** **285**

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STEP 275 **Water balance area (m^{2</}**

LAND APPLICATION AREA (LAA)

Location: 53 McAuleys Lane, MYOCUM
File No. 2023.320

Water Supply: Non-reticulated
Water Saving: AAA

TABLE A1: SIZE OF AREA PER MONTH

(1) Month	(2) Days in Month (n)	(3) Pan Evaporation E (evap maps) mm	(4) Evapo- transpiration ET (ET = 0.75E) mm	(5) Rainfall R Mean mm	(6) Retained rainfall RR (Rr = 0.75R) mm	(7) Design Loading Rate (DLR) per month mm	(8) Disposal rate per month (3) - (5) + (6) mm	(9) Treated Effluent applied per month L	(10) Size of area (8)/(7) m2
Jan.	31	177	132.5	195.5	146.6	112	97.5	22320	228.9
Feb.	28	140	105.0	228.8	171.6	101	34.2	20160	589.5
Mar.	31	133	100.0	236.6	177.5	112	34.1	22320	654.1
Apr.	30	105	78.8	185.4	139.1	108	47.7	21600	452.8
May	31	84	62.8	190.9	143.2	112	31.2	22320	715.4
Jun.	30	72	54.0	167.9	125.9	108	36.1	21600	598.8
Jul.	31	84	62.8	119.2	89.4	112	85.0	22320	262.7
Aug.	31	109	81.4	94	70.5	112	122.5	22320	182.2
Sept.	30	132	99.0	71	53.3	108	153.8	21600	140.5
Oct.	31	155	116.3	105.2	78.9	112	149.0	22320	149.8
Nov.	30	162	121.5	123.2	92.4	108	137.1	21600	157.5
Dec.	31	183	137.2	155.7	116.8	112	132.0	22320	169.1
AVERAGE:									358.4

TABLE A2: DEPTH OF STORED EFFLUENT

(1) Month	(2) First trial area LAA m2	(3) Application rate (8)/(2) mm	(4) Disposal rate /month (7) mm	(5) Nett Application rate (3) - (4) mm	(6) Increase in depth of stored effluent (5)/n mm	(7) Depth of effluent for month (X - 1) mm	(8) Increase in depth of effluent + (6) mm	(9) Computed depth of effluent = month (X) mm
Jan.	450.0	49.6	97.5	-48	-258.9	0	-258.9	0.0
Feb.		44.8	34.2	10.6	57.3	0	57.3	57.3
Mar.		49.6	34.1	15.5	83.6	57	83.6	140.9
Apr.		48.0	47.7	0.3	1.6	140.9	1.6	142.6
May		49.6	31.2	18.4	99.5	142.6	99.5	242.0
Jun.		48.0	36.1	11.9	64.5	242.0	64.5	306.5
Jul.		49.6	85.0	-35.4	-191.2	306.5	-191.2	115.3
Aug.		49.6	122.5	-72.9	-393.9	115.3	-393.9	0.0
Sept.		48.0	153.8	-105.8	-571.6	0.0	-571.6	0.0
Oct.		49.6	149.0	-99.4	-537.0	0.0	-537.0	0.0
Nov.		48.0	137.1	-89.1	-481.6	0.0	-481.6	0.0
Dec.		49.6	132.0	-82.4	-445.4	0.0	-445.4	0.0
MAX:								306

Rainfall (mm)

Byron Bay (Jacaranda Drive): BOM Station No. 58007 (1961-1990)

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	195.5	228.8	236.6	185.4	190.9	167.9	119.2	94	71	105.2	123.2	155.7

Pan Evaporation - Alstonville (Ballina Shire Council, OSSM Guidelines, 2019)

No of days Daily

Per Month	effluent	DLR/DIR
31	720	3.6
28	720	3.6
31	720	3.6
30	720	3.6
31	720	3.6
30	720	3.6
31	720	3.6
31	720	3.6
30	720	3.6
31	720	3.6
30	720	3.6
31	720	3.6

TOTAL 8640

Porosity (n)	gravel	0.300
	Clay	0.200
	Clay	0.179
	Clay Loam	0.185
	Tunnel Trench	0.60

Depth	Trench	450.0	mm
Topsoil	Irrigation	300.0	mm

APPENDIX 2 - SOIL INVESTIGATION

SOIL ASSESSMENT - PROFILE SUMMARY HMC – 30th October 2023

BH1 Clay loam topsoil to 400mm overlying light clay to 600mm with medium clay subsoil (1m depth).	BH2 Clay loam soil to 1m depth.	BH3 Clay loam topsoil to 250mm overlying light clay to 500mm, with medium clay subsoil to 1m depth.	BH4 Fine sandy loam topsoil to 100mm overlying sandy clay loam soil to 700mm, with sandy clay subsoil to 1m depth.	BH5 Fine sandy clay loam topsoil to 200mm overlying sandy clay to 400mm, with a medium clay subsoil to 1m depth.
BH6 Clay loam soil to 1m depth.	BH7 Clay loam soil to 1m depth.	BH8 Clay loam soil to 1m depth.	BH9 Clay loam soil to 800m depth. Numerous large boulders encountered.	

SOIL ASSESSMENT - CHEMICAL PROPERTIES SUMMARY HMC – 30th October 2023 (see Appendix 8 for laboratory certificates)

SAMPLE ID & DEPTH	BH1C 600-1000mm	BH2B 500-1000mm	BH3A 0-250mm	BH4B 100-700mm	BH5C 400-1000mm	BH6A 0-500mm
P-sorption (kg/ha/m)–	12,924	90,691	16,192	6,194	9,244	38,863
pH	3.8	4.7	4.5	4.3	4.2	4.7
Exchangeable sodium percentage (ESP) Rating (Hazelton & Murphy, 2007)	0.4 Low	2.5 High	1.5 High	2.4 High	1.0 Moderate	3.0 High
Effective Cation Exchange Capacity (ECEC) cmol+/kg Rating (Hazelton & Murphy, 2007)	17.5 Moderate	1.1 Very Low	4.4 Very Low	1.3 Very Low	9.3 Low	2.4 Very Low

SOIL ASSESSMENT – HMC – 30th October 2020

BOREHOLE No. BH1

SOIL LANDSCAPE (Morand, 1994):

Wollongbar variant a (woa) soil landscape (Expected)

Mostly deep (<200cm) well drained Krasnozems with shallower (80-150cm) stonier Krasnozems on crest/upper slope boundaries. Wet alluvial Krasnozems in drainage lines. Moderately broad to broad (100->300 m) crests and ridges.

Groundwater intrusion	Depth (mm)	Texture	Structure	Colour (MUNSELL)	Soil Category	Coarse Fragments	Soil pH	Dispersive Class (BSC, 2004)	Phosphorus sorption (kg P/ha)
Not encountered	0-400	Clay Loam	Strong (Moist)	Brown 10YR 4/3	4	Fine & Moderate Gravels <20%	5.5	3	-
	400-600	Light Clay	Strong (Moist)	Dark Yellowish Brown 10YR 4/6	5	Fine, Moderate & Large Gravels <20%	5.5	3	-
	600-1000	Medium Clay	Moderate (Moist)	Reddish Yellow 7.5YR 8/1 Mottles	6	Fine & Moderate Gravels <20%	5.0	3	12,924
	>1000	Heavy Clay	Massive (Moist)	White 7.5YR 8/1	6	Nil	4.5	4	-
Tick box if limitation to effluent land application					✓				



SOIL ASSESSMENT – HMC – 30th October 2020

BOREHOLE No. BH2

SOIL LANDSCAPE (Morand, 1994):

Wollongbar variant a (woa) soil landscape (Expected)

Mostly deep (<200cm) well drained Krasnozems with shallower (80-150cm) stonier Krasnozems on crest/upper slope boundaries. Wet alluvial Krasnozems in drainage lines. Moderately broad to broad (100->300 m) crests and ridges.

Groundwater intrusion	Depth (mm)	Texture	Structure	Colour (MUNSELL)	Soil Category	Coarse Fragments	Soil pH	Dispersive Class (BSC, 2004)	Phosphorus sorption (kg P/ha)
Not encountered	0-500	Clay Loam	Strong (Moist)	Dark Reddish Brown 2.5YR 2.5/3	4	Nil	6.0	3	-
	500-1000	Clay Loam	Strong (Moist)	Dusky Red 10R 3/4	4	Nil	5.5	3	90,691
Tick box if limitation to effluent land application									



SOIL ASSESSMENT – HMC – 30th October 2020

BOREHOLE No. BH3

SOIL LANDSCAPE (Morand, 1994):

Wollongbar variant a (woa) soil landscape (Expected)

Mostly deep (<200cm) well drained Krasnozems with shallower (80-150cm) stonier Krasnozems on crest/upper slope boundaries. Wet alluvial Krasnozems in drainage lines. Moderately broad to broad (100–>300 m) crests and ridges.

Ground water intrusion	Depth (mm)	Texture	Structure	Colour (MUNSELL)	Soil Category	Coarse Fragments	Soil pH	Dispersive Class (BSC, 2004)	Phosphorus sorption (kg P/ha)
Not encountered	0-250	Clay Loam	Strong (Moist)	Dark Brown 7.5YR 3/2	4	Fine Gravels <20%	5.5	3	16,192
	250-500	Light Clay	Strong (Moist)	Dark Yellowish Brown 10YR 4/4	5	Fine & Moderate Gravels <20%	5.5	3	-
	500-1000	Medium Clay	Moderate (Moist)	Reddish Yellow 7.5YR 6/6 Mottles	6	Fine Gravels <20%	5.0	4	-
Tick box if limitation to effluent land application					✓				



SOIL ASSESSMENT – HMC – 30th October 2020

BOREHOLE No. BH4

SOIL LANDSCAPE (Morand, 1994):

Wollongbar variant a (woa) soil landscape (Expected)

Mostly deep (<200cm) well drained Krasnozems with shallower (80-150cm) stonier Krasnozems on crest/upper slope boundaries. Wet alluvial Krasnozems in drainage lines. Moderately broad to broad (100->300 m) crests and ridges.

Groundwater Depth	Depth (mm)	Texture	Structure	Colour (MUNSELL)	Soil Category	Coarse Fragments	Soil pH	Dispersive Class (BSC, 2004)	Phosphorus sorption (kg P/ha)
Not encountered	0-100	Fine Sandy Loam	Strong (Moist)	Very Dark Gray 7.5YR 3/1	2	Fine & Moderate Gravels <20%	5.0	4	-
	100-700	Sandy Clay Loam	Strong (Moist)	Brown 7.5YR 4/4	4	Fine Gravels <20%	5.5	2	6,194
	700-1000	Sandy Clay	Strong (Moist)	Strong Brown 7.5YR 4/6	5	Fine, Moderate & Large Gravels >20%	6.0	2	-
Tick box if limitation to effluent land application						✓		✓	



SOIL ASSESSMENT – HMC – 30th October 2020

BOREHOLE No. BH5

SOIL LANDSCAPE (Morand, 1994):

Wollongbar variant a (woa) soil landscape (Expected)

Mostly deep (<200cm) well drained Krasnozems with shallower (80-150cm) stonier Krasnozems on crest/upper slope boundaries. Wet alluvial Krasnozems in drainage lines. Moderately broad to broad (100->300 m) crests and ridges.

Groundwater intrusion	Depth (mm)	Texture	Structure	Colour (MUNSEL L)	Soil Category	Coarse Fragments	Soil pH	Dispersive Class (BSC, 2004)	Phosphorus sorption (kg P/ha)
Not encountered	0-200	Fine Sandy Clay Loam	Strong (Moist)	Dark Brown 7.5YR 3/2	4	Fine & Moderate Gravels <20%	5.0	3	-
	200-400	Sandy Clay	Strong (Moist)	Brown 7.5YR 4/4	4	Fine & Moderate Gravels <20%	5.5	2	-
	400-1000	Medium Clay	Strong (Moist)	Strong Brown 7.5YR 4/6	6	Fine & Moderate Gravels <20%	6.0	3	9,244
Tick box if limitation to effluent land application					✓			✓	



SOIL ASSESSMENT – HMC – 30th October 2020

BOREHOLE No. BH6

SOIL LANDSCAPE (Morand, 1994):

Wollongbar variant a (woa) soil landscape (Expected)

Mostly deep (<200cm) well drained Krasnozems with shallower (80-150cm) stonier Krasnozems on crest/upper slope boundaries. Wet alluvial Krasnozems in drainage lines. Moderately broad to broad (100->300 m) crests and ridges.

Groundwater intrusion	Depth (mm)	Texture	Structure	Colour (MUNSELL)	Soil Category	Coarse Fragments	Soil pH	Dispersive Class (BSC, 2004)	Phosphorus sorption (kg P/ha)
Not encountered	0-500	Clay Loam	Strong (Moist)	Dark Reddish Brown 2.5YR 2.5/4	4	Fine Gravels <20%	5.5	3	38,863
	500-1000	Clay Loam	Strong (Moist)	Dusky Red 10YR 3/4	4	Fine & Moderate Gravels <20%	5.0	3	-
Tick box if limitation to effluent land application									



SOIL ASSESSMENT – HMC – 30 th October 2020								
BOREHOLE No. BH7								
SOIL LANDSCAPE (Morand, 1994): Wollongbar variant a (woa) soil landscape (Expected) Mostly deep (<200cm) well drained Krasnozems with shallower (80-150cm) stonier Krasnozems on crest/upper slope boundaries. Wet alluvial Krasnozems in drainage lines. Moderately broad to broad (100–>300 m) crests and ridges.								
Groundwater intrusion	Depth (mm)	Texture	Structure	Colour (MUNSELL)	Soil Category	Coarse Fragments	Soil pH	Dispersive Class (BSC, 2004)
Not encountered	0-500	Clay Loam	Strong (Moist)	Dark Reddish Brown 2.5YR 2.5/4	4	Nil	6.0	3
	500-1000	Clay Loam	Strong (Moist)	Dusky Red 10YR 3/4	4	Fine Gravels <20%	5.5	3
Tick box if limitation to effluent land application								
								

SOIL ASSESSMENT – HMC – 30 th October 2020								
BOREHOLE No. BH8								
SOIL LANDSCAPE (Morand, 1994): Wollongbar variant a (woa) soil landscape (Expected) Mostly deep (<200cm) well drained Krasnozems with shallower (80-150cm) stonier Krasnozems on crest/upper slope boundaries. Wet alluvial Krasnozems in drainage lines. Moderately broad to broad (100→300 m) crests and ridges.								
Groundwater intrusion	Depth (mm)	Texture	Structure	Colour (MUNSELL)	Soil Category	Coarse Fragments	Soil pH	Dispersive Class (BSC, 2004)
Not encountered	0-500	Clay Loam	Strong (Moist)	Dark Reddish Brown 5YR 3/4	4	Nil	5.0	3
	500-1000	Clay Loam	Strong (Moist)	Dark Reddish Brown 5YR 3/3	4	Nil	5.5	3
Tick box if limitation to effluent land application								
								

SOIL ASSESSMENT – HMC – 30th October 2020

BOREHOLE No. BH9

SOIL LANDSCAPE (Morand, 1994):

Wollongbar variant a (woa) soil landscape (Expected)

Mostly deep (<200cm) well drained Krasnozems with shallower (80-150cm) stonier Krasnozems on crest/upper slope boundaries. Wet alluvial Krasnozems in drainage lines. Moderately broad to broad (100–>300 m) crests and ridges.

Groundwater intrusion	Depth (mm)	Texture	Structure	Colour (MUNSELL)	Soil Category	Coarse Fragments	Soil pH	Dispersive Class (BSC, 2004)
Not encountered	0-400	Clay Loam	Strong (Moist)	Dark Reddish Brown 2.5YR 2.5/3	4	Fine Gravels <20%, large boulders	5.0	3
	400-800	Clay Loam	Strong (Moist)	Dark Reddish Brown 5YR 3/4	4	Fine, Moderate & Large Gravels >20%. Large boulders	4.5	3
Tick box if limitation to effluent land application						✓	✓	



APPENDIX 3 – SOIL LANDSCAPE MAPPING

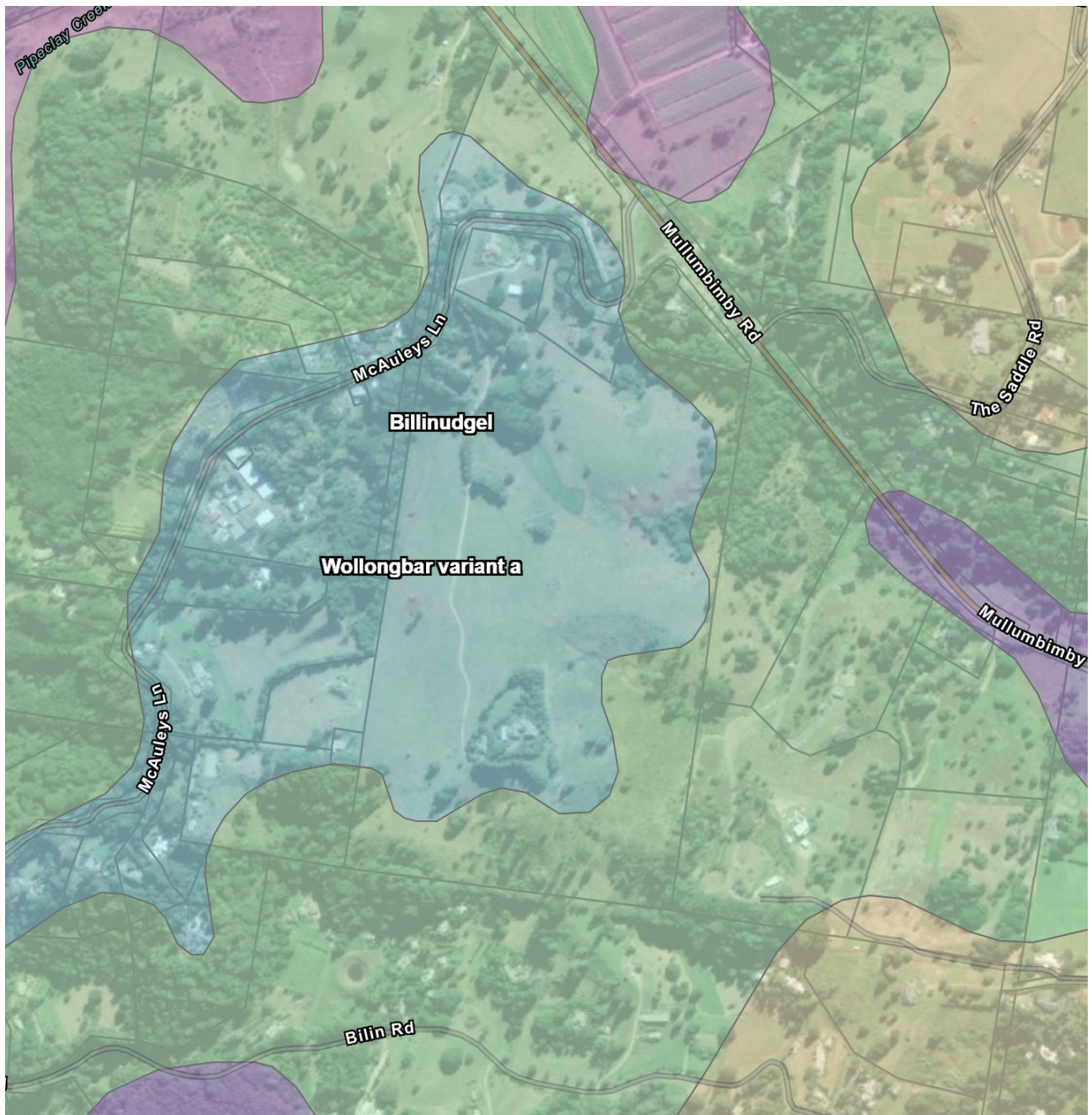


Figure 3: Soil Landscapes (Morand, 1994).

APPENDIX 4 – BYRON FLOOD INFORMATION MAPPING



Figure 4 – Byron Shire Council We Map - Flood Information

APPENDIX 5 - SITE PHOTOS



Photo 1 Aerial photograph looking north over subject site, with existing dwelling in foreground and BH5 location at arrow.



Photo 2 Aerial photograph looking south-west over subject site.



Photo 3 View SE showing gentle sloping land, BH1 location at arrow.



Photo 4 View SW showing gentle sloping land towards a gully, BH2 location at arrow.



Photo 5 View SW showing moderate sloping land, BH3 location on top of ridge at arrow.



Photo 6 View E showing steep sloping land, BH4 location on top of ridge at arrow.



Photo 7 View S showing BH5 location on top of ridge at arrow.



Photo 8 View NE and downslope showing gullies feeding into property dam. Location of BH6 shown by arrow.



Photo 9 View SW from BH6 looking upslope, location of BH5 shown via arrow.



Photo 10 View SE showing gentle sloping towards the centre of the property, BH7 shown via arrow.



Photo 11 View E through E2 zoned land (rainforest), not suitable for effluent disposal.



Photo 12 View E from BH9 looking towards the location of BH8, shown via arrow.



Photo 13 View W from BH8 looking towards the location of BH9, shown via arrow.



Photo 14 View S showing permanent watercourse.

APPENDIX 6 – LABORATORY RESULTS – EFFLUENT DISPOSAL ANALYSIS

WASTEWATER DISPOSAL SOIL ASSESSMENT

6 samples supplied by HMC Environmental Consulting Pty Ltd on 2/11/2020 - Lab Job No. K0115

Analysis requested by Helen Tunks. - **Your Project: HMC2020.248**

PO Box 311 TWEED HEADS NSW 2485

	SAMPLE 1 BH1C	SAMPLE 2 BH2B	SAMPLE 3 BH3A	SAMPLE 4 BH4B	SAMPLE 5 BH5C	SAMPLE 6 BH6A
Job No.	K0115/1	K0115/2	K0115/3	K0115/4	K0115/5	K0115/6
Description	Medium Clay	Clay Loam	Clay Loam	Sandy Clay Loam	Medium Clay	Clay Loam
Moisture Content (% moisture)	20	26	21	12	13	29
Emerson Aggregate Stability Test (SAR 5 Solution)	EAST Class 3/6, Slake 3 see note 12	EAST Class 3/6, Slake 3 see note 12	EAST Class 3/6, Slake 1 see note 12	EAST Class 3/6, Slake 3 see note 12	EAST Class 3/6, Slake 3 see note 12	EAST Class 3/6, Slake 2 see note 12
Soil pH (1:5 CaCl ₂)	3.82	4.66	4.49	4.33	4.17	4.67
Soil Conductivity (1:5 water dS/m)	0.038	0.018	0.022	0.018	0.018	0.021
Soil Conductivity (as EC _e dS/m) ^{note 10}	0.324	0.158	0.189	0.151	0.152	0.183
Native NaOH Phosphorus (mg/kg P)	2.38	95.40	43.20	132.12	14.80	77.40
Residual phosphorus remaining in solution from the initial phosphate phosphorus						
Initial Phosphorus concentration (ppm P)	31.428	31.428	31.428	31.428	31.428	31.428
72 hour - 3 Day (ppm P)	10.94	0.21	7.60	20.33	15.80	0.84
120 hour - 5 Day (ppm P)	10.21	0.16	6.90	19.93	15.23	0.66
168 hour - 7 Day (ppm P)	9.88	0.08	6.71	19.36	14.66	0.51
Equilibrium Phosphorus (ppm P)	9.10	0.01	5.99	18.80	13.95	0.29
EXCHANGEABLE CATIONS						
Calcium (cmol+/kg)	0.42	0.35	1.19	0.31	0.87	0.91
Magnesium (cmol+/kg)	0.15	0.24	0.60	0.20	0.28	0.40
Potassium (cmol+/kg)	0.04	0.03	0.15	0.02	0.03	0.36
Sodium (cmol+/kg)	0.06	0.03	0.07	0.03	0.09	0.07
Aluminium (cmol+/kg)	16.82	0.44	2.15	0.59	7.68	0.60
Hydrogen (cmol+/kg)	0.00	0.02	0.21	0.10	0.33	0.09
ECEC (effective cation exchange capacity)(cmol+/kg)	17.5	1.1	4.4	1.3	9.3	2.4
Exchangeable Calcium %	2.4	31.4	27.3	24.5	9.4	37.5
Exchangeable Magnesium %	0.8	21.8	13.7	15.9	3.0	16.4
Exchangeable Potassium %	0.2	2.3	3.4	1.8	0.3	14.8
Exchangeable Sodium % (ESP)	0.4	2.5	1.5	2.4	1.0	3.0
Exchangeable Aluminium %	96.2	40.0	49.2	47.2	82.7	24.5
Exchangeable Hydrogen %	0.0	1.9	4.9	8.2	3.6	3.8
Calcium/ Magnesium Ratio	2.84	1.44	1.99	1.53	3.11	2.29

Notes:

1. ECEC = Effective Cation Exchange Capacity = sum of the exchangeable Mg, Ca, Na, K, H and Al
2. Exchangeable bases determined using standard Ammonium Acetate extract (Method 15D3) with no pretreatment for soluble salts. When Conductivity ≥ 0.25 dS/m soluble salts are removed (Method 15E2).
3. ppm = mg/kg dried soil
4. Insitu P determined using 0.1M NaOH and shaking for 24 hrs before determining phosphate
5. Soils were crushed using a ceramic grinding head and mill; five 1g subsamples of each soil were used to which 40ml of 0.1M NaCl with Xppm phosphorus was added to each. The samples were shaken on an orbital shaker
6. Exchangeable sodium percentage (ESP) is calculated as sodium (cmol+/kg) divided by ECEC
7. All results as dry weight DW - soils were dried at 60C for 48hrs prior to crushing and analysis.
8. Phosphorus Capacity method from Ryden and Pratt, 1980.
9. Aluminium detection limit is 0.05 cmol+/kg; Hydrogen detection limit is 0.1 cmol+/kg.
However for calculation purposes a value of 0 is used.
10. For conductivity 1 dS/m = 1 mS/cm = 1000 μ S/cm; EC_e conversions: sand loam 14, loam 9.5; clay loam 8.6; heavy clay 5.8
11. 1 cmol+/kg = 1 meq/100g
12. Emerson Aggregate Stability Test (EAST) for Wastewater applications (see Sheet 3 - Patterson, 2015). MEAT Class 1: Slaking, complete dispersion;
Class 2: Slaking, some dispersion; Class 3-6: Slaking 1 slight to 3 complete, No dispersion; Class 7: No slaking, yes swelling; Class 8: No slaking, no swelling.
13. Analysis conducted between sample arrival date and reporting date.
14. ... Denotes not requested.
15. This report is not to be reproduced except in full.
16. All services undertaken by EAL are covered by the EAL Laboratory Services Terms and Conditions (refer scu.edu.au/eal or on request).



PHOSPHORUS SORPTION TRIAL

6 samples supplied by HMC Environmental Consulting Pty Ltd on 2/11/2020 - Lab Job No. K0115

Analysis requested by Helen Tunks. - Your Project: HMC2020.248

Calculations for Equilibrium Absorption Maximum for Soil provided

I.D.	JOB NO.	Equilibrium P mg P/L (in solution)	Added P mg P/L	P Sorb at Equil. mg P/kg	Native P mg P/kg	Equilibrium P Sorption Level µg P/g soil	Divide Ø (from Table)	Equilibrium Absorption Maximum (B) µg P/g soil
BH1C	K0115/1	9.1	31.428	893	2	896	0.75	1,186
BH2B	K0115/2	0.0	31.428	1257	95	1352	0.16	8,419
BH3A	K0115/3	6.0	31.428	1017	43	1061	0.69	1,534
BH4B	K0115/4	18.8	31.428	505	132	637	0.88	724
BH5C	K0115/5	14.0	31.428	699	15	714	0.83	864
BH6A	K0115/6	0.3	31.428	1246	77	1323	0.36	3,651

Calculations for phosphorus sorption capacity

	JOB NO.	Equilibrium Absorption Maximum (B) µg P/g soil	multiply by theta of wastewater to be applied (=X)	minus the native P (=Y)	kg P sorption / hectare (to a depth of 15cm) (1.95 is a correction factor for density, etc)	kg P sorption / hectare (to a depth of 100cm) (1.95 is a correction factor for density, etc)
BH1C	K0115/1	1186	(=B x theta)	(=X - native P)	(=Y x 1.95)	(=Y x 1.95 x 100/15)
BH2B	K0115/2	8419	(=B x theta)	(=X - native P)	(=Y x 1.95)	(=Y x 1.95 x 100/15)
BH3A	K0115/3	1534	(=B x theta)	(=X - native P)	(=Y x 1.95)	(=Y x 1.95 x 100/15)
BH4B	K0115/4	724	(=B x theta)	(=X - native P)	(=Y x 1.95)	(=Y x 1.95 x 100/15)
BH5C	K0115/5	864	(=B x theta)	(=X - native P)	(=Y x 1.95)	(=Y x 1.95 x 100/15)
BH6A	K0115/6	3651	(=B x theta)	(=X - native P)	(=Y x 1.95)	(=Y x 1.95 x 100/15)

EXAMPLE 1 - Calculations for phosphorus sorption capacity using a wastewater phosphorus of 15mg/L P

	JOB NO.	Equilibrium Absorption Maximum (B) µg P/g soil	multiply by theta of wastewater to be applied (ie. 0.84)	minus the native P (=Y)	kg P sorption / hectare (to a depth of 15cm) (1.95 is a correction factor for density, etc)	kg P sorption / hectare (to a depth of 100cm) (1.95 is a correction factor for density, etc)
BH1C	K0115/1	1186	996	994	1,939	12,924
BH2B	K0115/2	8419	7072	6976	13,604	90,691
BH3A	K0115/3	1534	1289	1246	2,429	16,192
BH4B	K0115/4	724	609	476	929	6,194
BH5C	K0115/5	864	726	711	1,387	9,244
BH6A	K0115/6	3651	3067	2989	5,829	38,863



APPENDIX 7 – VIRAL DISEASE MODELLING

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: $M_t / M_o = e^{-kt}$

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

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 ($^{\circ}\text{C}$).

For treated effluent from a secondary treatment on-site system, M_t/M_o should be 0.001 (3 orders of magnitude reduction)

For primary treated effluent from a septic tank, M_t/M_o should be 0.0000001 (7 orders of magnitude reduction)

For raw wastewater, M_t/M_o should be 0.0000001 (7 orders of magnitude reduction)

For greywater, M_t/M_o should be 0.00001 (5 orders of magnitude reduction)

Input: M_t / M_o (dimensionless ratio of viral concentration)

T (groundwater temp $^{\circ}\text{C}$)

Calculate k $(14 - 8.5) / 20$

$k = 0.275$

Calculate t $\ln (M_t / M_o) / -k$

$\ln (0.0000001) / -0.275$

$t = 25.1$

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: $dg = (t - dv \cdot P/K)/(P/K \cdot i)$

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)
3	K1 (saturated hydraulic conductivity in metres/day)
3	K2 (saturated hydraulic conductivity in metres/day)
0.05	i (groundwater gradient - the steeper, the more conservative the answer)

Calculate dg $(t - dv \cdot P/K)/(P/K \cdot i)$

dg = **12.51** metres

dg + safety factor (*2) = **25.0** metres