Onsite Sewage Site Feasibility Assessment
Proposed LEP Amendment

Location:

Lot 8 DP 589795
53 McAuley's Lane
Myocum NSW 2481

Prepared for:

Ardill Payne & Partners

Report No:

HMC2020. 248

November 2020
As Amended August 2022

HMC environmental consulting pty ltd

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RE: Lot 8 DP 589795, 53 McAuleys Lane, Myocum, NSW, 2481.

HMC Environmental Consulting Pty Ltd is pleased to present our report for On-site Sewage Management Design 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

Dated 17 December 2020

Helen Tunks
(B.Env.Sc.)

Document Control Summary			
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Title:	On-site Sewage Site Feasibility Assessment – Proposed LEP Amendment		
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EXECUTIVE SUMMARY

HMC Environmental Consulting Pty Ltd has been commissioned by the client to prepare an Onsite Sewage Site Feasibility Assessment for proposed amendments to the Byron Local Environmental Plan 2014 relating to Lot 8 DP 589795, 53 McAuley's Lane, Myocum, NSW.

The rural property contains two existing dwellings with On-Site Sewage Management (OSSM) facilities. The property is predominantly zoned RU1 primary production and also contains small portions of Environmental Conservation (E2) zoned land within rainforest. It is proposed to rezone a portion of the rural primary production zone (RU1) to Large Lot, part RU2, and part Residential (R5).

The LEP amendments involve:

- changing the existing 40ha minimum lot size for the proposed R5 zoned land to part 4000m2 and part 2.5ha minimum lot size.
- proposed 8000m2 minimum Lot size for the RU2 land zone

There are no changes to the boundaries of any of the existing E2 – Environmental Conservation zoned land on the subject land.

This report provides a site and soil assessment to support the planning proposal and justify the feasibility of the proposed minimum lot sizes for the future provision of on-site sewage management. This report assumes maximum development including dual occupancy dwellings on proposed lots.

A site walkover and soil investigation were carried out on the 30th of October 2020 by Taylah Richards & Matthew Flanagan of HMC Environmental Consulting. The soil investigation was carried out via the excavation of nine (9) test pits, as shown in Appendix 2 of this report. Laboratory analyses for soil chemistry was carried out to determine site limitations, see Appendix 8. Figure 1 within the report provides an aerial view of the site, looking north.

The soil profiles recorded for the majority of the test pits were deep Krasnozems (BH2, BH4, BH6, BH7, BH8 & BH9), and mapped as a Wollongbar soil landscape (Morand, 1994). Light to medium clay subsoils were observed within the more perimeter locations at BH1, BH3 & BH5, which were mapped as a Burringbar soil landscape

To determine the feasibility of the proposed minimum lot sizes, the land area required for typical on-site sewage management systems was calculated for secondary treatment systems using water balance and nutrient modelling. By adopting worst case modelling factors of a 20m setback to the drainage lines and dams, and the least permeable soil type recorded, the likely maximum LAA size was determined, based on dual occupancy development.

The likely lot yield of a future possible subdivision is dependent on road and boundary configurations and will be assessed via a future planning proposal.

This report concludes that, on the basis of the information presented, on-site sewage management is feasible within the proposed minimum lot sizes on the subject site, assuming secondary treatment and shallow irrigation systems.

There is adequate land area available for effluent land application of each zone that presents with >15% ground slope, lies outside the minimum 30m buffer to streams and records soil suitable for effluent disposal. It is considered the site is suitable for the planning proposal in regard to on-site sewage management, reflecting maximum development that assumes dual occupancy dwellings on each lot

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)
HMC	HMC Environmental Consulting Pty Ltd
LAA	Land application area for effluent
LTAR	Long term acceptance rate (also described as Deep Drainage Rate in LCC OSSWM Strategy, 2013)
SDI	Subsurface Drip Irrigation
STS	Secondary Treatment System accredited under the "Secondary Treatment System Accreditation Guideline May 2018". STS are tested and product certified to Australian Standard AS1546.3:2017
TN	Total nitrogen
TP	Total phosphorus
TSS	Total suspended solids

TABLE OF CONTENTS

1 INTRODUCTION

HMC Environmental Consulting Pty Ltd has been commissioned by Tareeda Developments Pty Ltd and Boreas Group Pty Ltd (the client) to prepare an Onsite Sewage Site Feasibility Assessment for a proposed Local Environmental Plan 2014 relating to Lot 8 DP 589795, 53 McAuley's Lane, Myocum, NSW.

The rural property contains two existing dwellings with On-Site Sewage Management (OSSM) facilities. The property also contains small portions of Environmental Conservation (E2) zoned land within rainforest.

The property is predominantly zoned rural (RU1) land and also contains small portions of Environmental Conservation (E2) zoned land within rainforest. It is proposed to rezone a portion of the rural primary production zone (RU1) to Large Lot Residential (R5).

The LEP amendments also involve:

- changing the existing 40ha minimum lot size for the proposed R5 zoned land to part 4000m2 and part 2.5ha minimum lot size.
- proposed 8000m2 minimum Lot size for the RU1 land zone

This report supports the planning proposal and provides justification for the proposed minimum lot sizing based on a site and soil investigation and relevant water balance and nutrient modelling, assuming dual occupancy dwellings on future lots.

Figure 1 Property boundary (Source: BSC, 2020).

2 PROJECT OUTLINE

Proposal	Proposed Rezoning		
Address	Lot 8 DP 589795 53 McAuley's Lane Myocum NSW 2481		
Allotment Size	~34.95 ha		
Proposed Minimum Lot Size	RU2: Rural Landscape 8000m2	R5: Large Lot Residential	
		4000m2	2.5 Ha
Regulatory Authority & Guidelines:	Byron Shire Council Byron Shire Rural Settlement Strategy Byron Shire Council On-site Sewage Management Strategy (2001) Byron Shire Council Design Guidelines for On-site Sewage Management for Single Households (2004)		
Water Supply	Non-reticulated roof watch catchment supply		
Site constraints	High volume seasonal rainfall, typical of region Moderate to steep slopes Proximity to watercourses Proximity to groundwater bores/wells Low permeability of sub-soils		

3 SITE INFORMATION

Should conditions vary from those described below 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 and is not intended to be used for installation or construction.

3.1 Site Conditions

Inspected by	Taylah Richards & Matthew Flanagan
Date & Time of Inspection	30th October 2020
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).
Summary of Soil Types (AS/NZS1547:2012)	Clay Loam, Light Clay, and Medium Clay subsoils Soil Category 4 – 6 See Appendix 7 for full soil profiles, field test and laboratory results and photos
Drainage	Moderate drainage available
Slope Range	<10%-25% slope available.
Ground cover/vegetation	Pasture grass 100% coverage

4 LAND APPLICATION AREA SIZING FOR LOT SIZE FEASIBILITY

	SITE FEASIBILITY ONLY – NOT FOR INSTALLATION		
	4000m2 MINIMUM LOT SIZE		
Development	Typical dual occupancy dwelling – 2 x 4 bedrooms assumed		
Treatment Type	Typical: Aerated Wastewater Treatment System, TN reduction Minimum 53%		
LAA Method	Typical: Pressure compensated shallow sub-surface drip irrigation		
Model Used	Byron Shire Council OSSM Design Model		
Soil Type	Clay Loam Soil Category 4	Light Clay Soil Category 5	Medium Clay Soil Category 6
Design Hydraulic Load	1380L/day	1380L/day	1380L/day
Typical system components	SDI field – shallow sub-surface	SDI field – shallow sub-surface	SDI field – shallow sub-surface
RECOMMENDED LAA	**857m2**	**857m2**	**857m2**
LIMITING FACTOR	**Nitrogen Load**	**Nitrogen Load**	**Nitrogen Load**

	SITE FEASIBILITY ONLY – NOT FOR INSTALLATION		
	8000m2 MINIMUM LOT SIZE		
Development	Typical dual occupancy dwelling – 2 x 4 bedrooms assumed		
Treatment Type	Typical: Aerated Wastewater Treatment System, TN reduction 53%		
LAA Method	Typical: Pressure compensated sub-surface drip irrigation		
Model Used	Byron Shire Council OSSM Design Model		
Soil Type	Clay Loam Soil Category 4	Light Clay Soil Category 5	Medium Clay Soil Category 6
Design Hydraulic Load	1380L/day	1380L/day	1380L/day
Typical system components	SDI field – shallow sub-surface	SDI field – shallow sub-surface	SDI field – shallow sub-surface
RECOMMENDED LAA	**783m2**	**783m2**	**783m2**
LIMITING FACTOR	**Nitrogen Load**	**Nitrogen Load**	**Nitrogen Load**

	SITE FEASIBILITY ONLY – NOT FOR INSTALLATION		
	2.5ha MINIMUM LOT SIZE		
Development	Typical dual occupancy dwelling – 2 x 4 bedroom assumed		
Treatment Type	Typical: Aerated Wastewater Treatment System, TN reduction 53%		
LAA Method	Typical: Pressure compensated sub-surface drip irrigation		
Model Used	Byron Shire Council OSSM Design Model		
Soil Type	Clay Loam Soil Category 4	Light Clay Soil Category 5	Medium Clay Soil Category 6
Design Hydraulic Load	1380L/day	1380L/day	1380L/day
Typical system components	SDI field – shallow sub-surface	SDI field – shallow sub-surface	SDI field – shallow sub-surface
RECOMMENDED LAA	**448m2**	**484m2**	**543m2**
LIMITING FACTOR	**Hydraulic Loading**	**Hydraulic Loading**	**Hydraulic Loading**

5 SETBACK DISTANCE ASSESSMENT

The setbacks from the existing on-site sewage management system for this 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

There are several non-perennial drainage lines and dams on the subject site. An ecological assessment has been carried out as part of the planning proposal and includes an assessment of the threats to flora, fauna, and water quality (Biodiversity Assessments & Solutions, Project #201009, 28/11/2020). The drainage lines and dams have been identified by ecological assessment as 1st and 2nd Order streams, and the recommended buffers are 30m and 40m, as shown in the On-site Sewage Site Feasibility Assessment plan in Appendix 2.

The ecological assessment identifies the site as having low to moderate ecological value or provide low to moderate wildlife habitat. Sub-tropical rainforest species and freshwater wetland species were identified. The ecological assessment concludes that with protection of freshwater wetlands, native vegetation and stream order buffers, the site is entirely suitable for the proposed and subsequent development.

There are existing cleared areas can be utilised for future possible residential development, thereby minimising the need for removal of existing native vegetation.

Using the modelling calculations provided within the previous section, this report demonstrates that future possible on-site sewage management is feasible within the minimum lot sizes, even when adopting a more conservative 20m setback to watercourses for LAA sizing.

A total of four registered groundwater bores off-site are located less 250m of the property boundary and these locations are also detailed in Appendix 2. The nearest GW bore to the property boundary is located <50m from the property boundary, off-site in the northwest, adjacent to McAuleys Road. This bore is located approximately 150m from the existing dwelling and is effectively upslope of the dwelling due to the formed McAuleys Road. The remaining bores are all located approximately 200m from the boundary. Due to the steep slopes and E2 zoning, it is not feasible that land application areas would ever be sited within 250m of these bores.

The table below presents a summary the setback distance compliance assessment for the existing site features and constraints that are most limiting to on-site sewage management (OSSM) systems.

Non-compliance with future possible land uses is capable of being addressed via design mitigation options set out in future applications. The design mitigations are in accordance with those recommended with Byron Shire Council Design Guidelines for On-site Sewage Management for Single Households (BSC, 2004).

This report therefore demonstrates that proposed minimum lot sizes and rezoning are feasible in terms of on-site sewage management, including maximum development of dual occupancy dwellings per lot.

Table 1 Setback Distance Compliance Assessment Summary

Site Feature	Setback Distance/Criteria	Proposed	Compliance OR Design Mitigation
Flood prone land (flood level)	> 1:100-year flood level	>1:100 year	COMPLIES

Sloping land	<15% >	<20%	Pressure-compensating shallow sub-surface dripperline
Groundwater Well	>250m to GW bore >50m to upslope GW bore	>250m >50m	COMPLIES COMPLIES
Permanent/perennial watercourse, dam	>100m	>40m to 2nd Order stream	Ecological assessment recommendations Secondary effluent treatment
Dam or intermittent watercourse	>40m	>20m to 1st Order streams	
Buffer to seasonally high-water table or bedrock	>1200mm	>1200mm	COMPLIES
Soil permeability	Avoid very poorly drained soil K_{sat} <0.06m/day	Strong structured Medium Clay K_{sat} >0.06m/day	COMPLIES
Reserve Land Application Area	Normally applied to septic tank (primary treatment) systems. The improved effluent quality and distribution via irrigation minimises soil degradation and therefore reduces the need for a Reserve LAA. (AS/NZS1547:2012 Commentary C5.5.3.4)		No Reserve LAA Secondary effluent treatment Shallow irrigation to topsoil layer

6 OVERALL EVALUATION

The subject site for the proposed rezoning is generally constrained by proximity to watercourses and slopes greater than 15%. This report has assessed the feasibility of minimum lot sizes assuming worst case scenarios for sizing of land application areas:

- conservative 20m setback to streams
- maximised development for dual occupancy dwellings on each lot.

The southern portion of the property is constrained by steep slopes and medium clay sub-soil. Elevated areas of the property are constrained by an abundance of gravels, cobbles and boulders which would also present a limitation to effluent disposal and would be a factor in the future lot layout.

The LAA minimum requirement was sized using modelling based on secondary treatment and shallow sub-surface drip irrigation. This effluent quality and distribution is therefore recommended on all lots with the minimum land application area sizes dependent on the three identified soil categories throughout the site, category 4 (clay loams), category 5 (light clays) and category 6 (medium clays).

The results of the modelling support the recommendation that the proposed rezoning and minimum lot sizes are feasible in terms of on-site sewage management. Existing cleared areas can be utilised for future possible residential development, thereby minimizing the need for removal of native vegetation.

7 CONCLUSION

The subject site is considered suitable in terms of on-site sewage management for the planning proposal involving rezoning and adoption of minimum lot sizes, including the consideration of maximum development in the form of dual occupancy dwellings on each lot.

8 REFERENCES

- 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, "Byron *Rural Settlement Strategy,"* October 1998.
- 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;
- 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

9 LIMITATIONS

The information within this document is and shall remain the property of HMC Environmental Consulting Pty Ltd.

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

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

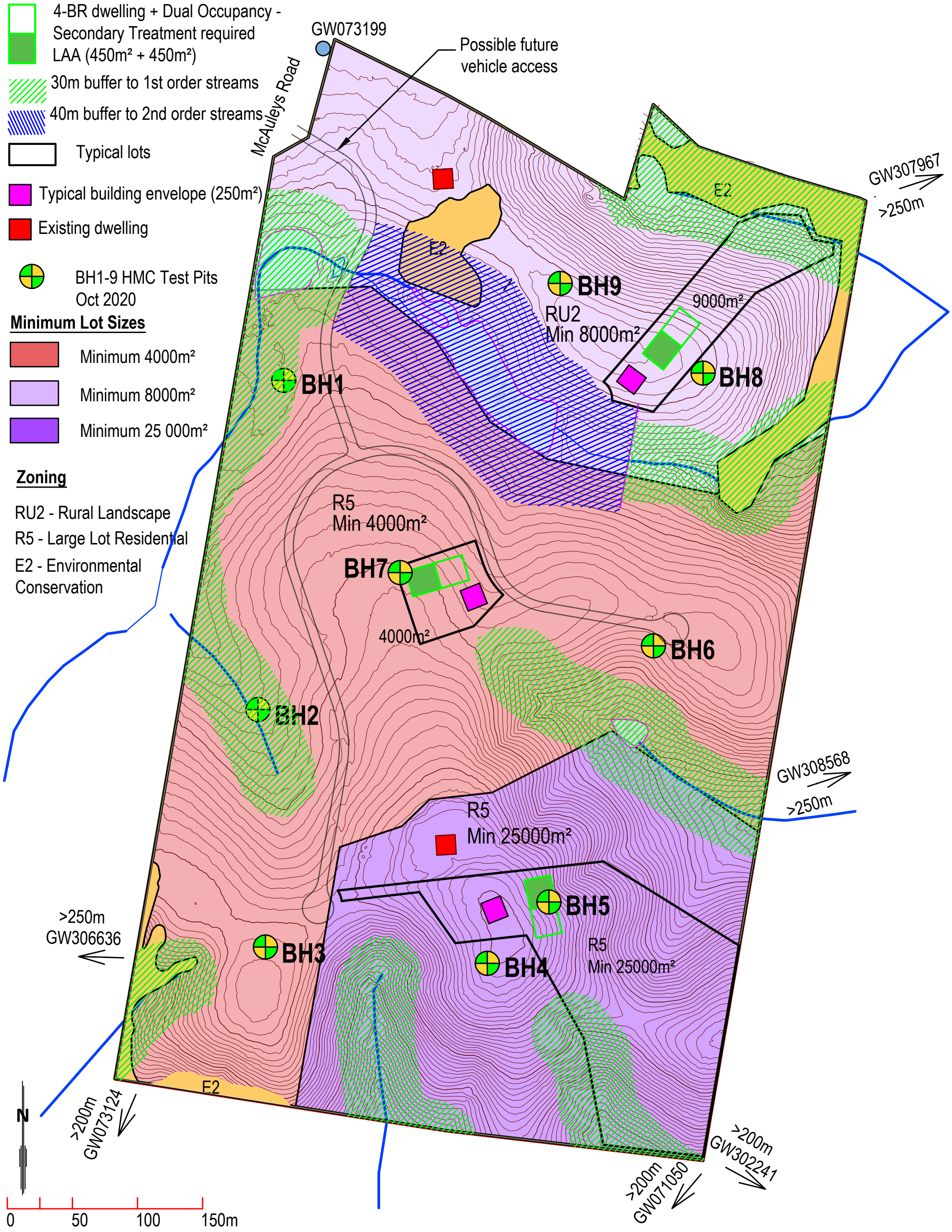
The findings of this report are based on the objectives and scope of work outlined within. HMC performed the services in a manner consistent with the normal level of care and expertise exercised by members of the environment assessment profession. No warranties or guarantees, expressed or implied, are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

10 APPENDICES

APPENDIX 1 Site Location within Myocum Locality

APPENDIX 2 Site Plan

SEE NEXT PAGE



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On-Site Sewage Site Feasibility Assessment - Proposed Land Rezoning - Not for Construction

Lot 8 DP 589795
53 McAuleys Lane Myocum

Base Drawing Source: Venue Design Group HMC Ref: HMCDWG2020.248.06

Job No: 2020.248

Date: December 2020
Revision Date: 30.08.2022

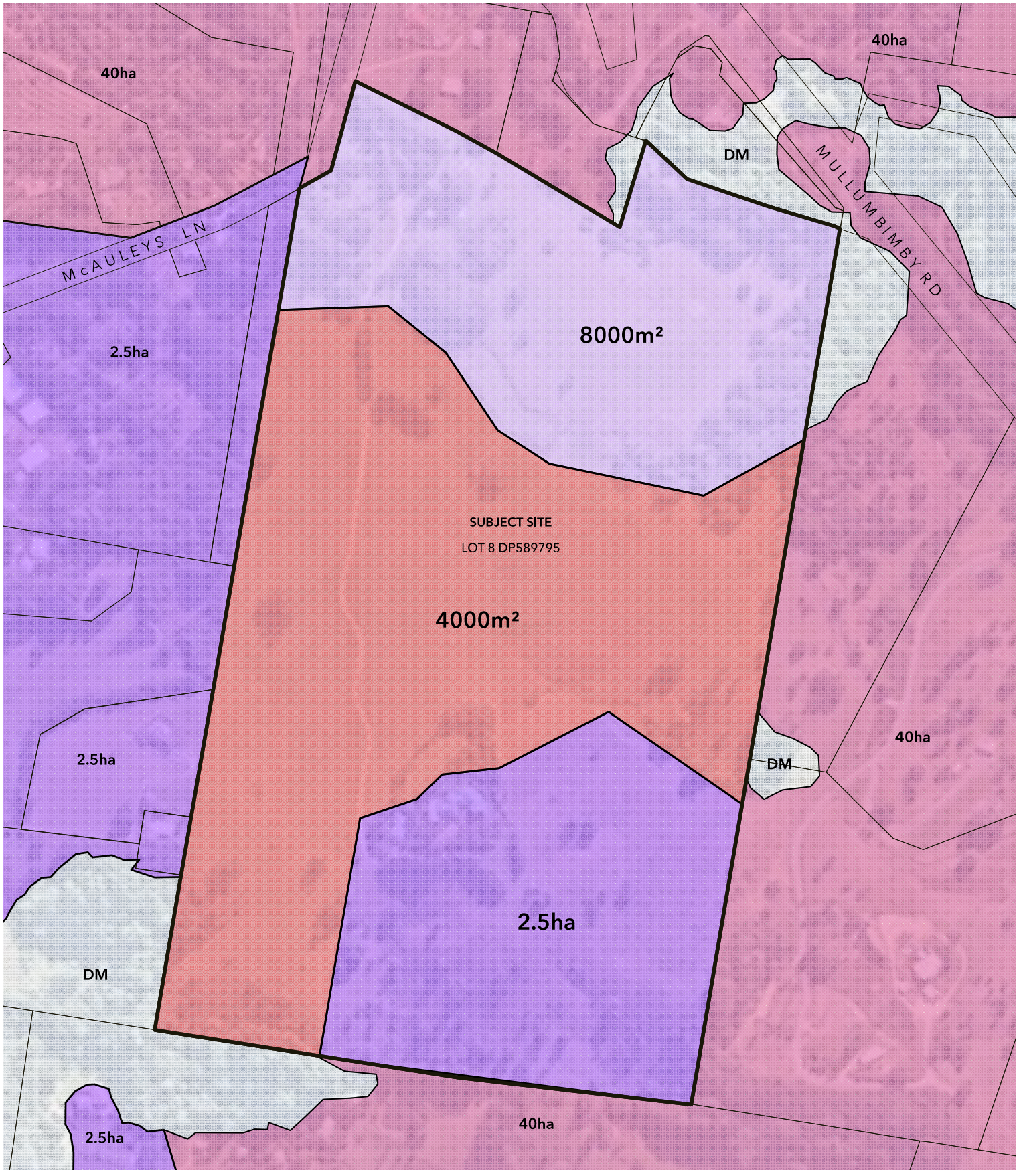
APPENDIX 3 Rezoning Plan

SEE NEXT PAGE

MCAULEYS LANE SUBDIVISION

53 McAULEYS LN, MYOCUM, NSW
LOT 8 DP589795

CONCEPT MASTERPLAN



SCALE 1:3000 at A3

0m 100m 200m 300m

PROJECT	MCAULEYS LN SUBDIVISION	DRAWING	CONCEPT MIN. LOT SIZE PLAN		
ADDRESS	53 MCAULEYS LN.	JOB NO.	1819		
	MYOCUM, NSW	DATE	28.08.20	SCALE	1:3000
DOCUMENT	SKETCH PLAN -CONFIDENTIAL	DRAWING NO.	SK.1.32	REV NO.	B

VENU. DESIGN GROUP

APPENDIX 4 Land Application Area Modelling – 4000m2 Minimum Lot Size

SEE FOLLOWING PAGES

Byron OSMS Design Model *Version:* 8000 - LIGHT CLAY.xlsm

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

Set Defaults

STEP 1: bedrooms / persons

STEP 2:
 # bedrooms (Grp 1) 4
 # bedrooms (Grp 2) 4

STEP 3: Buffer to permanent water / Buffer to intermittant water — 20

STEP 4: **Block size (m2)** 4000

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: **Wastewater stream**

Grp1	Grp 2
☑ Toilet	☑ Toilet
☑ Bathroom	☑ Bathroom
☑ Laundry	☑ Laundry
☑ Kitchen	☑ Kitchen

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

Total Daily Flow (L/day) *	1380	Daily Effluent Flow per person (L/day)	115	% black to tot WW in a full system	32%
TN production per year (kg/year)	50.40	N prod. per capita (kg/person/yr)	4.20	% black to tot WW in a full system: TN	70%
TN reduced by all N loss (kg/year) *	18.95	N loss in treatment system (% reduction)	53%	N loss in disposal bed (% reduction)	20%
N Plant Uptake rate (kg/ha/year)	200				
Phosphorus in effluent (Ip) (kg/yr) *	7.20	P prod. per person per yr (kg/person/yr)	0.60	wastewater in a full system: TP	40%

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

Nitrogen Report

P uptake by plants (Hp) (kg/ha/yr)	10	N plant uptake (kg/yr)	17.14	Total N-load 18.95kg/yr	
P soil sorption (Ps) (kg/ha/m depth)	10000	N load exceedence	0.00		
Water Table/ Bedrock Depth (m) (STEP 10)	3.00	N load percolated (kg/yr)	1.81		
Buffer to Water Table (Bwt) (m)	0.5	N released (perc+exceed.) (kg/yr)	1.81		
Time for accumulation of P(years)	50	Enviro.N limit (kg/yr)	1.81		
Final area (m^2)	**857**	Nitrogen area (m^2)	857		
Phosphorus area (m^2)	141	Hydraulic area (m2)	402		
Water balance area (m^2)	857				
☑ Specific Crop Coeff.(grass=1.00)	1.00				
% Effective Rainfall	65%				
Percolation (mm/d)	5				

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)

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)

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 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
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/m^2)	1.61				
Exceedence (L)	0.00000				

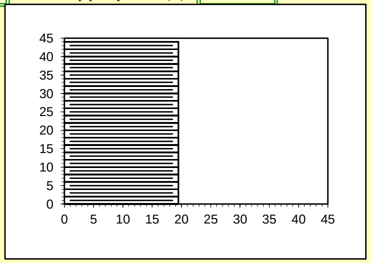
Trench under root zone <-

STEP 13 → **Land Application Type**
- SSI
- ETA

STEP 14: Calculate (or Cntl- q)

STEP 15: 2.00

22



Byron OSMS Design Model *Version:* 4000 - CLAY LOAM.xls.xlsm ***Period of Rainfall & Evaporation Record: 01/07/1980 - 30/06/2001***

Set Defaults

STEP 1 — bedrooms / persons

STEP 2

# bedrooms (Grp 1)	4
# bedrooms (Grp 2)	4
Total Daily Flow (L/day) *	1380
TN production per year (kg/year)	50.40
TN reduced by all N loss (kg/year) *	18.95
N Plant Uptake rate (kg/ha/year)	200
Phosphorus in effluent (Ip) (kg/yr) *	7.20
P uptake by plants (Hp) (kg/ha/yr)	10
P soil sorption (Ps) (kg/ha/m depth)	10000
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)	**857**
Phosphorus area (m^2)	**141**
Water balance area (m^2)	857
Specific Crop Coeff.(grass=1.00)	1.00
% Effective Rainfall	65%
Percolation (mm/d)	4
Avg depth of root zone (m)	0.30
Avg depth bluemetal (etc) in trench below root zone (m)	0.00
Soil Moisture Holding Capacity: saturation & AWC (mm)	111.00
Permissible percentile exceedence	5.00%
Minimum effluent application (mm/day/m^2)	1.61
Exceedence (L)	0.00000

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

STEP 4 — Block size (m2): 4000 / 20

Daily Effluent Flow per person (L/day)	115
N prod. per capita (kg/person/yr)	4.20
N loss in treatment system (% reduction)	53%
P prod. per person per yr (kg/person/yr)	0.60
N plant uptake (kg/yr)	17.14
N load exceedence	0.00
N load percolated (kg/yr)	1.81
N released (perc+exceed.) (kg/yr)	1.81
Enviro.N limit (kg/yr)	1.81
Nitrogen area (m^2)	857
Hydraulic area (m2)	484
Total ETA trench area	830.48
ETA trench length (m)	18.87
Number of SSI laterals	22
beds total plus separating spaces	X,Y dimensions = 19.5m x 44.0m
Effective porosity of root zone	0.37
Effective porosity of bluemetal in trench below root zone	0.00
45.00	
SSI lateral pipe separation (m)	2.00

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 — Wastewater stream

Grp1	Grp 2
☑ Toilet	☑ Toilet
☑ Bathroom	☑ Bathroom
☑ Laundry	☑ Laundry
☑ Kitchen	☑ Kitchen

% 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)	27.2
BOD target of 20mg/L is	Current Outlet BOD

STEP 10 — Water Table/ Bedrock Depth (m)

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)

Avail.Water Capacity (AWC) of root zone	0.15
Default AWC of bluemetal in trench below root zone	0.00

Trench under root zone <-

Land Application Type

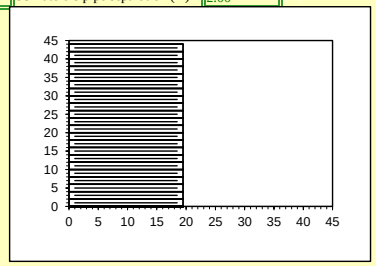
STEP 13 — SSI / ETA

STEP 14 — Calculate (or Cntl- q)

Lateral seepage width (m)	0.50
ETA trench separation	2.00
ETA bed separation	1.40

STEP 15 — 2.00

22



Byron OSMS Design Model *Version:*

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

Set Defaults

bedrooms
persons
STEP 1

STEP 2 | STEP 3 | STEP 4 | STEP 5 | STEP 6

# bedrooms (Grp 1)	4	Buffer to permanent water	**Block size (m2)**	4000	
# bedrooms (Grp 2)	4	Buffer to intermittant water		20	
Total Daily Flow (L/day) *	1380	Daily Effluent Flow per person (L/day)	115	% black to tot WW in a full system	32%
TN production per year (kg/year)	50.40	N prod. per capita (kg/person/yr)	4.20	% black to tot WW in a full system: TN	70%
TN reduced by all N loss (kg/year) *	18.95	N loss in treatment system (% reduction)	53%	N loss in disposal bed (% reduction)	20%
N Plant Uptake rate (kg/ha/year)	200				
Phosphorus in effluent (Ip) (kg/yr) *	7.20	P prod. per person per yr (kg/person/yr)	0.60	wastewater in a full system: TP	40%

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

Wastewater stream

Grp1	Grp 2
☑ Toilet	☑ Toilet
☑ Bathroom	☑ Bathroom
☑ Laundry	☑ Laundry
☑ Kitchen	☑ Kitchen

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

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

Nitrogen Report

P uptake by plants (Hp) (kg/ha/yr)	10	N plant uptake (kg/yr)	17.14	Total N-load 18.95kg/yr
P soil sorption (Ps) (kg/ha/m depth)	10000	N load exceedence	0.00	
Water Table/ Bedrock Depth (m)	3.00	N load percolated (kg/yr)	1.81	
Buffer to Water Table (Bwt) (m)	0.5	N released (perc+exceed.) (kg/yr)	**1.81**	
Time for accumulation of P(years)	50	**Enviro.N limit (kg/yr)**	**1.81**	
Final area (m^2)	**857**	Nitrogen area (m^2)	**857**	
Phosphorus area (m^2)	**141**	Hydraulic area (m2)	**543**	
Water balance area (m^2)	857			
☑ Specific Crop Coeff.(grass=1.00)	1.00			
% Effective Rainfall	65%			
Percolation (mm/d)	4			

STEP 10

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)	

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)

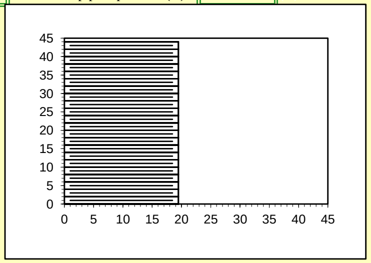
Avg depth of root zone (m)	0.30	Effective porosity of root zone	0.37	Avail.Water Capacity (AWC) of root zone	0.15
Avg depth bluemetal (etc) in trench below root zone (m)	0.00		0.00		0.00
Soil Moisture Holding Capacity: saturation & AWC (mm)	111.00	45.00			
Permissible percentile exceedence	5.00%	SSI laterals pipe separation (m)	2.00		
Minimum effluent application (mm/day/m^2)	1.61				
Exceedence (L)	0.00000				

STEP 13
Land Application Type
- SSI
- ETA

STEP 14
Calculate (or Cntl- q)

STEP 15
2.00

22



APPENDIX 5 Land Application Area Modelling – 8000m2 Minimum Lot Size

Byron OSMS Design Model *Version:* e201821531-byron-osms-design-model-final-version-for-distribution-with-design-guidelines-491834 (41).xlsm ***Period of Rainfall & Evaporation Record: 01/07/1980 - 30/06/2001***

Set Defaults

STEP 1: bedrooms / persons

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

STEP 3: Buffer to permanent water / Buffer to intermittant water — 20

STEP 4: **Block size (m2)** 8000

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: **Wastewater stream**

Grp1	Grp 2
☑ Toilet	☑ Toilet
☑ Bathroom	☑ Bathroom
☑ Laundry	☑ Laundry
☑ Kitchen	☑ Kitchen

Total Daily Flow (L/day) *	1380	Daily Effluent Flow per person (L/day)	115	% black to tot WW in a full system	32%
TN production per year (kg/year)	50.40	N prod. per capita (kg/person/yr)	4.20	% black to tot WW in a full system: TN	70%
TN reduced by all N loss (kg/year) *	18.95	N loss in treatment system (% reduction)	53%	N loss in disposal bed (% reduction)	20%
N Plant Uptake rate (kg/ha/year)	200				
Phosphorus in effluent (Ip) (kg/yr) *	7.20	P prod. per person per yr (kg/person/yr)	0.60	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

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

Nitrogen Report

P uptake by plants (Hp) (kg/ha/yr)	10	N plant uptake (kg/yr)	15.65
P soil sorption (Ps) (kg/ha/m depth)	10000	N load exceedence	0.00
Water Table/ Bedrock Depth (m) (STEP 10)	3.00	N load percolated (kg/yr)	3.30
Buffer to Water Table (Bwt) (m)	0.5	N released (perc+exceed.) (kg/yr)	3.30
Time for accumulation of P(years)	50	**Enviro.N limit (kg/yr)**	3.30
Final area (m²)	**783**	Nitrogen area (m²)	**783**
Phosphorus area (m²)	**141**	Hydraulic area (m2)	**402**

Total N-load 18.95kg/yr

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)

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)

Water balance area (m²)	783
☑ Specific Crop Coeff.(grass=1.00)	1.00
% Effective Rainfall	65%
Percolation (mm/d)	5

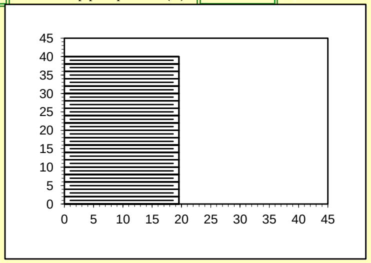
Avg depth of root zone (m)	0.30	Effective porosity of root zone	0.37	Avail.Water Capacity (AWC) of root zone	0.15
Avg depth bluemetal (etc) in trench below root zone (m)	0.00		0.00		0.00
Soil Moisture Holding Capacity: saturation & AWC (mm)	111.00	45.00			
Permissible percentile exceedence	5.00%	SSI laterals pipe separation (m)	2.00		

STEP 13: **Land Application Type**
- SSI
- ETA

STEP 14: Calculate (or Cntl- q)

STEP 15: 2.00

Minimum effluent application (mm/day/m²)	1.76
Exceedence (L)	0.00000



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Byron OSMS Design Model *Version:* 8000 - MEDIUM CLAY.xlsm ***Period of Rainfall & Evaporation Record: 01/07/1980 - 30/06/2001***

Set Defaults

STEP 1 bedrooms / persons

STEP 2

# bedrooms (Grp 1)	4
# bedrooms (Grp 2)	4
Total Daily Flow (L/day) *	1380
TN production per year (kg/year)	50.40
TN reduced by all N loss (kg/year) *	18.95
N Plant Uptake rate (kg/ha/year)	200
Phosphorus in effluent (Ip) (kg/yr) *	7.20
P uptake by plants (Hp) (kg/ha/yr)	10
P soil sorption (Ps) (kg/ha/m depth)	10000
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)	**783**
Phosphorus area (m^2)	**141**
Water balance area (m^2)	783
Specific Crop Coeff.(grass=1.00)	1.00
% Effective Rainfall	65%
Percolation (mm/d)	4
Avg depth of root zone (m)	0.30
Avg depth bluemetal (etc) in trench below root zone (m)	0.00
Soil Moisture Holding Capacity: saturation & AWC (mm)	111.00
Permissible percentile exceedence	5.00%
Minimum effluent application (mm/day/m^2)	1.76
Exceedence (L)	0.00000

STEP 3 Buffer to permanent water / Buffer to intermittant water

STEP 4 Block size (m2): 8000 / 20

Daily Effluent Flow per person (L/day)	115
N prod. per capita (kg/person/yr)	4.20
N loss in treatment system (% reduction)	53%
P prod. per person per yr (kg/person/yr)	0.60
Nitrogen area (m^2)	783
Hydraulic area (m2)	484
Total ETA trench area	758.68
ETA trench length (m)	18.97
Number of SSI laterals	20
beds/ total plus separating spaces	X,Y dimensions = 19.6m x 40.0m
Effective porosity of root zone	0.37
Effective porosity of bluemetal in trench below root zone	0.00
45.00	
SSI laterals pipe separation (m)	2.00

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	☑ Toilet
☑ Bathroom	☑ Bathroom
☑ Laundry	☑ Laundry
Wastewater stream	
☑ Kitchen	☑ Kitchen

% 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

Nitrogen Report

N plant uptake (kg/yr)	15.65
N load exceedence	0.00
N load percolated (kg/yr)	3.30
N released (perc+exceed.) (kg/yr)	3.30
Enviro.N limit (kg/yr)	3.30
Total N-load 18.95kg/yr	

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) 27.2

BOD target of 20mg/L is 92.0% of Current Outlet BOD

STEP 10

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)

Avail.Water Capacity (AWC) of root zone	0.15
Default AWC of bluemetal in trench below root zone	0.00

Trench under root zone <-

Land Application Type

STEP 13 SSI / ETA

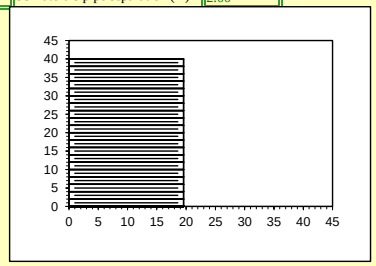
Lateral seepage width (m)

STEP 14 Calculate (or Cntl- q)

ETA trench separation

STEP 15 2.00

ETA bed separation 1.40



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Byron OSMS Design Model *Version:* 8000 - CLAY LOAM.xlsm

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

Set Defaults

bedrooms
persons

STEP 1

STEP 2

# bedrooms (Grp 1)	4
# bedrooms (Grp 2)	4

STEP 3
Buffer to permanent water
Buffer to intermittant water

STEP 4
Block size (m2) 8000
20

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: Toilet, Bathroom, Laundry, Kitchen
Grp 2: Toilet, Bathroom, Laundry, Kitchen

Wastewater stream

Total Daily Flow (L/day) *	1380	Daily Effluent Flow per person (L/day)	115	% black to tot WW in a full system	32%
TN production per year (kg/year)	50.40	N prod. per capita (kg/person/yr)	4.20	% black to tot WW in a full system: TN	70%
TN reduced by all N loss (kg/year) *	18.95	N loss in treatment system (% reduction)	53%	N loss in disposal bed (% reduction)	20%
N Plant Uptake rate (kg/ha/year)	200				
Phosphorus in effluent (Ip) (kg/yr) *	7.20	P prod. per person per yr (kg/person/yr)	0.60	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

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

P uptake by plants (Hp) (kg/ha/yr)	10	N plant uptake (kg/yr)	15.65
P soil sorption (Ps) (kg/ha/m depth)	10000	N load exceedence	0.00
Water Table/ Bedrock Depth (m)	3.00	N load percolated (kg/yr)	3.30
Buffer to Water Table (Bwt) (m)	0.5	N released (perc+exceed.) (kg/yr)	3.30
Time for accumulation of P(years)	50	Enviro.N limit (kg/yr)	3.30
Final area (m^2)	**783**	Nitrogen area (m^2)	783
Phosphorus area (m^2)	141	Hydraulic area (m2)	543
Water balance area (m^2)	783		
Specific Crop Coeff.(grass=1.00)	1.00		
% Effective Rainfall	65%		
Percolation (mm/d)	4		

Nitrogen Report
Total N-load 18.95kg/yr

STEP 10

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)

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)

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 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
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/m^2)	1.76				
Exceedence (L)	0.00000				

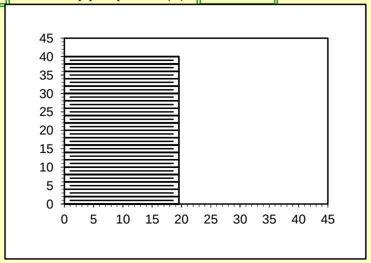
Trench under root zone <-

Land Application Type
STEP 13
SSI
ETA

STEP 14
Calculate (or Cntl- q)

STEP 15
2.00

20



APPENDIX 6 Land Application Area Modelling – 2.5 ha Minimum Lot Size

SEE FOLLOWING PAGES

Byron OSMS Design Model *Version:* 250000 - LIGHT CLAY.xlsm ***Period of Rainfall & Evaporation Record: 01/07/1980 - 30/06/2001***

Set Defaults

STEP 1 — bedrooms / persons

STEP 2

# bedrooms (Grp 1)	4	
# bedrooms (Grp 2)	4	
Total Daily Flow (L/day) *	1380	Daily Effluent Flow per person (L/day) 115
TN production per year (kg/year)	50.40	N prod. per capita (kg/person/yr) 4.20
TN reduced by all N loss (kg/year) *	18.95	N loss in treatment system (% reduction) 53%
N Plant Uptake rate (kg/ha/year)	200	
Phosphorus in effluent (Ip) (kg/yr) *	7.20	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)	10000	
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)	**448**	
Phosphorus area (m^2)	**141**	
Water balance area (m^2)	448	
Specific Crop Coeff.(grass=1.00)	1.00	
% Effective Rainfall	65%	
Percolation (mm/d)	5	

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

STEP 4 — Block size (m2): 250000; 20

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

Nitrogen Report

P uptake by plants (Hp) (kg/ha/yr)	10	N plant uptake (kg/yr)	8.95
P soil sorption (Ps) (kg/ha/m depth)	10000	N load exceedence	0.00
Water Table/ Bedrock Depth (m)	3.00	N load percolated (kg/yr)	10.00
Buffer to Water Table (Bwt) (m)	0.5	N released (perc+exceed.) (kg/yr)	10.00
Time for accumulation of P(years)	50	Enviro.N limit (kg/yr)	10.00
		Nitrogen area (m^2)	448
		Hydraulic area (m2)	402
		Total ETA trench area	433.12
		ETA trench length (m)	18.05
		number of SSI laterals	12
		beds total plus separating spaces	X,Y dimensions = 16.6m x 24.0m

Total N-load 18.95kg/yr

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) 27.2

BOD target of 20mg/L is Current Outlet BOD conc. = 20 mg/L

STEP 10

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)

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 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
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/m^2)	3.08				
Exceedence (L)	0.00000				

Trench under root zone <-

STEP 13 — Land Application Type: SSI; ETA

Lateral seepage width (m)

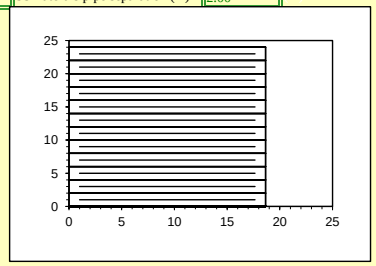
STEP 14 — Calculate (or Cntl- q)

ETA trench separation

STEP 15 — 2.00

ETA bed separation 1.40

12



Byron OSMS Design Model *Version:* 250000 - MEDIUM CLAY.xlsm

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

Set Defaults

STEP 1: bedrooms / persons

STEP 2: **# bedrooms (Grp 1)** 4 | **# bedrooms (Grp 2)** 4

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

STEP 4: **Block size (m2)** 250000 | 20

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 (all checked) — **Wastewater stream**

Total Daily Flow (L/day) *	1380	Daily Effluent Flow per person (L/day)	115	% black to tot WW in a full system	32%
TN production per year (kg/year)	50.40	N prod. per capita (kg/person/yr)	4.20	% black to tot WW in a full system: TN	70%
TN reduced by all N loss (kg/year) *	18.95	N loss in treatment system (% reduction)	53%	N loss in disposal bed (% reduction)	20%
N Plant Uptake rate (kg/ha/year)	200				
Phosphorus in effluent (Ip) (kg/yr) *	7.20	P prod. per person per yr (kg/person/yr)	0.60	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

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

Nitrogen Report

P uptake by plants (Hp) (kg/ha/yr)	10	N plant uptake (kg/yr)	9.68
P soil sorption (Ps) (kg/ha/m depth)	10000	N load exceedence	0.00
Water Table/ Bedrock Depth (m) (STEP 10)	3.00	N load percolated (kg/yr)	9.27
Buffer to Water Table (Bwt) (m)	0.5	N released (perc+exceed.) (kg/yr)	9.27
Time for accumulation of P(years)	50	Enviro.N limit (kg/yr)	10.00
Final area (m^2)	**484**	Nitrogen area (m^2)	448
Phosphorus area (m^2)	141	Hydraulic area (m2)	484
Water balance area (m^2)	484		
Specific Crop Coeff.(grass=1.00)	1.00		
% Effective Rainfall	65%		
Percolation (mm/d)	4		

Total N-load 18.95kg/yr

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)

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)

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 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
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/m^2)	2.85				
Exceedence (L)	0.00000				

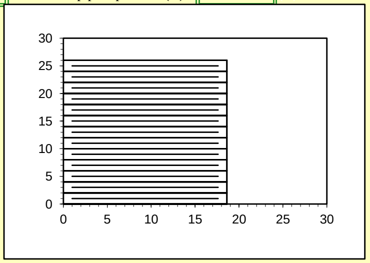
Trench under root zone <-

STEP 13: **Land Application Type**
- SSI
- ETA

STEP 14: Calculate (or Cntl- q)

STEP 15: 2.00

13



Byron OSMS Design Model *Version:* 4000 - MEDIUM CLAY.xlsm

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

Set Defaults

STEP 1: bedrooms / persons

STEP 2

# bedrooms (Grp 1)	4
# bedrooms (Grp 2)	4

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

STEP 4

Block size (m2)	250000
Buffer	20

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: **Wastewater stream**

Grp1	Grp 2
☑ Toilet	☑ Toilet
☑ Bathroom	☑ Bathroom
☑ Laundry	☑ Laundry
☑ Kitchen	☑ Kitchen

Total Daily Flow (L/day) *	1380	Daily Effluent Flow per person (L/day)	115	% black to tot WW in a full system	32%
TN production per year (kg/year)	50.40	N prod. per capita (kg/person/yr)	4.20	% black to tot WW in a full system: TN	70%
TN reduced by all N loss (kg/year) *	18.95	N loss in treatment system (% reduction)	53%	N loss in disposal bed (% reduction)	20%
N Plant Uptake rate (kg/ha/year)	200				
Phosphorus in effluent (Ip) (kg/yr) *	7.20	P prod. per person per yr (kg/person/yr)	0.60	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

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

		Nitrogen Report		
P uptake by plants (Hp) (kg/ha/yr)	10	N plant uptake (kg/yr)	10.86	Total N-load 18.95kg/yr
P soil sorption (Ps) (kg/ha/m depth)	10000	N load exceedence	0.00	
Water Table/ Bedrock Depth (m) (STEP 10)	3.00	N load percolated (kg/yr)	8.09	
Buffer to Water Table (Bwt) (m)	0.5	N released (perc+exceed.) (kg/yr)	8.09	
Time for accumulation of P(years)	50	**Enviro.N limit (kg/yr)**	10.00	
Final area (m^2)	**543**	Nitrogen area (m^2)	448	
Phosphorus area (m^2)	141	Hydraulic area (m2)	543	
Water balance area (m^2)	543			
☑ Specific Crop Coeff.(grass=1.00)	1.00			
% Effective Rainfall	65%			
Percolation (mm/d)	4			

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)

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)

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

STEP 13: **Land Application Type**

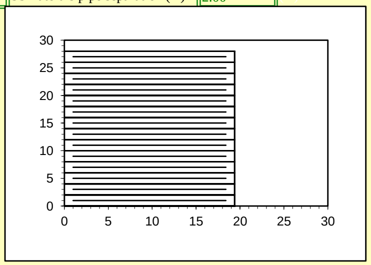
- SSI
- ETA

STEP 14: Calculate (or Cntl- q)

STEP 15: 2.00

Minimum effluent application (mm/day/m^2)	2.54
Exceedence (L)	0.00522

14



APPENDIX 7 Soil Profile Investigation – HMC Test Pits

	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 Chemistry	**BH1C**	**BH2B**	**BH3A**	**BH4B**	**BH5C**	**BH6A**
Sample Depth	(600-1000mm)	(500-1000mm)	(0-250mm)	(100-700mm)	(400-1000mm)	(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)	0.4	2.5	1.5	2.4	1.0	3.0
Effective Cation Exchange Capacity (ECEC) cmol+/kg	17.5	1.1	4.4	1.3	9.3	2.4
See Appendix 8 for laboratory certificates						

SEE FOLLOWING PAGES

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 (MUNSELL)	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 – 30th 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 – 30th 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 8 Laboratory Results – Effluent Disposal Analyses

SEE FOLLOWING PAGES

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) [12]	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+/k	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 µS/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.

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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 applie (=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 applie (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**

Checked:.....

APPENDIX 9 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.