

Geotechnical Investigation

728 Selwyn Road Springston Christchurch

Submitted to: Hughes Developments Ltd Canterbury



ENGEO Limited 124 Montreal Street, Sydenham, Christchurch 8023 PO Box 373, Christchurch 8140, New Zealand Tel +64 3 328 9012 Fax +64 3 328 9013 www.engeo.co.nz

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1 Introduction

ENGEO Ltd was requested by Hughes Developments Ltd to undertake a Geotechnical Investigation for the proposed subdivision of 728 Selwyn Road, as outlined in our variation proposal (ref. P2016.000.248, dated 12 May 2017).

The purpose of this investigation was to determine a geological model of the site; assess the likely future land performance; comment on the suitability of the site for residential subdivision; address the requirements of Section 106 of the Resource Management Act (RMA); and provide recommendations for subdivision works and foundations for typical timber framed residential dwellings.

Our scope of works included the following:

- Complete a desktop study of relevant available geotechnical and geological publications, including the NZ Geotechnical and Environment Canterbury Databases;
- Undertake a geotechnical site walkover;
- Undertake fourteen hand auger boreholes with associated Scala penetrometer tests to assess the near surface material types and strength characteristics;
- Organise and technically supervise the excavation of fourteen test pits, including geotechnical logging of the exposed soils; and
- Preparation of this report outlining our findings on the ground conditions and the suitability of the site for residential subdivision. This will include geotechnical advice on the likely foundation Technical Category, conceptual foundation recommendations for typical timber framed residential dwellings, and address likely geohazards as required by Section 106 of the RMA.

2 Site Description

The site covers at total area of 10.3 ha (Figure 1), and has the legal description of Lot 2 DP 63632 and Lot 3 DP 441634 (Selwyn District Council). It is located approximately 3.4 km south of Rolleston town centre and is bound to the south-east by Selwyn Road and farmland on the remaining sides.





Figure 1: Site Location

Image obtained from Canterbury Maps. Not to scale.

The predominantly flat site is currently used as agricultural land with one residential dwelling and associated sheds and buildings (Figure 1).

There are no significant watercourses in the area and the site is outside of any ECan defined flood zones as indicated in the Selwyn District Council (SDC) Operative District Plan (SDC, 2015).

The Canterbury Earthquake Recovery Authority (CERA, now disestablished) has categorised the site as 'N/A Rural & Unmapped', meaning future development can proceed following normal consenting processes.



3 Geological Model

3.1 Regional Geology

The site has been regionally mapped by GNS (Forsyth et al., 2008) as being underlain by grey river alluvium.

3.2 Geomorphology

The site comprises relatively flat ground, with gentle undulations and depressions in some areas. As evident on aerial imagery (Canterbury Maps, 2016) and observed during our site walkover conducted on 16 May 2017, undulating and depressed ground can be attributed to paleo-channels, which traverse the site in a general northwest to southeast trend. Based on observations, silt and sand deposits with variable thickness (up to 0.7 m) are expected to have in-filled the paleo-channels where they have not remained as channel features. Inferred paleo-channels have been mapped to give an indication of areas with potential channel in-fill (Appendix 1).

Water was observed in an irrigation trench approximately 1 m wide on the north-western boundary of site. A shallow depression with standing water was observed on the north-eastern boundary.

3.3 Geohazards

3.3.1 Seismicity

There are no known or mapped faults in the immediate area of the site, however the site may be at risk of ground shaking induced by movement of proximal or distal faults.

The site is located between two recently discovered fault systems, the Greendale Fault and the Port Hills Fault, the ruptures of which initiated the ongoing Canterbury Earthquake Sequence (CES). The Greendale Fault has been mapped approximately 5 km northwest / west of the site and trends roughly east-west with a surface rupture of approximately 28 km (GNS, 2015), while the Port Hills Fault remains unmapped as the fault did not rupture at the surface. Movement on the Port Hills Fault is believed to have occurred at a depth of 1 km to 2 km below ground surface.

Large regional areas of faulting (GNS, 2015) namely the Ashley Fault, Porters Pass-Amberley Fault Zone, and the Hope and Alpine Faults, are further afield but present a high seismic hazard to the Christchurch area due to the anticipated size of earthquakes generated. The largest of these faults is the Alpine Fault, which has a return period of 250-300 years and is expected to produce a M8 earthquake. The last rupture on the Alpine Fault is believed to have occurred in 1717 (Pettinga et al., 2001).

3.3.2 Liquefaction and Lateral Spreading

The site is located within an area mapped as 'damaging liquefaction unlikely' (NZGD Map CGD5140, 2012).



3.4 Site Investigation

Site investigations to assess the shallow subsurface material types and strength characteristics were undertaken by ENGEO on 15 and 16 May 2017. The investigations comprised 14 hand auger boreholes with associated Scala penetrometer tests and 14 test pit investigations with associated Scala penetrometer tests.

The investigations revealed subsurface conditions across the site are consistent with the published geological mapping, as summarised in Table 1.

Investigations undertaken within or adjacent to inferred paleo-channels revealed deeper silt deposits to depths up to 0.7 m.

Soil Type	Depth to Top of Layer (m)	Layer Thickness (m)	Density / Consistency	Comment
TOPSOIL	0.0	0.2 - 0.3	Firm to Hard	-
SILT / Gravelly SILT / Gravelly SAND	0.1 to 0.3	0.1 to 0.4	Very Stiff to Hard / Dense	Not encountered in all test pits
Sandy GRAVEL and GRAVEL	0.2 to 0.7	Unknown	Dense	-

Table 1: Generalised Summary of Subsurface Conditions

"Good ground" (as defined in NZS 3604:2010) under static conditions was typically encountered immediately beneath the topsoil layer typically 0.3 m below ground level (maximum depth of 0.3 m).

Test Locations are shown on the site plan presented in Appendix 1. Test pit and hand auger hole logs, showing detailed soil descriptions are presented in Appendix 2.

3.5 ECan Boreholes

A review of three deep ECan borehole logs located on site (M36/3884), 80 m east of the site (M36/20687) and 120 m east of site (M36/4553) was conducted (Canterbury Maps). The location of these boreholes is presented in Figure 2 and includes the well points that have no log data available. The logs from the three holes of interest are presented in Appendix 3 and indicate the site is underlain by a mixture of gravel and sand to depths of at least 36 m below ground level. A layer of clay and clay bound gravel up to 6 m thick was encountered between 24 and 27 m below ground level.





Figure 2: Nearby ECan Borehole Locations

Image sourced from Canterbury Maps. Not to scale.

3.6 Groundwater

Groundwater level is recorded in the surrounding ECan boreholes between approximately 5.8 and 6.7 m depth. We note that the water was likely encountered in the boreholes at approximately 30 m depth within the "water-bearing gravel" layer.

3.7 Site Seismic Class

In accordance with NZS 1170.5:2004, Class D applies to this particular site, defining it as a 'deep soft soil site'.



4 Liquefaction Assessment

Based on our site investigation and observations, and owing to the nature of the subsurface materials and depth to groundwater at the site, we consider the potential for liquefaction and lateral spreading on the site to be very low.

We therefore consider the site of the proposed subdivision to have Technical Category 1 (TC1) future land performance where by future land damage from liquefaction is unlikely, and ground settlements are expected to be within normally accepted tolerances.

5 RMA Section 106 Requirements and Suitability to Subdivide

Section 106 of the Resource Management Act 1991 states a consent authority may refuse to grant a subdivision consent, or may grant a consent subject to specific consent conditions if the land is likely to be subject to the following:

- Erosion, including surface and subsurface erosion, associated with water and wind;
- Falling debris, including rockfall that could impact the site from upslope sources;
- Subsidence, which involves the removal of underlying support by natural or artificial means;
- Slippage, which is defined as the downslope transfer of materials by sliding and / or flowage; and
- Inundation, which may be sourced from streams, coastal processes or excess precipitation.

Based on our observations and the nature of the site, its performance during the CES, and the site's distance from the nearest significant watercourse, we consider it is unlikely for the site to be subject to any of the above hazards and, as such, the site is considered suitable for subdivision from a geotechnical perspective.

6 Geotechnical Recommendations

6.1 Earthworks

Earthworks carried out for the subdivision shall be in accordance with NZS 4404:2010, Land Development and Subdivision Infrastructure and NZS 4431:1989, Code of Practice for Earthfilling for Residential Development. In particular, any areas to receive fill should be stripped of any vegetation, topsoil, non-engineered fill, soft or organic soils prior to fill placement.

Fill may comprise clean natural sandy gravel or silty soils, or clean imported soils and / or granular fill, compacted to achieve no less than 95% of maximum dry density. Fill faces steeper than 2:1 and higher than 600 mm should be retained and referred back to ENGEO. Although unlikely, where any springs or groundwater seeps are encountered they should be intercepted with suitable drainage and discharged to a Council approved outlet.

All unretained batters of pond and stormwater drains constructed with the native sandy gravel material should be at an inclination of 1V:3H, with protection schemes in place to control erosion of the formed batters within the waterways.



A comprehensive earthworks specification should be provided to the earthworks contractor prior to starting excavations and an inspection / testing regime agreed, along with a robust erosion and sediment control plan.

6.2 Subdivision Roading

Vegetation, any organic or deleterious material, topsoil and non-engineered fill should be removed from the site under pavement areas prior to aggregate placement. Based on our observations during testing, we consider the natural ground below the topsoil at the site should provide an adequate subgrade for the proposed pavement areas.

6.3 Stormwater Control

Concentrated stormwater flows from all impermeable areas must be collected and carried in sealed pipes to the Council system or an alternative disposal point subject to approval from Council. Uncontrolled stormwater must not be allowed to saturate the ground as this will potentially affect future foundation performance both statically and during future seismic activity.

6.4 Foundations

Foundations for future proposed residential dwellings within the subdivision may comprise pad, strip or slab foundations designed in accordance with the provisions of NZS 3604 Timber Framed Buildings.

An Ultimate Bearing Capacity of 300 kPa may be assumed for foundations bearing on natural silt, sandy gravel or engineered fill, below any topsoil. We anticipate this to be below 0.3 m depth based on our subsurface investigations.



7 References

Canterbury Earthquake Recovery Authority. New Zealand Geotechnical Database. Retrieved May 2017, from https://canterburyrecovery.projectorbit.com/cgd.

Canterbury Maps, Groundwater. Retrieved May, 2017 from http://canterburymaps.govt.nz/Viewer.

- Forsyth, P., Barrell, D. J., & Jongens, R. (2008). Sheet 16 Geology of the Christchurch Area 1:250,000. Lower Hutt: Institute of Geological and Nuclear Sciences.
- GNS Science, Earthquake Commission. (n.d.). Aftershocks. Retrieved 2013, from Geonet: www.geonet.org.nz/canterbury-quakes/aftershocks.
- GNS Science (2015). New Zealand Active Faults Database. Retrieved May 2017, from http://data.gns.cri.nz /af/.

The Ministry of Business, Innovation, and Employment (2016). New Zealand Geotechnical Database. Retrieved May 2017, from https://www.nzgd.org.nz.

- Standards Association of New Zealand (2004). NZS 1170.5:2004. Structural Design Actions Part 5: Earthquake Actions – New Zealand.
- Standards Association of New Zealand (2010). NZS 3604:2010. Timber Framed Buildings.
- Standards Association of New Zealand (2010). NZS 4404:2010. Land Development and Subdivision Infrastructure.
- Standards Association of New Zealand (1989). NZS 4431:1989. Code of Practice for Earthfilling for Residential Development.
- Pettinga J.R., Yetton M.D., Van Dissen R.J., & Downes G. (2001). Earthquake Source Identification and Characterisation for the Canterbury Region, South Island, New Zealand. Bulletin of the New Zealand Society for Earthquake Engineering, Vol 34, No. 4, pp 282-317.
- Selwyn District Council (2015), Selwyn District Council Operative District Plan. Retrieved 2016, from http://www.selwyn.govt.nz/services/planning/district-plan.
- Selwyn District Council, Property Search, retrieved May 2017 from https://www.selwyn.govt.nz/my-property/rates/search-properties.



8 Limitations

- i. We have prepared this report in accordance with the brief as provided. This report has been prepared for the use of our client, Hughes Developments Ltd, their professional advisers and the relevant Territorial Authorities in relation to the specified project brief described in this report. No liability is accepted for the use of any part of the report for any other purpose or by any other person or entity.
- ii. The recommendations in this report are based on the ground conditions indicated from published sources, site assessments and subsurface investigations described in this report based on accepted normal methods of site investigations. Only a limited amount of information has been collected to meet the specific financial and technical requirements of the client's brief and this report does not purport to completely describe all the site characteristics and properties. The nature and continuity of the ground between test locations has been inferred using experience and judgement and it should be appreciated that actual conditions could vary from the assumed model.
- iii. Subsurface conditions relevant to construction works should be assessed by contractors who can make their own interpretation of the factual data provided. They should perform any additional tests as necessary for their own purposes.
- iv. This Limitation should be read in conjunction with the IPENZ / ACENZ Standard Terms of Engagement.
- v. This report is not to be reproduced either wholly or in part without our prior written permission.

We trust that this information meets your current requirements. Please do not hesitate to contact the undersigned on (03) 328 9012 if you require any further information.

Report prepared by

Jed Watts Engineering Geologist

Report reviewed by

Greg Martin, PEngGeol, PEngGeol Principal Engineering Geologist





APPENDIX 1: Site Plan and Test Locations





REF's: selwyn-0125m-urban-aerial-photos-2012-13

ORIGINAL FIGURE PRINTED IN COLOUR



APPENDIX 2:

Test Pit and Hand Auger Borehole Logs



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Depth (m)	Material	Excava (Relativ	atability /e Scale) Harder	USCS Symbol	DE	SC	RIP	TIO	N			Ciderer Ciderer	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index		She Un Shear Peak/ (ar Va drain Stre Remo kPa)	ane ed ength olded		Scala Blov 2 4	a Per vs pe 6	netro er 10 8	mete 0mn 10	er n 12
-	TOPSOIL			ML	SILT with trace plasticity [TOPS	root SOIL	lets;].	brow	/n. Lo	wc						F-SI	t						•		•	•
0.5 -	-			SP	Gravelly fine to brown. Poorly g coarse, subrout	med grade nded	lium ed. G I.	SAN	ID; gi I, fine	reyisl e to	h					MD-I	D								-	
	ALLUVIUM			GW	Sandy fine to ca cobbles; brown subrounded. Sa	oarse ish g and,	e GR	AVE Well to co	L wit grac arse	h tra	ace				М	D										>>
			· · ·		Depth of Excave Termination Co	ation Indition	1: 2 n on: F	n Pract	ical r	efusa	al															
Sca Sta	la Pe nding	enetrom	leter met dwater w	practi as not	cal refusal encountered																					

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	Ge	eotecl 728 1290	hnical 3 Selw Rolle 3.000	Inve yn R ston .000	stigation coad - 019	Client Date Max Test Pit Depth Digger Type/Size Bucket Type/Size	: Hughes : 16/05/1 : 2 m : Bucket	Dev 7 Exca	elopr vator	nent Ltd	Shear Vane No Logged By Reviewed By Latitude Longitude	•: •:RP •:JW •:JW	, /		
Depth (m)	Material	Excav (Relativ	atability /e Scale) Jarder Hard	USCS Symbol	DES	CRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength Peak/Remolded (kPa)	Sca Bl 2	ala Pe ows p 4 6	netron er 100	neter mm 0 12
-	TOPSOIL			ML	SILT with trace ro plasticity [TOPSO	ootlets; brown. Low IIL].	$\frac{\sqrt{1}}{\sqrt{1}} + \frac{\sqrt{1}}{\sqrt{1}}			F-St		•	/		
0.5 -					Sandy fine to coar silt and trace cobt graded, subround	rse GRAVEL with mind bles; brownish grey. W ed. Sand, fine to coars	or ell e.								
	ALLUVIUM			GW					м	D					
- - 2.0					Depth of Excavati Termination Conc	on: 2 m lition: Practical refusal									
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	Ge	eotec 728 1290	hnical 8 Selw Rolle 03.000	Inve /yn F eston 0.000	estigation Road - 019	Client Date Max Test Pit Depth Digger Type/Size Bucket Type/Size	: Hughes : 16/05/1 : 2 m : Bucket :	Dev 7 Exca	elopr	nent Ltd	Shear Vane No Logged B Reviewed B Latitude Longitude): /:RP /:JW):JW		
Depth (m)	Material	Excav (Relatin Jasier Lasier Lasier	vatability ve Scale Tarder H	USCS Symbol	DES	SCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength Peak/Remolded (kPa)	Sca Blo 2	la Penet ws per 1 4 6 8	rometer 100mm 3 10 12
-	TOPSOIL			ML	SILT with trace r plasticity [TOPS	ootlets; brown. Low OIL].	<u>x 17</u> 17 - <u>x 17</u> - <u>x 17</u> 17, <u>x 17</u>			F-St				
0.5 -				GM	Silty fine to coars sand; greyish bro subrounded. Sar	se GRAVEL with trace own. Well graded, nd, fine.				D				•
-					Sandy fine to co cobbles; brownis subrounded. Sar	arse GRAVEL with trac sh grey. Well graded, nd, fine to coarse.	e							
-	ALLUVIUM			GW						D				
1.5 - - - -							•							
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Tes Sca Sta	t pit la Pe nding	reache enetron g groun	d target on neter me dwater v	depth t pract vas not	ical refusal t encountered	<u></u>	 	_i		<u>, i</u>				<u> </u>

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	Ge	eotecl 728 1290	hnical 3 Selw Rolle 3.000	Inve yn R ston	stigation Road - 019	Client Date Max Test Pit Depth Digger Type/Size Bucket Type/Size	: Hughes : 16/05/1 : 2 m : Bucket I :	Dev 7 Exca	elopr vator	nent Ltd	Shear Vane No Logged By Reviewed By Latitude Longitude): r:RP r:JW):		
Depth (m)	Material	Excava (Relativ Basier E	atability /e Scale) Jarder Harder	USCS Symbol	DES	CRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength Peak/Remolded (kPa)	Scala F Blows 2 4	² enetrome per 100m <u>6 8 10</u>	/ter m 12
-	TOPSOIL			ML	SILT with trace ro plasticity [TOPSC	ootlets; brown. Low DIL]. RAVEL with some silt	$\frac{1}{1} \frac{1}{1} \frac{1}$	•		F-St		•		• • • • • • • • • • • • • • • • • • • •
-				GW	and trace sand; g graded, subround	ded. Sand, fine.				D				/>
0.5 -					Sandy fine to coa cobbles; brownisi subrounded. San	arse GRAVEL with trace h grey. Well graded, id, fine to coarse.	3							
1.0— - -	ALLUVIUM			GW					M	D				
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Sca Star	la Pending	enetrom g groun	neter me dwater w	t practi as not	cal refusal encountered									

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	Ge	eotec 728 1290	hnical 3 Selw Rolle)3.000	Inve yn F ston .000	estigation Road - 019	Client Date Max Test Pit Depth Digger Type/Size Bucket Type/Size	: Hughes : 16/05/1 : 2 m : Bucket	Dev 7 Exca	elopr vator	nent Ltd	Shear Vane N Logged B Reviewed B Latitud Longitud	o): y):RP y):JW e): e):	
Depth (m)	Material	Excav (Relativ .ses 	ratability ve Scale) Jarder Harder	USCS Symbol	DES	CRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength Peak/Remolded (kPa)	Scala F Blows 2 4	Penetrometer per 100mm 6 8 10 12
-	TOPSOIL			ML	SILT with trace rc plasticity [TOPSO	ootlets; brown. Low DIL].	$\frac{\sqrt{1}}{2} \frac{1}{\sqrt{2}$			F-St			
- 0.5 -				GM	Silty fine to coarse sand; greyish bro subrounded. Sand	e GRAVEL with trace wn. Well graded, d, fine.				D			
	ALLUVIUM			GW	Sandy fine to coa cobbles; brownish subrounded. Sand	rse GRAVEL with track n grey. Well graded, d, fine to coarse.			М	D			∕⊼
					Depth of Excavati Termination Conc	ion: 2 m dition: Practical refusal							

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Depth (m)	Material	Easier leJ)	cavatabi ative Sc	Harder (əle:	USCS Symbol			C)ES	CR	(IPT	-101	N				Graphic Symbol	Water Level	Moisture Cond.	Consistencv/	Density Index	S l She Pea	hear Jndr ear S ik/Re (kł	· Var aine Strer emol Pa)	ne d ngth Ided	S 1 2	icala Blow	ı Per vs pe 6	netro er 10 8	mete 0mn <u>10 -</u>	ər n 12
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0.5 -	-				GW	Sar silt; sub	ndy fii grey pround	ne to ish b ded.	o coa prowr San	rse n. W d, fir	GRA /ell g ne to	VEI grade me	∟ wit ed, ediun	th so n.	ome					1	D							•		·····	/ .
	GW Sandy fine t silt; greyish subrounded Sandy fine t cobbles; bro subrounded GW Depth of Ex Termination							f Exc	o coa vnish San	rse n gre d, fin	GRA ey. V ne to 2 m		_ wit grad arse.	th tr	ace				М		D										
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	Ge	eotec 728 1290	hnical 3 Selw Rolle)3.000	Inve /yn R eston .000	stigation Road - 019	Client Date Max Test Pit Depth Digger Type/Size Bucket Type/Size	: Hughes : 16/05/17 : 2 m : Bucket E :	Dev 7 Exca	elopr vator	ment Ltd	Shear Vane No Logged By Reviewed By Latitude Longitude): /:RP /:JW):	
Depth (m)	. Material	Excav (Relativ Easier	atability ve Scale) Harder H	USCS Symbol	DES	CRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength Peak/Remolded (kPa)	Scala P Blows p 2 4 6	enetrometer per 100mm <u>6 8 10 12</u>
-	TOPSOIL			ML	SILT with trace ro plasticity [TOPSO Sandy fine to coar silt: grevish brown	otlets; brown. Low IL]. rse GRAVEL with som). Well graded.	e			F-St			
- 0.5 - -				GW	subrounded. Sand	d, fine to medium.				D			
- - 1.0	LUVIUM				Sandy fine to coar cobbles; brownish subrounded. Sand	rse GRAVEL with trace grey. Well graded, d, fine to coarse.			м				
	AL			GW						D			
- 2.0—					Depth of Excavation Termination Cond	on: 2 m lition: Practical refusal							
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	Ge	eotec 728 1290	hnical 3 Selw Rolle)3.000	Inve yn R ston .000	estigation Road - 019	Client Date Max Test Pit Depth Digger Type/Size Bucket Type/Size	: Hughes : 16/05/17 : 2 m : Bucket E :	Dev 7 Exca	elopr vator	nent Ltd	Shear Vane No Logged B Reviewed B Latitude Longitude): /:RP /:JW	
Depth (m)	Material	Excav (Relativ Lasier E	ratability ve Scale) Jager Hatter	USCS Symbol	DES	CRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength Peak/Remolded (kPa)	Scala F Blows 2 4	Penetrometer per 100mm <u>6 8 10 12</u>
-	TOPSOIL			ML	SILT with trace ro plasticity [TOPSC Fine to coarse GF	ootlets; brown. Low DIL]. RAVEL with some silt	$\frac{y^{1}}{l_{f}} + \frac{y^{2}}{s^{2}} + \frac{y^{2}}{s^{2}}$	•		F-St		•	······································
-				GW	and sand; greyish subrounded. Sand	brown. Well graded, d, fine.				D			
0.5 -					Sandy fine to coa cobbles; brownish subrounded. Sand	rse GRAVEL with trace n grey. Well graded, d, fine to coarse.							
1.0	ALLUVIUM			GW					М	D			
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Depth (m)	Material	Exca (Relat) Easier	vatability ive Scale	USCS Symbol		DES	CRIF	PTIO	N			Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength Peak/Remolded (kPa)	S E 2	cala P Blows (enetro per 1(<u>6 8</u>	omete 00mm <u>10 1</u>	r: ۱
-	TOPSOIL			ML	SILT with plasticity	h trace ro [TOPSC	ootlets: DIL].	; brow	n. Lov	N					F-St						•
0.5 -				GW	Fine to c and sand subround	coarse G d; greyish ded. San	RAVEL n brown d, fine	L with n. We	some Il grad	silt led,					D			•			/>
	ALLUVIUM			GW	Sandy fil cobbles; subround	Excavat	ion: 2	RAVE Well to coa	L with grade arse.	trace				Μ	D						
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Depth (m)	Material	Exca (Relat) Easier Easier	vatability ive Scale	USCS Symbol	DES	CRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength Peak/Remolded (kPa)	Scala Pe Blows p 2 4 6	enetrometer er 100mm
-	TOPSOIL			ML	SILT with trace ro plasticity [TOPSO	otlets; brown. Low IL].	$\frac{\sum_{i=1}^{n} \frac{1}{i_{i_{i_{i_{i_{i_{i_{i_{i_{i_{i_{i_{i_{$			F-St			
0.5 -				GW	Fine to coarse GF and sand; greyish subrounded. Sand	RAVEL with some silt brown. Well graded, d, fine.				D)
-					Sandy fine to coal cobbles; brownish subrounded. Sand	rse GRAVEL with trace a grey. Well graded, d, fine to coarse.							
1.0	LUVIUM								м				
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	Ge	otec 72 129	chnical Investigation 8 Selwyn Road Rolleston 03.000.000 - 019	Client F D Hole De Hole Diame	Ref. : N ate : 1 pth : 0 ter : 5	l/A 5/05 .3 m 0 mr	/17 n	velopme	nt Lto Shear Vi Logi Reviev Li Lor	ged By : EG wed By : JW atitude : ngitude :
Depth (m)	Material	USCS Symbol	DESCRIPTION		Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Scala Penetrometer Blows per 100mm 2 4 6 8 10 12
-	TOPSOIL	ML	SILT with trace sand and rootlets; plasticity [TOPSOIL].	brown. Low	<u>x 1, x 1</u> 1 <u>1</u> - <u>x 1,</u> <u>x 1<u>7</u> - <u>x 1</u> <u>1<u>7</u> - <u>x 1</u>7 <u>17</u> - <u>x 1</u>7 - <u>x 17</u> - <u>x 1</u>7</u></u>		М	S		•
-			End of Hole Depth: 0.3 m Termination Condition: Practical re	fusal	$\frac{1}{1}$ (λ, l)			VSt		
0.5 -										
-										
1.0										
1.5 -										
2.0- 										
Ha Sc Sta	ind ai ala P andin	uger n 'enetro Ig grou	net practical refusal at 0.3 m depth o ometer met practical refusal at 0.5 n undwater was not encountered	on inferred grav n depth.	el.					

		E	Expect Excellence		LC	C	GC)F A	UGER H	IAO	3			
	Ge	oteo 72 129	chnical Investigation 8 Selwyn Road Rolleston 03.000.000 - 019	Cli Client F D Hole De Hole Diame	ent :H Ref. :N ate :1 pth :0 eter :5	lughe I/A 5/05 .3 m 0 mr	es De /17 n	velopme	nt Ltd Shear Va Log Review La Lor	ane No ged By wed By atitude ngitude	: 2022 : EG : JW :			
:pth (m)	aterial	SCS Symbol	DESCRIPTION		aphic Symbol	ater Level	visture Cond.	insistency/ insity Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	S	cala Per Blows pr	netrom	neter	
- -	TOPSOIL Ma	ML	SILT with trace sand and rootlets; plasticity [TOPSOIL].	brown. Low	<u>U</u>	N N	≥ MG	<u> </u>		2	4 6	8	<u>10 1</u>	2
-			End of Hole Depth: 0.3 m Termination Condition: Practical re	fusal	1/2	8						/		
0.5 -														
-														
-														
1.0-														
-														
1.5 -														
-	-													
	-													
2.0-												•		
-														
Ha Sc	and a ala P andin	uger n 'enetro Ig grou	net practical refusal at 0.3 m depth o ometer met practical refusal at 0.5 n undwater was not encountered	on inferred grav n depth.	el.				I	I :	· · · ·	_:	<u> </u>	

		E	NGEO Expect Excellence		L	C	G C)F A	UGER H	A04	
	Ge	eoteo 72 129	chnical Investigation 28 Selwyn Road Rolleston 03.000.000 - 019	Cli Client F D Hole De Hole Diame	ent :⊢ Ref. :N ate :1 pth :0 eter :5	lughe J/A 5/05 .3 m 0 mr	es De /17 n	velopme	nt Ltd Shear Va Logg Reviev La Lon	ane No: 2022 ged By: EG/JC ved By: JW atitude: gitude:	
Jepth (m)	/aterial	JSCS Symbol	DESCRIPTION		sraphic Symbol	Vater Level	Aoisture Cond.	consistency/ consity Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Scala Penetromete Blows per 100mm	er 1
	TOPSOIL	ML	SILT with trace sand and rootlets; plasticity [TOPSOIL].	brown. Low		>	M	S-St			
- 0.5 -	-		End of Hole Depth: 0.3 m Termination Condition: Practical re	fusal	14, <u>3</u> , 14, 5	3			UTP		×
	-										
	-										
2.0-	-										
Ha So St	and a ala P andin	uger r Penetr Ig groi	net practical refusal at 0.3 m depth o ometer met practical refusal at 0.5 n undwater was not encountered	on inferred grav m depth.	el.						

	Ge	eoteo 72	chnical Investigation 8 Selwyn Road Rolleston 03.000.000 - 019	Cli Client F D Hole De	ent : H Ref. : N ate : 1 pth : 0	DC lughe I/A 5/05	GC es De)FA	NUGER H	A05 ane No : 2022 ged By : EG/RP ved By : JW atitude :
Jepth (m)	<i>A</i> aterial	JSCS Symbol	DESCRIPTION	Hole Diame	Graphic Symbol	Vater Level	Aoisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Scala Penetrometer Blows per 100mm
-	TOPSOIL	ML	SILT with minor sand and trace roo Low plasticity. Sand, fine [TOPSO	otlets; brown. IL].			M	S-St		
-	A	ML	Gravelly SILT with minor sand; bro plasticity. Gravel, fine to medium, p	wn. Low boorly graded.		5		н		
0.5 - - - 1.0	-		End of Hole Depth: 0.4 m Termination Condition: Practical re	fusal						
2.0-										
Ha Sc Sta A =	nd a ala P andin = ALI	uger r Penetro Ig grou LUVIL	net practical refusal at 0.4 m depth of ometer met practical refusal at 0.6 m undwater was not encountered JM	on inferred grav	el.					

		E			LC	00	GC)F A	UGER H	A06			
	Ge	eoteo 72 129	chnical Investigation 8 Selwyn Road Rolleston 03.000.000 - 019	Clin Client F D Hole De Hole Diame	ent :⊢ Ref. :N ate :1 pth :0	lugh I/A 5/05 0.4 m	es De /17 n	velopme	nt Ltd Shear Va Logg Reviev La Lon	ane No:2 ged By:E ved By:J' atitude: gitude:	022 G/RP W		
Depth (m)	Material	USCS Symbol	DESCRIPTION		Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Scal Blov 2 4	a Peno ws per 6	etrome • 100m 8 1	ter ۱m 0 12
-	TOPSOIL	ML	SILT with minor sand and trace roo Low plasticity. Sand, fine [TOPSO	otlets; brown. IL].	<u>21.2</u> <u>17.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>21.2</u> <u>2</u>		w	S-F		•			
-	A	ML	Gravelly SILT with minor sand; bro plasticity. Gravel, fine to medium, p	wn. Low boorly graded.		3		н		•			
- 0.5			End of Hole Depth: 0.4 m Termination Condition: Practical re	fusal					UTP				*
1.0													
Ha Science Sta Geogeneer A	and a ala F andin = ALI	uger r Penetro g grou _UVIL	net practical refusal at 0.4 m depth of ometer met target depth at 0.6 m. undwater was not encountered IM	on inferred grav	el.								

	Ge	eoteo 72	chnical Investigation 8 Selwyn Road Rolleston 03.000.000 - 019	Cli Client I D Hole De Hole Diame	ient : F Ref. : N Date : 1 Spth : 0 eter : 5	D lughe 1/A 5/05 0.3 m	GC es De /17 n)F A	NUGER H Int Ltd Shear V Log Review L Lor	ane No : : ged By : : wed By : : atitude : ngitude :	2022 RP/EG JW		
Depth (m)	Material	JSCS Symbol	DESCRIPTION		Graphic Symbol	Nater Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Sca Blo	ila Pene	etromet	ier n 12
-	TOPSOIL	ML	SILT with trace gravel and rootlets plasticity. Gravel, fine to medium, s [TOPSOIL].	; brown. Low subrounded	<u>-112</u> <u>111</u> <u>117</u> <u>-24</u> -17 <u>-116</u> <u>-117</u> <u>117</u> <u>-117</u> <u>117</u> <u>-117</u> <u>117</u> <u>-117</u>		M	S-VSt			,		
-			End of Hole Depth: 0.3 m Termination Condition: Practical re	fusal	$f_{j} = \sqrt{f_{j}}$							•	
0.5 -	-												
-	-												>>
-													
-													
-													
-	-												
-	-										- - - - - - - - - -		
-	-												
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	-												
2.0													
Ha Sc Sta	and a ala P andin	uger r Penetro Ig grou	net practical refusal at 0.3 m depth o ometer met practical refusal at 0.6 undwater was not encountered	on inferred grav m depth.	/el.								

		E			L	C	G ()F A	UGER H	IA08			
	Ge	oteo 72 129	chnical Investigation 28 Selwyn Road Rolleston 03.000.000 - 019	Cli Client I D Hole De Hole Diame	ient : H Ref. : N Date : 1 Spth : 0 Seter : 5	lughe I/A 5/05 0.2 m	es De /17 n	velopme	nt Ltd Shear V. Log Review Li Lor	ane No: 20 ged By: RF wed By: JW atitude: ngitude:	22 ?/EG /		
Depth (m)	Material	USCS Symbol	DESCRIPTION		Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Scala Blow 2 4	Penetro s per 100 6 8	meter Omm 10 1	2
-	TOPSOIL	ML	SILT with trace gravel and rootlets plasticity. Gravel, fine to medium, s [TOPSOIL]. End of Hole Depth: 0.2 m Termination Condition: Practical re	; brown. Low subrounded fusal	$\frac{\sqrt{t_2}}{\sqrt{t_1}} \frac{\sqrt{t_2}}{\sqrt{t_1}} \frac{\sqrt{t_2}}{\sqrt{t_2}}$		М	S-VSt		•			
- 0.5	-												•
-	-												· · · · · · · · · · · · · · · · · · ·
1.0	-												•
- 1.5 -	-												•
	-												
Ha Sc St	and a and a and P andin	uger r 'enetro ig grou	net practical refusal at 0.2 m depth o ometer met practical refusal at 0.6 n undwater was not encountered	on inferred grav m depth.	/el.								

	Ge	eoteo 72	chnical Investigation 8 Selwyn Road Rolleston 03.000.000 - 019	Cli Client I E Hole De Hole Diame	L ient : H Ref. : N Date : 1 opth : 0 eter : 5	Ughe J/A 5/05 0.3 m	G C es De /17	DF A	UGER H ent Ltd Shear V Log Revier L Log	ane No : ged By : wed By : atitude :	2022 RP/EG JW	i	
Depth (m)	Aaterial	JSCS Symbol	DESCRIPTION		Sraphic Symbol	Nater Level	Aoisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Sc.	ala Pen ows per	etrome r 100m	eter
-	TOPSOIL	ML	SILT with trace gravel and rootlets plasticity. Gravel, fine to medium, s [TOPSOIL].	; brown. Low subrounded	$\frac{\langle \mathbf{x}^{\dagger} \rangle_{\mathbf{y}}}{\langle \mathbf{y}^{\dagger} \rangle \langle \mathbf{x}^{\dagger} \rangle_{\mathbf{y}}} = \frac{\langle \mathbf{x}^{\dagger} \rangle_{\mathbf{y}}}{\langle \mathbf{x}^{\dagger} \rangle_{\mathbf{y}}}$ $= \frac{\langle \mathbf{x}^{\dagger} \rangle_{\mathbf{y}}}{\langle \mathbf{x}^{\dagger} \rangle_{\mathbf{y}}} = \frac{\langle \mathbf{x}^{\dagger} \rangle_{\mathbf{y}}}{\langle \mathbf{x}^{\dagger} \rangle_{\mathbf{y}}}$ $= \frac{\langle \mathbf{x}^{\dagger} \rangle_{\mathbf{y}}}{\langle \mathbf{x}^{\dagger} \rangle_{\mathbf{y}}} = \frac{\langle \mathbf{x}^{\dagger} \rangle_{\mathbf{y}}}{\langle \mathbf{x}^{\dagger} \rangle_{\mathbf{y}}}$		M	S-St		•			
-			End of Hole Depth: 0.3 m Termination Condition: Practical re	fusal	$i_j \propto i_j$.								
0.5 -	-												^ ^
-													
-	-												
-	-												
1.0	-												
-	-												
	-												
1.5 -	-												
-	-												
-													
- 	-												
2.0													
1													
Ha Sc Sta	and a ala P andin	uger r enetro g grou	net practical refusal at 0.3 m depth o ometer met practical refusal at 0.5 n undwater was not encountered	on inferred grav m depth.	/el.								

		E		LOG OF AUGER HA10											
	Ge	oteo 72 129	chnical Investigation 28 Selwyn Road Rolleston 03.000.000 - 019	Cli Client I D Hole De Hole Diame	ent : H Ref. : N Pate : 1 pth : 0 Ster : 5	lughe I/A 5/05 2 m	es De /17 n	velopme	Logged By : RP/EG Reviewed By : JW Latitude : Longitude :						
Depth (m)	Material	USCS Symbol	DESCRIPTION		Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	2	Scala F Blows 4	Penet	rome 100m 8 1(ter m 0 12	
-	TOPSOIL	ML	SILT with trace gravel and rootlets plasticity. Gravel, fine to medium, s [TOPSOIL]. End of Hole Depth: 0.2 m Termination Condition: Practical re	; brown. Low subrounded fusal	<u>17. 17. 10</u> <u>17. 17. 17.</u> <u>17. 17. 17.</u> <u>17. 17. 17.</u>		М	S-F		•		•			
- - 0.5 -	-										×				/>
-	-										· · · · · · · · · · · · · · · · · · ·	•			
- 1.0 -	-											•			
	-														
1.5 - - -	-											• • • • • • • • • • • • • • • • • • • •			
- - 2.0	-											•			
-	and a		net practical refusal at 0.2 m denth (on inferred grav								-			
Sc	and a andin	enetro g grou	ometer met practical refusal at 0.2 m deptit ometer met practical refusal at 0.5 i undwater was not encountered	m depth.	сı.										

		E			L	C	6 C)F A	UGER H	A11				
	Ge	eoteo 72 129	chnical Investigation 8 Selwyn Road Rolleston 03.000.000 - 019	Cli Client F D Hole De Hole Diame	ent : - Ref. : N ate : 1 pth : 0 eter : 5	lugha I/A 6/05 0.2 m 50 mr	es De /17 n	velopme	pment Ltd Shear Vane No : 2022 Logged By : RP Reviewed By : JW Latitude : Longitude :					
Depth (m)	Material	USCS Symbol	DESCRIPTION		Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Sca Blc 2 4	la Pen ws per 6	etrome r 100m 8 1	eter Im 0 12	2
-	TOPSOIL	ML	SILT with trace gravel and rootlets: plasticity. Gravel, fine to medium, s [TOPSOIL]. End of Hole Depth: 0.2 m Termination Condition: Practical re	; brown. Low subrounded fusal	$\frac{\sqrt{4}}{\sqrt{2}} \frac{\sqrt{2}}{\sqrt{4}} \frac{\sqrt{4}}{\sqrt{4}}$		М	F-VSt		•	•			
- 0.5	-													>>
-	-													
	-													
1.5 -	-													
2.0-	-													
Ha So St	and a ala F andin	uger r Penetro Ig grou	net practical refusal at 0.2 m depth o ometer met practical refusal at 0.3 r undwater was not encountered	on inferred grav m depth.	el.				I					

		E			LOG OF AUGER HA12										
Geotechnical Investigation Client : Hughes Development Ltd Shear Vane No : 2022 728 Selwyn Road Client Ref. : N/A Logged By : RP Rolleston Date : 16/05/17 Reviewed By : JW 12903.000.000 - 019 Hole Depth : 0.6 m Latitude : Hole Diameter : 50 mm Longitude :						2									
Depth (m)	Material	USCS Symbol	DESCRIPTION		Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	2	Scala P Blows 4 (Penet	romel 100mi 8 1(ter m	
-	TOPSOIL	ML	SILT with trace rootlets; brown. Lo [TOPSOIL].	w plasticity	$\frac{\underline{x}^{A}}{\underline{y}^{A}} = \frac{\underline{x}^{A}}{\underline{y}^{A}}$ $\frac{\underline{y}^{A}}{\underline{y}^{A}} = \frac{\underline{x}^{A}}{\underline{y}^{A}}$			S-F		•				<u> </u>	
- 0.5	ALLUVIUM	ML	SILT; greyish brown. Low plasticity	Ι.			Μ	VSt	114/23		······				
-			End of Hole Depth: 0.6 m Termination Condition: Practical re	fusal										^ ^ ^ ^ ^ ^	Ý/
1.0															
												•			
												•			
												•			
												•			
Ha Score Sta	and a ala F andin	uger r 'enetr Ig groi	net practical refusal at 0.6 m depth o ometer met practical refusal at 0.7 n undwater was not encountered	on inferred grav m depth.	el.										

		E			L	C	G ()F A	UGER H	IA13				
	Ge	oteo 72 129	chnical Investigation 8 Selwyn Road Rolleston 03.000.000 - 019	Cli Client F D Hole De Hole Diame	ent : - Ref. : N ate : 1 pth : 0 eter : 5	lughe I/A 6/05/ 0.3 m	es De /17 n	velopme	nt Ltd Shear V. Log Review L. Lor	Shear Vane No : 2022 Logged By : RP Reviewed By : JW Latitude : Longitude :				
(m)	a	Symbol	DESCRIPTION		ic Symbol	Level	Ire Cond.	stency/ y Index	Shear Vane Undrained Shear Strength (kPa)	Scala	Pene	etrome	eter	
Depth	Materi	nscs			Graph	Water	Moistu	Consis Densit	Peak/Remolded	Blow 2 4	s per 6	100m 8 1	יות 10 12	2
-	TOPSOIL	ML	SILT with trace gravel and rootlets plasticity. Gravel, fine to medium, s [TOPSOIL].	; brown. Low subrounded	<u>21 22</u> <u>21 12</u> 12 <u>24 12</u> <u>24 12</u> <u>24 12</u> <u>24 12</u> <u>24 12</u> <u>25 24 12</u> <u>21 12</u> <u>24 12</u>		М	F-VSt						
-			End of Hole Depth: 0.3 m Termination Condition: Practical re	fusal	$\hat{y} \propto \hat{y}$.									
0.5 -	-											•	<u> </u>	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
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Ha Sc St	and ai ala P andin	uger n enetro g grou	net practical refusal at 0.3 m depth o ometer met practical refusal at 0.5 n undwater was not encountered	on inferred grav n depth.	el.				ı		·	<u> </u>		

		E		LOG OF AUGER HA14									
	Ge	eoteo 72 129	chnical Investigation 28 Selwyn Road Rolleston 03.000.000 - 019	Cli Client F D Hole De Hole Diame	ent : H Ref. : N ate : 1 pth : 0 eter : 5	lughe I/A 6/05 .2 m	es De /17 n	velopme	lopment Ltd Shear Vane No : 2022 Logged By : RP Reviewed By : JW Latitude : Longitude :				
Depth (m)	Material	USCS Symbol	DESCRIPTION		Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Scala Blows 2 4	Penetron s per 100 6 8	neter mm 10 12	 2
-	TOPSOIL	ML	SILT with trace gravel and rootlets plasticity. Gravel, fine to medium, s [TOPSOIL]. End of Hole Depth: 0.2 m Termination Condition: Practical re	; brown. Low subrounded fusal	$\frac{\sqrt{t_{\mu}}}{\sqrt{t_{\mu}}} = \frac{\sqrt{t_{\mu}}}{\sqrt{t_{\mu}}}$		Μ	S-F		•			
- 0.5 -													~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
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APPENDIX 3: ECan Borehole Logs



Borelog for well M36/3884

Grid Reference (NZTM): 1551397 mE, 5169641 mN Location Accuracy: 50 - 300m Ground Level Altitude: 34.2 m +MSD Accuracy: < 2.5 m Driller: McMillan Drilling Ltd Drill Method: Rotary/Percussion Borelog Depth: 30.0 m Drill Date: 18-Apr-1988





Borelog for well M36/20687

Grid Reference (NZTM): 1551357 mE, 5169911 mN Location Accuracy: 2 - 15m Ground Level Altitude: m +MSD Accuracy: Driller: East Coast Drilling Drill Method: Rotary Rig Borelog Depth: 36.0 m Drill Date: 12-Oct-2011



Scale(m) Level Depth(m) Full Dillers Description Code 0.60m 0.60m soils sand 2.50m 0.000 sandy gravel 0.000 0.000 sandy gravel 0.000 0.000 0.000 0.000 0.0000 0.000 0.0000 0.000 0.0000 0.000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	
5 5 5 5 5 5 5 5 5 5 5 5 5 5	
5 2.50m 2.50	
5 2.50m 2.50m 2.50m 2.50m 0.0000 0.0000 0.00000 0.0000 0.0000 0.00000 0.00000 0.0000 0.0000 0.0000 0.00000 0.0000 0.0000 0.0000 0.000000 0.00000000	
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5 10.0.0.0 10.0.0 10.0.0 10.0.0 10.0	
5 0.0.0.0 0.0.0 0.0.0 0.0.0 0.0.0 0	
1.0.0.0	
10 10.00m	
[0.00]	
D: 0: 0: 0	
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25 27.00m 27.00m	
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25 27.00m 30 30 30 25 27.00m 27	
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25 27.00m 30.00m 30.00m 27	
25 27.00m 27	
25 27.00m 30.00m 31 32 34 35 35 35 35 35 35 35 30 30 30 30 30 30 30 30 30 30	

Borelog for well M36/4553

Grid Reference (NZTM): 1551477 mE, 5169781 mN Location Accuracy: 50 - 300m Ground Level Altitude: 35.2 m +MSD Accuracy: < 2.5 m Driller: Smiths Welldrilling Drill Method: Unknown Borelog Depth: 33.0 m Drill Date: 01-Nov-1992



Carala (ar)	Water	De eth (er)		Evil Dellara Danasiatian	Formation
Scale(m)	Level	Deptn(m)		Full Drillers Description	Code
		0.89m		00	RI
Н			0:.0::0::	Rough gravel and sand	RI
Ц					
			Bill and and		
Н					
		4.00m			
Н		4.00111	000000	Claybound gravel	RI
5					
			000000		
- H					
			000000		
			000000		
- H			00000		
10					
Π			000000		
Н					
			000000		
Н			000000		
Ц			200,000		
			000000		
Н			000000		
15					
			000000		
			000000		
		17.00m			
		-	0:0:0::	Free sandy gravel	RI
			b. a dial		
- H					
20		20.00m	0.0.0		
Π			0:0::0::	Sandy gravel some clay	RI
Н					
Н			5:.0::o::		
Н					
		24.00m	1.0:10.10		
Н		24.000	<u>v÷c÷</u> t	Larger claybound gravel	RI
25			ニューシー		
			<u>「ニビニビオ</u> 」		
- H			0-0-4		
			$O \equiv O \equiv 0$		
		28.00m		Blue dev	00
				blue day	
		29.50m			
30		30.00m	20000	Brown clay and stone	LI-1
				Free stained sandy gravel	LI-1
Н		Ш			
			bio		
П			[A Y A Y A Y A Y		
		33.00m	₽.₩.₩.₩.₩		