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Land Capability Services

Site & Soil Assessment
for
On-site Effluent Disposal

Proposed Lot 18 DP754900
309 Isabel Drive
Murrumbateman NSW 2582

Amended March 2024

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CONTENTS

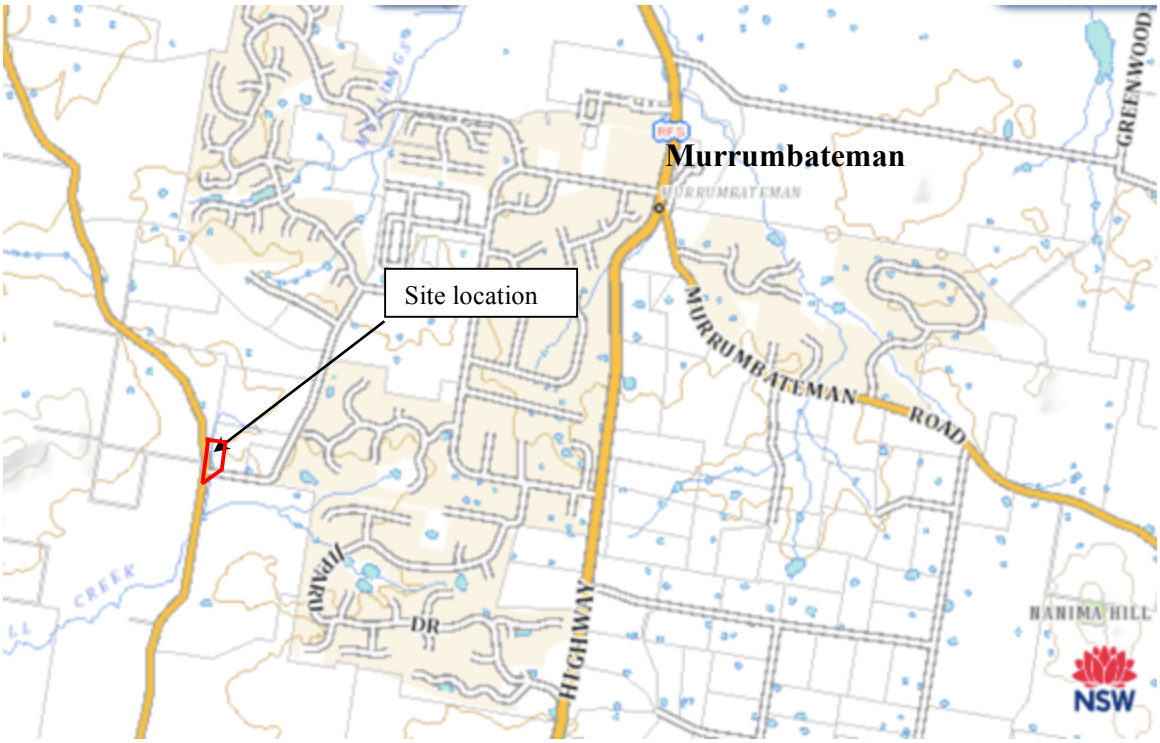
INTRODUCTION

Scope

This report provides site and soil assessment for on-site effluent disposal at the applicant's proposed four-bedroom dwelling and shed office. An Aerated Wastewater Treatment System (AWTS) is proposed.

An AWTS coupled with surface or subsurface irrigation provides a suitable form of effluent treatment for the site and soil characteristics of the land in question.

The management recommendations include the size and location of the proposed irrigation area.



References

AS/NZS 1547:2012 *On-site domestic wastewater management*

On-site sewerage management for single households (Anon, 1998)

Hird, C. (1991) *Soil Landscapes of the Goulburn 1:250 000 Sheet*

Septic tank & collection well accreditation guideline (NSW Health 2001)

SITE CHARACTERISTICS

The terrain of the site comprises a gently inclined lower slope of 3-4 degrees overlying Quaternary residual deposits. The slope across the proposed irrigation area has a linear divergent configuration ensuring that runoff does not concentrate within the site. The soil at the site is an imperfectly drained Chromosol within the Binalong soil landscape. It comprises loam then light clay loam topsoil horizons to 15cm and 30cm respectively, overlying light clay then medium clay subsoil horizons to 60cm and 100cm+ respectively.

SITE EVALUATOR

Company	Land Capability Services
Name	Richard Miller
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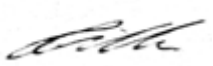
email:	rgmiller@me.com
Date of assessment	Amended March 25, 2024
Signature of evaluator	

SITE INFORMATION

Address	Proposed Lot 18 DP754900, 309 Isabel Drive, Murrumbateman, NSW 2582
Council area	Yass Valley
Owner/developer	Greenwood
Area:	8.8 ha
Site plan attached	Yes
Photograph attached	Yes
Intended water supply	Rainwater
Expected wastewater quantity (litres/day)	815 (4 bedroom dwelling, potentially housing 5 occupants generating design flows of 120L/person/day = 600 litres/day Shed office up to 5 staff generating design flows of 43L/person/day = 215 litres/day)
Local experience	Aerated wastewater treatment systems provide adequate treatment of effluent on appropriate soils.

SITE ASSESSMENT

Climate	Warm to hot summers with a high evaporative deficit. Cool to cold winters with a small evaporative deficit

Where appropriate:	
Rainfall water balance calculated	Yes
Land application area calculated	Yes
Wet weather storage area calculation attached	NA
Flood potential:	
Land application area above 1 in 20 year flood level	Yes
Land application area above 1 in 100 year flood level	Yes
Electrical components above 1 in 100 year flood level	Yes

Exposure	Well exposed with minimal shade
Slope	Linear divergent
Landform	Lower slope
Run-on	Slight in divergent landscape
Seepage	None
Erosion Potential	Slight with adequate vegetation
Site Drainage	Imperfectly drained
Fill	None in application area
Groundwater:	
Horizontal distance to groundwater well used for domestic water supply	>250m
Groundwater vulnerability map referred to	Yass LEP 2013 Sheet CL2_005
Vulnerability rating	Not within vulnerability area
Bores in the area and their purpose	Stock & domestic
Buffer distance from wastewater management system to:	
Perennial watercourses	NA
Dams	>40m
Drainage lines	>40m
Boundary of property	>3m
Driveway	>6m
Swimming pools	>6m
Dwelling	>15m
Is there sufficient land area for:	
Application system (including buffer distances)	Yes
Reserve application system (including buffer distances)	Yes
Surface rocks	None

SOIL ASSESSMENT

Depth to bedrock or hardpan	>100cm
Depth to soil water table	>100cm
Hydraulic loading rate	
Soil structure	Moderately structured topsoil Moderately structured subsoil
Soil texture	Loam to clay loam topsoil Light clay to medium clay subsoil
Permeability category	(3) 1.5-3.0m/day in topsoil (5) 0.06-0.12m/day in subsoil
Hydraulic loading recommended for irrigation system	1.8mm/day irrigation
Coarse Fragments	5% to 10mm in topsoil 10% to 10mm in B_1 subsoil
Bulk Density	Estimate 1.5 in topsoil Estimate 1.3 in subsoil
Ph (1:5 Water)	Topsoil 5.6 Subsoil 6.3
Electrical conductivity (dS/m)	Topsoil .04 Subsoil .02
Geology & soil landscape survey	
Presence of discontinuities	None
Presence of fractured rock	None
Soil landscape reference	Binalong
Dispersiveness	None in topsoil EAT 8 None in subsoil EAT 5(2)

SYSTEM SELECTION

Consideration of connection to a centralised sewerage system

Nearest feasible connection point	>5km
Potential for future connection to centralised sewerage	None
Potential for future connection to reticulated water	None

Type of land application system best suited to site:

Surface or shallow subsurface irrigation

Reason Medium clay subsoil unsuited to subsoil dispersal of effluent

Type of treatment system best suited to site and application system:

Aerated wastewater treatment system

Reason Superior standard of treatment for site and soil conditions.

GENERAL COMMENTS

Are there any specific environmental constraints?

None provided 40m setback to low lying wet area is observed.

Are there any specific health constraints? None

MANAGEMENT PRESCRIPTIONS

Aerated wastewater treatment systems treat effluent to an improved, or secondary standard, reducing any impact on groundwater and making available water for landscaping and other purposes. The following prescriptions are site specific and must be strictly adhered to, in order to maximise water and nutrient uptake, and thus minimise runoff and seepage.

The AWTS must be accredited by NSW Health.

An irrigation area of 450 m^2 should be determined within the area shown as suitable in Figure 1.

The irrigation area should be sown to improved perennial pastures, which once established, should be regularly mown to improve rates of nitrogen uptake.

The treated effluent may be applied by surface irrigation. Surface sprays must be of the large droplet type that do not produce aerosols and are to be regularly rotated throughout the effluent application area to evenly spread hydraulic and nutrient loads.

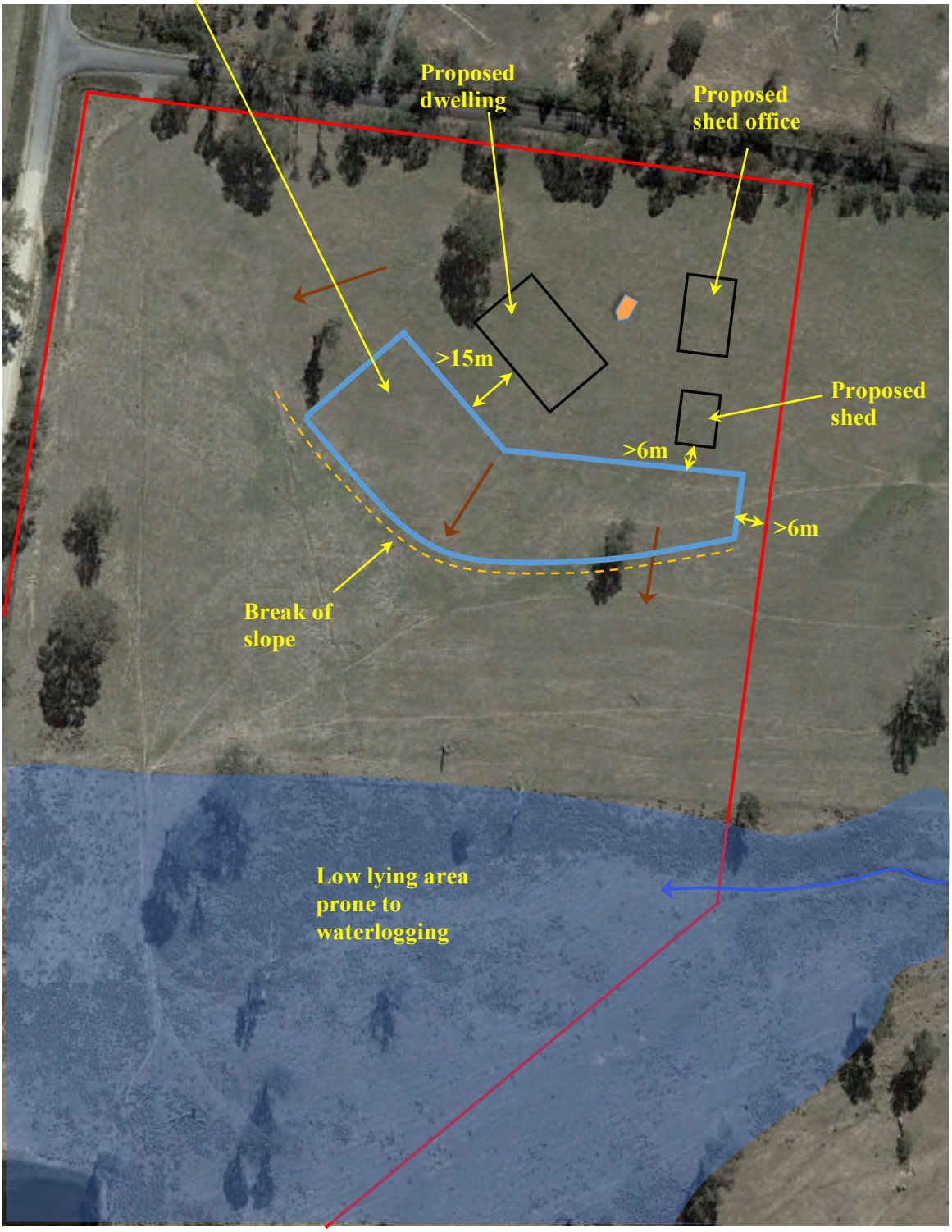
The treated effluent may also be applied by sub-surface irrigation.
Auto flush return to the tank should be installed to ensure flocculants in the lines are recycled back to the tank. Pressure compensating dripper heads to be used. Vacuum breakers or air release valves to be installed at highest point in irrigation field, to prevent migration of soil into irrigation lines. Irrigation laterals to be installed on the contour at 100mm depth and at nominal 1000mm spacing. A single disc filter of nominal 100mm diameter (85mm internal) to be installed upstream of irrigation system. Filter to be cleaned at quarterly service intervals.

The distribution line from the AWTS to the effluent irrigation area must be buried at least 300mm underground or 450mm where vehicles pass over.

The irrigation area must not be disturbed by any building activity such as stockpiles of excavated material or vehicle traffic.

Detergents should be selected for low levels of phosphorus and sodium.
(See appendix 3)

Fig 1. Area suitable for effluent application



WATER BALANCE

A water balance model is helpful in assessing the sensitivity of the design to various input and output characteristics.

Irrigation area sizing using Nominated Area Water Balance for Zero Storage

Site Address:	**309 Isabel Drive, Murrumbateman**			
Date:		**Assessor:**		

INPUT DATA

Design Wastewater Flow	Q	815	L/day	Based on maximum potential occupancy and derived from Table 4 in the EPA Code of Practice (2013)
Design Irrigation Rate	DIR	3.5	mm/day	Based on soil texture class/permeability and derived from Table 9 in the EPA Code of Practice (2013)
Nominated Land Application Area	L	450	m^2	[1]
Crop Factor	C	0.6-0.8	unitless	Estimates evapotranspiration as a fraction of pan evaporation; varies with season and crop type[2]
Rainfall Runoff Factor	RF	1.0	unitless	Proportion of rainfall that remains onsite and infiltrates, allowing for any runoff
Mean Monthly Rainfall Data	Yass(Linton Hostel) (070014)			BoM Station and number
Mean Monthly Pan Evaporation Data	Canberra Airport (070091)			BoM Station and number

Parameter	Symbol	Formula	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Days in month	D		days	31	28	31	30	31	30	31	31	30	31	30	31	365
Rainfall	R		mm/month	50.3	45.5	46.7	49	49.9	57.9	59.6	59.3	56.8	64.5	56.6	55.8	651.9
Evaporation	E		mm/month	260.4	207.2	176.7	111	68.2	48	52.7	80.6	114	161.2	198	248	1726
Crop Factor	C		unitless	0.8	0.8	0.7	0.7	0.6	0.6	0.6	0.6	0.7	0.8	0.8	0.8	
OUTPUTS																
Evapotranspiration	ET	ExC	mm/month	208.32	165.76	123.69	77.7	40.92	28.8	31.62	48.36	79.8	128.96	158.4	198.4	1290.73
Percolation	B	DIRxD	mm/month	108.5	98	108.5	105.0	108.5	105.0	108.5	108.5	105.0	108.5	105.0	108.5	1277.5
Outputs		ET+B	mm/month	316.8	263.76	232.2	182.7	149.4	133.8	140.1	156.9	184.8	237.5	263.4	306.9	2568.2
INPUTS																
Retained Rainfall	RR	RxRF	mm/month	50.3	45.5	46.7	49	49.9	57.9	59.6	59.3	56.8	64.5	56.6	55.8	651.9
Applied Effluent	W	(QxD)/L	mm/month	56.1	50.7	56.1	54.3	56.1	54.3	56.1	56.1	54.3	56.1	54.3	56.1	661.1
Inputs		RR+W	mm/month	106.4	96.2	102.8	103.3	106.0	112.2	115.7	115.4	111.1	120.6	110.9	111.9	1313.0
STORAGE CALCULATION																
Storage remaining from previous month			mm/month	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Storage for the month	S	(RR+W)-(ET+B)	mm/month	-210.4	-167.5	-129.3	-79.4	-43.4	-21.6	-24.4	-41.4	-73.7	-116.8	-152.5	-195.0	
Cumulative Storage	M		mm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Maximum Storage for Nominated Area	N		mm	0												
	V	NxL	L	0												
LAND AREA REQUIRED FOR ZERO STORAGE			m^2	94.7968877	104.5542014	136.2068	182.8721	253.8686	322.1344	313.773	258.9688	191.0156	146.0742	118.2302	100.6173	

MINIMUM AREA REQUIRED FOR ZERO STORAGE: 323.0 m^2

Based on a potential quantity of 815 litres/day of wastewater, spread across 450 m^2 of irrigation area, the effluent application rate of 1.8mm/day results in a moisture deficit in all months of the year. Importantly, the deficit is theoretical and it should be noted that saturation is possible at any time following periods of extended wet weather.

The application rate of 1.8mm/day is comparatively conservative, against the rate of 4mm/day for a loam topsoil determined from table M1 from AS1547:2012.

NUTRIENT BALANCE

The nutrient balance examines the discharge of nitrogen and phosphorus against the capacity of plants and soil to assimilate those nutrients. Excess nutrients may eventually impact upon watercourses via surface run-off or groundwater.

Nitrogen Balance

Site Address:	**309 Isabel Drive, Murrumbateman**							
SUMMARY - LAND APPLICATION AREA REQUIRED BASED NITROGEN BALANCE							**396.6333**	m^2
INPUT DATA[1]								
Wastewater Loading			**Nutrient Crop Uptake**					
Hydraulic Load	815	L/day	Crop N Uptake	180	kg/ha/yr	which equals	49.3150685	$mg/m^2/day$
Effluent N Concentration	30	mg/L						
% N Lost to Soil Processes (Geary & Gardner 1996)	0.2	Decimal						
Total N Loss to Soil	4890	mg/day						
Remaining N Load after soil loss	19560	mg/day						
NITROGEN BALANCE BASED ON ANNUAL CROP UPTAKE RATES								
Minimum Area required with zero buffer			**Determination of Buffer Zone Size for a Nominated Land Application Area (LAA)**					
Nitrogen	396.6333	m^2	Nominated LAA Size	450	m^2			
			Predicted N Export from LAA	-0.9606	kg/year			
			Minimum Buffer Required for excess nutrient	0	m^2			

815 litres/day wastewater quantity at 30mg/l total N concentration
= 8.9 kg Nitrogen discharged per year, applied over an irrigation area of 450 m^2 = 198 kg/ha/yr.

A mix of existing native and improved grasses should provide a rate of nitrogen uptake of around 180kg/ha/yr at this location.
Total nitrogen loss to soil processes should account for 40kg/ha/yr.
Therefore the discharge of nitrogen should be balanced by plant uptake and soil processes.

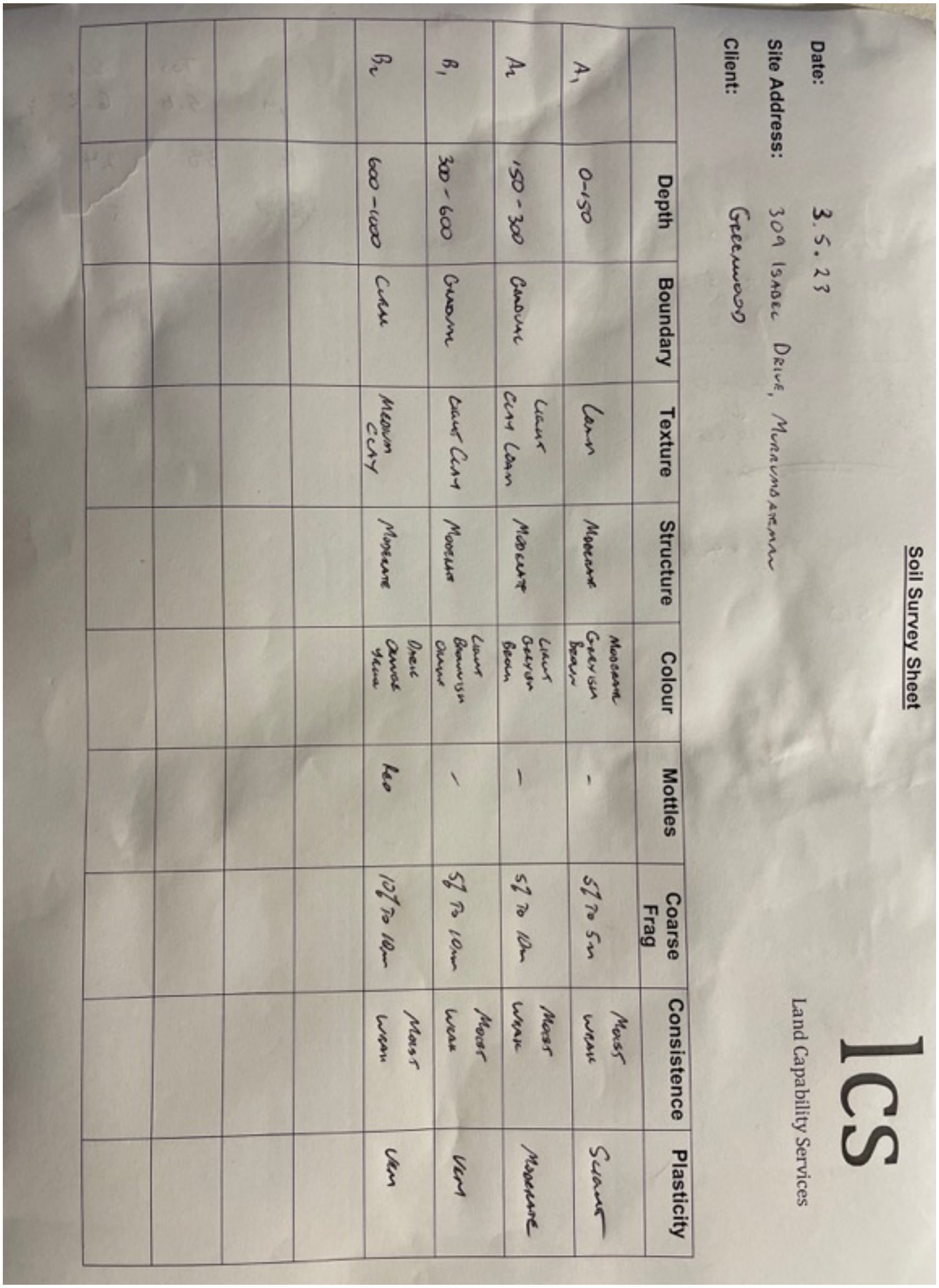
Phosphorus Loading

815 litres/day wastewater quantity at 10 mg/l of P
= 3kg P discharged per year, applied over an irrigation area of 450m^2
= 67kg/ha/yr.
Native & improved grasses should provide a rate of P uptake of around 20kg/ha/yr.
Balance of 47kg/ha/yr. applied to P sorption capacity of soil;
P sorption capacity of in-situ soil 5510kg/ha. [1]

Lifetime of irrigation area 117 years in terms of P sorption capacity.

[1] SCA "*Design and Installation of On-site Wastewater Systems",* P. Sorption Uptake Values (Typical)

APPENDIX 1: SOIL SURVEY SHEET



Soil Survey Sheet

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Land Capability Services

Date: 3.5.23

Site Address: 309 Isabel Drive, Murrumbateman

Client: Greenwood

	Depth	Boundary	Texture	Structure	Colour	Mottles	Coarse Frag	Consistence	Plasticity
A_1	0-150		Loam	Moderate	Moderate Greyish Brown	-	5% to 5mm	Moist Weak	Slight
A_2	150 - 300	Gradual	Light Clay Loam	Moderate	Light Greyish Brown	—	5% to 10mm	Moist Weak	Moderate
B_1	300 - 600	Gradual	Light Clay	Moderate	Light Brownish Orange	/	5% to 10mm	Moist Weak	Very
B_2	600 -1000	Clear	Medium Clay	Moderate	Dark Orange Yellow	Red	10% to 10mm	Moist Weak	Very

APPENDIX 2: NSW HEALTH ACCREDITED AWTS

AWTS Model	Company/Agent	Contact
Ultra Clear, ST8, ST10	Capital Waterworks	02 6258 1378
Taylex ABS 1500	Clearwater Sewage	0419 229 313
Fuji Clean CE1200, CRX1500,	Septics Filters & Pumps	0429 481 106
ECO PRO	The Tank People	02 6254 6949
Alpha Treat DP10	Alpha Treat Pty Ltd	0409 042 689
BioSeptic Performa, S-TEN NR	Bio-Septic Pty Ltd	1300 658 111
Aqua Advanced	Septics Filters & Pumps	0429 481 106
Garden Master Elite Advanced	Garden Master	02 4932 1011
Ozzi Kleen RP10	Suncoast Waste Water	1800 450 767
Super-Treat SE 10, SB 10	Super-Treat Systems	02 4422 3861
Taylex Poly ABS, ABS, DMS	Clearwater Sewage	0419 229 313
Turbojet Single Advanced	Icon-Septech	1300 557 143
Alpha Treat DP10	EcoWater Qld Pty Ltd	07 3205 3666
Earthsafe SS10	Earthsafe Australia Pty Ltd	1800 043 635
UBI Aqua	Global Tanks	07 4697 7099
Kingspan BioFicient	Kingspan Water & Energy	1300 736 562
Rivatec RWT10	Rivatec Environmental	1300 327 847

Appendix 3: Important Reading

Phone Office/Lab (02) 6775 1157
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Website: http://www.lanfaxlabs.com.au
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Soil Scientists and Environmental Engineers

Lanfax Laboratories

Performance certified by Aust. Soil & Plant Analysis Council

LAUNDRY PRODUCTS RESEARCH

Laundry products were purchased by ***Lanfax Labs*** from supermarkets in Armidale, NSW and a number of boutique products were provided by manufacturers. A total of 41 liquids and 54 powders were tested by mixing each product at the manufacturer's recommended dose for either front loading or top loading automatic washing machines. The dose was calculated at the full cycle load, that is 75 L for front loaders and 150 L for top loaders. The full cycle accounts for the water used in the wash, spin, rinse, deep rinse and spin rinse cycle. The quantities of 75 L for front loaders and 150 L for top loaders were taken from averaged rates for those machines (Patterson, 2004).

Each sample was mixed with cold (20°C) deionised water (to replicate good quality rainwater). Where town water supplies are used, the values reported for sodium concentrations may increase because of sodium in the reticulated water – that will vary from location to location, usually higher in inland than coastal towns. Each sample was shaken for 30 minutes to replicate the washing action.

The concentrations of sodium and phosphorus (and other elements) were measured on the samples using Inductively Coupled Plasma (ICP) technology in accordance with current Good Laboratory Practices at ***Lanfax Labs***.

Only sodium (g/wash) and phosphorus (mg/L) are reported in the graphs presented here.

Additional information on this unique research may be obtained at: **www.lanfaxlabs.com.au/laundry.htm**

Other papers on laundry detergents can be found at: www.lanfaxlabs.com.au/publications.html

HOW TO READ THE GRAPHS

Each product is represented by two bars: the top bar (if present) shows the phosphorus concentration (mg/L); while the lower bar shows the sodium load (g/wash). The graph is arranged in ranked order of sodium load. Figure F1 is for 54 detergents at the front loader rate, Figure T1 is for 89 detergents at the top loader rate.

Sodium Load

For all on-site systems that apply the effluent by surface or subsurface application, the levels of sodium in the discharge are critical to long term absorption. Choose the product with the lowest sodium load (g/wash). Levels above 20 g/wash are likely to be detrimental to plants and the soil although plant tolerance and soil types will vary. The shorter the bar, the lower the load. When in doubt, choose the lower sodium load.

The detergents with long sodium bars (greater than 20 g/wash) should not be thrown onto your favourite garden as the sodium may be detrimental to the plants. High pH (see the website for pH data) is also detrimental to plants and soil. The pH of liquids (average pH 8) is generally lower than pH of powder detergents (average pH 10.5).

Phosphorus Concentration

The choice of a suitable level of phosphorus in the greywater (laundry water discharge) will depend upon the soil type and the use of the effluent. In some soils, phosphorus is not a real concern because of the natural ability of the soil to immobilize the phosphorus and limit its leaching from the disposal site. In other soils, phosphorus is likely to build up to high levels and leach from the soil. It is preferable to choose the lower phosphorus values as well as the low sodium values. The load of phosphorus for each product is available in the website data.

This research was funded by Lanfax Labs and was independent of any manufacturer or other organisation.

Caution: Formulations may have changes since these products were purchased in 2005.

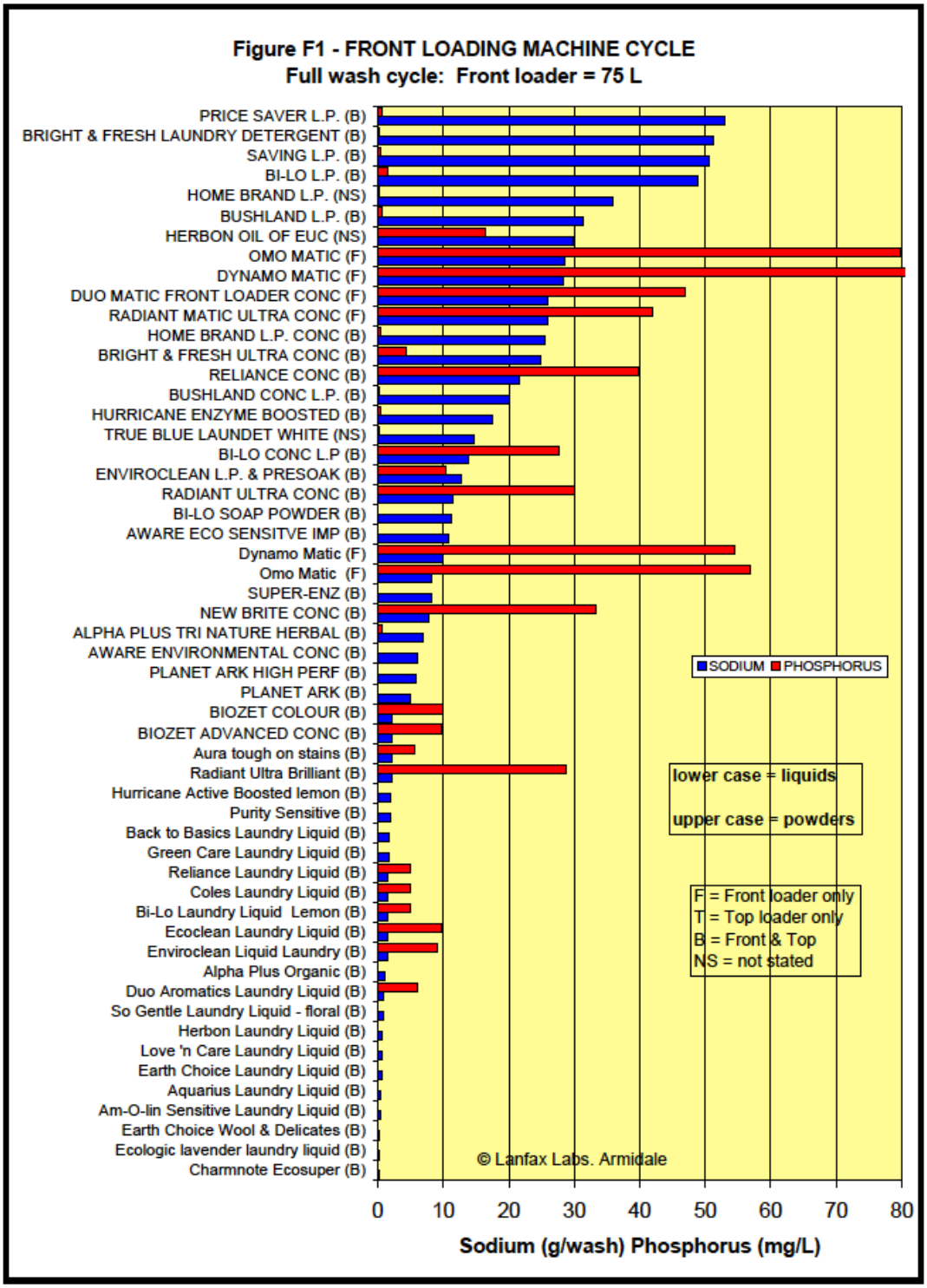
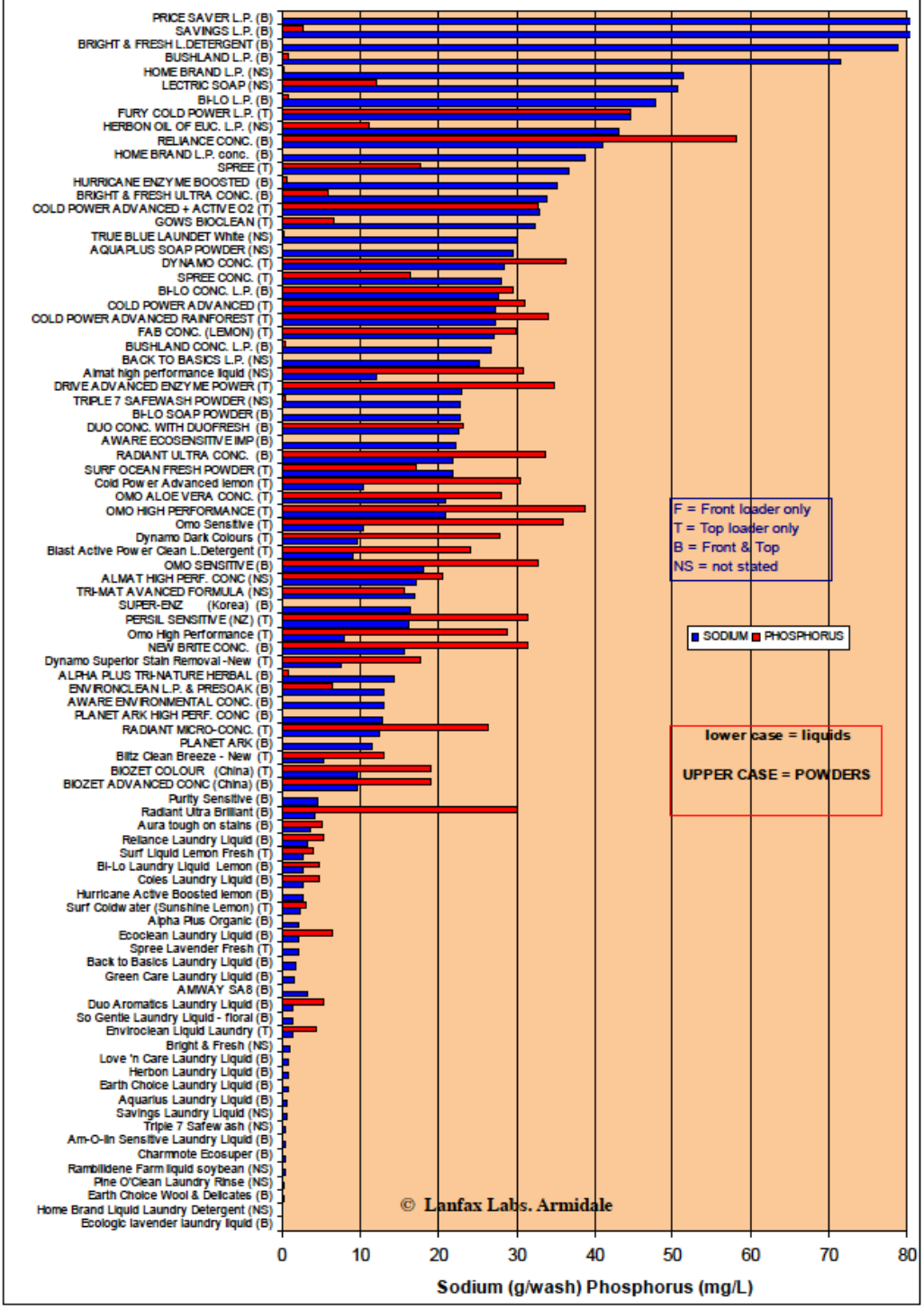


Figure T1 - TOP LOADING MACHINE CYCLE
Full wash cycle: Top loader = 150 L



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