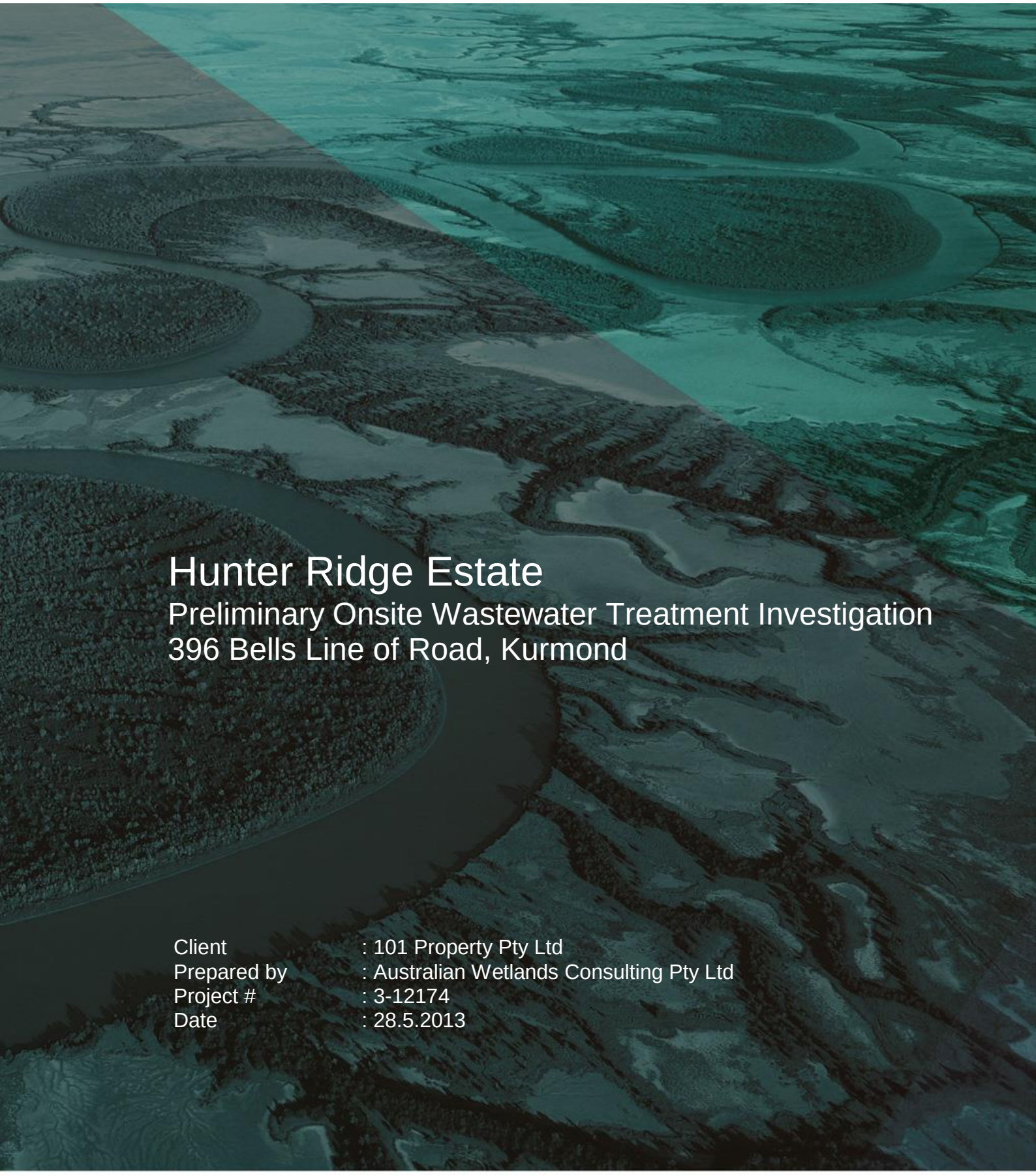

Hunter Ridge Estate

Preliminary Onsite Wastewater Treatment Investigation
396 Bells Line of Road, Kurmond

Client	: 101 Property Pty Ltd
Prepared by	: Australian Wetlands Consulting Pty Ltd
Project #	: 3-12174
Date	: 28.5.2013

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Project control

Project name: Hunter Ridge Estate Wastewater Treatment Investigation
396 Bells Line of Road, Kurmond

Job number: 3-12174
Client: 101 Group
Contact: Rob Montgomery

Prepared by: Australian Wetlands Consulting Pty Ltd

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Date:	Revision:	Prepared by:	Reviewed by:	Distributed to:
5.06.2013	A	R. Berry	DM	101

Table of Contents

Introduction

The purpose of this investigation is to develop, with a high degree of confidence, an understanding of the site and its constraints to ascertain requirements for the sustainable on-site treatment and disposal of residential wastewater generated within the proposed Hunter Ridge Estate. Extensive investigations were undertaken regarding the best options for waste management onsite. In consultation with Hawkesbury Council (Onsite Wastewater approvals officer D. West, 4.6.13) it was established that 40m offsets from the water courses onsite would be appropriate.

The property is located at 396 Bells Line of Road, Kurmond. The proposal comprises 27 residential lots with an average lot size of 4000m2. House types are assumed to be typically 4-5 bedroom homes with 1.5 people per room or six people per house.

ASNZS 1547:2012 On-site domestic wastewater management and Sydney Catchment Authorities Design and Installation of On-Site Wastewater Systems 2012 , the 'Silver Book' have been adopted as the guiding documents and standard for sampling procedures and analysis.

Climate – BOM data obtained for Richmond RAAF base.

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years	
Temperature															
Mean maximum temperature (°C)	30.0	29.1	26.8	23.9	20.6	17.9	17.4	19.7	22.7	25.0	26.7	28.5	24.0	19	1993 2013
Mean minimum temperature (°C)	17.6	17.7	15.6	11.4	7.6	4.9	3.6	4.4	8.0	11.0	14.1	16.0	11.0	18	1993 2013
Rainfall															
Mean rainfall (mm)	78.5	125.8	74.2	48.9	52.4	48.0	31.2	30.7	49.7	52.8	83.5	61.6	737.8	19	1994 2013
Decile 5 (median) rainfall (mm)	67.4	141.2	70.2	40.0	37.1	35.2	24.6	16.4	33.2	32.8	82.2	55.4	721.4	19	1994 2013
Mean number of days of rain ≥ 1 mm	7.6	8.5	7.6	5.8	5.7	5.4	4.2	3.4	4.7	5.9	8.1	6.5	73.4	19	1994 2013
Mean 9am temperature (°C)	22.1	21.3	19.1	17.0	13.1	10.0	8.9	11.4	15.4	18.3	19.2	20.9	16.4	17	1993 2010
Mean 9am relative humidity (%)	72	78	80	76	82	83	80	69	63	58	68	68	73	16	1993 2010
Mean 9am wind speed (km/h)	9.1	8.1	6.6	6.9	5.7	6.3	5.9	8.1	9.9	10.3	9.9	8.9	8.0	16	1993 2010
3 pm conditions															
Mean 3pm temperature (°C)	28.5	27.4	25.8	23.0	19.7	17.0	16.5	18.7	21.5	23.5	25.2	27.5	22.9	17	1993 2010
Mean 3pm relative humidity (%)	47	52	52	49	53	53	48	39	39	40	46	44	47	16	1993 2010
Mean 3pm wind speed (km/h)	16.6	15.6	14.7	14.4	12.6	13.5	14.3	17.7	19.4	19.1	19.0	17.7	16.2	16	1993 2010

Site character

The site is orientated North/ South ranging from flat to undulating grazing to relatively shallow gullies. Three unnamed, temporary water courses cross the site flowing West to East. Appendix A illustrates the watercourse lines and 40m offsets plus land areas steeper than 1V:6H.

Historically the site has been heavily modified through fire and tree felling for grazing land. The majority of land at the site comprises scattered trees (predominantly black wattle and woody weed species) cleared grazing land, 4 dams, isolated patches of Eucalypt sp (various) and vegetated watercourse lines with mixed invasive ground and shrub layer and native tree species.

Soils

Soils samples at 3 sites were taken as a preliminary assessment of site soils to determine whether soils are suitable for on-site waste management. From the 3 sites, 4 soil samples (S1-S4) were taken at intercepted soil horizons to min 500mm depth.

- S1 and S2 were taken from sample site 1 (S 33.33.231, E 150,42.163, 80m). S1 is the top AH horizon and is deemed to be consistent over the site varying only in depth.
- S3 from sample site 2, (S33,33.233, E150,42.044, 73m),
- S4 from sample site 3, (S33,33.234, E150,42.12, 75m).

Soil samples were collected and sent to Environmental Analysis Laboratory for analysis and were tested for the following parameters:

- colour,
- texture,
- salinity and sodicity,
- instability,
- cation exchange capacity,
- mobility of nutrients,

Soil Characteristics

Soil results are provided in Appendix B. In summary site soils are:

- Generally light to medium clay
- Slight sodic in places
- Moderately acidic
- Slightly low Cation Exchange Capacity

Site and soil limitations to wastewater disposal

These limitations include:

- Hydrology
- Existing watercourse lines
- Slope/ gradient
- pH between 5.17-5.65

- Slightly low effective cation exchange capacity of 4.76-8.41, which may affect nutrient uptake of some plants.
- Overland flow of water from upslope land.

As per Table L1 of ASNZS 1547:2012 for category 5 and 6 soils light to medium clays, soil modification procedures may be required.

In order to ameliorate against these limitations for absorption by the soil, the follow actions are needed at a preliminary level. Soils can be improved with addition of lime and organic matter as per the following table. Alternative options and technologies will be explored in addition to absorption by the soil during design development.

	Sample 1 (S 33.33.231, E 150,42.163, 80m).	Sample 2 (S 33.33.231, E 150,42.163, 80m).	Sample 3 (S33,33.233, E150,42.044, 73m)	Sample 4 (S33,33.234, E150,42.12, 75m).
Lime mg/kg DW	1486	1865	2369	1997
Lime kg/m3 DW	2.4	3.0	3.8	3.2
Phosphorus kg/m3 DW	0.25	0.23	0.22	0.19
Gypsum kg/m3 DW	1.0	1.1	0.4	3.4

System setbacks and exclusion zones

As per published standards and guidelines the following setbacks are provided for system locations on site:

- 40m from dams or drainage lines
- 100m from named water courses
- 6m (up grade), 3m (down grade) of property boundaries
- 3m from paths, walkways, driveways,
- 15m from dwellings for surface irrigation,
- 6m to dwellings for sub-surface irrigation
- 6m to swimming pools

Existing vegetation

The preliminary Ecological survey for site flora and fauna was undertaken on the 20th of April at 396 Bells line of Road. A site assessment was completed by inspecting the site and mapping/describing vegetation communities present and identifying conservation values as per the *Threatened Species Conservation Act 1995* or the *Environment Protection Biodiversity Conservation Act 1999.* The Hawkesbury Council's biodiversity mapping identifies significant vegetation on the land in the form of SSTF. The ecological inspection confirmed that the most areas identified as significant vegetation comprises of scattered trees with cleared grazing pasture or invasive weed species. Accordingly, it is considered that the proposal and the establishment of exclusion zones for onsite wastewater treatment and disposal will have no significant impact on threatened species populations or ecological communities.

Figure 1 – Site showing shaded riparian zone surrounded by grazing land

Land application

A dedicated irrigation area is proposed for each lot based on the current lot layout. It has been assumed that a 1000m2 area be dedicated to the treatment system most suited to individual sites. Design analysis of individual sites at a later date will determine individual system requirements based on site character.

As per ASNZS 1547:2012 and at a preliminary level, the site lends itself to most technologies. Land application/ irrigation methods will be implemented dependent on detailed soil analysis, slope analysis, hydrology and available land. The results of soil analysis show the site has light to medium clays that are slightly acidic soil with a low cation exchange capacity (CEC) and so it is suggested that soils would improved through cultivation and addition of organic matter and gypsum regardless of slope. This being the case treatment systems characterised by slope will be employed as follows:

- Surface irrigation up to 10% slope
- Evaporation/ transpiration trenches/ beds up to 10% slope
- Mounds up to 15% slope
- Sub-surface irrigation up to 30% slope

Possible Cumulative Impact

On-site wastewater management involves the treatment and release of domestic wastewater into the environment. Inappropriate use or disposal can have an adverse impacts such as: contamination of ground and surface water, degradation of soil and vegetation, spread of disease and pathogens, decreased amenity caused by odour. To manage these and the long term impacts of on-site wastewater treatment, regulatory and legislative requirements, guidelines and current best practice, management, and monitoring will be adopted and determine design and operational procedures to limit any adverse impacts. On-site systems will be designed and managed under these principles. Individual systems will be designed in a holistic manner taking into consideration the water cycle, catchment management, sustainable development principles and public health to mitigate any adverse cumulative impact.

Conclusion

Preliminary investigations including soil analysis, flora and fauna investigations and constraints mapping indicate that the site exhibits suitable characteristics and available land, based on the preliminary lot layout for a variety of on-site wastewater treatment systems. Concern has been raised by the Council in respect of the potential cumulative impact of on-site disposal on individual future allotments. It is submitted that the characteristics of the land, combined with recommended soil improvement and systems as required, will ensure that the impacts will be managed within the site. Therefore, it is proposed that, pending detailed design there will be no cumulative impact imposed on the environment by on-site wastewater management.

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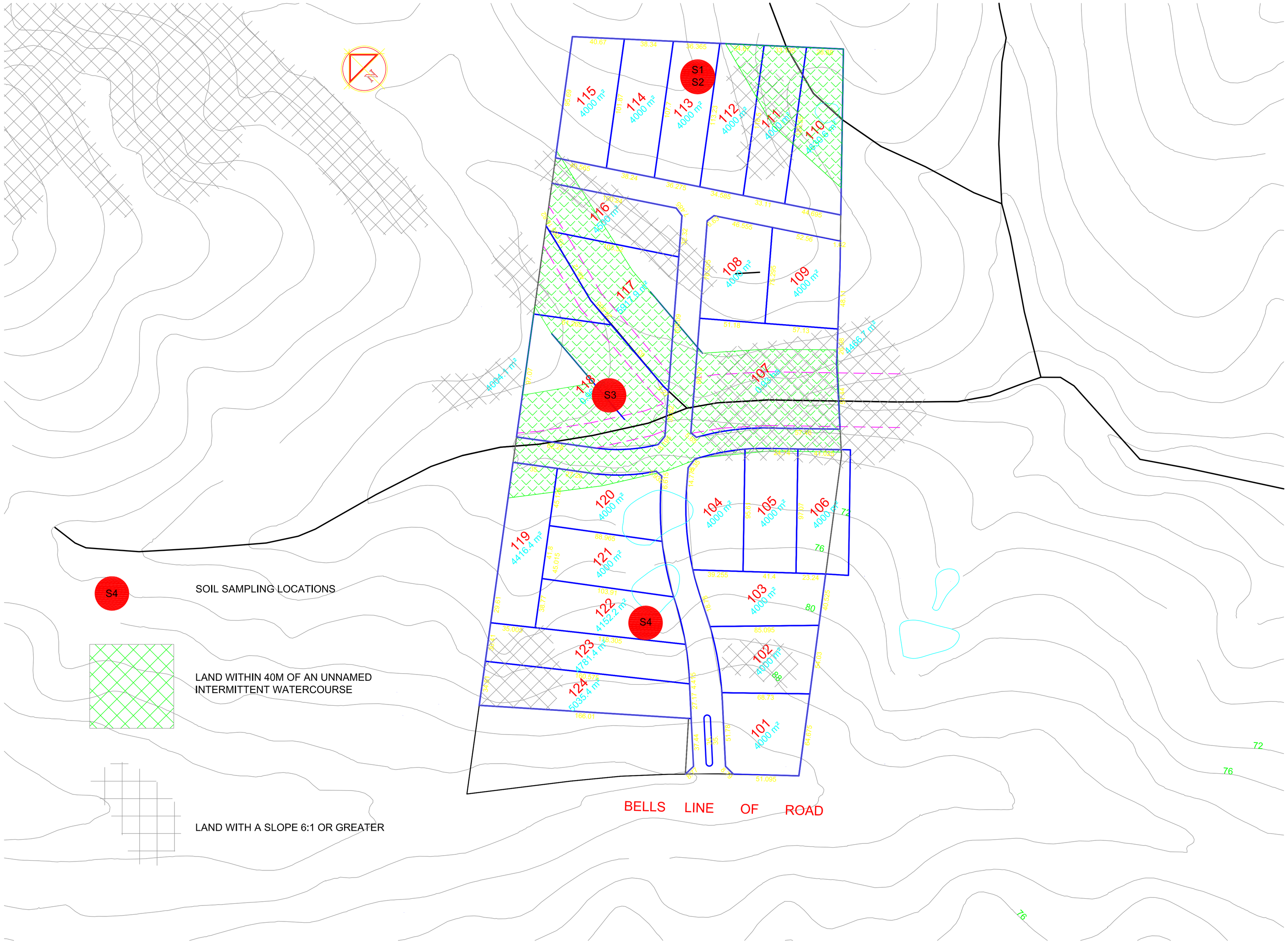
Appendix A – Site Plan and Constraints



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REV.	ISSUE / AMENDMENTS	DATE	DESIGNED	DRAWN	CHECKED

CLIENT: 101

PROJECT: Hunter Ridge Estate

DRAWING: Wastewater Constraints Mapping

DRAWING CREATED: 28.12.11

SCALE: NTS

AW JOB No.	CAD FILE No.	DWG No.	REV.

Appendix B - Soil Analysis

ROUTINE AGRICULTURAL SOIL ANALYSIS REPORT

Job No:	C2662
No of Samples:	4
Date Supplied:	15/10/2012
Supplied by:	Richard Berry

	Sample 1	Sample 2	Sample 3
Sample ID:	S1	S2	S3
Crop:	N/G	N/G	N/G
Client:	AWC	AWC	AWC

Method	*Nutrient*		*Units*	*C2662/1*	*C2662/2*	*C2662/3*
Morgan 1	Calcium	Ca	mg/kg	204	165	41
	Magnesium	Mg		102	144	40
	Potassium	K		115	68	44
	Phosphorus	P		0.8	0.5	0.3
Bray1	Phosphorus	P	mg/kg	4.1	5.6	6.0
Colwell				13	5.6	4.5
Bray2				12	4.0	2.4
KCl	Nitrate Nitrogen	N	mg/kg	2.4	0.4	0.7
	Ammonium Nitrogen			6.5	3.8	6.2
	Sulfur	S		13	7.1	8.8
1:5 Water	pH		units	5.52	5.49	5.17
	Conductivity		dS/m	0.049	0.027	0.017
Calculation	Organic Matter		% OM	5.8	4.7	3.0
Ammonium Acetate + Calculations	Calcium	Ca	$cmol^+/Kg$	2.02	1.27	0.26
			kg/ha	909	569	117
			mg/kg	406	254	52
	Magnesium	Mg	$cmol^+/Kg$	1.62	1.69	0.41
			kg/ha	442	460	111
			mg/kg	197	205	50
	Potassium	K	$cmol^+/Kg$	0.72	0.37	0.19
			kg/ha	630	327	168
			mg/kg	281	146	75
	Sodium	Na	$cmol^+/Kg$	0.16	0.20	0.06
			kg/ha	81	103	32
			mg/kg	36	46	14
KCl	Aluminium	Al	$cmol^+/Kg$	0.41	0.68	0.77
			kg/ha	83	137	155
			mg/kg	37	61	69
Acidity Titration	Hydrogen	H^+	$cmol^+/Kg$	1.38	2.71	3.06
			kg/ha	31	61	69
			mg/kg	14	27	31
Calculation	Effective Cation Exchange Capacity (ECEC)		$cmol^+/Kg$	6.32	6.92	4.76
Base Saturation Calculations	Calcium	Ca	%	32.1	18.3	5.5
	Magnesium	Mg		25.7	24.4	8.6
	Potassium	K		11.4	5.4	4.0
	Sodium - ESP	Na		2.5	2.9	1.3
	Aluminium	Al		6.5	9.8	16.1
	Hydrogen	H^+		21.9	39.2	64.4
Calculation	Calcium/ Magnesium Ratio		ratio	1.2	0.8	0.6
DTPA	Zinc	Zn	mg/kg	1.2	0.7	0.5
	Manganese	Mn		22	9	10
	Iron	Fe		163	162	221
	Copper	Cu		1.0	1.2	0.3
$CaCl_2$	Boron	B	mg/kg	0.46	0.50	0.40
	Silicon	Si		45	49	38
LECO IR Analyser	Total Carbon	C	%	3.34	2.66	1.70
	Total Nitrogen	N	%	0.19	0.13	0.09
Calculation	Carbon/ Nitrogen Ratio		ratio	17.4	20.4	18.8
	Lab Texture			Light Clay	Light Clay	Clay Loam
	Basic Colour			Brownish	Brownish	Brownish
Calculation	Chloride Estimate		equiv. ppm	31	17	11
See note 10	Emerson Aggregate Test		..	*EAT Class 5*	*EAT Class 3*	*EAT Class 5*

EAL Soil Testing Notes

1. All results as dry weight - 40°C oven dried soil crushed to <2mm
2. Methods from Rayment and Lyons, 2011. *Soil Chemical Methods*
3. Soluble Salts included in Exchangeable Cations - NO PRE-WASH
4. 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and Lamonte Soil Handbook.
5. Guidelines for phosphorus have been reduced for Australian soils
6. Indicative guidelines are based on 'Albrecht' and 'Reams' concepts
7. Total Acid Extractable Nutrients indicate a store of nutrients
8. Contaminant Guides based on 'Residential with gardens and accessible soil including childrens daycare centres, preschools, primary schools, town houses or villas' (NSW EPA 1998).
9. Information relating to testing colour codes is available on Sheet 2 - "*Understanding you soil results*"
10. MEAT Method from On-site Sewage Management Guidelines using the SAR5 solution. **MEAT Class 1:** Worked bolus material disperses; **Class 2:** Aggregates disperse (cloud solution); **Class 3:** Aggregates slake; **Class 4:** No change to aggreagate- non-dispersive.

Calculations

1. For conductivity 1 dS/m = 1 mS/cm = 1000 µS/cm
2. 1 $cmol^+/Kg$ = 1 meq/100g; 1 Lb/Acre = 2 ppm (parts per million); kg/ha = 2.24 x ppm; mg/kg = ppm
3. Conversions for 1 $cmol^+/Kg$ = 230 Kg/Hectare Sodium, 780 Kg/Ha Potassium, 240 Kg/Ha Magnesium, 400 Kg/Ha Calcium
4. Organic Matter = %C x 1.75
5. Chloride Estimate = EC x 640 (most likely over-estimate)
6. ECEC = sum of the exchangeable cations $cmol^+/Kg$
7. Base saturation calculations = (cation cmol+/Kg) /ECEC x 100
8. Ca/Mg ratio from the exchangeable $cmol^+/Kg$ results

Environmental Analysis Laboratory,
Southern Cross University,
Tel. 02 6620 3678, website: scu.edu.au/eal

Results Checked by Kris Saville
Senior Agricultural Analyst

ROUTINE AGRICULTURAL SOIL ANALYSIS REPORT

Job No:	C2662
No of Samples:	4
Date Supplied:	15/10/2012
Supplied by:	Richard Berry

					Sample ID:	**Sample 4** S4	***Medium Soil***	***Light Soil***	***Sandy Soil***
					Crop:	N/G			
					Client:	AWC	*e.g Clay Loam*	*e.g Loam*	*e.g Loamy Sand*
	Method	*Nutrient*			*Units*	*C2662/4*			
	Morgan 1	Calcium	Ca		mg/kg	129	*750*	*375*	*175*
		Magnesium	Mg			170	*105*	*60*	*25*
		Potassium	K			83	*75*	*60*	*50*
		Phosphorus	P			0.6	*12*	*10*	*5.0*
	Bray1	Phosphorus	P		mg/kg	8.5	*30 note 8*	*24 note 8*	*20 note 8*
	Colwell					6.4	*50*	*45*	*35*
	Bray2					2.8	*60 note 8*	*48 note 8*	*40 note 8*
	KCl	Nitrate Nitrogen	N		mg/kg	0.8	*13*	*10*	*10*
		Ammonium Nitrogen				6.1	*18*	*15*	*12*
		Sulfur	S			12	*8.0*	*8.0*	*7.0*
	1:5 Water	pH			units	5.65	*6.5*	*6.3*	*6.3*
		Conductivity			dS/m	0.039	*0.150*	*0.120*	*0.100*
	Calculation	Organic Matter			% OM	4.1	*>4.5*	*>3.5*	*>2.5*
	Ammonium Acetate + Calculations	Calcium	Ca		$cmol^+/Kg$	1.00			
					kg/ha	451			
					mg/kg	201	*2150*	*1000*	*375*
		Magnesium	Mg		$cmol^+/Kg$	2.03			
					kg/ha	552			
					mg/kg	246	*200*	*145*	*75*
		Potassium	K		$cmol^+/Kg$	0.50			
					kg/ha	442			
					mg/kg	197	*190*	*150*	*100*
		Sodium	Na		$cmol^+/Kg$	0.58			
					kg/ha	300			
					mg/kg	134	*60*	*51*	*25*
	KCl	Aluminium	Al		$cmol^+/Kg$	0.90			
					kg/ha	181			
					mg/kg	81	*45*	*41*	*14*
	Acidity Titration	Hydrogen	H^+		$cmol^+/Kg$	3.40			
					kg/ha	76			
					mg/kg	34	*5*	*5*	*2*
	Calculation	Effective Cation Exchange Capacity (ECEC)			$cmol^+/Kg$	8.41	*14*	*7*	*4*
	Base Saturation Calculations	Calcium	Ca		%	11.9	*76*	*69*	*60*
		Magnesium	Mg			24.1	*12*	*16*	*20*
		Potassium	K			6.0	*4*	*5*	*8*
		Sodium - ESP	Na			6.9	*2*	*3*	*3*
		Aluminium	Al			10.7	*7*	*7*	*9*
		Hydrogen	H^+			40.4			
	Calculation	Calcium/ Magnesium Ratio			ratio	0.5	*6.3*	*4.3*	*3.0*
	DTPA	Zinc	Zn		mg/kg	0.7	*5.0*	*4.0*	*3.0*
		Manganese	Mn			11	*22*	*18*	*15*
		Iron	Fe			149	*22*	*18*	*15*
		Copper	Cu			1.6	*2.0*	*1.6*	*1.2*
	$CaCl_2$	Boron	B		mg/kg	0.60	*1.7*	*1.4*	*1.0*
		Silicon	Si			57	*45*	*40*	*35*
	LECO IR Analyser	Total Carbon	C		%	2.35	*>2.6*	*>2.0*	*>1.4*
		Total Nitrogen	N		%	0.15	*>0.25*	*>0.20*	*>0.15*
	Calculation	Carbon/ Nitrogen Ratio			ratio	15.6	*10-12*	*10-12*	*10-12*
		Lab Texture				Medium Clay	..	..	..
		Basic Colour				Brownish	..	..	..
	Calculation	Chloride Estimate			equiv. ppm	25	..	..	..
	See note 10	Emerson Aggregate Test			..	*EAT Class 3*	..	..	..

EAL Soil Testing Notes

1. All results as dry weight - 40°C oven dried soil crushed to <2mm
2. Methods from Rayment and Lyons, 2011. *Soil Chemical Methods*
3. Soluble Salts included in Exchangeable Cations - NO PRE-WASH
4. 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and Lamonte Soil Handbook.
5. Guidelines for phosphorus have been reduced for Australian soils
6. Indicative guidelines are based on 'Albrecht' and 'Reams' concepts
7. Total Acid Extractable Nutrients indicate a store of nutrients
8. Contaminant Guides based on 'Residential with gardens and accessible soil including childrens daycare cent preschools, primary schools, town houses or villas' (NSW EPA 1998).
9. Information relating to testing colour codes is available on Sheet 2 - "*Understanding you soil results*"
10. MEAT Method from On-site Sewage Management Guidelines using the SAR5 solution. **MEAT Class 1:** W
Class 2: Aggregates disperse (cloud solution); **Class 3:** Aggregates slake; **Class 4:** No change to aggreagate

Calculations

1. For conductivity 1 dS/m = 1 mS/cm = 1000 µS/cm
2. 1 $cmol^+/Kg$ = 1 meq/100g; 1 Lb/Acre = 2 ppm (parts per million); kg/ha = 2.24 x ppm; mg/kg = ppm
3. Conversions for 1 $cmol^+/Kg$ = 230 Kg/Hectare Sodium, 780 Kg/Ha Potassium, 240 Kg/Ha Magnesium, 400
4. Organic Matter = %C x 1.75
5. Chloride Estimate = EC x 640 (most likely over-estimate)
6. ECEC = sum of the exchangeable cations $cmol^+/Kg$
7. Base saturation calculations = (cation cmol+/Kg) /ECEC x 100
8. Ca/Mg ratio from the exchangeable $cmol^+/Kg$ results

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Tel. 02 6620 3678, website: scu.edu.au/eal

Results Checked by Kris Saville
Senior Agricultural Analyst

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