

# Appendix B

**Geotechnical Assessment** 



# **Skellerup South Plan Change**

**Preliminary Geotechnical Assessment Report** 

Rolleston Industrial Developments Limited



Reference: 773-CHCGE293048

27 September 2021

### SKELLERUP SOUTH PLAN CHANGE

### Preliminary Geotechnical Assessment Report

Report reference number: 773-CHCGE293048

27 September 2021

### PREPARED FOR

Rolleston Industrial Developments Limited ASB House, 166 Cashel Street Christchurch Central 8011

### PREPARED BY

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### **QUALITY INFORMATION**

### **Revision history**

Revision	Description	Date	Author	Reviewer	Approver
V1	PGAR	27/09/21	ВС	KWH	СТ
V0	PGAR	07/09/21	ВС	KWH	СТ

#### **Distribution**

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### EXECUTIVE SUMMARY<sup>1</sup>

Rolleston Industrial Developments Limited proposed a Plan Change and future subdivision of a 28Ha block on the corner of Dunns Crossing Road and Selwyn Road, Rolleston, Canterbury. This preliminary geotechnical suitability assessment report is to support a Plan Change application for the construction of residential Lots at the site.

The data from previous site investigations and preliminary liquefaction assessment indicates that the site is TC1-like. Other geotechnical hazards (erosion, slippage and inundation) are considered low to very low risk with appropriate future engineering design.

Our assessment has considered the items required by Section 106 of the RMA and in our opinion the site is considered geotechnically suitable for Plan Change and future subdivision. Further investigations and design will need to be carried out at the subdivision consent stage.

Tetra Tech Coffey (NZ) Limited NZBN 9429033691923

<sup>&</sup>lt;sup>1</sup> This executive summary must be read in the context of the full report and the attached limitations.

### **CONTENTS**

1.	INTF	RODUCTION	1
2.	scc	)PE	1
3.	PRC	POSED DEVELOPMENT	1
4.	SITE	E INVESTIGATION	2
5.	SITE	PERFORMANCE	3
	5.1	Ground motion	3
6.	GRO	DUND MODEL	3
	6.1	Geology	3
	6.2	Groundwater	4
	6.3	Subsurface profile	4
	6.4	Site sub-soil class	4
7.	GEC	DTECHNICAL HAZARD ASSESSMENT	4
	7.1	Erosion	4
	7.2	Falling debris	4
	7.3	Subsidence	4
		7.3.1 Liquefaction induced settlement	4
		7.3.2 Static settlement	5
	7.4	Slippage	5
	7.5	Inundation	5
8.	CON	NCLUSIONS	5
9.	LIMI	TATIONS	5
10.	CLO	OSURE	6
LIS	T OF	FTABLES	
Table	e 1: Sl	kellerup South Investigation Data	2
		round profile	

### **APPENDICES**

APPENDIX A: INVESTIGATION PLAN APPENDIX B: INVESTIGATION DATA

### 1. INTRODUCTION

Rolleston Industrial Developments Limited has engaged Tetra Tech Coffey (NZ) Limited (Tetra Tech Coffey) to carry out a geotechnical investigation and assessment of suitability for the proposed Plan Change and future subdivision of a 28Ha block on the corner of Dunns Crossing Road and Selwyn Road, Rolleston, Canterbury. The purpose of this report is to support a Plan Change application for the construction of Residential Lots at the site.

### SCOPE

A scope of assessment work for the approximately 28Ha total area of the site was developed and carried out by Tetra Tech Coffey, as outlined below:

- Review of previous geotechnical investigations including previous work on the site and surrounding area.
- Assessment of the geotechnical hazards at the site per Section 106 of the RMA.
- Geotechnical analyses and reporting.

Tetra Tech Coffey have considered the following in the preparation of this report:

- Existing geotechnical investigation data available from the New Zealand Geotechnical Database (NZGD) and Environment Canterbury well database.
- Project correspondence with the wider Plan Change consultants engaged by Rolleston Industrial Developments Limited.

Reference has also been made to the MBIE Guidance Part D: Subdivisions, to confirm that the requirements outlined in these documents have been incorporated in this report.

### PROPOSED DEVELOPMENT

Tetra Tech Coffey understands that the current proposal is to rezone the land for residential usage. The proposed Plan Change area comprises multiple residential land parcels on the corner of Dunns Crossing Road and Selwyn Road, south of Rolleston and west of Faringdon. The site is predominantly flat and is used for grazing and crops.

Tetra Tech Coffey Report reference number: 773-CHCGE293048 Date: 27 September 2021



Figure 1: Proposed Plan Change area (Red)

## 4. SITE INVESTIGATION

The location of the previous geotechnical investigations carried out on / near the site to develop the ground model is provided in Appendix A and are summarised in Table 1. Investigation logs are presented in Appendix B.

**Table 1: Skellerup South Investigation Data** 

Reference	Depth of test (metres below ground level)	Termination criteria	Reference	Depth of test (metres below ground level)	Termination criteria
ENGEO TP03	1.9	Target depth	ENGEO TP28	2.0	Target depth
ENGEO TP04	2.0	Target depth	ENGEO TP29	2.0	Target depth
ENGEO TP12	2.0	Target depth	ENGEO TP36	2.0	Target depth
ENGEO TP13	2.0	Target depth	ENGEO TP37	2.0	Target depth
ENGEO TP14	2.0	Target depth	CW S-2	1.5	Target depth
ENGEO TP15	2.0	Target depth	CW S-3	1.4	Target depth
ENGEO TP22	1.9	Target depth	M36/7416	47.7	Target depth
ENGEO TP24	2.0	Target depth	M36/4449	24.0	Target depth
ENGEO TP25	2.0	Target depth	M36/4387	35.6	Target depth
ENGEO TP26	2.0	Target depth	BX23/0895	53.3	Target depth
ENGEO TP27	2.0	Target depth	BX23/0735	48.0	Target depth

Tetra Tech Coffey Report reference number: 773-CHCGE293048 Date: 27 September 2021 The test pit logs have been sourced from the ENGEO Revised Geotechnical Investigation Report<sup>2</sup> and our previous work on the adjacent site. ECan well logs have been sourced from ECan Well Search<sup>3</sup>.

#### 5. SITE PERFORMANCE

#### 5.1 **GROUND MOTION**

The site is not in an area mapped for ground damage effects as part of the Canterbury Earthquake Sequence response. A report commissioned by ECan<sup>4</sup> mapped the site as being in an area where 'damaging liquefaction is unlikely'. An extract from the ECan report is shown in Figure 2 with the site location indicated.

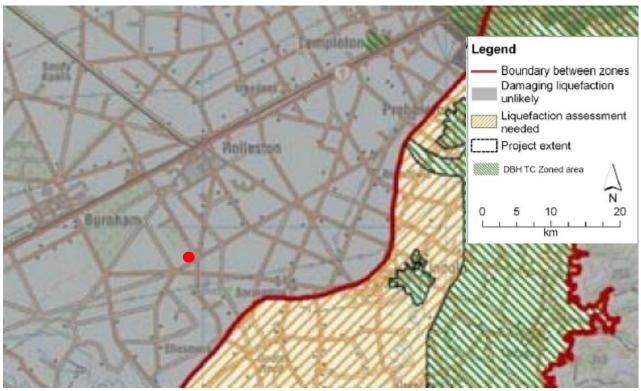


Figure 2: Extract from ECan liquefaction report (site location marked with red dot)

#### **GROUND MODEL** 6.

#### 6.1 **GEOLOGY**

The geological map<sup>5</sup> of the area indicates the site is underlain by "Brownish-grey river alluvium (Q2a)".

Report reference number: 773-CHCGE293048 Date: 27 September 2021

<sup>&</sup>lt;sup>2</sup> ENGEO Revised Geotechnical Investigation Report, 92 Dunns Crossing Road, Rolleston, Christchurch. ENGEO, Ref: 12903.001.000 02. Dated: 13.12.2019

<sup>3</sup> https://www.ecan.govt.nz/data/well-search/

<sup>&</sup>lt;sup>4</sup> ECan (2012), Review of liquefaction hazard information in Eastern Canterbury, including Christchurch City, and parts of Selwyn, Waimakariri and Hurunui Districts, Ref. R12/83

<sup>&</sup>lt;sup>5</sup> Forsyth, P.J.; Barrell, D.J.A.; Jongens, R. (compilers) 2008: Geology of the Christchurch area: scale 1:250,000. Lower Hutt: GNS Science. Institute of Geological & Nuclear Sciences 1:250,000 geological map 16. 67 p. + 1 folded map

#### 6.2 GROUNDWATER

Based on the nearby well logs, initial groundwater was encountered between 5.3 to 5.8 mbgl. We consider these groundwater levels to be relatively consistent and representative of the general area.

#### 6.3 SUBSURFACE PROFILE

A summary of the ground model for the site is provided below:

Table 2: Ground profile

Description	Strength/ consistency	Thickness (m)	Depth to top of layer (mbgl)
Silt (topsoil)	N/A	0.10 to 0.30	0.00
Silty sand/sandy silt with some gravel	Medium dense to dense/ Stiff to very stiff	0.40 to 0.50	0.30 to 0.50
Sandy Gravel	Medium dense to dense	>30	0.30 to 0.90

#### 6.4 SITE SUB-SOIL CLASS

In accordance with NZS1170.5, Section 3.1.3, a subsoil classification of "Class D – Deep or soft soil sites" can be assumed for the site.

#### GEOTECHNICAL HAZARD ASSESSMENT 7.

#### 7.1 **EROSION**

The site has relatively flat topography and is bounded by existing roads. Provided appropriate stormwater systems are installed as part of the development, there will be few viable sources of erosion at this site.

#### 7.2 **FALLING DEBRIS**

As there are no slopes or exposed hills or rock faces surrounding the site, there are no sources of falling debris at the site, or for the surrounding area.

#### 7.3 **SUBSIDENCE**

#### 7.3.1 Liquefaction induced settlement

Saturated, loose, uniform fine grained alluvial soils are subject to seismic (liquefaction-induced) settlement during a significant earthquake. Liquefaction typically affects saturated, loose granular soils ranging from sandy silts to sands, but seismic shaking can also result in strength losses in fine-grained, cohesive soils. Liquefaction does not occur in dense, well-graded alluvial gravel soils that are present at this site.

Due to the dense nature of the gravel encountered, liquefaction risk is considered to be negligible for this project. The site is considered to be TC1-like.

Tetra Tech Coffey Report reference number: 773-CHCGE293048 Date: 27 September 2021

### 7.3.2 Static settlement

Settlement is a crucial factor that can cause structure serviceability issues. Static load-induced settlement typically occurs in low-lying areas underlain by soft, compressible soils as a result of increased overburden loads. As the site is underlain by dense river gravels, static settlement is not deemed a hazard for the site provided any earthworks are carried out to the relevant standards.

#### 7.4 SLIPPAGE

We have not observed any sources of land instability on the site and due to the flat site topography, we consider the risk of slope failure to be very low. The appropriate design of batter slopes near waterways will mitigate this risk further.

#### 7.5 INUNDATION

In relation to stormwater inundation, we recommend that drainage design and management at the site be addressed by specialist consultants as it is beyond the scope of this report. We expect that with appropriate stormwater and flood control systems, the risk of inundation will be low.

### 8. CONCLUSIONS

We consider that the site is suitable for development subject to further investigation and design at the subdivision consent stage. Based on the mapped geology and testing carried out to date, the site is considered TC1-like.

Additional geotechnical investigation (comprising test pits and DCPs) will be required to refine the ground model and address any geotechnical risks for the proposed Lots once a subdivision plan has been further developed.

### 9. LIMITATIONS

This report has been prepared solely for the use of our client, Rolleston Industrial Developments Limited, their professional advisers and Selwyn District Council (SDC) in relation to the specific project described herein. No liability is accepted in respect of its use for any other purpose or by any other person or entity.

It is recommended that all other parties seek professional geotechnical advice to satisfy themselves as to its on-going suitability for their intended use.

As subsurface information has been obtained from discrete investigation locations, which by their nature only provide information about a relatively small volume of subsoils, there may be special conditions pertaining to this site which have not been disclosed by the investigation and which have not been taken into account in the report. If variations in the subsoils occur from those described or assumed to exist, then the matter should be referred to us immediately.

Please also refer to the enclosed Important Information about Your Tetra Tech Coffey Report.

Tetra Tech Coffey Report reference number: 773-CHCGE293048 Date: 27 September 2021

## 10. CLOSURE

If you have queries or require further clarification regarding aspects of this report, please contact the undersigned.

For and on behalf of Tetra Tech Coffey

Prepared by

Benjamin Chau

BSc, Prof. Mast (Engineering Geology)
Graduate Engineering Geologist

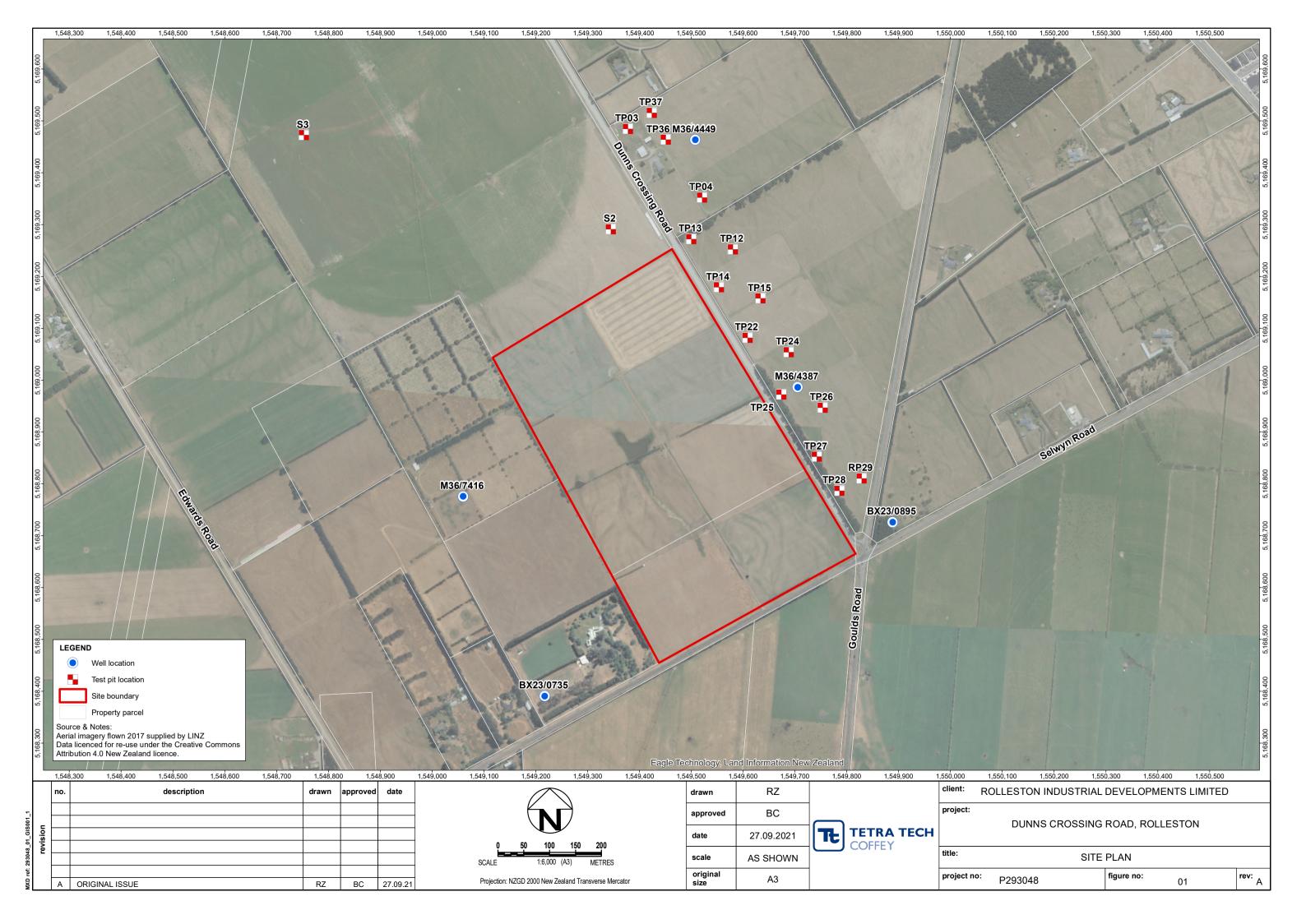
Reviewed by

Kah-Weng Ho BE (Hons) CMEngNZ Senior Principal

6

## APPENDIX A: INVESTIGATION PLAN

Tetra Tech Coffey Report reference number: 773-CHCGE293048 Date: 27 September 2021



## APPENDIX B: INVESTIGATION DATA

Tetra Tech Coffey Report reference number: 773-CHCGE293048 Date: 27 September 2021



**Geotechnical Investigation** 92 Dunns Crossing Road Rolleston 12903

Client: Hughes Developments Ltd Shear Vane No: N/A Date: 25/11/2019 Logged By: KF Max Test Pit Depth : 1.9 m Reviewed By: JW

Digger Type/Size : 24 Tonne Latitude: -43.625939 Bucket Type/Size : Bucket Excavator Longitude: 172.372464

						Bucket Type/Size	DUCKEL L	.xcavai	LOI			Longitude	. 1/2		404		
Depth (m BGL)	Material	Exca Rela (Rela	avatal tive S	y (elid Harder Harder	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Peak/Remolded (kPa)	Blo	ows	eneti per 1		nm
-	TOPSOIL				ML	Sandy SILT with trace gravel and rootlets; brown. Low plasticity. Sand, fine [TOPSOIL].				D	St-VSt		•	•			
0.5 -					SM	Silty fine to medium SAND with some gravel and trace rootlets; greyish brown. Well graded. Gravel, fine to medium, subangular to subrounded.					MD-D				•	<del>\</del>	\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\
- 1.0 - - -	ALLUVIUM					Sandy fine to coarse GRAVEL with trace silt; grey. Well graded, subangular to subrounded. Sand, fine to coarse.	TX XX			М							
- 1.5 - - -					GW	Trace cobbles encountered from 1.7 m depth.					MD-D						
2.0			•	•		Depth of Excavation: 1.9 m Termination Condition: Target depth											
Scal	la Pe	enetro	omete	depther met	pract	ical refusal. No t encountered.	ticeable	sand i	incre	ease	from 0.8	m depth.					



**Geotechnical Investigation** 92 Dunns Crossing Road Rolleston 12903

Client: Hughes Developments Ltd Shear Vane No: N/A Date: 25/11/2019 Logged By: KF Max Test Pit Depth : 2 m Reviewed By: JW

Digger Type/Size : 24 Tonne Latitude : -43.6271 Longitude: 172.374267 Bucket Type/Size : Bucket Excavator

							Bucket Type/Size	: Bu	cket Ex	xcava	tor			Longitude	: 1/2.3	74267	
Depth (m BGL)	Material	Easier (Rela	avatabi itive Sc	Harder (ale:	USCS Symbol	DES	CRIPTION		Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Peak/Remolded (kPa)		s per 1	100mm 3 10 12
-	TS				ML	SILT with some sa rootlets; brown. Lo [TOPSOIL].	and, trace gravel and ow plasticity. Sand, fir	ne /	7 · <del>7</del> · 7 · 7 · 7 · 7 · 7 · 7 · 7 · 7 · 7 ·			D	F-St		•		
-	-			•	GW	Sandy fine to med some silt and trac brown. Well grade subrounded.	dium GRAVEL with the rootlets; greyish ted, subangular to						MD-D				À
0.5 -					SM	gravel; greyish bro	m SAND with minor own. Well graded. dium, subangular to						MD-D				
1.0	ALLUVIUM					Sandy fine to coal cobbles; grey. We subrounded. Sand	rse GRAVEL with trac ell graded, subangular d, fine to coarse.	ce to				М					
1.4 TE.GDT 4/12/19					GW								MD-D				
ATA TEMPL	-					Depth of Excavation Condition	on: 2 m lition: Target depth										
GEOTECH TEST PIT LOG 2019.11.27 - TEST PIT LOGS.GPJ NZ MASTER DATA TEMPLATE.GDT 4/12/19 GEOTECH TEST PIT LOG 2019.11.27 - TEST PIT LOGS.GPJ NZ MASTER DATA TEMPLATE.GDT 4/12/19 B. S.																	
Tes Sca Sta	ıla Pe	enetro	arget de ometer undwate	met	practi	ical refusal. encountered.		TS = Notic	TOPS eable	OIL sand	incre	ease 1	from 0.9	m depth.			



**Geotechnical Investigation** 92 Dunns Crossing Road Rolleston 12903

Client: Hughes Developments Ltd Shear Vane No: N/A Date: 26/11/2019 Logged By: KF Max Test Pit Depth : 2 m Reviewed By: JW

Digger Type/Size : 24 Tonne Latitude: -43.628017 **Longitude**: 172.374975 Bucket Type/Size : Bucket Excavator

					I	Bucket Type/Size . E	T T	.ncava	LOI			Longitude	. 17	2.51	491		
Depth (m BGL)	Material	Easier (les)	cavatab ative S	ility cale) Harder	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Peak/Remolded (kPa)		lows	Pene per	100r	
_	TS				ML	SILT with some sand, trace gravel and rootlets; brown. Low plasticity. Sand, fine	7. 7. 7. 7. 7. 7. 7. 7. 7. 7. 7. 7. 7. 7				F-St						-
_					GW	[TOPSOIL].  Fine to medium GRAVEL with some sand, silt and trace rootlets; greyish brown. Well graded, subangular to subrounded. Sand, fine.				D	MD-D						
0.5 -						Sandy fine to coarse GRAVEL with trace rootlets; grey. Well graded, subangular to subrounded. Sand, fine to coarse.	X X										>
-	Σ					No rootlets observed from 0.8 m depth.				М							
1.0	ALLUVIUM				GW	Trace cobbles encountered from 1.0 m depth.					MD-D						
- 1.5 - - -						Cobbles become minor from 1.5 m depth.				w							
2.0-						Depth of Excavation: 2 m Termination Condition: Target depth	X					-					
Sca	la Pe	enetr	target o	met	pract	ical refusal. TS t encountered.	= TOPS	SOIL									



Geotechnical Investigation 92 Dunns Crossing Road Rolleston 12903 Client: Hughes Developments Ltd Shear Vane No: N/A

Date: 26/11/2019 Logged By: KF
t Depth: 2 m Reviewed By: JW

Max Test Pit Depth: 2 mReviewed By : JWDigger Type/Size: 24 TonneLatitude : -43.627819Bucket Type/Size: Bucket ExcavatorLongitude : 172.373988

Shear Vane Peak/Remolded (kPa) Excavatability (Relative Scale) Graphic Symbol Scala Penetrometer Depth (m BGL) Symbol Elevation (mRL) Moisture Cond. Consistency/ Density Index Water Level **DESCRIPTION** Blows per 100mm Material Harder uscs : Easier 6 8 10 12 SILT with some sand, trace gravel and മ F-St ML rootlets; brown. Low plasticity. Sand, fine [TOPSOIL]. Sandy fine to medium GRAVEL with some silt and trace rootlets; greyish brown with orange mottles. Well graded, subangular to subrounded. Sand, fine. D MD-D Sand becomes some from 0.4 m depth. 0.5 Sandy fine to coarse GRAVEL; greyish brown. Well graded, subangular to subrounded. Sand, fine to coarse. MD-D GW 1.5 Trace cobbles encountered from 1.6 m depth. Depth of Excavation: 2 m Termination Condition: Target depth

Test pit met target depth Scala Penetrometer met practical refusal. Standing groundwater was not encountered

GEOTECH TEST PIT LOG 2019;11:27 - TEST PIT LOGS;GPJ NZ MASTER DATA TEMPLATE.GDT 4/12/19

TS = TOPSOIL

Noticeable sand increase from 0.7 m depth.



**Geotechnical Investigation** 92 Dunns Crossing Road Rolleston 12903

Client: Hughes Developments Ltd Shear Vane No: N/A Date: 26/11/2019 Logged By: KF

Max Test Pit Depth : 2 m Reviewed By: JW

Digger Type/Size : 24 Tonne Latitude : -43.628684 **Longitude**: 172.374642 Bucket Type/Size : Bucket Excavator

					Bucket Type/Size . E	DUCKEL L	λCava	.OI				<b>3</b> .172.374042
Depth (m BGL)	Material	Excavata (Relative S	bility Scale) Harder	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Peak/Remolded (kPa)	Scala Penetrometer  Blows per 100mm  2 4 6 8 10 12
- {	TS			ML	SILT with some sand, trace gravel and rootlets; brown. Low plasticity. Sand, fine [TOPSOIL].	7. 3.1.				F-St		f
				GW	Fine to medium GRAVEL with some sand and silt; brownish grey. Well graded, subangular to subrounded. Sand, fine to medium.	X			D	MD-D		Â
0.5 1.0	ALLUVIUM			GW	Sandy fine to coarse GRAVEL with trace cobbles; grey. Well graded, subangular to subrounded. Sand, fine to coarse.  Cobbles become minor from 1.1 m depth.				М	MD-D		
1.5 -					Depth of Excavation: 2 m							
-					Termination Condition: Target depth							
Scala	a Pe	met target enetromete	er met	bract	ical refusal. TS t encountered.	= TOPS	SOIL					



**Geotechnical Investigation** 92 Dunns Crossing Road Rolleston 12903

Client: Hughes Developments Ltd Shear Vane No: N/A Date: 26/11/2019 Logged By: KF

Max Test Pit Depth : 2 m Reviewed By: JW

Digger Type/Size : 24 Tonne Latitude : -43.628875 **Longitude**: 172.375619 Bucket Type/Size : Bucket Excavator

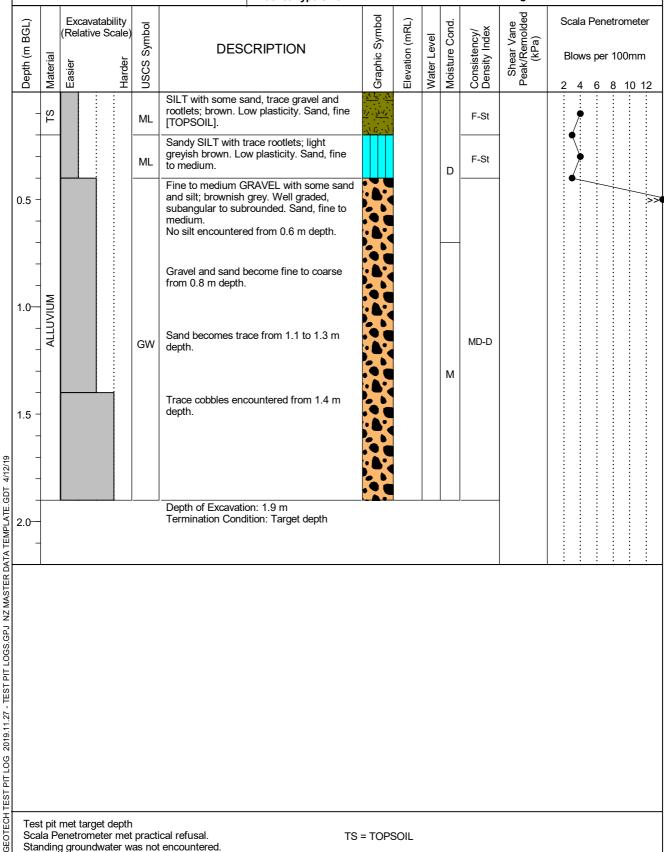
					Bucket Type/Size	: Bucket Ex	xcavat	tor			Longitude	<b>3</b> :1/2.	3/561	9			
Depth (m BGL)	Easier Harder USCS (				USCS Symbol	DES	CRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Peak/Remolded (kPa)	Blov	ws per	100m	nm
0.5 -	rootlets; brown [TOPSOIL].  Sandy fine to r some silt and t grey. Well grad subrounded. S  Trace silt and to 0.4 m depth.					rootlets; brown. L. [TOPSOIL].  Sandy fine to med some silt and trace grey. Well graded subrounded. Sand Trace silt and sand 0.4 m depth.	and, trace gravel and ow plasticity. Sand, find dium GRAVEL with se rootlets; brownish, subangular to d, fine to medium. In the decomes some from served from 0.6 m dept				М	F-St					
1.0	ALLUVIUM				GW	Fine to coarse GF and trace cobbles subangular to sub	RAVEL with some sand ; grey. Well graded, prounded.				W	MD-D					
- 2.0						Depth of Excavati Termination Cond	on: 2 m dition: Target depth	33									
Sca	la Pe	met tar	neter	r met	pract	ical refusal. t encountered.		TS = TOPS Loosely pac	SOIL cked g	grave	el end	countere	d from 1.4 t	to 2.0 n	n deptl	<b>1</b> .	



Geotechnical Investigation 92 Dunns Crossing Road Rolleston 12903

Client: Hughes Developments Ltd Shear Vane No: N/A Logged By: KF Date: 26/11/2019

Max Test Pit Depth: 1.9 m Reviewed By: JW Digger Type/Size : 24 Tonne Latitude: -43.62955 Bucket Type/Size : Bucket Excavator Longitude: 172.375318





Geotechnical Investigation 92 Dunns Crossing Road Rolleston 12903 Client: Hughes Developments Ltd:
Shear Vane No: N/A

Date: 26/11/2019
Logged By: KF

Max Test Pit Depth: 2 m
Reviewed By: JW

Digger Type/Size: 24 Tonne Latitude: -43.629807
Bucket Type/Size: Bucket Excavator Longitude: 172.376332

						Ducker	i Type/Size . Do	JONOL L	nouvu	.01			Longitudo	. 172.0	77 000	,		
Depth (m BGL)	Material	Easier (b)	cavatabi ative So	ळ kijii Harder (a Ki	USCS Symbol	DESCRIPTION	ON	Graphic Symbol	∃levation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Peak/Remolded (kPa)	Scala		etron		
۵	Ž	ш		Ĭ	Š			Ō	ш	≥	ž	ŏՃ	Д.	2 4	6	8 1	10 12	2
-	TS				ML	SILT with some sand, trace rootlets; brown. Low plastic [TOPSOIL].	gravel and ity. Sand, fine	1/ · 2/ ·// · ·//				F-St		•				
_	-				ML	Sandy SILT with trace grave greyish brown. Low plasticit	el and rootlets; y. Sand, fine.					St-H			<del>\</del>			>>
0.5 -					GW	Fine to medium GRAVEL w and silt; brownish grey. Wel subangular to subrounded. medium.	ll graded,				D	MD-D						
-						Sandy fine to coarse GRAV cobbles; grey. Well graded, subrounded. Sand, fine to co	subangular to	X										
1.0-	ALLUVIUM					Becomes moist from 1.0 m	depth.											
-	A				GW	Sand becomes trace from 1 depth.	.2 to 1.4 m					MD-D						
1.5 - -					Gvv						М	MD D						
- 2 0-	-					Sand becomes trace from 1 depth.	.8 to 2.0 m											
2.0						Depth of Excavation: 2 m Termination Condition: Targ	get depth											

Test pit met target depth Scala Penetrometer met practical refusal. Standing groundwater was not encountered

GEOTECH TEST PIT LOG 2019.11.27 - TEST PIT LOGS.GPJ NZ MASTER DATA TEMPLATE.GDT 4/12/19



Geotechnical Investigation 92 Dunns Crossing Road Rolleston 12903

Client: Hughes Developments Ltd Shear Vane No: N/A Date: 26/11/2019 Logged By: KF Reviewed By: JW

Max Test Pit Depth : 2 m Digger Type/Size : 24 Tonne Latitude : -43.630517 **Longitude**: 172.376123 Bucket Type/Size : Bucket Excavator

				120		Bucket Type/Size : I	Bucket E	xcava	tor			Longitude	: 1/	2.37	6123		
Depth (m BGL)	Material	Easier System	avatak tive S	y (ale)	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Peak/Remolded (kPa)			per '	romet 100mr	m
-	TS				ML	SILT with some sand, trace gravel and rootlets; brown. Low plasticity. Sand, fine [TOPSOIL].	17. 37.17. 37. 18. 37.	_			F-St			•		, 10 :	
0.5 -					GW	Fine to medium GRAVEL with some sand, silt and trace rootlets; greyish brown. Well graded, subangular to subrounded. Sand, fine. No silt observed from 0.4 m depth.				D	MD-D					•	,
- - -						Sandy fine to coarse GRAVEL with some sand, silt and trace rootlets; greyish brown. Well graded, subangular to subrounded. Sand, fine.											
1.0	ALLUVIUM				0.44	Trace cobbles encountered from 0.9 m depth.				М	MD-D						
1.5 - - -					GW	Cobbles become minor from 1.4 m depth.					MU-U						
2.0			<u> </u>			Depth of Excavation: 2 m Termination Condition: Target depth											
Tes Sca Star																	
Tes Sca	t pit	met ta	arget (	depth	pract	ical refusal. TS	S = TOP	SOII									



**Geotechnical Investigation** 92 Dunns Crossing Road Rolleston 12903

Client: Hughes Developments Ltd Shear Vane No: N/A Date : 27/11/2019 Logged By: KF Reviewed By: JW

Max Test Pit Depth : 2 m Digger Type/Size : 24 Tonne

Latitude: -43.630801 Longitude: 172.377121 Bucket Type/Size : Bucket Excavator

						Bucket Type/Size . I	JUCKEL L	лсаvа	LOI				# . I/Z.3// IZI	
Depth (m BGL)	Material	Excav (Relativ	vatabi ve So	Harder (alg	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Peak/Remolded (kPa)	Scala Penetro Blows per 10	
0.5	ST				ML	SILT with some sand, trace gravel and rootlets; brown. Low plasticity. Sand, fine [TOPSOIL].  Fine to medium GRAVEL with some sand, silt and trace rootlets; greyish brown. Well graded, subangular to subrounded. Sand, fine to medium.  No rootlets observed from 0.4 m depth.				D	St-VSt MD-D			, ( ^
1.0-	ALLUVIUM				GW	Fine to coarse GRAVEL with some sand and trace rootlets; grey. Well graded, subangular to subrounded. Sand, fine to coarse.  Trace cobbles encountered from 1.4 m				М	MD-D			
1.5 -						depth.  Depth of Excavation: 2 m Termination Condition: Target depth								
						remination Condition. Target depth								
Sca	la Pe	met tar	neter	met	practi	ical refusal. TS t encountered.	s = TOP®	SOIL						



Geotechnical Investigation 92 Dunns Crossing Road Rolleston 12903

Client: Hughes Developments Ltd Shear Vane No: N/A Date : 27/11/2019 Logged By: KF

Max Test Pit Depth : 2 m Reviewed By: JW

Digger Type/Size : 24 Tonne **Latitude**: -43.631612 Longitude: 172.376997 Bucket Type/Size : Bucket Excavator

						Bucket Type/Size : I	Sucket E	xcava	tor			Longitude	: 1/2.	3/69	197	
Depth (m BGL)	Material	Excavatab (Relative Solicity is is is is is is	y (elli cale) Harder	USCS Symbol	DES	CRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Peak/Remolded (kPa)	Blo		er 10	ometer 00mm 10 12
-	TS			ML	SILT with some s rootlets; brown. Le [TOPSOIL].	and, trace gravel and ow plasticity. Sand, fine	1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1				F-St		•			
-				GW		GRAVEL with some be rootlets; greyish ed, subangular to d. fine to medium.	以			D	MD-D					
0.5 -					Fine to coarse GF trace cobbles and	RAVEL with some sand, I rootlets; grey. Well ar to subrounded. Sand,										
1.0	ALLUVIUM			GW	Cobbles become	minor from 1.4 m depth.				М	MD-D					
1.5 -					CODDICS DECOME	TILLION TO THE COPULE										
2.0					Depth of Excavati Termination Cond	on: 2 m dition: Target depth										
													•	<del>- 1</del>		-; ;
Scal	la Pe	met target o enetrometer g groundwa	r met	pract	ical refusal. t encountered.	TS	S = TOPS	OIL								

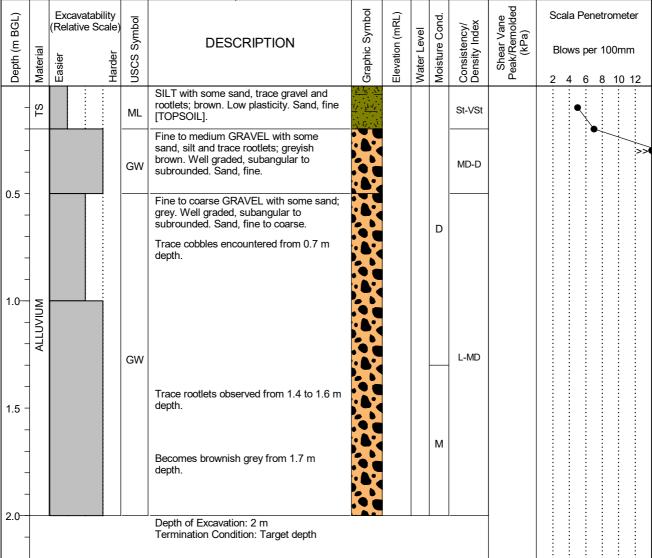


Geotechnical Investigation 92 Dunns Crossing Road Rolleston 12903

Client: Hughes Developments Ltd Shear Vane No: N/A Logged By: KF Date : 27/11/2019 Reviewed By: JW

Max Test Pit Depth : 2 m Digger Type/Size : 24 Tonne Latitude: -43.632226

Longitude: 172.377512 Bucket Type/Size : Bucket Excavator Excavatability Scala Penetrometer (Relative Scale)



Test pit met target depth Scala Penetrometer met practical refusal. Standing groundwater was not encountered

GEOTECH TEST PIT LOG 2019;11:27 - TEST PIT LOGS;GPJ NZ MASTER DATA TEMPLATE.GDT 4/12/19

TS = TOPSOIL

Loosely packed gravel encountered from 0.5 to 1.0 m depth.



Geotechnical Investigation 92 Dunns Crossing Road Rolleston 12903

Client: Hughes Developments Ltd Shear Vane No: N/A Date : 27/11/2019 Logged By: KF

Max Test Pit Depth : 2 m Reviewed By: JW

Digger Type/Size : 24 Tonne Latitude : -43.632008 Longitude: 172.378017 Bucket Type/Size : Bucket Excavator

						ı	Bucket Type/Size : E	Bucket E	xcava	tor			Longitude	: 1/2	.378	017	
Depth (m BGL)	Material	Excav (Relativ	vatabi ve Sc	Harder (ale	USCS Symbol	DES	CRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Peak/Remolded (kPa)	Blo		er 10	ometer 00mm 10 12
-	TS				ML	SILT with some s rootlets; brown. L [TOPSOIL].	and, trace gravel and ow plasticity. Sand, fine	17. 31.17. 17. 31.17.				F-St		•			
-					GW	and silt; greyish b	GRAVEL with some sand rown. Well graded, prounded. Sand, fine.	以				MD-D				<del></del>	
0.5 - - -					GW	and trace cobbles	RAVEL with some sand ; brownish grey. Well ar to subrounded. Sand,				D	MD-D					
1.0	ALLUVIUM						rse GRAVEL with trace ell graded, subangular to d, fine to coarse.				М						
1.5 - - -					GW	Becomes wet fror	n 1.8 m depth.					MD-D					
+						Cobbles become	minor from 1.9 m depth.	75			w						
2.0		,				Depth of Excavati Termination Cond	on: 2 m lition: Target depth										
Sca	la Pe	met targ	neter	met	pract	ical refusal. t encountered.	TS	s = TOPS	SOIL								



Geotechnical Investigation 92 Dunns Crossing Road Rolleston 12903 Client : Hughes Developments Ltd Shear Vane No : N/A

Date : 05/12/2019 Logged By : KF/CR

Max Test Pit Depth: 2 mReviewed By : JWDigger Type/Size: 24 TonneLatitude : -43.62611Bucket Type/Size: Bucket ExcavatorLongitude : 172.373398

Depth (m BGL) Material	(R	xcavatability elative Scale be En	Sym	DESCRIPTION	Symbol	mRL)	le	ond.	:y/ lex	ane olded	Sca	la Per	etrom	eter
			nscs		Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Peak/Remolded (kPa)		ws pe 4 6		mm 0 12
- ST			ML	SILT with some sand, trace gravel and rootlets; brown. Low plasticity. Sand, fine [TOPSOIL].	11. 37.13. 34.18. 34				St-VSt				•	
0.5 -			GW	Sandy fine to coarse GRAVEL with some silt; greyish brown. Well graded, subangular to subrounded. Sand, fine.	なな			D	MD-D			•		/ <u>*</u>
			sw	Fine to coarse SAND with trace gravel; grey. Well graded.				•	MD-D					
1.0   1.5			GW	Sandy fine to coarse GRAVEL with trace cobbles; grey. Well graded, subangular to subrounded. Sand, fine to coarse.				М	MD-D					
2.0				Depth of Excavation: 2 m Termination Condition: Target depth				J						

Test pit met target depth. Scala Penetrometer met target depth Standing groundwater was not encountered.

GEOTECH TEST PIT LOG 2019.12.XX - REMAINING TP LOGS.GPJ NZ MASTER DATA TEMPLATE. GDT 9/12/19



Geotechnical Investigation 92 Dunns Crossing Road Rolleston 12903 Client: Hughes Developments Ltd: Shear Vane No: N/A
Date: 05/12/2019 Logged By: KF/CR
Max Test Pit Depth: 2 m Reviewed By: JW

Digger Type/Size: 24 TonneLatitude: -43.625636Bucket Type/Size: Bucket ExcavatorLongitude: 172.37306

						Bucket Type/Size . D	JUCKEL L	.xcava	ıoı			Longitude	, . 172	.07.00	,0	
Depth (m BGL)	Material	Excavata (Relative S	tarder Harder Harder	USCS Symbol	DES	CRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Peak/Remolded (kPa)	Blo	ws pe	netron er 100	mm
-	SL		_ <del></del>	ML	rootlets; brown. Lo [TOPSOIL]. Fine to coarse GF	and, trace gravel and by plasticity. Sand, fine		ш.			F-St			•		0 12
0.5 -				GW	graded, subangula fine.	ets; greyish brown. Well ar to subrounded. Sand,	K C			D	MD-D					>>
- - - 1.0-	ALLUVIUM			GW	Sandy fine to coal cobbles; grey. We subrounded. Sand	se GRAVEL with trace ill graded, subangular to d, fine to coarse.					MD-D					
1.5 -	ALL			GW	and trace cobbles	RAVEL with some sand grey. Well graded, rounded. Sand, fine to				М	MD-D					
-	-				Sand becomes tra	ace from 1.8 m depth.										
2.0-			-		Depth of Excavati Termination Cond	on: 2 m ition: Target depth										

Test pit met target depth. Scala Penetrometer met target depth Standing groundwater was not encountered.

GEOTECH TEST PIT LOG 2019.12.XX - REMAINING TP LOGS.GPJ NZ MASTER DATA TEMPLATE. GDT 9/12/19

	195 Hereford St. (PO Box 1061 +64 3 366 0821 Project Project					en E	Exc	avation Log		Test Pit N	lo.	TP	· S	-2		
Conne	II Wagner L	imited		Selwyn Plantation Bo	ard L	.td			, 5169261	Date		12/0	09/20	08		
				SPBL Rolleston Plan	Char	nge		Logged By CG	Weather Conditions  cloudy & dry	Job Numb			951-0			
ır	(m)	loqu	FAC	CE 1	Ji.	(E)	loqu	FAG	CE 2		ined SI ed Using a 50	Hand I	-			•
Water	Depth (m)	Soil Symbol	SOIL DESC Colour, structure, weatherin COMPO	g, subordinate/ main / minor	Water	Depth (m)	Soil Symbol	Colour, structure, weathering	CCRIPTION: ng, subordinate/ main / minor DNENTS.	Scala	Penetr s/ 150n	omete			12	<
	_		Grass over silty TOPSOIL, with landiameter, brown, moist.	rge tree roots up to 60mm		_						j		-10	12	
Test D	0.5	× × × × × × × × × × × × × × × × × × ×	diameter, brown, moist. Gravelly SILT with boulders a cohesive. Gravel is medium: gap graded, near horizontal le Moist. Large tree roots in the	to coarse grained, rounded, ong-axis pebble alignment. upper part.		0.5		Notes	<u>Pi</u>	t dim	enside	DD S				
			ne test in accordance with BS		notore			Groundwater not e		arat	olv		1 0	_	1.0n	า

	Con	nell	Wagner		Op	oen E	Exc	avation Log	J	Test Pit N	· T	PS	S-3		
Conne	ell Wagner L	imited	Telephone: 061 +64 3 366 0821	Selwyn Plantation Bo	ard L	_td			3, 5169475	Date		2/09/2	800		
	ereford St. (F church New		Facsimile: +64 3 379 6955	SPBL Rolleston Plan	Chai	nge		Logged By CG	Weather Conditions  cloudy & dry	Job Numb		86951-	001		
	(m)	loqu	FAC	CE 1	J6	(m)	loqu	FAG	CE 2		ined Shead Ind Using a H	and Held S			•
Water	Depth (m)	Soil Symbol	SOIL DESI Colour, structure, weatherin COMPO	g, subordinate/ main / minor	Water	Depth (m)	Soil Symbol	Colour, structure, weathering	SCRIPTION: ng, subordinate/ main / minor ONENTS.	Scala	Penetron s/ 150mm	neter Te )	-	12	<
	-		Grass over silty TOPSOIL, with landiameter, brown, moist.			-									
	0.5	*,*, *,*,	Silty Sandy GRAVEL with mir rounded, gap graded, near ho alignment. Sand is angular. I upper part.	rizontal long-axis pebble		0.5									
	1.5	\$\circ\$ \circ\$ \	End of Test pit at 1.4m (Targ	et depth)		1.5									
	2					2									
T	2.5					2.5		Notoo	5:						
1 -			ne test in accordance with BS		neters			Notes Groundwater not el Soak test undertak			ension ely		0m	1.0n	1

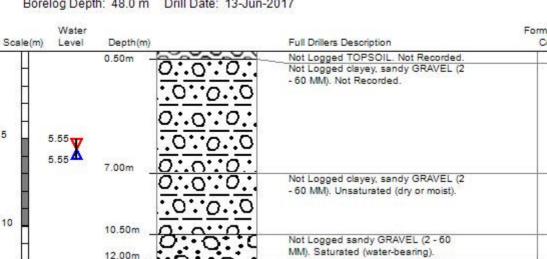
## Borelog for well BX23/0735

Grid Reference (NZTM): 1549221 mE, 5168386 mN



Location Accuracy: 10 - 50m Ground Level Altitude: m +MSD Accuracy:

		Rotary/Per th: 48.0 m	Drill Date: 13-Jun-2	2017	
Scale(m)	Water Level	Depth(m)		Full Drillers Description	Formation Code
5	5.55 <b>X</b>	0.50m %-	0:.0::0:.0 :0::0::0 0:.0::0:.0	Not Logged TOPSOIL. Not Recorded.  Not Logged clayey, sandy GRAVEL (2  - 60 MM). Not Recorded.	
	5.55	7.00m _	0:.0::0: 0:.0::0:.0	Not Logged clayey, sandy GRAVEL (2 - 60 MM). Unsaturated (dry or moist).	
10		10.50m _	8:00:0	Not Logged sandy GRAVEL (2 - 60 MM). Saturated (water-bearing).	
15		12.00m _		Not Logged sandy GRAVEL (2 - 60 MM). Not Recorded.	
20		17.00m _	0:.0:.0:.0 .0:.0:.0	Not Logged clayey, sandy GRAVEL (2 - 60 MM). Not Recorded.	
Ħ		24.00m _	000000	Not Logged GRAVEL (2 - 60 MM) Saturated (water-bearing).	
25		25.50m	0::0::0	Not Logged sandy GRAVEL (2 - 60 MM) Not Recorded.	
		27.00m _	500000 500000	Not Logged GRAVEL (2 - 60 MM) Saturated (water-bearing). Not Logged GRAVEL (2 - 60 MM) Not Recorded.	
30		31.00m _	000000		
			000000	Not Logged GRAVEL (2 - 60 MM) Saturated (water-bearing).	



Driller: McMillan Drilling Ltd.

Kaunihera Taiao ki Waitaha

Not Logged sandy GRAVEL (2 - 60 MM). Not Recorded. Not Logged sandy GRAVEL (2 - 60 MM). Saturated (water-bearing).

Not Logged clayey GRAVEL (2 - 60 MM). Not Recorded. Not Logged clayey GRAVEL (2 - 60 MM) with some sand. Not Recorded.

40

40.00m

43.00m

46.00m

48.00m

### Borelog for well BX23/0895

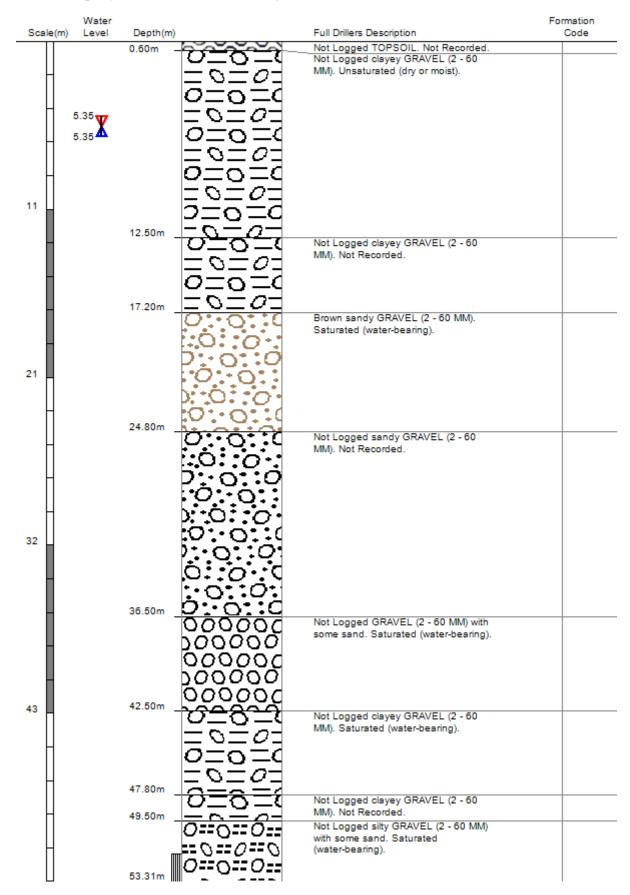
Grid Reference (NZTM): 1549888 mE, 5168727 mN

Location Accuracy: 50 - 300m

Ground Level Altitude: m +MSD Accuracy: Driller: Clemence Drilling Contractors Drill Method: Rotary/Percussion

Borelog Depth: 53.3 m Drill Date: 16-Apr-2019





# Borelog for well M36/4387

Grid Reference (NZTM): 1549704 mE, 5168988 mN

Location Accuracy: 2 - 15m

30

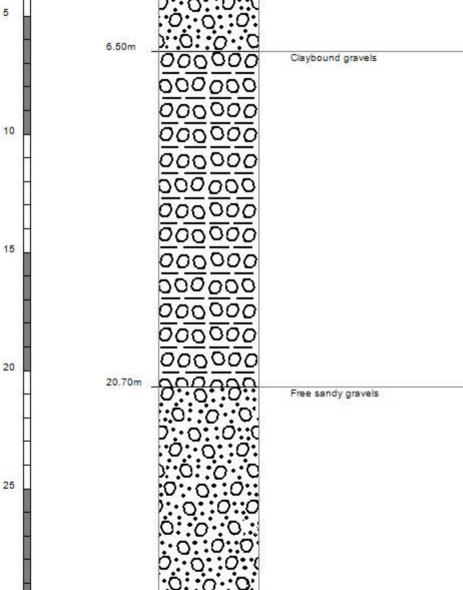
35

35.59m

Ground Level Altitude: 36.5 m +MSD Accuracy: < 2.5 m Driller: McMillan Drilling Ltd Drill Method: Rotary/Percussion



Wat cale(m) Leve		Full Drillers Description	Formation Code
	0.30m	Earth	
	2000	Large Grey gravels	
	2.50m	Sandy gravels	12
	:0::0 P::0::0	5::0 5::0	
20	6.50m ): O C	Claybound gravels	c c
1	0000	<u> </u>	
	0000	<del> </del>	
		<del></del>	
П	0000	<del></del>	
H	0000	00	
Н	2000	00	
H	0000		
1	<u> </u>		
83 <u>-3</u>	<del></del>	<del></del>	
- 40	0000	<u>00</u>	
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Ť	<del></del> -	<del></del>	
	0000		
H	20.70m	Free sandy gravels	



## Borelog for well M36/4449

Grid Reference (NZTM): 1549508 mE, 5169471 mN

Location Accuracy: 50 - 300m

Ground Level Altitude: 38.8 m +MSD Accuracy: < 2.5 m

Driller: Dynes Road Drilling Drill Method: Cable Tool

Borelog Depth: 24.2 m Drill Date: 09-Jun-1992



Scale(m)	Water Level	Depth(m)		Full Drillers Description	Formation Code
5		8.00m	00000000 00000000 00000000 00000000 0000	Medium-small gravel	
10		10.00m	00000000 00000000 00000000 00000000 0000	Medium-small gravel, very open	
		12.00m	00000000 00000000 00000000 00000000 0000	Medium-small gravel	
		14.00m	000000 000000	Claybound small-medium gravel	
15				Small to large sandy gravel	
20		18.00m	000000000 00000000 00000000 00000000 0000	Medium gravel, Water-bearing	
20		22.00m	00000000	Small-medium gravel,clean,open	
		24.00m	000000000 000000000 000000000 00000000	Small to medium gravel,stained	

Borelog for well M36/7416 Grid Reference (NZTM): 1549058 mE, 5168781 mN

Location Accuracy: 50 - 300m

Driller: McMillan Drilling Ltd

Environment Canterbury

Drill	Method: Rotary/Pe elog Depth: 47.7 m		-2003	
Scale(m)	Water Level Depth(m)		Full Drillers Description	Formation Code
	0.30m . 0.30m	0.0.0.	Earth and gravels Earth and gravels	
2 0		0:0:0:	Sandy gravels	
		p. 0oq		
		)		
Ħ		0:0:0:		
Н		1.0.0.0		
5		00.0.0		
	5.60m	D::0::0::€		
77 W.	5.60m	0:.0:.0:	Sandy gravels Wet claybound sandy gravels	
		0::0::0		
		0:.0::0:		
64		0::0::0:		
		0:.0:.0:		
70.00		ooo		
10		<u>o∴o∵o∴</u>		
Ш	11.00m	.000	· Materials and send of sends	
	11.00m	000.	Wet claybound sandy gravels Water-bearing claybound sandy gravels	Ť
3		.000		
	13.10m	0:.0:.0:	Notes herefor No.	
	13.10m	00	Water-bearing claybound sandy gravels Water-bearing claybound sandy gravels	
22	14.70m	.000		
15	14.70m	0:0::0::	Water-bearing claybound sandy gravels Medium water-bearing stained	
		0:0:0:0	gravels, some sand	
	16.80m	0:0:0:		
	16.80m	000000000	Medium water-bearing stained gravels, some sand	
64		000000000	Small to medium water-bearing gravels	
- 1		000000000		
-	20.70	000000000		
20	19.70m 19.70m	000000000	Small to medium water-bearing gravels	
		000000000	Medium water-bearing stained gravels	
2 4		000000000		
1	50.50	1000000000		
5250	22.50m 22.50m	0.0.0.	Medium water-bearing stained gravels	
		0:0:0:	water-bearing sandy gravels	
2		p. 0 o q		
25		: o : o : a		
		0:0:0:		
77 W	25.40m	)::0::0::0		
	26.40m	00000000	water-bearing sandy gravels Medium water-bearing lightly stained	+
		888888888888888888888888888888888888888	gravels	
		0000000000		
		000000000		
30		000000000		
30		000000000		
2 1		000000000		
202		000000000		
		000000000		
	33.20m	000000000000000000000000000000000000000	Medium water-bearing lightly stained	
	33.20m	000000000	gravels  Medium water-bearing lightly stained	
		000000000	gravels	
35		000000000		
		000000000		
		000000000		
		000000000		
:		000000000		
		000000000		
		000000000		
40		000000000000000000000000000000000000000		
		200000000		
		000000000		
		000000000		
240		1000000000		
	43.70m	000000000		
2	43.70m	0:0:0:	Medium water-bearing lightly stained gravels	ľ
45	i		Medium to large well stained sandy gravels	

46.80m

46.80m 47.70m

Medium to large well stained sandy

- Drill Method: Rotary/Percussion
- Regional Council Kaunihera Taiao ki Waitaha