SEEC

Strategic Environmental & Engineering Consulting

Geotechnical Assessment for Proposed Subdivision

Lot 1 DP 940895 No. 600 West Parade Buxton, NSW

Prepared by: Liam O'Rourke

SEEC Ref: 17000198-GA-01

16th October 2017

Strategic Environmental and Engineering Consulting

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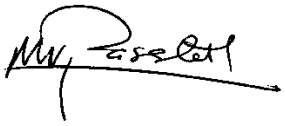
Document Certification

This report has been developed based on agreed requirements as understood by SEEC at the time of investigation. It applies only to a specific task on the nominated lands. Other interpretations should not be made, including changes in scale or application to other projects.

The contents of this report are based on a professional appraisal of the conditions that existed at the site at the time of our investigation. Where subsurface investigations have been done the results are only applicable to the specific sampling or testing locations and only to the depth(s) investigated. Because of natural geological variability, and/or because of possible anthropogenic influences, the subsurface conditions reported can change abruptly. Such changes can also occur after the site investigation. The accuracy of the advice provided in this report is limited by these possible variations and influences and/or is limited by budget constraints imposed by others and/or by adequate accessibility.



Mark Passfield
Director
SEEC

16th October 2017

Version	Date	Author	Reviewed	Date
0A DRAFT	05/10/17	LO	MP	6/10/17
01 FINAL	16/10/17	LO		

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1 Introduction

Strategic Environmental and Engineering Consulting have been commissioned by Mr. Stuart Farmer, owner of Lot 1 DP 640895 No. 600 West Parade, Buxton, to provide this Geotechnical Assessment (Figure 1). It will accompany a development application to subdivide the land into four rural allotments (Figure 2).

This study includes:

(i) Undertaking a site inspection and soil survey to assess the suitability of each proposed allotment for onsite effluent disposal;

(ii) Assessment of soil texture, depth, pH, electrical conductivity, dispersion potential, and phosphorous sorption;

(iii) Dynamic Cone Penetrometer (DCP) testing to determine the density and depth of soil;

(iv) Discussion of suitable methods for treatment and land application of effluent;

(v) Hydraulic and nutrient modeling to determine the necessary size of effluent management areas;

(vi) Preparation of a site plan showing suitable effluent management areas;

(vii) A discussion of any special wastewater management initiatives;

(viii) A site classification of the natural land for AS 2870:2011; and,

(ix) Preparation of this written report for submission to Council.

The site and soil investigation is undertaken in accordance with:

(i) AS/NZS 1547: 2012 On-site Domestic Wastewater Management (Standards Australia / Standards New Zealand, 2012).

(ii) AS 2870:2011 Residential Slabs and Footings – Construction (Australian Standards).

(iii) DLG (1998) Environment and Health Protection Guidelines: Onsite Sewage Management for Single Households, Department of Local Government; and,

(iv) Wollondilly Shire Council (2011). *Onsite Sewage Management Strategy*.

(v) WaterNSW (2011): Water Quality Requirements.

Figure 1: Existing Lot 1 DP 940895 to be subdivided into four Lots.

2 Proposed Development

It is proposed to subdivide Lot 1 DP 940895, West Parade, Buxton, into four rural residential allotments (Figure 2). Proposed Lots 50, 51and 52 will be 4,000 m^2 in size while Lot 53 will be 4,350 m^2 in size.

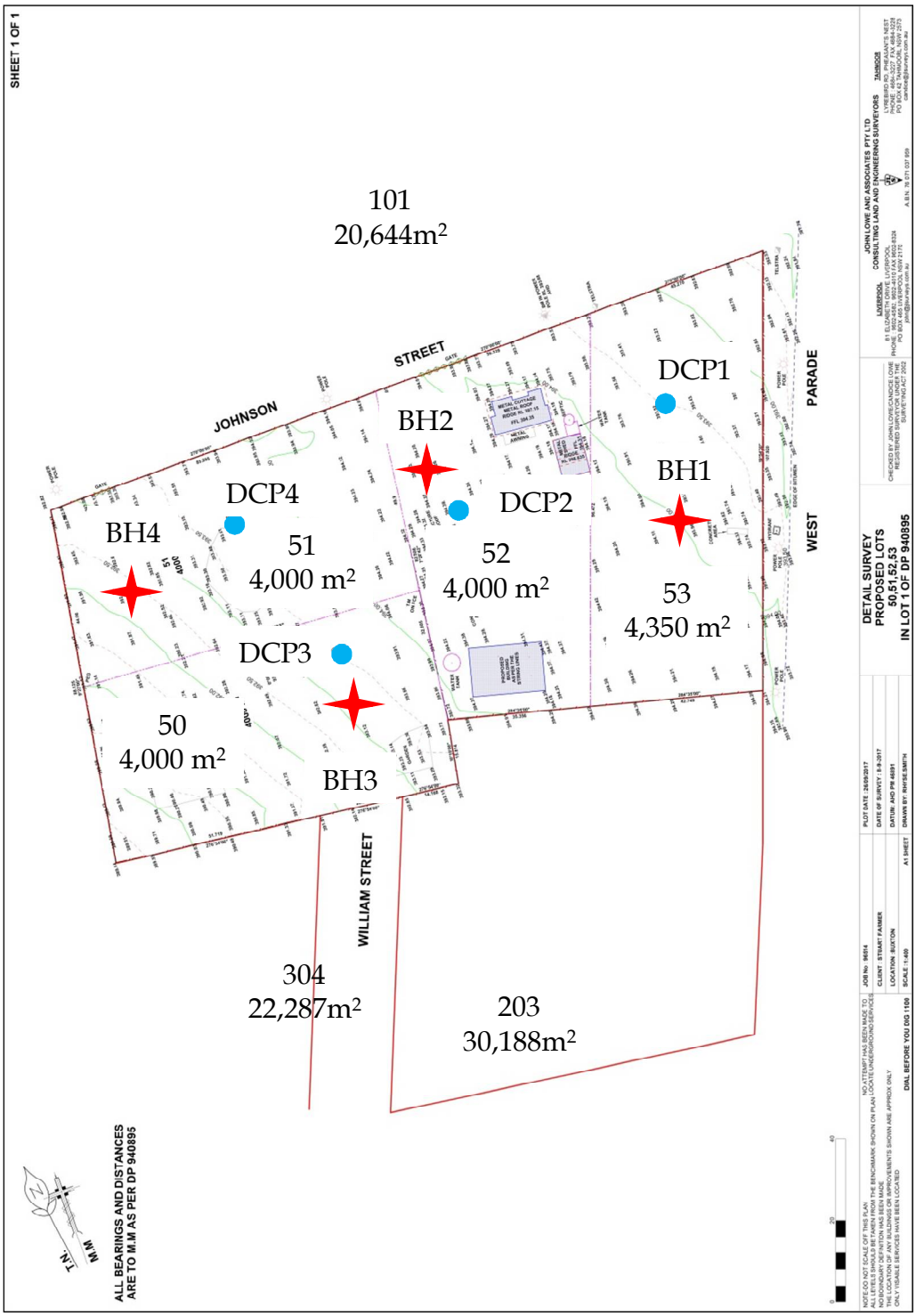


Figure 2: Proposed subdivision and approximate borehole and DCP locations.

3 Assumptions

It is assumed that the new lots would be rural residential developments and could potentially include:

(i) New rural home (assumed five-bedrooms) and access;

(ii) Workshops, garages, etc.

This report aims to show that post-subdivision each new lot could be developed and how new owners could sustainably manage treated wastewater. However, future owners would require a site specific Wastewater Site and Geotechnical Assessment for their individual lot, considering their proposed development and their preferences.

4 Site Assessment

4.1 Introduction

A site assessment was undertaken by Liam O'Rourke of SEEC on 22nd September 2017. The assessment was undertaken following Table 4 in DLG (1998), Environment and Health Protection Guidelines: Onsite Sewage Management for Single Households (Department of Local Government), which describes a rating system for onsite effluent management constraints. Several possible site constraints are considered including, but not limited to:

- proximity to permanent and intermittent watercourses;
- landform, site gradient and drainage characteristics;
- aspect and exposure;
- extent of surface rock and outcrop;
- climate of the area;
- existing vegetation; and
- available land area.

The following sections provide a brief commentary on the levels of constraint for onsite effluent disposal and potential building envelopes across this site. The "Limitations" are defined in DLG (1998).

4.2 Location and General Site Conditions

Lot 1 DP 940895 is a rural lot located on the western side of West Parade, Buxton. The property is bound by similar properties to the north and west and low density residential properties to the south and east. The existing topography consists of mid to upper slopes with a ridge running north to south through proposed lots 52 and 53. Lot 53 grades at 2% to the east while Lots 50 and 51 grade at 4% to 7% to the west. The site has access to reticulated water but not reticulated sewer. As such effluent would need to be managed on-site.

Proposed Lot 52 has an existing two-bedroom dwelling and associated sheds onsite. At the time of the site inspection the existing dwelling was serviced by an Aerated Wastewater Treatment System (AWTS) to semi-fixed surface spray irrigation. The dwelling will remain but the irrigation system will be upgraded (**Section 6.3**)

4.3 Climate

Buxton experiences a temperate climate with warm summers and cool winters. According to the Australian Bureau of Meteorology Buxton Rainfall Station (Site No. 68166) receives 858.8 mm of annual average rainfall and according to SCA (2012) Buxton is in Zone 2 of the catchment evaporation zones and experiences approximately 1,157 mm of evaporation. Rainfall is heavier during the summer months and then is reasonably evenly distributed across the rest of the year. Evaporation is significantly greater in summer (Figure 3) (*Minor Limitation*).

Table 1: Average monthly rainfall and evaporation (Moss Vale)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Rain (mm)	92.2	125.5	82.2	74	51.6	67.3	35.8	51.2	45.4	62.2	91.1	78	858.8
Evap (mm)	153	129	102	82	62	38	46	65	92	129	111	148	1157

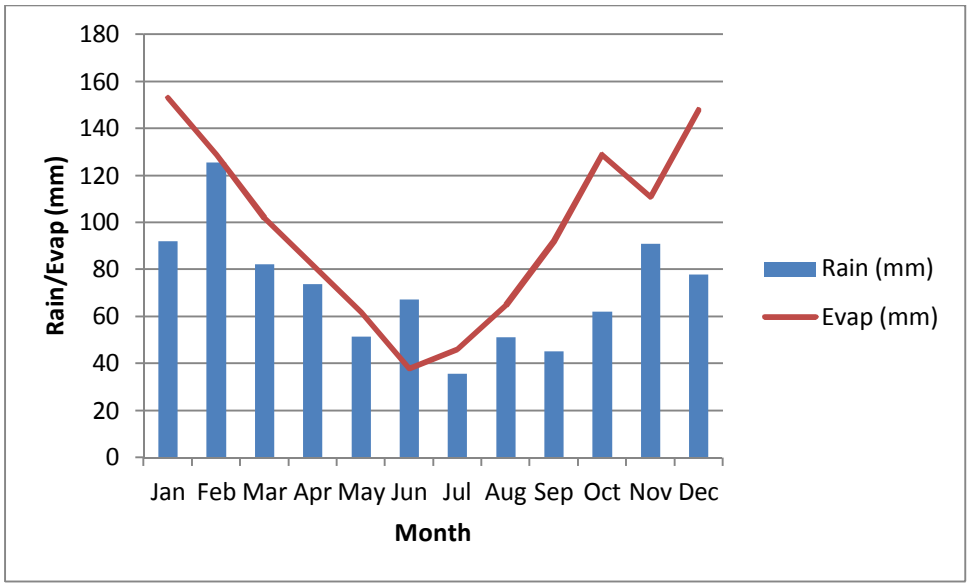


Figure 3: Graph showing Rainfall and Evaporation

4.4 Flood Potential

While no formal flood study has been undertaken, all land identified as potentially suited to on-site effluent management appears to be well above any potential flooding (*Minor Limitation*).

4.5 Exposure

Land identified as potentially suited to on-site effluent management on all proposed lots is well exposed to sun and wind. (*Minor Limitation*).

4.6 Slope

All land identified as potentially suited to on-site effluent management on Lots 50 and 51 grades at 7% or less to the west. Land potentially suited to on-site effluent management on Lots 52 and 53 grades at 2% or less to the east (*Minor Limitation*).

4.7 Stormwater Run-on

Some of the land identified as potentially suited to on-site effluent management might be subject to some degree of run-on. An upslope drain/berm could be required on some lots (*Minor to moderate Limitation*).

4.8 Proximity to Watercourses and Dams

There are no drainage depressions or watercourse affecting this site (*Minor Limitation*).

4.9 Surface Rock

No surface rock was identified during our site investigation (*Minor Limitation*).

4.10 Groundwater Seepage

No areas of seepage or moisture tolerant vegetation were observed within the potentially suitable effluent management areas (*Minor Limitation*).

4.11 Groundwater

Wollondilly Shire Council requires that no onsite effluent disposal occur within 250 m of bores used for potable water supply. According to the Department of Primary Industries Office of Water there are no bores used for potable water supply within a 250 m radius of the proposed EMAs (*Minor Limitation).*

4.12 Erosion Potential

There were no visible signs of erosion. Soil erosion is not expected to be a significant problem on this site as much of the site was mulched and/or seeded with grass at the time of the site inspection (*Minor Limitation*).

4.13 Fill

No fill was encountered during our investigation (*Minor Limitation*).

4.14 Vegetation

At the time of inspection much of the site had poor vegetation cover as the property had been cleared of all trees and shrubs. Mulch from clearing trees and shrubs had been

spread over the property and seeded with grass in some areas. It is expected that all lots would ultimately have fully managed-lawns as was observed on neighbouring properties (*Minor Limitation*).

4.15 Land Availability

No less than 1,500 m^2 of land potentially suited to on-site effluent management has been identified on all proposed lots (Appendix 1) (refer to Section 6.2) (*Minor Limitation*).

Future owners would need to be considerate of their available (and required) effluent management areas when planning potential developments. As previously mentioned, future owners would require a site specific Wastewater Site Assessment to suit their individual development and preferences.

5 Soils and Geology

5.1 Soil Landscape Mapping

Soil Landscape mapping by DLWC/SCA (2002) identifies the site is on the Lucas Heights Soil Landscape (Figure 4).

The Lucas Heights Soil Landscape is a residual soil landscape formed on shale and sandstone. Topography consists of predominately level plains to gently undulating rises on the Mittagong Formation. Soils typically comprise of loose, greyish, sandy loam topsoil over weakly pedal, yellowish brown, clay or weakly pedal clayey sand. The site inspection confirmed the mapping is accurate.

Figure 4: Soil Landscapes and Lot 4 DP 851104 boundary.

5.2 Site Specific

Four bores were excavated by SEEC staff while on site (Figure 2). The soil profiles for each were similar consisting of:

Bore 1

0-100 mm	Organic matter (mulch)
100-500 mm	Greyish browny orange sand clay loam
500-1,400+ mm	Red, orange, yellow and white moderately structured light clay

Bore 2

0-400 mm	Greyish brown sandy loam topsoil
400-700 mm	Greyish browny-orange, moderately structured, sandy clay loam
700-1,300+ mm	Red and orange moderately structured sandy-light clay

Bore 3

0-50 mm	Orange matter (mulch)
50-400 mm	Greyish brown sandy loam topsoil
400-700 mm	Browny-orange, moderately structured, sandy clay loam
700-1,300 mm	Red, orange and white moderately structured sandy clay

Bore 4

0-50 mm	Organic matter (mulch)
50-400 mm	Greyish brown sandy loam topsoil
400-900 mm	Orange moderately structured sandy clay. Refusal on weathered rock

5.3 Soils Summary

The bores and soil testing showed the soils at this site:

- Are moderately deep to deep. Boreholes 1-3 showed approx. 1,300-1400+ mm of soil, while borehole 4 refused at 900 mm (*Moderate Limitation*);
- Are moderately to well drained. Bores generally revealed moderately pedal sandy clay loam to sandy/light clay subsoil (*Minor Limitation*).
- Are non-acidic (*Minor Limitation*);
- Are negligible to slightly dispersive (subsoil) *(Minor Limitation);* and
- Are predicted to have a moderate to good ability to sorb phosphorous *(Moderate Limitation).*

6 Wastewater Management

6.1 Design Wastewater Load

The Design Wastewater Load is calculated assuming a five-bedroom dwelling (Wollondilly Shire Council, 2011 and SCA, 2012) on each proposed lot with access to reticulated water supply (150 L/person/day). This equates to 1,350 L/day wastewater generated for each proposed lot.

6.2 Proposed Wastewater Systems – Lots 50, 51 and 53

As the soils on all lots are sandy loam topsoil over sandy/light clay subsoils, wastewater generated on each lot could be either primary-treated in a 3,500 L septic tank with an outlet filter and then disposed in Evapotranspiration/absorption (ETA) beds or secondary-treated in an approved Aerated Wastewater Treatment System (AWTS) and disposed via subsurface or fixed-surface spray irrigation. As only 900 mm of soil was encountered on Lot 50 (Borehole 4) the ETA beds might need to be raised to ensure 600 mm of soil between the base of the bed and bedrock, unless another suitable location can achieve a soil depth greater than 1,200 mm.

6.2.1 Primary Treatment

Primary-treated effluent could be disposed in ETA beds on Lots 50, 51 and 53. For a five-bedroom home the required area of bed would be 1,350/8 = 169 m^2. This could be provided as a three 2.8 m x 20 m absorption beds. As the effluent would be only primary-treated a reserve area would be required of equal size in case it was ever required.

6.2.2 Secondary Treatment

For proposed Lots 50, 51 and 53 the required area for irrigation is calculated by undertaking a hydraulic balance and a nutrient balance. In this case, a Design Irrigation Rate (DIR) of 3 mm/day (light clay) is used. This equates to an Effluent Application Area (EAA) of approximately 450 m^2 for a design load of 1,350 L/day. However, NorBE nutrient modelling requires a minimum Effluent Management Area (EMA) of 616 m^2 (assuming the vegetation is expected to be fully managed lawn (Appendix 2)). Therefore, the total EMA for a five-bedroom dwelling would comprise of:

- 450 m^2 of fixed-surface spray or subsurface irrigation built to the requirements of AS/NZS1547:2012; and
- 166 m^2 of Nutrient Uptake Area (NUA) immediately downslope of the EAA which must be left undeveloped.

6.3 Existing System – Lot 52

At the time of inspection proposed Lot 52 had an existing two-bedroom dwelling located in the northern portion. The existing dwelling is currently serviced by an AWTS to semi-fixed surface spray irrigation. However, as the site is within the Sydney's Drinking Water Catchment, WaterNSW requires either subsurface or fixed-surface spray irrigation.

Hydraulic modelling requires a minimum Effluent Application Area (EAA) of 200 m^2. However, NorBE nutrient modelling requires a minimum EMA of 274 m^2. Therefore, the total EMA for the two-bedroom dwelling would be 274 m^2 comprising of:

- 200 m^2 of irrigation area built to the requirements of AS/NZS1547:2012; and
- 74 m^2 of Nutrient Uptake Area (NUA) immediately downslope of the EAA which must be left undeveloped (Appendix 1).

6.4 General Requirements for Effluent Management Areas

6.4.1 Vegetative Cover

An effluent management area must be well vegetated before it is commissioned to prevent runoff and possible erosion. Vegetation is required to promote nutrient uptake. Grass is generally the most suitable form of vegetation and, at the time of inspection, the site generally had a poor covering of grass suitable for effluent management. Given the nature of the nearby similar developments; all lots are expected to have fully managed lawns.

6.4.2 Protection from Stock and Heavy Vehicles

Future owners should identify their effluent management area and ensure it is protected from stock or heavy vehicle access (fence it off if need be).

6.4.3 Buffers

Buffers are required to effluent management areas from lot boundaries and the built environment. They vary depending on the relative position of the effluent management area to a given feature (Table 2):

Table 2: Buffer distances (NSW Health, 1998 Table 5)

	Primary-Treated	Secondary-treated
Property boundary	12 m up-gradient and 6 m down-gradient	4 m up-gradient and 2 m down-gradient (Subsurface irrigation). 6 m up or down-gradient (surface spray irrigation)
Buildings, driveways and swimming pools	6 m up-gradient and 3 m down-gradient	15 m for surface spray irrigation. 6 m up-gradient and 3 m down-gradient for subsurface irrigation.
Watercourses and dams	100 m from watercourses. 40 m to farm dams, depressions and drainage channels.	
Bore or well used for domestic consumption	100 m (WaterNSW)	

6.4.4 Future Management

It would be the responsibility of new owners to maintain their effluent disposal areas by ensuring effluent is distributed evenly over the entire Effluent Application Area (EAA) and that the entire EMA is regularly mown.

7 Geotechnical Site Classification (AS 2870:2011)

7.1 Method of Investigation

7.1.1 Site Specific

Figure 1 shows the location(s) of soil cores and Dynamic Cone Penetrometer (DCP) testing.

The site investigation showed a moderately deep profile (approx. 900-1,400 mm) of sandy loam over sandy/light clay subsoils (**Section 5.2**). This confirmed that the site lies on the Lucas Heights Soil Landscape (**Section 5.1**).

DCP testing shows the soils are in a very stiff to hard condition (Appendix 3). Descriptions of drainage, topography and vegetation observed during the site inspection can be found in **Sections 4.6-4.14**.

7.1.2 Adjacent Developments

At the time of inspection the site had an existing two-bedroom dwelling and associated sheds. All existing buildings were built using slab on-ground footings but none showed signs of footing distress.

7.1.3 Site Classification

The soil landscape mapping by SCA/DLWC does not identify the soils to be at risk of shrink-well.

Subsoil is lightly-textured sandy clay and so no shrink-well testing was considered necessary. Moisture changes at the site will result in slight ground movement and so the natural site is classified as Class S per AS 2870:2011. Future owners of the proposed lots would require a site specific Site Classification to take into account their preferences and final dwelling location.

8 Summary and Conclusion

In conclusion, site and soil conditions on the proposed lots are considered suitable for on-site wastewater management. Possible EMA locations have been identified on the plan in Appendix 1.

Wastewater from the proposed lots can be primary-treated in a septic tank with an outlet filter and then disposed into ETA beds. If the effluent is primary-treated a reserve area of equal size would also be required. Alternatively, wastewater could be secondary-treated in an approved AWTS and disposed via subsurface or fixed surface spray irrigation.

Suitable building envelopes are shown in Appendix 1. As the soils are sandy clay, moisture changes at the site will result in only slight ground movement and so the natural site is classified as Class S per AS 2870:2011.

Given the conceptual nature of this assessment, it is expected that future owners would require a *site specific* Wastewater Report and Site Classification to suit their individual development and preferences.

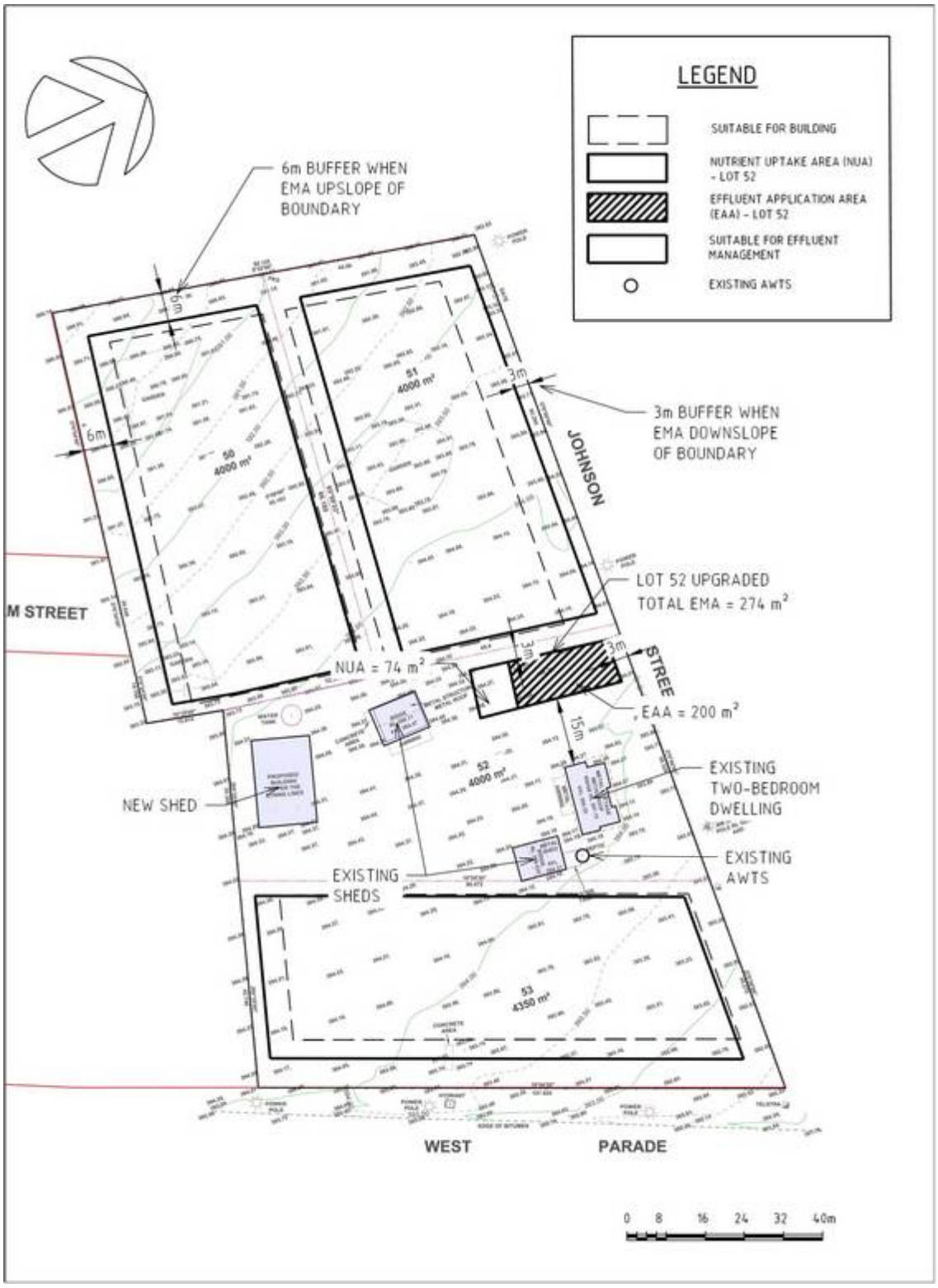
We conclude, providing the general mitigation measures contained herein are adhered to, the risk of pollution to receiving waters is minimal.

9 References

- DLWC/SCA (2002). *Soil Landscapes of The Sydney Catchment Authority's Hydrological Catchments.* NSW Department of Land and Water Conservation and Sydney Catchment Authority.
- Department of Local Government (1998). Environment and Health Protection Guidelines: *Onsite Sewage Management for Single Household.*
- SCA (2012). Designing and Installing On-site Wastewater Systems.
- SCA (2011). Water Quality Requirements.
- Wollondilly Shire Council (2011). *Onsite Sewage Management Strategy*.
- Standards Australia (2011). AS 2870:2011 Residential Slabs and Footings – Construction.
- Standards Australia / Standards New Zealand (2012). AS/NZS 1547:2012 *On-site Domestic Wastewater Management*.

10 Appendices

10.1 Appendix 1 – Possible locations of EMAs.



10.2 Appendix 2 – NorBE Nutrient Modelling – Lots 50, 51 and 53)

NorBE Assessment

WEM Summary

version 3

General Information

WEM model ID	**1501166**	Associated DA number	
Model description	**AWTS to irrigations**		
Consultancy	**SEEC**	Consultant	**lorourke@seec.com.au**
Consultant reference number	**17000198**		
Council	**Wollondilly Shire**	Assessing officer	
Nominated lot	**1//940895**	Associated lots	
Development class	**New dwelling/dual occ <8bdrm unsewered**		
Date of model run	**10/5/2017 11:22:21 AM**		

Lot	Section	Plan
1		940895

WEM Model Run Summary

Model run outcome **Pending**

Any of the sub-surface plumes reaches:

Lot boundary	**N/A**
Drainage depression	**N/A**
Top bank of watercourse	**N/A**
Another disposal field or onsite stormwater management system	**N/A**
Within 50m, and up gradient of,a licensed drinking water bore	**N/A**

Proposed Front End Design

Length (across slope)(m)	**30.0**	Width (up slope)(m)	**20.6**
Proposed area(m2)	**618.0**	Minimum Required area (m2)	**615.9**
Number of trenches	**0**		
Effluent volume proposed (l/day)	**1350**		
Effluent volume calculated (l/day)	**1350**		

WEM Model Inputs

Location

Easting	**9625161.401874**	Northing	**4383416.226954**
Slope (m/m)	**0.02463**	Slope is suitable based on site inspection (Applicable to some disposal systems on steep slopes)	**N/A**

Development

Development type	**Dwellings**	Development detail	**5 bedrooms**

WaterNSW

NorBE Assessment

WEM Summary

version 3

Water supply type	**Reticulated**	Spa Bath	**No**
Continuous system use	**Yes**		
Treatment system	**AWTS standard**	Disposal system	**Irrigation surface**

Site

Lot size(m2)	**4000**		
Subject to severe frost	**No**	Bulk density(g/cm3)	**1.30**
Vegetation for nurtrient uptake	**Lawn - fully managed (clippings removed)**	Phosphorus sorption (mg/kg)	**500**
Soil depth (to impermeable layer) (m)	**1.30**	Soil structure	**Strong**
Saturated hydraulic conductivity (Ksat)(m/day)	**0.01**		
Soil texture	**Light clays**		

Effluent disposal risk factors

Depth to water table	**> 1.0**
Flood potential of disposal system	**Above 1 in 50 year ARI**
Landform score	**Hill crests, convex side slopes and plains**
Run-on and upslope seepage	**None-low, diversion possible**
Rock outcrops, scarp and bedrock	**< 5%**
Distance to drainage dpression	**> 50**
Distance to watercourses and water supply reservoirs	**> 120**
Distance to licenced drinking water bores	**> 150**

WaterNSW

NorBE Assessment

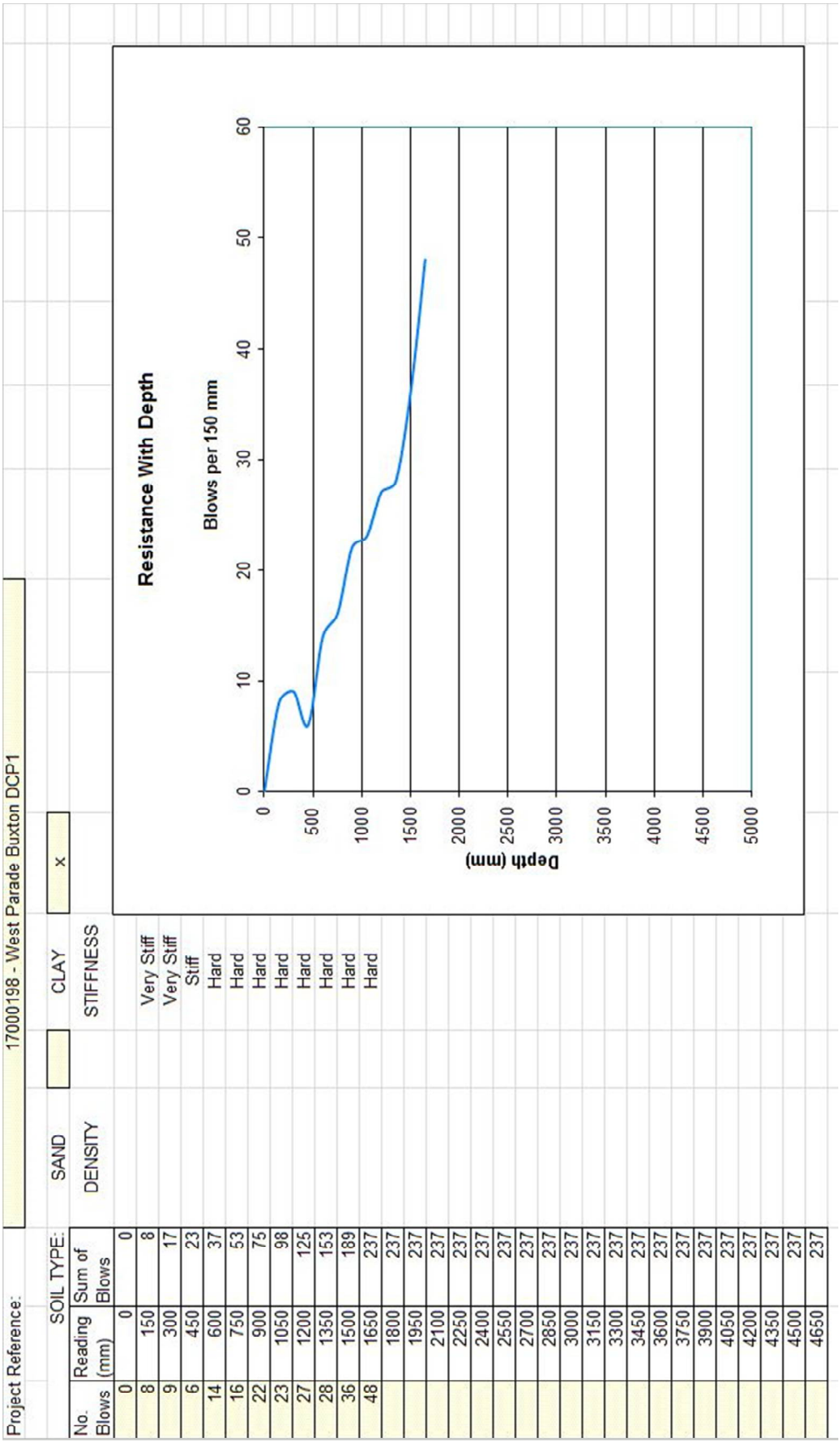
WEM Summary

version 3

WEM Plume Map

WaterNSW

10.3 Appendix 3 – Dynamic Cone Penetrometer (DCP) Logs



Project Reference: 17000198 - West Parade Buxton DCP1

SOIL TYPE: SAND [ ] CLAY [x]

DENSITY / STIFFNESS

No. Blows	Reading (mm)	Sum of Blows	
0	0	0	
8	150	8	Very Stiff
9	300	17	Very Stiff
6	450	23	Stiff
14	600	37	Hard
16	750	53	Hard
22	900	75	Hard
23	1050	98	Hard
27	1200	125	Hard
28	1350	153	Hard
36	1500	189	Hard
48	1650	237	Hard
	1800	237	
	1950	237	
	2100	237	
	2250	237	
	2400	237	
	2550	237	
	2700	237	
	2850	237	
	3000	237	
	3150	237	
	3300	237	
	3450	237	
	3600	237	
	3750	237	
	3900	237	
	4050	237	
	4200	237	
	4350	237	
	4500	237	
	4650	237	

Project Reference: 17000198 - West Parade Buxton DCP2

SOIL TYPE: SAND [ ] CLAY [x]

No. Blows	Reading (mm)	Sum of Blows	DENSITY	STIFFNESS
0	0	0		
11	150	11		Very Stiff
9	300	20		Very Stiff
18	450	38		Hard
36	600	74		Hard
42	750	116		Hard
48	900	164		Hard
	1050	164		
	1200	164		
	1350	164		
	1500	164		
	1650	164		
	1800	164		
	1950	164		
	2100	164		
	2250	164		
	2400	164		
	2550	164		
	2700	164		
	2850	164		
	3000	164		
	3150	164		
	3300	164		
	3450	164		
	3600	164		
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	3900	164		
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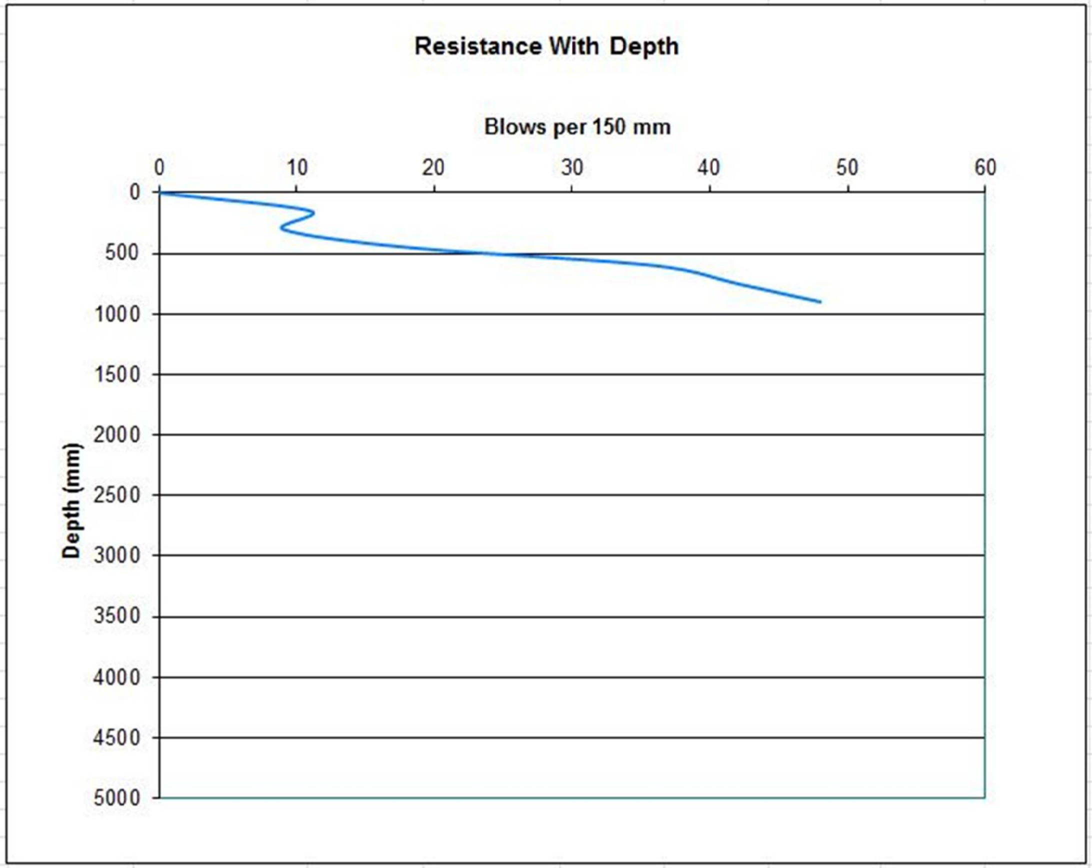
	4200	164		
	4350	164		
	4500	164		
	4650	164		



Project Reference: 17000198 - West Parade Buxton DCP3

SOIL TYPE: SAND [ ] CLAY [x]

No. Blows	Reading (mm)	Sum of Blows	DENSITY	STIFFNESS
0	0	0		
7	150	7		Very Stiff
7	300	14		Very Stiff
11	450	25		Very Stiff
13	600	38		Hard
13	750	51		Hard
18	900	69		Hard
21	1050	90		Hard
27	1200	117		Hard
28	1350	145		Hard
28	1500	173		Hard
37	1650	210		Hard
	1800	210		
	1950	210		
	2100	210		
	2250	210		
	2400	210		
	2550	210		
	2700	210		
	2850	210		
	3000	210		
	3150	210		
	3300	210		
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	3600	210		
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	4200	210		
	4350	210		
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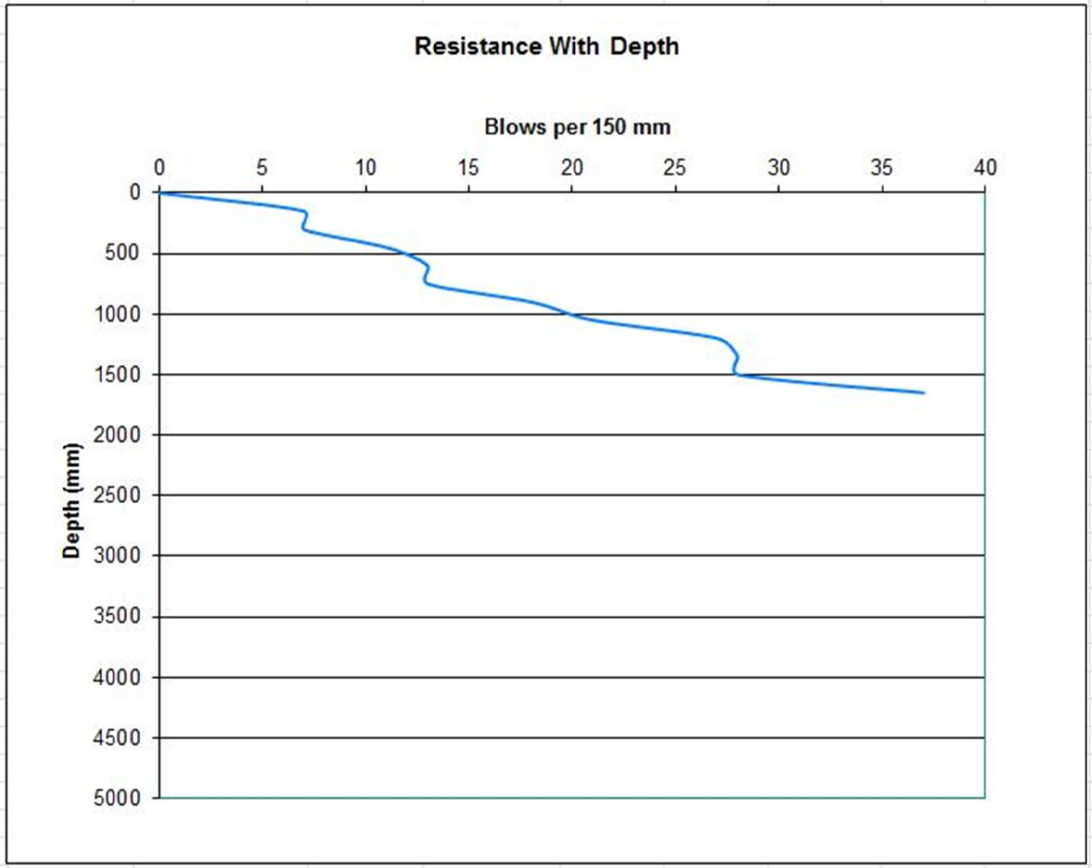
	4650	210		



Project Reference: 17000198 - West Parade Buxton DCP4

SOIL TYPE:			SAND		CLAY	x
No. Blows	Reading (mm)	Sum of Blows	DENSITY		STIFFNESS	
0	0	0				
4	150	4			Stiff	
4	300	8			Stiff	
8	450	16			Very Stiff	
12	600	28			Very Stiff	
40	750	68			Hard	
	900	68				
	1050	68				
	1200	68				
	1350	68				
	1500	68				
	1650	68				
	1800	68				
	1950	68				
	2100	68				
	2250	68				
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	4050	68				
	4200	68				
	4350	68				
	4500	68				
	4650	68