Geotechnical Investigation

Proposed channel Re-Alignment, Mamre Road Orchard Hills

G09-2756-A

Prepared for HB&B Property Group
18/06/2018

Construction Sciences

Contact Information

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A Construction Sciences Company
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Document Information

Prepared for	HB&B Property Group
Project Name	Proposed channel Re-Alignment, Mamre Road Orchard Hills
File Reference	Document2
Job Reference	G09-2756-A
Date	18/06/2018

Document History

Version	Effective Date	Description of Revision	Prepared by:	Reviewed by:
1	18.06.18	Original	Vipul de Silva	V de Silva

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Appendices

1.0 Introduction

Construction Sciences was commissioned by HB&B Group to assess soil conditions at the proposed channel re alignment at Mamre Road Orchard Hills in order to assess the soil salinity and topsoil characteristics. The investigation was triggered by an observation by officers from the Department of Environments and Conservation, NSW that vegetation has not been established on a similar channel in the property. The investigation was carried out in accordance with Network Geotechnics Pty Ltd (a Construction Science Company) proposal 8870r dated 23 may 2018.

2.0 Site Conditions and Geology

The site is located to the west of Mamre Road opposite Erskine Park Road within the proposed Stage 2 of the Mamre Road Industrial Park. The site is generally flat and is covered by patchy grass and isolated trees.

Surface soil contain clayey topsoil.

Geological maps for Penrith indicates that the area is underlain by Quaternary Deposits containing fine grained sand, Silt and Clay. It is likely that the deposits are of fluvial origin.

3.0 Field Investigation

Field investigation comprised drilling 5 boreholes (BH1 to BH5) drilled with a Utility mounted drill rig attached with solid flight augurs each to about 3m depth assumed to be 0.5m to 1.0m below the proposed channel bed. Soil samples were collected from augur cuttings in approximately 0.5m depth intervals. In addition three topsoil samples were collected from along the length of the proposed channel alignment.

Fieldwork was carried out by a geotechnical engineer from Construction Sciences on 1 June 2018. Approximate borehole locations are included in the Drawing No G09/2756-1 and the borehole logs are included in Appendix A.

4.0 Laboratory testing

The following laboratory tests were carried out on samples collected:

1. 30 Soil samples for pH and electrical Conductivity
2. 3 Soil samples for cation exchange capacity
3. One composite sample of topsoil for complete chemical analysis for assessment of plant growth

Laboratory test results are included in Appendix 2.

5.0 Subsurface Conditions.

Subsurface profile exposed in the boreholes BH1 to BH5 may be summarised as shown in table 1 below;

Layer	Description	Depth to base of layer m
TOPSOIL	Clayey SILT, low plasticity, brown	0.2-0.4
FLUVIAL	CLAY, Medium to high plasticity, orange mottled grey, becoming wetter with depth. Mottling increased with depth	>3.0

Groundwater table was not encountered during drilling of boreholes. However it should be noted that the depth to groundwater table and seepage could fluctuate with changes in the environmental factors.

For details of subsurface profile, reference should be made to borehole logs included in Appendix 1.

6.0 Discussion and Recommendations

Laboratory test results for composite topsoil sample recorded Electrical conductivity 3.2dS/m indicating extremely high saline (ECe>16dS/m).

Samples at depth recorded varying degree of salinity with Bh1 indicating Moderately saline and highly saline soils over the full 3m depth. BH3, Bh4 and BH5 recorded Non to Slightly saline soils for the full depth.

Cation Exchange capacity of three samples tested range from 8.0meq/100g to 11.0meq/100g with sodium and magnesium being the dominant cation much less than calcium and potassium.

Test results suggest only the most salt tolerant plants are likely to be able to grow in the soil

It is recommended that channel banks and bases be covered with treated topsoil after excavation. Topsoil on site should be modified by adding 0.9kg/m2 of gypsum and heavily irrigated to leach out sodium. Further recommendations are included in SESL soil analysis report in Appendix B.

This report should be read in conjunctions with the attached Explanation Sheets

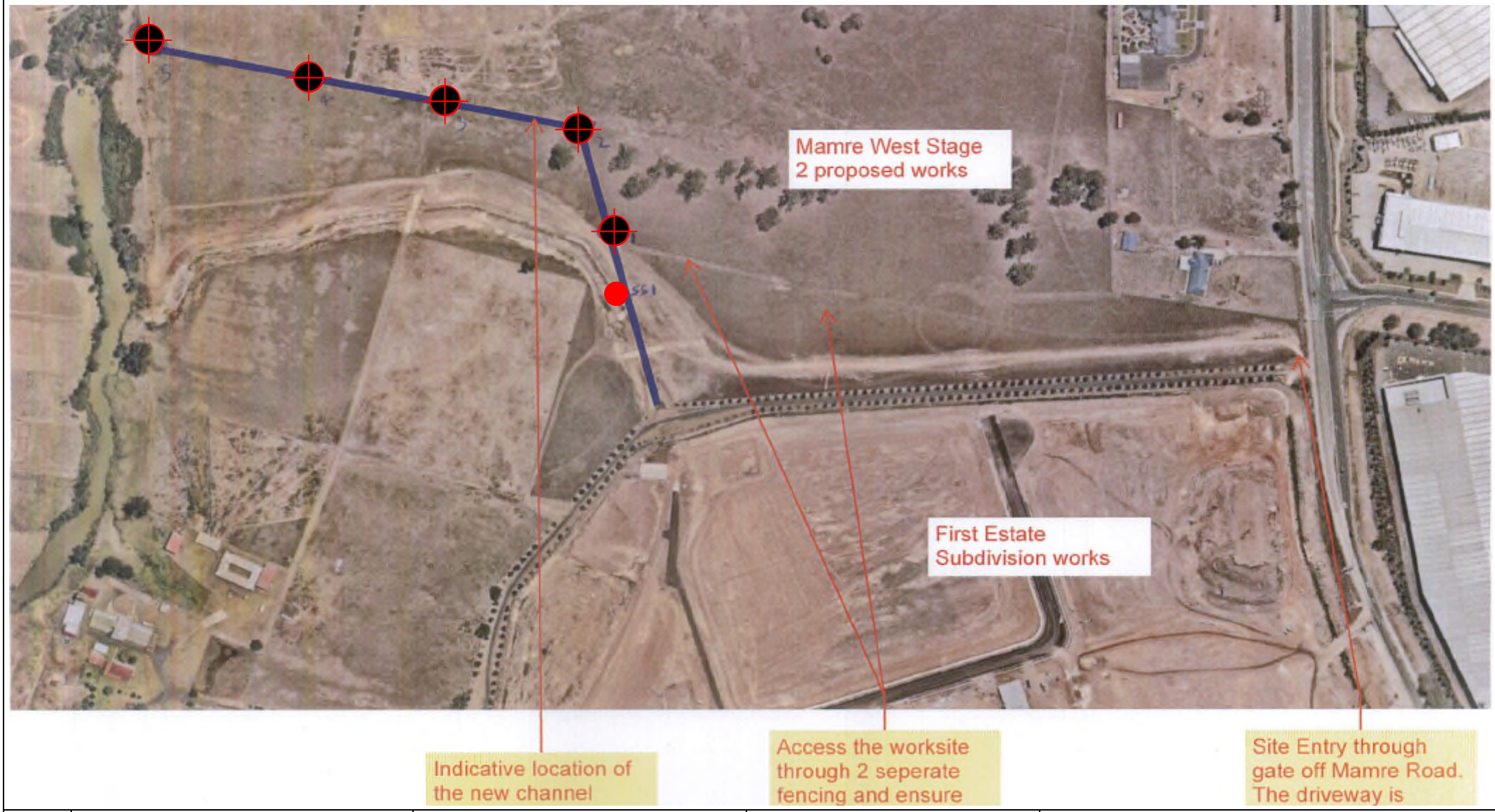
CONSTRUCTION SCIENCES PTY LTD

Vipul de Silva
Principal Geotechnical Engineer
0411720045
Vipul.desilva@constructionsciences.net

Proposed channel Re-Alignment, Mamre Road Orchard Hills

APPENDIX A

SITE PLAN , AND BOREHOLE LOGS



	LEGEND:	Network Geotechnics Pty Ltd	Scale: A4 - NOT TO SCALE	Client: HB+B
	APPROXIMATE BOREHOLE LOCATION		Date: 18/06/2018	Project: PROPOSED CHANNEL RE-ALIGNMENT
	APPROXIMATE SURFACE SAMPLING LOCATION	31 Anvil Road, SEVEN HILLS NSW 2147 Tel: (02) 8438 0300 Fax: (02) 8438 0310 Email: engineering@netgeo.com.au	Drawing: SM	Location: MAMRE ROAD ORCHARD HILLS
			Drawing No: G09/2756-1	Sheet: 1 of 1 — **SITE PLAN**

BOREHOLE LOG

Network Geotechnics Pty Ltd
ACN 069 211 561
31 Anvil Road
Seven Hills NSW 2147
02 8468 2000
02 8468 2025

Job No:	G09/2756
Hole No:	**BH1**
Sheet:	PAGE 1 / 1
Started:	01/06/18
Finished:	01/06/18
Logged:	ZK
Checked:	VDS
RL Surface:	
Datum:	

Client: HB + B Property

Project: Proposed Channel Re Alignment

Location: Mamre Road, Orchard Hills
GPS (-)

Equipment Type: Ute Mounted Drill Rig

Borehole Diameter: 100mm(O.D.) Inclination: Bearing:

method	water	samples, tests etc	DCP Blows per 150 mm	depth (m)	graphic log	USCS symbol	Material Description	Moisture condition	Consistency/ relative density	comments / notes, structure, and additional observations
ADT	▽	D		0.0		ML	Clayey SILT, low plasticity, brown	D		TOPSOIL
		D				CI/CH	CLAY, medium to high plasticity, medium to high plasticity, orange	>Wp		FLUVIAL
		D		1.0		CI/CH	CLAY, medium to high plasticity, orange mottled grey, traces of fine gravel			
		D				CI/CH	CLAY, medium to high plasticity, orange mottled grey, traces of fine gravel	>Wp		
		D		2.0						
		D								
		D		3.0		CI/CH	CLAY, medium to high plasticity, orange mottled grey, traces of fine grained sand, fine gravel	>Wp		
							BH1 Terminated at 3 m			
				4.0						
				5.0						
				6.0						
				7.0						

BOREHOLE LOG LOGS.GPJ NETWORK GEOTECHNICS PTY LTD.GDT 18/6/18

Refer To Explanation Sheets For Description Of Terms And Symbols Used.

BOREHOLE LOG

Network Geotechnics Pty Ltd
ACN 069 211 561
31 Anvil Road
Seven Hills NSW 2147
02 8468 2000
02 8468 2025

Job No:	G09/2756
Hole No:	**BH2**
Sheet:	PAGE 1 / 1
Started:	01/06/18
Finished:	01/06/18
Logged:	ZK
Checked:	VDS
RL Surface:	
Datum:	

Client: HB + B Property

Project: Proposed Channel Re Alignment

Location: Mamre Road, Orchard Hills
GPS (-)

Equipment Type: Ute Mounted Drill Rig

Borehole Diameter: 100mm(O.D.) Inclination: Bearing:

method	water	samples, tests etc	DCP Blows per 150 mm	depth (m)	graphic log	USCS symbol	Material Description	Moisture condition	Consistency/ relative density	comments / notes, structure, and additional observations
ADT	None Encountered	D				ML	Clayey SILT, low plasticity, brown, low to medium plasticity clay, traces of fine to medium gravel	D		TOPSOIL
		D				CI	Silty CLAY, medium plasticity, low plasticity silt	≤Wp		FLUVIAL
		D		1.0		CI/CH	CLAY, medium to high plasticity, orange, traces of fine gravel			
		D				CI/CH	CLAY, medium to high plasticity, orange, traces of fine gravel	≥Wp		
		D		2.0		CI/CH	CLAY, medium to high plasticity, orange-brown, traces of fine gravel			
		D		3.0		CI/CH	CLAY, medium to high plasticity, grey with some orange, traces of fine grained sand, fine gravel			
							BH2 Terminated at 3 m			
				4.0						
				5.0						
				6.0						
				7.0						

BOREHOLE LOG LOGS.GPJ NETWORK GEOTECHNICS PTY LTD.GDT 18/6/18

Refer To Explanation Sheets For Description Of Terms And Symbols Used.

BOREHOLE LOG

Network Geotechnics Pty Ltd
ACN 069 211 561
31 Anvil Road
Seven Hills NSW 2147
02 8468 2000
02 8468 2025

Job No:	G09/2756
Hole No:	**BH3**
Sheet:	PAGE 1 / 1
Started:	01/06/18
Finished:	01/06/18
Logged:	ZK
Checked:	VDS
RL Surface:	
Datum:	

Client: HB + B Property

Project: Proposed Channel Re Alignment

Location: Mamre Road, Orchard Hills
GPS (-)

Equipment Type: Ute Mounted Drill Rig

Borehole Diameter: 100mm(O.D.) Inclination: Bearing:

method	water	samples, tests etc	DCP Blows per 150 mm	depth (m)	graphic log	USCS symbol	Material Description	Moisture condition	Consistency/ relative density	comments / notes, structure, and additional observations
ADT	None Encountered	D		0.0		ML	Clayey SILT, low plasticity, brown, low to medium plasticity clay, traces of fine to medium gravel	D		TOPSOIL
		D				CI/CH	CLAY, medium to high plasticity, brown-orange, traces of fine gravel	≤Wp		FLUVIAL
		D		1.0						
		D				CI/CH	CLAY, medium to high plasticity, orange mottled grey, traces of fine gravel	≥Wp		
		D		2.0						
		D								
		D		3.0		CI/CH	CLAY, medium to high plasticity, orange with some grey, traces of fine grained sand, fine gravel			
							BH3 Terminated at 3 m			
				4.0						
				5.0						
				6.0						
				7.0						

BOREHOLE LOG LOGS.GPJ NETWORK GEOTECHNICS PTY LTD.GDT 18/6/18

Refer To Explanation Sheets For Description Of Terms And Symbols Used.

BOREHOLE LOG

Network Geotechnics Pty Ltd
ACN 069 211 561
31 Anvil Road
Seven Hills NSW 2147
02 8468 2000
02 8468 2025

Job No:	G09/2756
Hole No:	**BH4**
Sheet:	PAGE 1 / 1
Started:	01/06/18
Finished:	01/06/18
Logged:	ZK
Checked:	VDS
RL Surface:	
Datum:	

Client: HB + B Property

Project: Proposed Channel Re Alignment

Location: Mamre Road, Orchard Hills
GPS (-)

Equipment Type: Ute Mounted Drill Rig

Borehole Diameter: 100mm(O.D.) Inclination: Bearing:

method	water	samples, tests etc	DCP Blows per 150 mm	depth (m)	graphic log	USCS symbol	Material Description	Moisture condition	Consistency/ relative density	comments / notes, structure, and additional observations
ADT	None Encountered	D				ML	Clayey SILT, low plasticity, brown, low to medium plasticity clay, traces of fine to medium gravel	D		TOPSOIL
						CI/CH	CLAY, medium to high plasticity, orange, traces of fine gravel	≤Wp		FLUVIAL
				1.0						
						CI/CH	CLAY, medium to high plasticity, orange, traces of fine gravel	≥Wp		
						CI/CH	CLAY, medium to high plasticity, orange-brown, traces of fine gravel			
				2.0						
				3.0			BH4 Terminated at 3 m			
				4.0						
				5.0						
				6.0						
				7.0						

BOREHOLE LOG LOGS.GPJ NETWORK GEOTECHNICS PTY LTD.GDT 18/6/18

Refer To Explanation Sheets For Description Of Terms And Symbols Used.

BOREHOLE LOG

Network Geotechnics Pty Ltd
ACN 069 211 561
31 Anvil Road
Seven Hills NSW 2147
02 8468 2000
02 8468 2025

Job No:	G09/2756
Hole No:	**BH5**
Sheet:	PAGE 1 / 1
Started:	01/06/18
Finished:	01/06/18
Logged:	ZK
Checked:	VDS
RL Surface:	
Datum:	

Client: HB + B Property

Project: Proposed Channel Re Alignment

Location: Mamre Road, Orchard Hills
GPS (-)

Equipment Type: Ute Mounted Drill Rig

Borehole Diameter: 100mm(O.D.) Inclination: Bearing:

method	water	samples, tests etc	DCP Blows per 150 mm	depth (m)	graphic log	USCS symbol	Material Description	Moisture condition	Consistency/ relative density	comments / notes, structure, and additional observations
ADT	None Encountered	D				ML	Silty CLAY, medium plasticity, low plasticity silt	D		TOPSOIL
		D				CI/CH	CLAY, medium to high plasticity, grey, traces of fine gravel	≤Wp		FLUVIAL
		D		1.0		CI/CH	CLAY, medium to high plasticity, grey mottled orange, traces of fine gravel			
		D				CI/CH	CLAY, medium to high plasticity, grey mottled orange, traces of fine gravel	≥Wp		
		D		2.0		CI/CH	CLAY, medium to high plasticity, grey- brown, traces of fine gravel			
		D				CI/CH	CLAY, medium to high plasticity, brown, traces of fine gravel	>Wp		
		D		3.0			BH5 Terminated at 3 m			
				4.0						
				5.0						
				6.0						
				7.0						

BOREHOLE LOG LOGS.GPJ NETWORK GEOTECHNICS PTY LTD.GDT 18/6/18

Refer To Explanation Sheets For Description Of Terms And Symbols Used.

Proposed channel Re-Alignment, Mamre Road Orchard Hills

APPENDIX B

LABORATORY TSET RESULTS

SESL AUSTRALIA
Environment & Soil Sciences

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sample Drop Off: 16 Chilvers Road, Thornleigh NSW 2120
Mailing Address: PO Box 357, Pennant Hills NSW 1715
Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 48228 | **Sample N°: 1** | **Date Received: 12/6/18** | **Report Status:** ○ Draft ◉ Final

Client Name:	**Construction Sciences - NSW**	Project Name:	**G09/2756 Mamre Rd, Orchard Hills**
		SESL Quote N°:	
Client Contact:	**Vipul Desilva**	Sample Name:	**Composite (SS1, BH3, BH5)**
Client Order N°:		Description:	**Soil**
Address:	**31 Anvil Road** **Seven Hills NSW 2147**	Test Type:	**FSC**

RECOMMENDATIONS

This soil sample was submitted to SESL by the client for full soil chemistry analysis. Recommendations are provided on this soil's suitability for revegetation. The pH is moderately acidic with **extreme salinity**. The source of this salinity originates from sodium and chloride which dominates the exchangeable cation percentage. The eCEC is not representative of the soil as it is strongly influenced by sodicity. This soil is also magnesic and combined with sodicity, will lead to severe structural decline and hard setting. The soil is deficient in potassium, calcium, copper and boron. All other nutrients are at appropriate levels for plant growth, with the exception of magnesium and manganese, which are extreme. This soil may cause magnesium toxicity in plants by restricting potassium and calcium uptake.

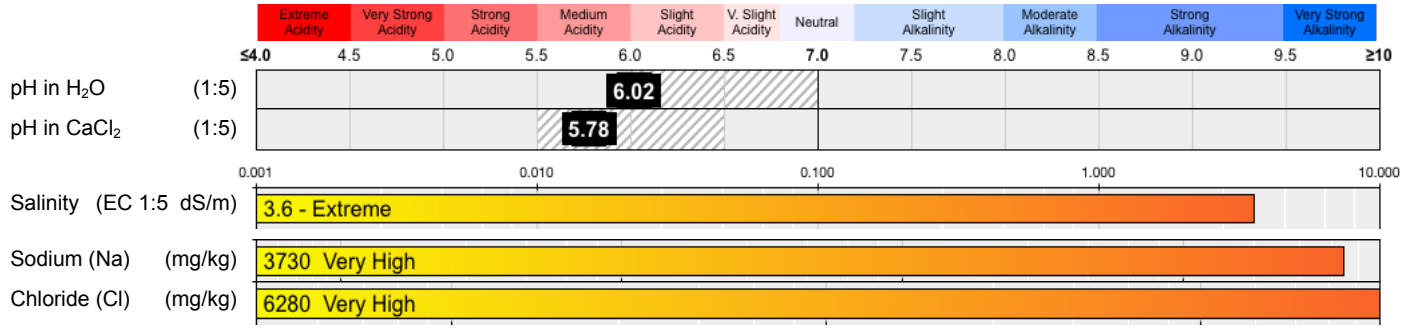
Overall, it is likely that this soil will not support healthy growth of most species that are not highly salt tolerant and most likely will present severe structural stability issues.

- Add gypsum at 900 g/m^2 followed by heavy irrigation to attempt to leach out sodium from the soil
- Repeat gypsum application in 6 months time

Gypsum will increase salinity further until leaching reduces it so choose moderately salt tolerant plants for the first sowing.

- Add muriate of potassium and urea at 20 g/m$^{2\ each}$ to improve nitrogen and potassium.

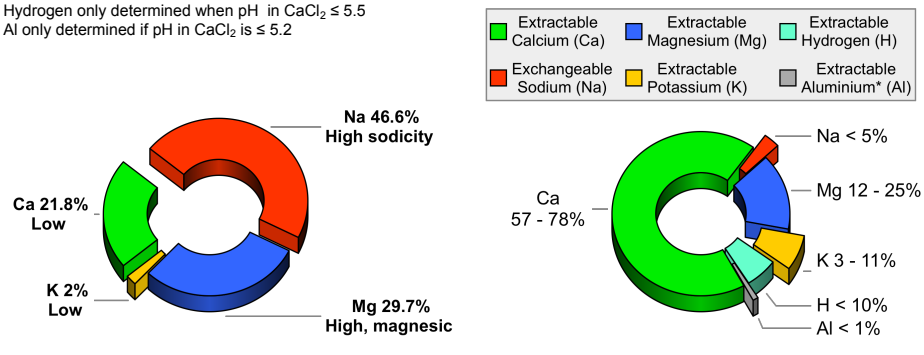
pH and ELECTRICAL CONDUCTIVITY



CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in $CaCl_2$ ≤ 5.5
Al only determined if pH in $CaCl_2$ is ≤ 5.2



EFFECTIVE CATION EXCHANGE CAPACITY (eCEC) (cmol(+)/kg)

CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	**0.7**	4.1 – 6.0
Comment: Potential Calcium deficiency		
Mg:K	**15.2**	2.6 – 5.0
Comment: Potential Potassium deficiency		
K/(Ca+Mg)	**0.04**	< 0.07
Comment: Acceptable		
K:Na	**0**	N/A

EXCHANGEABLE CATIONS (cmol(+)/kg)

Na:	K:	Ca:	Mg:	H:	Al:
16.22	0.68	7.59	10.33		

eCEC does not include correction for soluble salts as standard. Where exchangeable calcium exceeds 80 % of eCEC and/or salinity exceeds 0.75 dS/m, alternative methods are recommended to determine true eCEC.

The units of eCEC *cmol(+)/kg* are the SI unit and are equivalent to *meq/100g*.

ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS

Contact	Zubair Khan
Client	NETWORK GEOTECHNICS PTY LTD
Address	31 Anvil Rd Seven Hills NSW 2147
Telephone	02 4257 4458
Facsimile	02 4257 4463
Email	zubair.khan@constructionsciences.net
Project	**G09-2756**
Order Number	(Not specified)
Samples	30

LABORATORY DETAILS

Manager	Huong Crawford
Laboratory	SGS Alexandria Environmental
Address	Unit 16, 33 Maddox St Alexandria NSW 2015
Telephone	+61 2 8594 0400
Facsimile	+61 2 8594 0499
Email	au.environmental.sydney@sgs.com
SGS Reference	**SE179897 R0**
Date Received	1/6/2018
Date Reported	8/6/2018

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing. NATA accredited laboratory 2562(4354).

SIGNATORIES

Dong Liang
Metals/Inorganics Team Leader

Kamrul Ahsan
Senior Chemist

Shane McDermott
Inorganic/Metals Chemist

pH in soil (1:5) [AN101] Tested: 4/6/2018

PARAMETER	UOM	LOR	BH1 0.4-0.5 SOIL - 1/6/2018 SE179897.001	BH1 0.9-1.0 SOIL - 1/6/2018 SE179897.002	BH1 1.4-1.5 SOIL - 1/6/2018 SE179897.003	BH1 1.9-2.0 SOIL - 1/6/2018 SE179897.004	BH1 2.4-2.5 SOIL - 1/6/2018 SE179897.005
pH	pH Units	0.1	6.1	6.0	6.6	6.9	7.2

PARAMETER	UOM	LOR	BH1 2.9-3.0 SOIL - 1/6/2018 SE179897.006	BH2 0.4-0.5 SOIL - 1/6/2018 SE179897.007	BH2 0.9-1.0 SOIL - 1/6/2018 SE179897.008	BH2 1.4-1.5 SOIL - 1/6/2018 SE179897.009	BH2 1.9-2.0 SOIL - 1/6/2018 SE179897.010
pH	pH Units	0.1	7.8	7.2	7.3	6.9	7.3

PARAMETER	UOM	LOR	BH2 2.4-2.5 SOIL - 1/6/2018 SE179897.011	BH2 2.9-3.0 SOIL - 1/6/2018 SE179897.012	BH3 0.4-0.5 SOIL - 1/6/2018 SE179897.013	BH3 0.9-1.0 SOIL - 1/6/2018 SE179897.014	BH3 1.4-1.5 SOIL - 1/6/2018 SE179897.015
pH	pH Units	0.1	7.7	7.9	7.5	7.5	7.1

PARAMETER	UOM	LOR	BH3 1.9-2.0 SOIL - 1/6/2018 SE179897.016	BH3 2.4-2.5 SOIL - 1/6/2018 SE179897.017	BH3 2.9-3.0 SOIL - 1/6/2018 SE179897.018	BH4 0.4-0.5 SOIL - 1/6/2018 SE179897.019	BH4 0.9-1.0 SOIL - 1/6/2018 SE179897.020
pH	pH Units	0.1	7.0	7.3	7.7	7.0	5.7

PARAMETER	UOM	LOR	BH4 1.4-1.5 SOIL - 1/6/2018 SE179897.021	BH4 1.9-2.0 SOIL - 1/6/2018 SE179897.022	BH4 2.4-2.5 SOIL - 1/6/2018 SE179897.023	BH4 2.9-3.0 SOIL - 1/6/2018 SE179897.024	BH5 0.4-0.5 SOIL - 1/6/2018 SE179897.025
pH	pH Units	0.1	5.9	6.0	7.0	7.2	6.9

PARAMETER	UOM	LOR	BH5 0.9-1.0 SOIL - 1/6/2018 SE179897.026	BH5 1.4-1.5 SOIL - 1/6/2018 SE179897.027	BH5 1.9-2.0 SOIL - 1/6/2018 SE179897.028	BH5 2.4-2.5 SOIL - 1/6/2018 SE179897.029	BH5 2.9-3.0 SOIL - 1/6/2018 SE179897.030
pH	pH Units	0.1	6.8	8.6	9.0	9.0	8.9

Conductivity and TDS by Calculation - Soil [AN106] Tested: 4/6/2018

PARAMETER	UOM	LOR	BH1 0.4-0.5 SOIL - 1/6/2018 SE179897.001	BH1 0.9-1.0 SOIL - 1/6/2018 SE179897.002	BH1 1.4-1.5 SOIL - 1/6/2018 SE179897.003	BH1 1.9-2.0 SOIL - 1/6/2018 SE179897.004	BH1 2.4-2.5 SOIL - 1/6/2018 SE179897.005
Conductivity of Extract (1:5 dry sample basis)	µS/cm	1	600	970	1100	1100	960

PARAMETER	UOM	LOR	BH1 2.9-3.0 SOIL - 1/6/2018 SE179897.006	BH2 0.4-0.5 SOIL - 1/6/2018 SE179897.007	BH2 0.9-1.0 SOIL - 1/6/2018 SE179897.008	BH2 1.4-1.5 SOIL - 1/6/2018 SE179897.009	BH2 1.9-2.0 SOIL - 1/6/2018 SE179897.010
Conductivity of Extract (1:5 dry sample basis)	µS/cm	1	1000	20	89	180	390

PARAMETER	UOM	LOR	BH2 2.4-2.5 SOIL - 1/6/2018 SE179897.011	BH2 2.9-3.0 SOIL - 1/6/2018 SE179897.012	BH3 0.4-0.5 SOIL - 1/6/2018 SE179897.013	BH3 0.9-1.0 SOIL - 1/6/2018 SE179897.014	BH3 1.4-1.5 SOIL - 1/6/2018 SE179897.015
Conductivity of Extract (1:5 dry sample basis)	µS/cm	1	520	670	48	79	130

PARAMETER	UOM	LOR	BH3 1.9-2.0 SOIL - 1/6/2018 SE179897.016	BH3 2.4-2.5 SOIL - 1/6/2018 SE179897.017	BH3 2.9-3.0 SOIL - 1/6/2018 SE179897.018	BH4 0.4-0.5 SOIL - 1/6/2018 SE179897.019	BH4 0.9-1.0 SOIL - 1/6/2018 SE179897.020
Conductivity of Extract (1:5 dry sample basis)	µS/cm	1	150	140	96	18	48

PARAMETER	UOM	LOR	BH4 1.4-1.5 SOIL - 1/6/2018 SE179897.021	BH4 1.9-2.0 SOIL - 1/6/2018 SE179897.022	BH4 2.4-2.5 SOIL - 1/6/2018 SE179897.023	BH4 2.9-3.0 SOIL - 1/6/2018 SE179897.024	BH5 0.4-0.5 SOIL - 1/6/2018 SE179897.025
Conductivity of Extract (1:5 dry sample basis)	µS/cm	1	45	55	57	35	89

PARAMETER	UOM	LOR	BH5 0.9-1.0 SOIL - 1/6/2018 SE179897.026	BH5 1.4-1.5 SOIL - 1/6/2018 SE179897.027	BH5 1.9-2.0 SOIL - 1/6/2018 SE179897.028	BH5 2.4-2.5 SOIL - 1/6/2018 SE179897.029	BH5 2.9-3.0 SOIL - 1/6/2018 SE179897.030
Conductivity of Extract (1:5 dry sample basis)	µS/cm	1	500	280	210	190	110

Exchangeable Cations and Cation Exchange Capacity (CEC/ESP/SAR) [AN122] Tested: 7/6/2018

PARAMETER	UOM	LOR	BH1 1.9-2.0 SOIL - 1/6/2018 SE179897.004	BH3 0.9-1.0 SOIL - 1/6/2018 SE179897.014	BH5 2.9-3.0 SOIL - 1/6/2018 SE179897.030
Exchangeable Sodium, Na	mg/kg	2	890	130	730
Exchangeable Sodium, Na	meq/100g	0.01	3.9	0.58	3.2
Exchangeable Sodium Percentage*	%	0.1	41.8	7.3	28.7
Exchangeable Potassium, K	mg/kg	2	68	68	110
Exchangeable Potassium, K	meq/100g	0.01	0.17	0.17	0.29
Exchangeable Potassium Percentage*	%	0.1	1.9	2.2	2.6
Exchangeable Calcium, Ca	mg/kg	2	92	960	340
Exchangeable Calcium, Ca	meq/100g	0.01	0.46	4.8	1.7
Exchangeable Calcium Percentage*	%	0.1	5.0	60.2	15.3
Exchangeable Magnesium, Mg	mg/kg	2	580	300	720
Exchangeable Magnesium, Mg	meq/100g	0.02	4.7	2.4	5.9
Exchangeable Magnesium Percentage*	%	0.1	51.4	30.3	53.3
Cation Exchange Capacity	meq/100g	0.02	9.2	8.0	11

Moisture Content [AN002] Tested: 6/6/2018

PARAMETER	UOM	LOR	BH1 0.4-0.5 SOIL - 1/6/2018 SE179897.001	BH1 0.9-1.0 SOIL - 1/6/2018 SE179897.002	BH1 1.4-1.5 SOIL - 1/6/2018 SE179897.003	BH1 1.9-2.0 SOIL - 1/6/2018 SE179897.004	BH1 2.4-2.5 SOIL - 1/6/2018 SE179897.005
% Moisture	%w/w	0.5	13	13	15	15	17

PARAMETER	UOM	LOR	BH1 2.9-3.0 SOIL - 1/6/2018 SE179897.006	BH2 0.4-0.5 SOIL - 1/6/2018 SE179897.007	BH2 0.9-1.0 SOIL - 1/6/2018 SE179897.008	BH2 1.4-1.5 SOIL - 1/6/2018 SE179897.009	BH2 1.9-2.0 SOIL - 1/6/2018 SE179897.010
% Moisture	%w/w	0.5	16	4.9	8.3	8.4	12

PARAMETER	UOM	LOR	BH2 2.4-2.5 SOIL - 1/6/2018 SE179897.011	BH2 2.9-3.0 SOIL - 1/6/2018 SE179897.012	BH3 0.4-0.5 SOIL - 1/6/2018 SE179897.013	BH3 0.9-1.0 SOIL - 1/6/2018 SE179897.014	BH3 1.4-1.5 SOIL - 1/6/2018 SE179897.015
% Moisture	%w/w	0.5	15	16	6.5	7.1	10

PARAMETER	UOM	LOR	BH3 1.9-2.0 SOIL - 1/6/2018 SE179897.016	BH3 2.4-2.5 SOIL - 1/6/2018 SE179897.017	BH3 2.9-3.0 SOIL - 1/6/2018 SE179897.018	BH4 0.4-0.5 SOIL - 1/6/2018 SE179897.019	BH4 0.9-1.0 SOIL - 1/6/2018 SE179897.020
% Moisture	%w/w	0.5	10	13	14	6.5	12

PARAMETER	UOM	LOR	BH4 1.4-1.5 SOIL - 1/6/2018 SE179897.021	BH4 1.9-2.0 SOIL - 1/6/2018 SE179897.022	BH4 2.4-2.5 SOIL - 1/6/2018 SE179897.023	BH4 2.9-3.0 SOIL - 1/6/2018 SE179897.024	BH5 0.4-0.5 SOIL - 1/6/2018 SE179897.025
% Moisture	%w/w	0.5	9.0	12	14	14	11

PARAMETER	UOM	LOR	BH5 0.9-1.0 SOIL - 1/6/2018 SE179897.026	BH5 1.4-1.5 SOIL - 1/6/2018 SE179897.027	BH5 1.9-2.0 SOIL - 1/6/2018 SE179897.028	BH5 2.4-2.5 SOIL - 1/6/2018 SE179897.029	BH5 2.9-3.0 SOIL - 1/6/2018 SE179897.030
% Moisture	%w/w	0.5	13	10	13	14	13

METHOD	METHODOLOGY SUMMARY
AN002	The test is carried out by drying (at either 40°C or 105°C) a known mass of sample in a weighed evaporating basin. After fully dry the sample is re-weighed. Samples such as sludge and sediment having high percentages of moisture will take some time in a drying oven for complete removal of water.
AN101	pH in Soil Sludge Sediment and Water: pH is measured electrometrically using a combination electrode and is calibrated against 3 buffers purchased commercially. For soils, sediments and sludges, an extract with water (or 0.01M CaCl2) is made at a ratio of 1:5 and the pH determined and reported on the extract. Reference APHA 4500-H+.
AN106	Conductivity and TDS by Calculation: Conductivity is measured by meter with temperature compensation and is calibrated against a standard solution of potassium chloride. Conductivity is generally reported as µmhos /cm or µS/cm @ 25°C. For soils, an extract with water is made at a ratio of 1:5 and the EC determined and reported on the extract, or calculated back to the as-received sample. Salinity can be estimated from conductivity using a conversion factor, which for natural waters, is in the range 0.55 to 0.75. Reference APHA 2510 B.
AN122	Exchangeable Cations, CEC and ESP: Soil sample is extracted in 1M Ammonium Acetate at pH=7 (or 1M Ammonium Chloride at pH=7) with cations (Na, K, Ca & Mg) then determined by ICP OES/ICP MS and reported as Exchangeable Cations. For saline soils, these results can be corrected for water soluble cations and reported as Exchangeable cations in meq/100g or soil can be pre-treated (aqueous ethanol/aqueous glycerol) prior to extraction. Cation Exchange Capacity (CEC) is the sum of the exchangeable cations in meq/100g.
AN122	The Exchangeable Sodium Percentage (ESP) is calculated as the exchangeable sodium divided by the CEC (all in meq/100g) times 100. ESP can be used to categorise the sodicity of the soil as below: ESP < 6% non-sodic ESP 6-15% sodic ESP >15% strongly sodic Method is referenced to Rayment and Lyons, 2011, sections 15D3 and 15N1.-

FOOTNOTES

*	NATA accreditation does not cover the performance of this service.	-	Not analysed.	UOM	Unit of Measure.
		NVL	Not validated.	LOR	Limit of Reporting.
**	Indicative data, theoretical holding time exceeded.	IS	Insufficient sample for analysis.	↑↓	Raised/lowered Limit of Reporting.
		LNR	Sample listed, but not received.		

Samples analysed as received.
Solid samples expressed on a dry weight basis.

Where "Total" analyte groups are reported (for example, Total PAHs, Total OC Pesticides) the total will be calculated as the sum of the individual analytes, with those analytes that are reported as <LOR being assumed to be zero. The summed (Total) limit of reporting is calculated by summing the individual analyte LORs and dividing by two. For example, where 16 individual analytes are being summed and each has an LOR of 0.1 mg/kg, the "Totals" LOR will be 1.6 / 2 (0.8 mg/kg). Where only 2 analytes are being summed, the " Total" LOR will be the sum of those two LORs.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

If reported, measurement uncertainty follow the ± sign after the analytical result and is expressed as the expanded uncertainty calculated using a coverage factor of 2, providing a level of confidence of approximately 95%, unless stated otherwise in the comments section of this report.

Results reported for samples tested under test methods with codes starting with ARS-SOP, radionuclide or gross radioactivity concentrations are expressed in becquerel (Bq) per unit of mass or volume or per wipe as stated on the report. Becquerel is the SI unit for activity and equals one nuclear transformation per second.
Note that in terms of units of radioactivity:

a. 1 Bq is equivalent to 27 pCi
b. 37 MBq is equivalent to 1 mCi

For results reported for samples tested under test methods with codes starting with ARS-SOP, less than (<) values indicate the detection limit for each radionuclide or parameter for the measurement system used. The respective detection limits have been calculated in accordance with ISO 11929.

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here : http://www.sgs.com.au/~/media/Local/Australia/Documents/ Technical%20Documents/MP-AU-ENV-QU-022%20QA%20QC%20Plan.pdf

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SESL AUSTRALIA
Environment & Soil Sciences

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

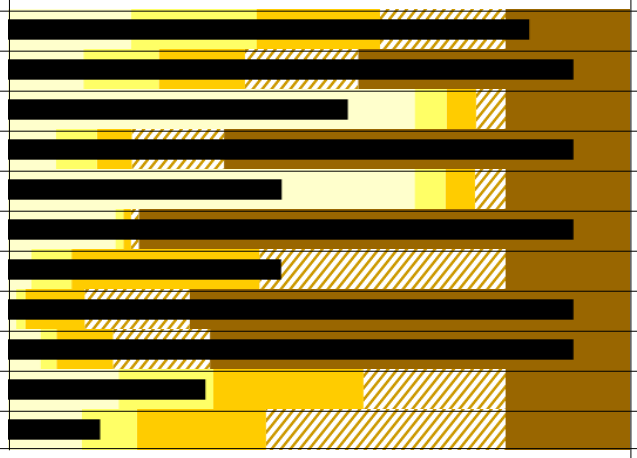
Sample Drop Off: 16 Chilvers Road, Thornleigh NSW 2120
Mailing Address: PO Box 357, Pennant Hills NSW 1715
Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 48228 | **Sample N°: 1** | **Date Received: 12/6/18** | **Report Status:** ○ Draft ◉ Final

PLANT AVAILABLE NUTRIENTS

EFFECTIVE AMELIORATION DEPTH (mm): ◉ 100 ○ 150 ○ 200 **DESIRED FERTILITY CLASS:** ○ Low ◉ Moderate ○ High

Major Nutrients	Unit	Result	Very Low / Low / Marginal / Adequate / High	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO_3)	mg N/kg	22		2.9	4	1.1
Phosphorus (P)	mg P/kg	105		14	8.4	Drawdown
Potassium (K)	mg/kg	265		35.2	51.6	16.4
Sulphur (S)	mg S/kg	178		23.7	9	Drawdown
Calcium (Ca)	mg/kg	1520		202.2	367.5	165.3
Magnesium (Mg)	mg/kg	1255		166.9	38.4	Drawdown
Iron (Fe)	mg/kg	303		40.3	73.4	33.1
Manganese (Mn)	mg/kg	137		18.2	5.9	Drawdown
Zinc (Zn)	mg/kg	14		1.9	0.7	Drawdown
Copper (Cu)	mg/kg	2.5		0.3	0.8	0.5
Boron (B)	mg/kg	0.5		0.1	0.4	0.3



Explanation of graph ranges:

Very Low — Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90 %.

Low — Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90 %.

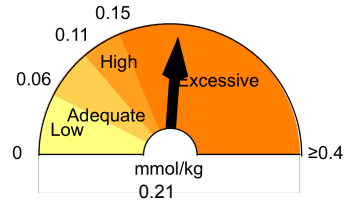
Marginal — Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60 %.

Adequate — Supply of this nutrient is adequate for the plant, and and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30 %.

High — The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2 %.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.
Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.
• g/sqm measurements are based on soil bulk density of 1.33 tonne/m^3 and effective amelioration depth.

Phosphorus Saturation Index



Excessive. Exceeds environmental threshold. Implement improved P management to reduce potential for nonpoint P pollution.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH):	-
Sum of Base Cations (cmol(+)/kg):	**34.8**
Eff. Cation Exch. Capacity (eCEC):	**34.8**
Base Saturation (%):	**100**
Exchangeable Acidity (cmol(+)/kg):	-
Exchangeable Acidity (%):	-

Lime Application Rate (g/sqm)

– to achieve pH 6.0:	**0**
– to neutralise Al:	-

Calculated Gypsum Application Rate (CGAR)
(g/sqm) to achieve 67.5 % exch. Ca: **1820**

The CGAR is corrected for the selected effective amelioration depth (100 mm) and any Lime addition to achieve pH 6.0.

PHYSICAL DESCRIPTION

Texture:	-	Munsell Colour:	-	Organic Carbon (OC %):	-
Estimated clay content:	-	Structure Size:	-	Organic Matter (OM %):	-
Tactually gravelly:	-	Structural Organisation:	-	Est. Field Capacity (% water):	-
Tactually organic:	-	Structural Unit:	-	Est. Permanent Wilting Point (% water):	-
Calculated EC_{SE} (dS/m):	-	Potential infiltration rate:	-	Est. Plant Available Water (% water):	-
Requires EC and Soil Texture result.		Est. Permeability Class (mm/hr):	-	Est. Plant Available Water (mm/m):	-
		Additional comments:			

Date Report Generated 15/06/2018

Consultant: Owen Guy

Authorised Signatory: Simon Leake

METHOD REFERENCES:
pH (1:5 H_2O) - SESL CM0002; Rayment & Lyons 4A1-2011
pH (1:5 $CaCl_2$) - SESL CM0002; Rayment & Lyons 4B4-2011
EC (1:5) - SESL CM0001; Rayment & Lyons 3A1-2011
Chloride - Rayment & Lyons 5A2a-2011
Nitrate - Rayment & Lyons 7B1a-2011
Aluminium - SESL CM0007; Rayment & Lyons 15A1-2011
P, K, S, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - SESL CM0007; Rayment & Lyons 18F1-2011
Buffer pH and Hydrogen - SSSA Methods of Soil Analysis 2007, Pt 3, Ch 17; Adams-Evans (1962)
Texture/Structure/Colour - PM0003 (Texture- "Northcote" (1992), Structure* - "Murphy" (1991), Colour- "Munsell" (2000))

*Structure analysed in the laboratory is conducted on a disturbed sample, therefore is only a representation of the macro-structures that may be present in the field, which provide an indication of the soil physical characteristics and behaviours that may exist.

Proposed channel Re-Alignment, Mamre Road Orchard Hills

APPENDIX C

INFORMATION SHEETS

Information About This Report

LIMITATIONS

Scope of Services: The report has been prepared in accordance with the scope of services set out in CS's Proposal under CS's Terms of Engagement, or as otherwise agreed with the Client. The scope of services may have been limited and/or amended by a range of factors including time, budget, access and site constraints.

Specific Purpose: The report is provided for the specific development and purpose as described in the report. The report may not contain sufficient information for developments or purposes other than that described in the report.

Currency of Information: The information in this report is considered accurate at the date of issue with regard to the current conditions of the site.

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Geotechnical and Environmental Reporting: Geotechnical and environmental reporting relies on the interpretation of factual information based on judgment and opinion and is far less exact than other engineering or design disciplines. Geotechnical and environmental reports are for a specific purpose, development and site as described in the report and may not contain sufficient information for other purposes, developments or sites (including adjacent sites) other than that described in the report.

Subsurface Conditions: Subsurface conditions can change with time and can vary between test locations. For example, the actual interface between the materials may be far more gradual or abrupt than indicated and contaminant presence may be affected by spatial and temporal patterns. Therefore, actual conditions in areas not sampled may differ from those predicted since no subsurface investigation, no matter how comprehensive, can reveal all subsurface details and anomalies. Construction operations at or adjacent to the site and natural events such as floods, earthquakes or groundwater fluctuations can also affect subsurface conditions and thus the continuing adequacy of a geotechnical report. CS should be kept informed of any such events and should be retained to identify variances, conduct additional tests if required, and recommend solutions to problems encountered on site.

Groundwater: Groundwater levels indicated on borehole and test pit logs are recorded at specific times. Depending on ground permeability, measured levels may or may not reflect actual levels if measured over a longer time period. Also, groundwater levels and seepage inflows may fluctuate with seasonal and environmental variations and construction activities.

Interpretation of Data: Data obtained from nominated discrete locations, subsequent laboratory testing and empirical or external sources are interpreted by trained professionals in order to provide an opinion about overall site conditions, their likely impact with respect to the report purpose and recommended actions in accordance with any relevant industry standards, guidelines or procedures.

Soil and Rock Descriptions: Soil and rock descriptions are based on AS 1726 – 1993, using visual and tactile assessment except at discrete locations where field and / or laboratory tests have been carried out. Refer to the accompanying soil and rock terms sheet for further information.

Further Advice: CS would be pleased to further discuss how any of the above issues could affect a specific project. We would also be pleased to provide further advice or assistance including:

- Assessment of suitability of designs and construction techniques;
- Contract documentation and specification;
- Construction control testing (earthworks, pavement materials, concrete);
- Construction advice (foundation assessments, excavation support).

Abbreviations, Notes & Symbols

SUBSURFACE INVESTIGATION

METHOD

Borehole Logs

AS#	Auger screwing (#-bit)
AD#	Auger drilling (#-bit)
B	Blank bit
V	V-bit
T	TC-bit
HA	Hand auger
R	Roller/tricone
W	Washbore
AH	Air hammer
AT	Air track
LB	Light bore push tube
MC	Macro core push tube
DT	Dual core push tube

Excavation Logs

BH	Backhoe/excavator bucket
NE	Natural exposure
HE	Hand excavation
X	Existing excavation

Cored Borehole Logs

NMLC	NMLC core drilling
NQ/HQ	Wireline core drilling

SUPPORT

Borehole Logs

C	Casing
M	Mud

Excavation Logs

S	Shoring
B	Benched

SAMPLING

B	Bulk sample
D	Disturbed sample
U#	Thin-walled tube sample (#mm diameter)
ES	Environmental sample
EW	Environmental water sample

FIELD TESTING

PP	Pocket penetrometer (kPa)
DCP	Dynamic cone penetrometer
PSP	Perth sand penetrometer
SPT	Standard penetration test
PBT	Plate bearing test
s_U	Vane shear strength peak/residual (kPa) and vane size (mm)
N*	SPT (blows per 300mm)
Nc	SPT with solid cone
R	Refusal

**denotes sample taken*

BOUNDARIES

——— Known

– – – - Probable

..... Possible

SOIL

MOISTURE CONDITION

D	Dry
M	Moist
W	Wet
Wp	Plastic Limit
Wl	Liquid Limit
MC	Moisture Content

CONSISTENCY

VS	Very Soft
S	Soft
F	Firm
St	Stiff
VSt	Very Stiff
H	Hard
Fb	Friable

DENSITY INDEX

VL	Very Loose
L	Loose
MD	Medium Dense
D	Dense
VD	Very Dense

USCS SYMBOLS

GW	Well graded gravels and gravel-sand mixtures, little or no fines
GP	Poorly graded gravels and gravel-sand mixtures, little or no fines
GM	Silty gravels, gravel-sand-silt mixtures
GC	Clayey gravels, gravel-sand-clay mixtures
SW	Well graded sands and gravelly sands, little or no fines
SP	Poorly graded sands and gravelly sands, little or no fines
SM	Silty sand, sand-silt mixtures
SC	Clayey sand, sand-clay mixtures
ML	Inorganic silts of low plasticity, very fine sands, rock flour, silty or clayey fine sands
CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays
OL	Organic silts and organic silty clays of low plasticity
MH	Inorganic silts of high plasticity
CH	Inorganic clays of high plasticity
OH	Organic clays of medium to high plasticity
PT	Peat muck and other highly organic soils

ROCK

WEATHERING

RS	Residual Soil
XW	Extremely Weathered
HW	Highly Weathered
MW	Moderately Weathered
DW*	Distinctly Weathered
SW	Slightly Weathered
FR	Fresh

**covers both HW & MW*

STRENGTH

EL	Extremely Low
VL	Very Low
L	Low
M	Medium
H	High
VH	Very High
EH	Extremely High

ROCK QUALITY DESIGNATION (%)

$$= \frac{\text{sum of intact core pieces} > 100\text{mm}}{\text{total length of section being evaluated}} \times 100$$

CORE RECOVERY (%)

$$= \frac{\text{core recovered}}{\text{core lIft}} \times 100$$

NATURAL FRACTURES

Type

JT	Joint
BP	Bedding plane
SM	Seam
FZ	Fractured zone
SZ	Shear zone
VN	Vein

Infill or Coating

Cn	Clean
St	Stained
Vn	Veneer
Co	Coating
Cl	Clay
Ca	Calcite
Fe	Iron oxide
Mi	Micaceous
Qz	Quartz

Shape

pl	Planar
cu	Curved
un	Undulose
st	Stepped
ir	Irregular

Roughness

pol	Polished
slk	Slickensided
smo	Smooth
rou	Rough

Soil & Rock Terms

SOIL

MOISTURE CONDITION

Term	Description
Dry	Looks and feels dry. Cohesive and cemented soils are hard, friable or powdery. Uncemented granular soils run freely through the hand.
Moist	Feels cool and darkened in colour. Cohesive soils can be moulded. Granular soils tend to cohere.
Wet	As for moist, but with free water forming on hands when handled.

For cohesive soils, moisture content may also be described in relation to plastic limit (W_P) or liquid limit (W_L). [>> much greater than, > greater than, < less than, << much less than].

CONSISTENCY

Term	c_u (kPa)	Term	c_u (kPa)
Very Soft	< 12	Very Stiff	100 - 200
Soft	12 - 25	Hard	> 200
Firm	25 - 50	Friable	-
Stiff	50 - 100		

DENSITY INDEX

Term	I_D (%)	Term	I_D (%)
Very Loose	< 15	Dense	65 – 85
Loose	15 – 35	Very Dense	> 85
Medium Dense	35 – 65		

PARTICLE SIZE

Name	Subdivision	Size (mm)
Boulders		> 200
Cobbles		63 - 200
Gravel	coarse	20 - 63
	medium	6 - 20
	fine	2.36 - 6
Sand	coarse	0.6 - 2.36
	medium	0.2 - 0.6
	fine	0.075 - 0.2
Silt & Clay		< 0.075

MINOR COMPONENTS

Term	Proportion by Mass coarse grained	fine grained
Trace	≤ 5%	≤ 15%
Some	5 - 2%	15 - 30%

SOIL ZONING

Layers	Continuous exposures
Lenses	Discontinuous layers of lenticular shape
Pockets	Irregular inclusions of different material

SOIL CEMENTING

Weakly	Easily broken up by hand
Moderately	Effort is required to break up the soil by hand

SOIL STRUCTURE

Massive	Coherent, with any partings both vertically and horizontally spaced at greater than 100mm
Weak	Peds indistinct and barely observable on pit face. When disturbed approx. 30% consist of peds smaller than 100mm
Strong	Peds are quite distinct in undisturbed soil. When disturbed >60% consists of peds smaller than 100mm

ROCK

SEDIMENTARY ROCK TYPE DEFINITIONS

Rock Type	Definition (more than 50% of rock consists of….)
Conglomerate	… gravel sized (> 2mm) fragments
Sandstone	… sand sized (0.06 to 2mm) grains
Siltstone	… silt sized (<0.06mm) particles, rock is not laminated
Claystone	… clay, rock is not laminated
Shale	… silt or clay sized particles, rock is laminated

STRENGTH

Term	Is50 (MPa)	Term	Is50 (MPa)
Extremely Low	< 0.03	High	1 – 3
Very Low	0.03 – 0.1	Very High	3 – 10
Low	0.1 – 0.3	Extremely High	> 10
Medium	0.3 – 1		

WEATHERING

Term	Description
Residual Soil	Soil developed on extremely weathered rock; the mass structure and substance fabric are no longer evident
Extremely Weathered	Rock is weathered to such an extent that it has 'soil' properties, i.e. it either disintegrates or can be remoulded, in water. Fabric of original rock is still visible
Highly Weathered	Rock strength usually highly changed by weathering; rock may be highly discoloured
Moderately Weathered	Rock strength usually moderately changed by weathering; rock may be moderately discoloured
Distinctly Weathered	See 'Highly Weathered' or 'Moderately Weathered'
Slightly Weathered	Rock is slightly discoloured but shows little or no change of strength from fresh rock
Fresh	Rock shows no signs of decomposition or staining

NATURAL FRACTURES

Type	Description
Joint	A discontinuity or crack across which the rock has little or no tensile strength. May be open or closed
Bedding plane	Arrangement in layers of mineral grains of similar sizes or composition
Seam	Seam with deposited soil (infill), extremely weathered insitu rock (XW), or disoriented usually angular fragments of the host rock (crushed)
Shear zone	Zone with roughly parallel planar boundaries, of rock material intersected by closely spaced (generally < 50mm) joints and /or microscopic fracture (cleavage) planes
Vein	Intrusion of any shape dissimilar to the adjoining rock mass. Usually igneous

Shape	Description
Planar	Consistent orientation
Curved	Gradual change in orientation
Undulose	Wavy surface
Stepped	One or more well defined steps
Irregular	Many sharp changes in orientation

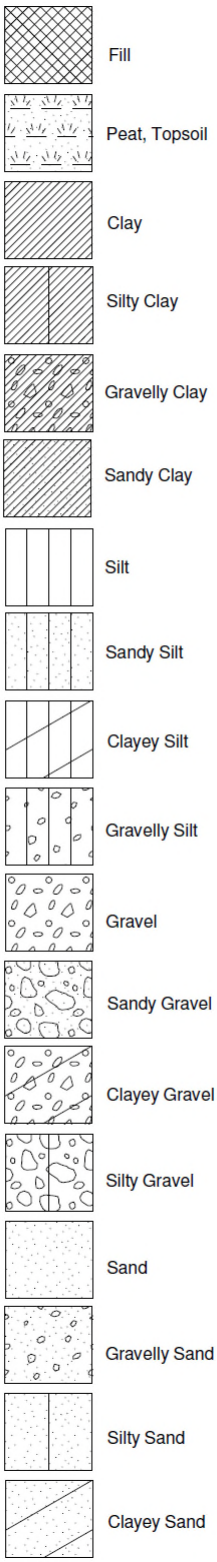
Infill or Coating	Description
Clean	No visible coating or discolouring
Stained	No visible coating but surfaces are discoloured
Veneer	A visible coating of soil or mineral, too thin to measure; may be patchy
Coating	Visible coating ≤ 1mm thick. Ticker soil material described as seam

Roughness	Description
Polished	Shiny smooth surface
Slickensided	Grooved or striated surface, usually polished
Smooth	Smooth to touch. Few or no surface irregularities
Rough	Many small surface irregularities (amplitude generally < 1mm). Feels like fine to coarse sandpaper

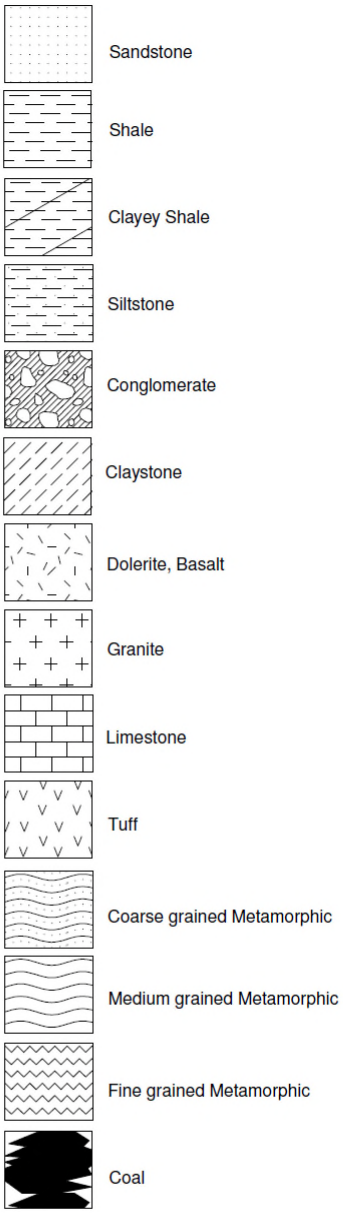
Note: soil and rock descriptions are generally in accordance with AS1726-1993 Geotechnical Site Investigations

Graphic Symbols Index

Soil

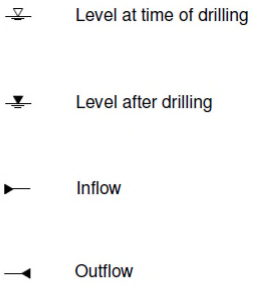


Rock



Other

Water Measurements



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