BASELINEGROUP

Appendix 5: Geotechnical Report

GEOTECHNICAL INVESTIGATION REPORT

FOR PROPOSED LAND USE CHANGE

Corner of Creyke & West Coast Roads (Section 1 SO 1227), Darfield

Client: Rupert Jack & Catherine Elizabeth Wright

Project Reference:	LTCL17312
Revision:	A
Date:	22 December 2017

Documentation Control:

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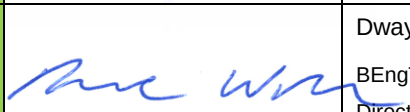
Document Title:	**Geotechnical Report for Proposed Land Use Change**	
Address:	Corner of Creyke & West Coast Roads (Section 1 SO 1227), Darfield	
Revision:	Revision A	
Client:	Rupert Jack & Catherine Elizabeth Wright	
Project Reference:	LTCL17312	
Author:		Liam Stewart, Associate Engineering Geologist BSc, PGDip (Geology)
Reviewed/Authorised:		Dwayne Wilson, Senior Geotechnical Engineer BEngTech (civil), MEngSt (geotechnical), CPEng, Director

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Table of Contents:

Appendices:

1.0 Introduction

1.1 Project Brief

LandTech Consulting Ltd. (LandTech) were engaged by Rupert Jack & Catherine Elizabeth Wright (the Client) to carry out a geotechnical investigation on the corner of Creyke & West Coast Roads, Darfield. The geotechnical investigation is in relation to the proposed land use change of the property from rural to residential and commercial.

The geotechnical investigation has been carried out to determine a geological model of the site, assess the future land performance (i.e. during seismic events) and assess the suitability of the proposed land use change from a geotechnical perspective. Where applicable assessment and reporting has been conducted in accordance with the Ministry of Business, Innovation and Employment document; Repairing and rebuilding houses affected by the Canterbury Earthquakes, dated December 2012 (MBIE Guidelines, 2012), and any relevant updates.

This geotechnical report summarises the findings of our investigation and assessment. It includes our evaluation of natural hazards, suitability of the proposed development, and may be used to support a Land Use Change Application to the Selwyn District Council.

1.2 Scope of Works

The geotechnical investigation for the proposed subdivision included the following:

- Desktop review of existing geological, geotechnical and natural hazard information;
- Detailed walkover inspection;
- Intrusive field investigation (i.e. testpit excavations);
- Geotechnical assessment and natural hazard evaluation; and
- Preparation of this geotechnical report, detailing all of the above and recommendations.

2.0 Site Description

The investigation site is located on the corner of Creyke & West Coast Roads (State Highway 73), Darfield and is legally described as Section 1 SO 1227. The property is approximately trapezoid shaped in plan view and 30.8ha in total area (the site area has been sourced from https://mapviewer.canterburymaps.govt.nz/, accessed 14 December 2017); as shown in Figure 1 and on the LandTech *Site Plan*, Drawing No. LTCL17312/ 1 (attached in Appendix A). The site is bound to the north by West Coast Road and Creyke Road runs adjacent the eastern site boundary. At present the property comprises a rural/pastoral setting and the ground surface is generally near level to undulating with a gradual fall toward the south. An open drainage channel flows along the southern boundary and is indicated on the LandTech *Site Plan* (referenced above).

Figure 1: Aerial photograph of investigation site

(Source: https://mapviewer.canterburymaps.govt.nz/, accessed 14 December 2017)

3.0 Proposed Development

Baseline Group have provided a drawing titled: *Outline Development Plan – Section 1 SO 1227, Plan Change – Darfield*, Sheet 1/1, Revision 1, dated 3 June 2016. The drawing indicates it is proposed to change the current land use from rural to commercial and residential. The proposed development following an approved land change by the Selwyn District Council will include the construction of commercial buildings (with associated car parking and landscaping), a community centre, low and medium density residential properties.

4.0 Area Geology

Reference has been made to the various maps and resources made available by GNS and NZGD (for example, the *New Zealand Geology Web Map*, http://data.gns.cri.nz/geology/, accessed 14 December 2017). The reviewed sources indicate that the site is underlain by Late Pleistocene River Deposits. These materials generally comprise rounded to subrounded gravel and cobble sized particles deposited via the lateral and vertical migration of the past and present river systems, from the Southern Alps, out toward the east coast.

The characteristics of the River Deposits can vary widely over small distances. These variances include vertical and horizontal differences in both soil particle size distribution and consolidation. It is discussed above that these materials generally comprise gravel and cobbles; however, interbedded horizons of fine to coarse grained sand, silt and clay can also exist.

4.1 Faults in Canterbury

New Zealand rests on the boundary between the Pacific and the Australian Tectonic Plates. This boundary is marked by a series of surface expressions through the Marlborough, North Canterbury, Wairau, Awatere, Clarence and Hope Faults. These faults converge near Otira and form the Alpine Fault. In places away from these major faults are smaller/minor faults that act in taking up some of the tectonic plate movements (for example the active Porters Pass Fault). These faults, and unknown unmapped faults below the Canterbury Plains contribute to the seismic hazard of the region.

The tectonic plates are constantly moving with respect to one another, and the Earth's crust can only accommodate a certain level of stress/strain before rupture occurs. This has been demonstrated during the recent Canterbury Earthquake Sequence (CES) and Kaikoura Earthquakes. The ruptures will generally emerge along a fault line and result in an earthquake. Depending on the nature and depth of the fault, an earthquake needs to be larger than approximately Mw 6.0 to 6.5 for the rupture to break through to the surface.

For the purpose of our investigation we have referred to a Selwyn District earthquake fault report compiled by GNS Science and Environment Canterbury (ECan). The referenced report is titled:

- General distribution and characteristics of active faults and folds in the Selwyn District, North Canterbury, GNS Science and Environment Canterbury, dated July 2013.

The sourced report gives a general outline of the nature of geologically active areas within the Selwyn District; indicating that the site is located approximately 10.0Km north of the mapped Greendale Fault.

The Greendale Fault and associated blind faults of the Darfield earthquake sequence have been defined by GNS Science via field inspection, aerial photograph interpretation and regional geologic mapping. The reference source indicates that these faults were unknown prior to 2010 and the ages of previous ruptures (if any) are also not known. The slip rate of the Greendale Fault has not been established and the Recurrence Interval is estimated to be 5,000 years or greater.

Potential hazards related to the Greendale Fault and other unknown faultlines is 1) strong ground motion and 2) the effects of abrupt ground surface offset or buckling which may result. With this being said, the reference report states that "of the later villages and towns, Springfield and Hororata are the only ones that lie close to known or suspected active faults" (GNS Science & ECan, 2013: 29).

5.0 Geotechnical Data Review

For the purpose of our desktop study/geotechnical data review we have referred to a number of sources including:

- New Zealand Geotechnical Database (NZGD); https://www.nzgd.org.nz/;
- Environment Canterbury (ECan): http://canterburymaps.govt.nz/; and
- Selwyn District Plan: http://eplan.selwyn.govt.nz/#!Property/3303741 (accessed 5 September 2017).

The following text summarises the findings of our data review:

- NZGD indicates that the site is located within Green Zone (CERA Residential Zoning Maps) and is classified as N/A – Rural & Unmapped according to Ministry of Business, Innovation and Employment (MBIE).

- The ECan Liquefaction Hazard Map (2012) shows that the site is located in an area where damaging liquefaction is unlikely.

- The Selwyn District Plan shows that the site rests within the *Outer Plains Planning Zone*. In these areas the Council specify that only one house is to exist per 20ha of land.

- The GNS Science Post 4 September 2010 & Post 22 February 2011 Observation Maps do not indicate the occurrence of liquefaction at the surface within the site (or surrounding area) as a consequence of the two referenced earthquakes.

- Local ECan well log data indicate that the area is underlain by river gravels from the surface and to a depth of at least 200m (based on Well L35/0624 & BX22/0051). This is in concurrence with the geology described by GNS Science and described in Section 4.0 (Area Geology).

6.0 Field Investigation

The field investigation for the site was carried out 19 December 2017; it comprised the following components:

- Detailed walkover inspection; and
- Excavation of 16 testpits;

The density of testing was determined in accordance with Part D of the MBIE Guidelines (2012) for Land Use Changes in Canterbury. Where in areas of known dense gravel and deep groundwater, shallow investigations in leu of boreholes and CPT's are suitable.

All field tests have been measured in via Garmin hand held GPS and are therefore approximate only. The test locations are shown on the LandTech *Site Plan*, Drawing No. LTCL17312/ 1 (attached in Appendix A).

The testpits were excavated by Francis Ward Ltd. via 8T digger and the soil conditions encountered were logged by a LandTech Engineering Geologist. The soil was logged in accordance with New Zealand Geotechnical Society *Guideline for the Description of Soil and Rock for Engineering Purposes* (2005). The field logs are attached in Appendix B.

7.0 Subsurface Conditions

The sites subsurface conditions mostly comprised a surficial layer of topsoil (and occasional Loess Deposits) underlain by gravel River Deposits. This is generally consistent with the geology described in Section 3.0 (Area Geology) and Section 5.0 (Geotechnical Data Review). Geologic summaries are given in Table 1 and detailed geologic descriptions follow in the subsequent sections.

Table 1: Subsurface summary

Testpit ID	Easting	Northing	Testpit Depth	Depth of Topsoil	Depth of Loess	Groundwater Level
TP01	1529278	5184289	3.0	0.3	NE	NE
TP02	1529436	5184283	3.0	0.3	NE	NE
TP03	1529688	5184253	3.0	0.4	NE	NE
TP04	1529971	5184198	3.0	0.3	NE	NE
TP05	1530131	5184185	3.0	0.3	NE	NE
TP06	1530353	5184142	3.0	NE	0.7	NE
TP07	1529232	5184178	3.0	0.2	NE	NE
TP08	1529430	5184145	3.0	NE	0.4	NE
TP09	1529669	5184102	3.0	0.4	0.7	NE
TP10	1529948	5184090	3.0	0.2	NE	NE
TP11	1530221	5184042	3.0	0.4	0.7	NE
TP12	1529232	5184036	3.0	0.4	NE	NE
TP13	1529431	5184006	3.0	NE	0.4	NE
TP14	1529656	5183976	3.0	0.4	NE	NE
TP15	1529948	5183939	3.0	0.2	0.5	NE
TP16	1530108	5183969	3.0	0.3	0.7	NE

Table notes: Coordinates are New Zealand Trans Mercator 2000 (NZM2000)
Measurements are in metres (m) below present ground level (bpgl)
NE = Not Encountered

7.1 Topsoil

Topsoil was encountered as a surficial deposit within most test locations. These materials were generally only up to 0.4m below present ground level (bpgl) and comprised brown silt with minor fractions of sand and gravel.

The topsoil is not considered suitable for the support of pavement, buildings or other permanent structures. This is due to its variable composition and strength characteristics that bear the potential for differential settlement.

7.2 Loess Deposits

Loess was encountered at a number of locations (indicated in Table 1) between the upper topsoil mantle and the underlying River Deposits and up to 0.7m bpgl. It is a windblown deposit, common around the Canterbury Plains and generally comprised major fractions of silt with subordinate and minor fractions of fine to coarse grained sand, and fine to coarse grained rounded to subrounded river gravel.

The Loess Deposits are described as yellowish brown/grey, very stiff to hard, non-plastic and moist. Scala penetrometer test results within these materials were mostly higher than 4 blows/100mm penetration.

7.3 River Deposits

River Deposits were encountered underlying the surficial topsoil and Loess Deposits to the termination depth of all testpits (i.e. 3.0m bpgl). These materials generally comprised horizons of fine to coarse grained rounded to subrounded gravel, with subordinate and minor fractions of fine to coarse grained sand, silt, rounded to subrounded cobbles and occasional boulders.

The density of these materials has been described as “tightly packed”; this term is a tactile field description defined as material that requires a pick for removal, either as lumps or as disaggregated material (NZGD, 2005).

7.4 Groundwater

The groundwater table was not encountered during our field investigation, however layers within the River Deposits have been described as moist to wet. A review of local ECan wells via https://mapviewer.canterburymaps.govt.nz/ (accessed 20 December 2017) indicates that the water table is approximately 80m below the ground; however, this does not preclude the existence of perched groundwater tables within the underlying strata.

It is inferred that groundwater levels within the site will be prone to fluctuation. For example, levels are expected to rise following periods of prolonged and/or heavy rain fall and fall during drier times. Groundwater levels will also be connected to seasonal river levels, and groundwater recharge from the alps and foothills.

7.5 Site Seismicity

For the purpose of applying requirements of NZS 1170.5:2004 the site subsoil is Class D – Deep or Soft Soil Site. This classification is based on depths of soil exceeding the limits of Table 3.2 of the reference standard. The seismic hazard factor (Z) for the site is 0.3 as per the standard.

8.0 Qualitative Liquefaction Assessment

The MBIE & New Zealand Geotechnical Society Inc. report titled *Earthquake geotechnical engineering practice, Module 3: Identification, assessment and mitigation of liquefaction hazards* (2016) explains that the evaluation of the geologic susceptibility of liquefaction is a key aspect in the assessment of liquefaction potential at a given site.

Based on our desktop study and field investigation, we have established that the site is generally underlain by Late Pleistocene horizons of tightly packed gravel (i.e. River Deposits) with groundwater levels generally below 80.0m depth. In addition to this the GNS Science Post 4 September 2010 & Post 22 February 2011 Observation Maps do not indicate the occurrence of liquefaction at the surface within the site (or surrounding area) as a consequence of the two referenced earthquakes.

8.1 Land Classification

The region comprises a rural/unmapped Residential Foundation Technical Category (based on MBIE); however, is considered an area that is not likely to be susceptible to liquefaction induced damage. This is based on the geology underlying the site (i.e. Late Pleistocene Aged River Deposits), the previously referenced reports and maps, and the qualitative assessment. Based on our assessment, we consider that the site can be classified as Technical Category 1 (TC1), and consider the property suitable for land use change from a geotechnical perspective.

9.0 Natural Hazard Evaluation

The following assessment addresses geo-hazards outlined in Section 106 of the RMA. These geo-hazards should be contemplated when making an application for subdivision of land (following the pending land use change). When considering the required geo-hazards, we have made our evaluations with respect to the proposed land use change with the potential for subdivision.

9.1 Erosion

The surface of the property is near level to undulating and the topography generally falls toward the southern direction. During our field investigation, we did not observe any obvious signs of erosion from concentrated surface runoff. Furthermore, we do not consider the proposed site developments will increase the erosion potential provided stormwater is disposed of in a controlled manner subject to usual Council Consenting procedures.

9.2 Flooding

For the purpose of our investigation the Selwyn District Council District Plan has been accessed (weblink: http://eplan.selwyn.govt.nz/, accessed 20 December 2017). The District Plan indicates that the site is located within *Outer Plains Planning Zone*, and is not located within an area of flood risk.

9.3 Liquefaction Induced Subsidence and Inundation

It is discussed in previous sections of this report, liquefaction is not likely to occur within the investigation site. This means that liquefaction induced ground damage (i.e. subsidence and inundation) is not likely to occur. Other forms of land subsidence are also not considered to be associated with the site, with the underlying ground conditions exhibiting a competent and stable nature.

9.4 Falling Debris and Slippage

No tall standing slopes exist in the vicinity of the investigation site, therefore falling debris hazard is non-existent, similarly, with risk of slippage (i.e. near level site).

10.0 Geotechnical Suitability

The site is not considered to be at risk of natural hazards, due to the topographic and geologic setting. Our qualitative assessment has found the property is equivalent to the residential classification TC1. This is with respect to liquefaction potential.

Based on the results of our field investigation, the natural ground below any surficial topsoil is considered to meet the criteria of "good ground" in accordance with Verification Method B1/VM1 of the New Zealand Building Code. In saying this, additional geotechnical investigations of appropriate spatial density will be needed during future Subdivision/Building Consent application stages of the development.

The competent and stable nature of the subsurface conditions mean that standard land development engineering, and follow-on building and foundation construction, is considered applicable for this site; this is from a geotechnical perspective.

Therefore, it is our professional geotechnical opinion that the proposed land use change for the site, from rural to commercial and residential, is suitable. The future proposed developments are not considered to be at risk of natural hazards and the local territorial authorities can rely on this when considering the Land Use Change application.

11.0 Limitations

This geotechnical report has been prepared for our Client, Rupert jack & Catherine Elizabeth Wright, for the purposes of supporting Consent applications to the Selwyn District Council. This report shall not be extrapolated for other nearby sites, or used for any other purposes without the express approval of LandTech and their Client.

This report has been based on the results of tests at point locations; therefore, subsurface conditions could vary away from the assumed geotechnical model. Should exposed soil conditions vary from those described herein we request to be informed to determine the continued applicability of our recommendations.

Industry investigation, research and analysis of Christchurch's seismic events has resulted in modifications to the building codes (including MBIE Guidelines, 2012). Because of this, further changes are to be expected with time. The findings and recommendations of this geotechnical report may require modification to accommodate any changes before building works are implemented. In these circumstances, it is recommended that LandTech is engaged to review the findings of this report are reviewed.

The geotechnical investigation was confined to geotechnical aspects of the site only and did not involve the assessment for environmental contaminants. In addition, our investigation and analyses have also not taken into account possible fault rupture that may cause deformations and displacements of the ground directly below the site. This type of assessment is outside of the scope of our geotechnical engagement.

END OF REPORT

Appendix A
Site Plan

Lot 2
DP 337806

Lot 1
DP 69875

Lot 2
DP 303118

Lot 1
DP 376965

Lot 4 DP 55935

Lot 2 DP 376965

Hordon Street

Section 1
SO 2368

North

West Coast Road (State Highway 73)

TP01
TP02
TP03
TP04
TP05
TP06
TP07
TP08
TP09
TP10
TP11
TP12
TP13
TP14
TP15
TP16

194m
193m
192m
192m
191m
190m

Lot 1
DP 23653

Lot 2
DP 434486

Part RS
27973

Part Lot 1
DP 6651

Creyke Road

KEY:

TP 1 — Approximate LandTech Testpit Locations, excavated 19 December 2017

Existing boundary

Major contours (1.0m)

Minor contours (0.5m)

Open drainage channel (approx)

Existing buildings

AMENDMENTS		
DATE	REV	DESCRIPTION
20/12/2017	A	Initial drafting - LS

Geotechnical Site Plan

Corner of Creyke & West Coast Roads
(Section 1 SO 1227)
DARFIELD

LandTech CONSULTING

Physical Address:
Unit 6, 31 Carlyle Street, Sydenham, Christchurch 8023

Postal Address:
PO Box 119, Christchurch 8013

Website: www.landtech.nz

Drawing No.	Drawn by:	Date:
LTCL17312/ 1	L Stewart	20 Dec 2017
Scale: 1: 3,000 (A3)	Checked by: D Wilson	Revision: A

Filename: LTCL17312 Site Plan LS.dwg

Appendix B
Field Investigation Logs

LandTech CONSULTING

Client:	Rupert Jack & Catherine Elizabeth Wright	Testpit No.	TP01
Project:	Geotechnical Investigation for Proposed Land Use Change		
Address:	Cnr Creyke & West Coast Roads (Section 1 SO 1227), Darfield	Sheet No.	1 of 1

Excavator Type:	9T Digger	Project No:	LTCL17312	Logged By:	L Stewart
Excavated By:	Francis Ward Ltd.	Coordinates:	NZTM2000 E1529278 N5184289	Shear Vane No:	NA
Date Started:	19-Dec-17	Ground Conditions:	Near level/undulating, pasture	Calibration Factor:	NA
Date Finished:	19-Dec-17	Groundwater Level (m):	Not Encountered	Calibration Date:	NA

Stratigraphy	Depth (m)	Graphic Log	Soil description in accordance with *Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes* , NZ Geotechnical Society Inc., 2005
TOPSOIL	0.0		SILT, minor fine to coarse sand, trace fine to coarse rounded to subrounded gravel, brown, very stiff, moist, non-plastic [TOPSOIL]
RIVER DEPOSITS	0.5		Fine to coarse sandy fine to coarse rounded to subrounded GRAVEL, brownish grey, tightly packed, moist, trace rounded to subrounded cobble inclusions [RIVER DEPOSITS]
	2.0		Fine to coarse rounded to subrounded GRAVEL, some fine to coarse sand to sandy, brownish grey, tightly packed, moist, trace rounded to subrounded cobble inclusions
	2.5		Fine to coarse sandy GRAVEL, brownish grey, tightly packed, moist to wet, trace rounded to subrounded cobble inclusions
	3.0		End of Testpit 3.0m [TARGET DEPTH]
	5.0		

Groundwater Level (m): NOT ENCOUNTERED

In-situ Field Testing

Shear Strength (kPa)

Peak:

Remoulded:

0

Dynamic Cone Penetrometer

Depth (m)	Blow Count	Scala Blow Count / 100mm (0 5 10 15 20)
-0.1	5	
-0.2	14	
-0.3	12	
-0.4	20+	
-0.5		
-0.6		
-0.7		
-0.8		
-0.9		
-1.0		
-1.1		
-1.2		
-1.3		
-1.4		
-1.5		
-1.6		
-1.7		
-1.8		
-1.9		
-2.0		
-2.1		
-2.2		
-2.3		
-2.4		
-2.5		
-2.6		
-2.7		
-2.8		
-2.9		
-3.0		
-3.1		
-3.2		
-3.3		
-3.4		
-3.5		
-3.6		
-3.7		
-3.8		
-3.9		
-4.0		
-4.1		
-4.2		
-4.3		
-4.4		
-4.5		
-4.6		
-4.7		
-4.8		
-4.9		
-5.0		

In-situ field testing in accordance with the following Standards:

Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

LandTech CONSULTING	Client: Rupert Jack & Catherine Elizabeth Wright Project: Geotechnical Investigation for Proposed Land Use Change Address: Cnr Creyke & West Coast Roads (Section 1 SO 1227), Darfield	Testpit No.	TP02
		Sheet No.	1 of 1

Excavator Type:	9T Digger	Project No:	LTCL17312	Logged By:	L Stewart
Excavated By:	Francis Ward Ltd.	Coordinates:	NZTM2000 E1529436 N5184283	Shear Vane No:	NA
Date Started:	19-Dec-17	Ground Conditions:	Near level/undulating, pasture	Calibration Factor:	NA
Date Finished:	19-Dec-17	Groundwater Level (m):	Not Encountered	Calibration Date:	NA

Stratigraphy	Depth (m)	Graphic Log	Soil description in accordance with *Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes* , NZ Geotechnical Society Inc., 2005
TOPSOIL	0.5		SILT, some fine to medium sand, trace fine to coarse rounded to subrounded gravel, brown, very stiff, moist, non-plastic [TOPSOIL]
RIVER DEPOSITS	1.0		Fine to coarse sandy fine to coarse rounded to subrounded GRAVEL, grey, tightly packed, moist [RIVER DEPOSITS]
	1.5		Fine to coarse rounded to subrounded gravelly fine to coarse SAND, grey, tightly packed, moist to wet
	2.0		Fine to coarse sandy fine to coarse rounded to subrounded GRAVEL, grey, tightly packed, moist to wet
	2.5		
	3.0		
	3.5		End of Testpit 3.0m [TARGET DEPTH]
	4.0		
	4.5		
	5.0		

Groundwater Level (m): NOT ENCOUNTERED

In-situ Field Testing

Shear Strength (kPa)

Peak:

Remoulded:

0

Dynamic Cone Penetrometer

Depth (m)	Blow Count	Scala Blow Count / 100mm (0 5 10 15 20)
-0.1	4	
-0.2	5	
-0.3	20	
-0.4		
-0.5		
-0.6		
-0.7		
-0.8		
-0.9		
-1.0		
-1.1		
-1.2		
-1.3		
-1.4		
-1.5		
-1.6		
-1.7		
-1.8		
-1.9		
-2.0		
-2.1		
-2.2		
-2.3		
-2.4		
-2.5		
-2.6		
-2.7		
-2.8		
-2.9		
-3.0		
-3.1		
-3.2		
-3.3		
-3.4		
-3.5		
-3.6		
-3.7		
-3.8		
-3.9		
-4.0		
-4.1		
-4.2		
-4.3		
-4.4		
-4.5		
-4.6		
-4.7		
-4.8		
-4.9		
-5.0		

In-situ field testing in accordance with the following Standards:

Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

LandTech CONSULTING	Client: Rupert Jack & Catherine Elizabeth Wright Project: Geotechnical Investigation for Proposed Land Use Change Address: Cnr Creyke & West Coast Roads (Section 1 SO 1227), Darfield	Testpit No.	TP03
		Sheet No.	1 of 1

Excavator Type:	9T Digger	Project No:	LTCL17312	Logged By:	L Stewart
Excavated By:	Francis Ward Ltd.	Coordinates:	NZTM2000 E1529688 N5184253	Shear Vane No:	NA
Date Started:	19-Dec-17	Ground Conditions:	Near level/undulating, pasture	Calibration Factor:	NA
Date Finished:	19-Dec-17	Groundwater Level (m):	Not Encountered	Calibration Date:	NA

Stratigraphy	Depth (m)	Graphic Log	Soil description in accordance with *Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes*, NZ Geotechnical Society Inc., 2005	Groundwater Level (m)	Depth (m)	In-situ Field Testing: Shear Strength (kPa) (Peak: / Remoulded:, 0)	In-situ Field Testing: Dynamic Cone Penetrometer Depth (m)	Blow Count	Scala Blow Count / 100mm (0 5 10 15 20)
TOPSOIL			SILT, some fine to medium sand, brown, very stiff, dry, non-plastic, trace fine to coarse rounded to subrounded gravel inclusions [TOPSOIL]	NOT ENCOUNTERED			-0.1	3	
							-0.2	4	
							-0.3	6	
							-0.4	20+	
RIVER DEPOSITS	0.5		Fine to coarse rounded to subrounded GRAVEL, minor to some fine to medium sand, minor silt, grey, tightly packed, moist [RIVER DEPOSITS]		0.5		-0.5		
							-0.6		
							-0.7		
							-0.8		
							-0.9		
	1.0				1.0		-1.0		
			Fine to coarse sandy fine to coarse rounded to subrounded GRAVEL, minor silt, grey, tightly packed, moist, trace rounded to subrounded cobble inclusions				-1.1		
							-1.2		
							-1.3		
							-1.4		
	1.5				1.5		-1.5		
							-1.6		
							-1.7		
							-1.8		
							-1.9		
	2.0		Fine to coarse sandy fine to coarse rounded to subrounded GRAVEL, brown and grey mottles, tightly packed, moist to wet, trace rounded to subrounded cobble inclusions		2.0		-2.0		
							-2.1		
							-2.2		
							-2.3		
							-2.4		
	2.5				2.5		-2.5		
							-2.6		
							-2.7		
							-2.8		
							-2.9		
	3.0				3.0		-3.0		
			End of Testpit 3.0m				-3.1		
			[TARGET DEPTH]				-3.2		
							-3.3		
							-3.4		
	3.5				3.5		-3.5		
							-3.6		
							-3.7		
							-3.8		
							-3.9		
	4.0				4.0		-4.0		
							-4.1		
							-4.2		
							-4.3		
							-4.4		
	4.5				4.5		-4.5		
							-4.6		
							-4.7		
							-4.8		
							-4.9		
	5.0				5.0		-5.0		

In-situ field testing in accordance with the following Standards:

Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

LandTech CONSULTING	Client: Rupert Jack & Catherine Elizabeth Wright Project: Geotechnical Investigation for Proposed Land Use Change Address: Cnr Creyke & West Coast Roads (Section 1 SO 1227), Darfield	Testpit No.	TP04
		Sheet No.	1 of 1

Excavator Type:	9T Digger	Project No:	LTCL17312	Logged By:	L Stewart
Excavated By:	Francis Ward Ltd.	Coordinates:	NZTM2000 E1529971 N5184198	Shear Vane No:	NA
Date Started:	19-Dec-17	Ground Conditions:	Near level/undulating, pasture	Calibration Factor:	NA
Date Finished:	19-Dec-17	Groundwater Level (m):	Not Encountered	Calibration Date:	NA

Stratigraphy	Depth (m)	Graphic Log	Soil description in accordance with *Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes* , NZ Geotechnical Society Inc., 2005
TOPSOIL	0.0		SILT, minor fine to medium sand, trace fine to coarse rounded to subrounded gravel, brown, very stiff, dry, non-plastic [TOPSOIL]
RIVER DEPOSITS	0.5		Silty fine to coarse rounded to subrounded GRAVEL, some fine to coarse sand, yellowish grey, tightly packed, moist [RIVER DEPOSITS]
	1.0		Fine to coarse sandy fine to coarse rounded to subrounded GRAVEL, brownish grey, tightly packed, moist, trace rounded to subrounded cobble inclusions
	2.5		Fine to coarse rounded to subrounded GRAVEL, some fine to coarse sand to sandy, brownish grey, tightly packed, moist to wet
	3.0		End of Testpit 3.0m [TARGET DEPTH]
	5.0		

Groundwater Level (m): NOT ENCOUNTERED

In-situ Field Testing

Shear Strength (kPa): Peak: / Remoulded: (0)

Dynamic Cone Penetrometer

Depth (m)	Blow Count	Scala Blow Count / 100mm (0 5 10 15 20)
-0.1	4	
-0.2	7	
-0.3	20+	

In-situ field testing in accordance with the following Standards:

Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

LandTech CONSULTING	Client: Rupert Jack & Catherine Elizabeth Wright Project: Geotechnical Investigation for Proposed Land Use Change Address: Cnr Creyke & West Coast Roads (Section 1 SO 1227), Darfield	Testpit No.	TP05
		Sheet No.	1 of 1

Excavator Type:	9T Digger	Project No:	LTCL17312	Logged By:	L Stewart
Excavated By:	Francis Ward Ltd.	Coordinates:	NZTM2000 E1530131 N5184185	Shear Vane No:	NA
Date Started:	19-Dec-17	Ground Conditions:	Near level/undulating, pasture	Calibration Factor:	NA
Date Finished:	19-Dec-17	Groundwater Level (m):	Not Encountered	Calibration Date:	NA

Stratigraphy	Depth (m)	Graphic Log	Soil description in accordance with *Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes* , NZ Geotechnical Society Inc., 2005
TOPSOIL	0.0		SILT, some fine to coarse sand, trace fine to coarse rounded to subrounded gravel, brown, very stiff, moist, non-plastic [TOPSOIL]
RIVER DEPOSITS	0.5		Silty fine to coarse rounded to subrounded GRAVEL, some fine to coarse sand to sandy, yellowish grey, tightly packed, moist [RIVER DEPOSITS]
	1.0		Fine to coarse rounded to subrounded GRAVEL, some fine to coarse sand, minor silt, brownish grey, tightly packed, moist
	1.5		
	2.0		
	2.5		Fine to coarse sandy fine to coarse rounded to subrounded GRAVEL, brownish grey, tightly packed, moist to wet, trace rounded to subrounded cobble inclusions
	3.0		End of Testpit 3.0m [TARGET DEPTH]
	3.5		
	4.0		
	4.5		
	5.0		

Groundwater Level (m): NOT ENCOUNTERED

In-situ Field Testing

Shear Strength (kPa) — Peak: — Remoulded: • — 0

Dynamic Cone Penetrometer

Depth (m)	Blow Count	Scala Blow Count / 100mm (0 5 10 15 20)
-0.1	6	
-0.2	6	
-0.3	20+	
-0.4		
-0.5		
-0.6		
-0.7		
-0.8		
-0.9		
-1.0		
-1.1		
-1.2		
-1.3		
-1.4		
-1.5		
-1.6		
-1.7		
-1.8		
-1.9		
-2.0		
-2.1		
-2.2		
-2.3		
-2.4		
-2.5		
-2.6		
-2.7		
-2.8		
-2.9		
-3.0		
-3.1		
-3.2		
-3.3		
-3.4		
-3.5		
-3.6		
-3.7		
-3.8		
-3.9		
-4.0		
-4.1		
-4.2		
-4.3		
-4.4		
-4.5		
-4.6		
-4.7		
-4.8		
-4.9		
-5.0		

In-situ field testing in accordance with the following Standards:

Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

LandTech CONSULTING	Client: Rupert Jack & Catherine Elizabeth Wright Project: Geotechnical Investigation for Proposed Land Use Change Address: Cnr Creyke & West Coast Roads (Section 1 SO 1227), Darfield	Testpit No.	TP06
		Sheet No.	1 of 1

Excavator Type:	9T Digger	Project No:	LTCL17312	Logged By:	L Stewart
Excavated By:	Francis Ward Ltd.	Coordinates:	NZTM2000 E1530353 N5184142	Shear Vane No:	NA
Date Started:	19-Dec-17	Ground Conditions:	Near level/undulating, pasture	Calibration Factor:	NA
Date Finished:	19-Dec-17	Groundwater Level (m):	Not Encountered	Calibration Date:	NA

Stratigraphy	Depth (m)	Graphic Log	Soil description in accordance with *Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes*, NZ Geotechnical Society Inc., 2005	Groundwater Level (m)	Depth (m)	In-situ Field Testing: Shear Strength (kPa) (Peak: / Remoulded:)	Dynamic Cone Penetrometer: Depth (m)	Blow Count	Scala Blow Count / 100mm
LOESS DEPOSITS	0.5		SILT, minor fine to medium sand, yellowish brown, very stiff, hard, moist, non-plastic [LOESS DEPOSITS]	NOT ENCOUNTERED	0.5		-0.1	4	
			minor fine to coarse rounded to subrounded gravel				-0.2	5	
RIVER DEPOSITS	1.0		Silty fine to coarse rounded to subrounded GRAVEL, some fine to medium sand, grey, tightly packed, moist [RIVER DEPOSITS]		1.0		-0.3	6	
	1.5		trace rounded to subrounded cobbles		1.5		-0.4	12	
	2.0		some fine to coarse sand		2.0		-0.5	14	
	2.5		Fine to coarse sandy fine to coarse rounded to subrounded GRAVEL, grey, tightly packed, moist, trace rounded to subrounded cobble inclusions		2.5		-0.6	20+	
	3.0		End of Testpit 3.0m [TARGET DEPTH]		3.0		-0.7		
	3.5				3.5		-0.8		
	4.0				4.0		-0.9		
	4.5				4.5		-1.0		
	5.0				5.0		-1.1		
							-1.2		
							-1.3		
							-1.4		
							-1.5		
							-1.6		
							-1.7		
							-1.8		
							-1.9		
							-2.0		
							-2.1		
							-2.2		
							-2.3		
							-2.4		
							-2.5		
							-2.6		
							-2.7		
							-2.8		
							-2.9		
							-3.0		
							-3.1		
							-3.2		
							-3.3		
							-3.4		
							-3.5		
							-3.6		
							-3.7		
							-3.8		
							-3.9		
							-4.0		
							-4.1		
							-4.2		
							-4.3		
							-4.4		
							-4.5		
							-4.6		
							-4.7		
							-4.8		
							-4.9		
							-5.0		

In-situ field testing in accordance with the following Standards:

Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

LandTech CONSULTING	Client: Rupert Jack & Catherine Elizabeth Wright Project: Geotechnical Investigation for Proposed Land Use Change Address: Cnr Creyke & West Coast Roads (Section 1 SO 1227), Darfield	Testpit No.	TP07
		Sheet No.	1 of 1

Excavator Type:	9T Digger	Project No:	LTCL17312	Logged By:	L Stewart
Excavated By:	Francis Ward Ltd.	Coordinates:	NZTM2000 E1529232 N5184178	Shear Vane No:	NA
Date Started:	19-Dec-17	Ground Conditions:	Near level/undulating, pasture	Calibration Factor:	NA
Date Finished:	19-Dec-17	Groundwater Level (m):	Not Encountered	Calibration Date:	NA

Stratigraphy	Depth (m)	Graphic Log	Soil description in accordance with *Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes* , NZ Geotechnical Society Inc., 2005
TS	0.0		SILT, minor fine to medium sand, brownish grey, very stiff, moist, non-plastic, trace fine to coarse rounded to subrounded gravel [TOPSOIL]
RIVER DEPOSITS	0.5		Fine to coarse rounded to subrounded GRAVEL, some fine to coarse sand, minor silt, grey, tightly packed, moist [RIVER DEPOSITS]
	1.0		Fine to coarse sandy fine to coarse rounded to subrounded GRAVEL, brownish grey, tightly packed, moist, trace rounded to subrounded cobble inclusions
	1.5		
	2.0		
	2.5		
	3.0		trace rounded to subrounded boulder inclusion
	3.5		End of Testpit 3.0m [TARGET DEPTH]
	4.0		
	4.5		
	5.0		

Groundwater Level (m): NOT ENCOUNTERED

In-situ Field Testing

Shear Strength (kPa) — Peak: — Remoulded: • — 0

Depth (m)	Dynamic Cone Penetrometer: Blow Count	Scala Blow Count / 100mm (0 5 10 15 20)
-0.1	4	
-0.2	9	
-0.3	20+	
-0.4		
-0.5		
-0.6		
-0.7		
-0.8		
-0.9		
-1.0		
-1.1		
-1.2		
-1.3		
-1.4		
-1.5		
-1.6		
-1.7		
-1.8		
-1.9		
-2.0		
-2.1		
-2.2		
-2.3		
-2.4		
-2.5		
-2.6		
-2.7		
-2.8		
-2.9		
-3.0		
-3.1		
-3.2		
-3.3		
-3.4		
-3.5		
-3.6		
-3.7		
-3.8		
-3.9		
-4.0		
-4.1		
-4.2		
-4.3		
-4.4		
-4.5		
-4.6		
-4.7		
-4.8		
-4.9		
-5.0		

In-situ field testing in accordance with the following Standards:

Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

LandTech CONSULTING	Client: Rupert Jack & Catherine Elizabeth Wright Project: Geotechnical Investigation for Proposed Land Use Change Address: Cnr Creyke & West Coast Roads (Section 1 SO 1227), Darfield	Testpit No.	TP08
		Sheet No.	1 of 1

Excavator Type:	9T Digger	Project No:	LTCL17312	Logged By:	L Stewart
Excavated By:	Francis Ward Ltd.	Coordinates:	NZTM2000 E1529430 N5184145	Shear Vane No:	NA
Date Started:	19-Dec-17	Ground Conditions:	Near level/undulating, pasture	Calibration Factor:	NA
Date Finished:	19-Dec-17	Groundwater Level (m):	Not Encountered	Calibration Date:	NA

Stratigraphy	Depth (m)	Graphic Log	Soil description in accordance with *Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes*, NZ Geotechnical Society Inc., 2005	Groundwater Level (m)	Depth (m)	In-situ Field Testing: Shear Strength (kPa) (Peak: / Remoulded:)	Dynamic Cone Penetrometer: Depth (m)	Blow Count	Scala Blow Count / 100mm
LOESS			SILT, minor fine to medium sand, yellowish brown, very stiff to hard, non-plastic, trace fine to coarse rounded to subrounded gravel inclusions [LOESS DEPOSITS]				-0.1	5	
							-0.2	5	
							-0.3	9	
							-0.4	20+	
RIVER DEPOSITS	0.5		Silty fine to coarse rounded to subrounded GRAVEL, minor to some fine to coarse sand, yellowish brown and grey mottles, tightly packed, moist [RIVER DEPOSITS]	NOT ENCOUNTERED	0.5		-0.5		
			trace rounded to subrounded cobble inclusions				-0.6		
							-0.7		
							-0.8		
							-0.9		
	1.0		moist to wet		1.0		-1.0		
							-1.1		
							-1.2		
							-1.3		
							-1.4		
	1.5		Fine to coarse sandy fine to coarse rounded to subrounded GRAVEL, minor silt, grey, tightly packed, moist to wet, trace rounded to subrounded cobble inclusions		1.5		-1.5		
			trace rounded to subrounded boulder inclusions				-1.6		
							-1.7		
							-1.8		
							-1.9		
	2.0				2.0		-2.0		
							-2.1		
							-2.2		
							-2.3		
							-2.4		
	2.5				2.5		-2.5		
							-2.6		
							-2.7		
							-2.8		
							-2.9		
	3.0				3.0		-3.0		
			End of Testpit 3.0m				-3.1		
			[TARGET DEPTH]				-3.2		
							-3.3		
							-3.4		
	3.5				3.5		-3.5		
							-3.6		
							-3.7		
							-3.8		
							-3.9		
	4.0				4.0		-4.0		
							-4.1		
							-4.2		
							-4.3		
							-4.4		
	4.5				4.5		-4.5		
							-4.6		
							-4.7		
							-4.8		
							-4.9		
	5.0				5.0		-5.0		

In-situ field testing in accordance with the following Standards:

Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

LandTech CONSULTING	Client: Rupert Jack & Catherine Elizabeth Wright Project: Geotechnical Investigation for Proposed Land Use Change Address: Cnr Creyke & West Coast Roads (Section 1 SO 1227), Darfield	Testpit No.	TP09
		Sheet No.	1 of 1

Excavator Type:	9T Digger	Project No:	LTCL17312	Logged By:	L Stewart
Excavated By:	Francis Ward Ltd.	Coordinates:	NZTM2000 E1529669 N5184102	Shear Vane No:	NA
Date Started:	19-Dec-17	Ground Conditions:	Near level/undulating, pasture	Calibration Factor:	NA
Date Finished:	19-Dec-17	Groundwater Level (m):	Not Encountered	Calibration Date:	NA

Stratigraphy	Depth (m)	Graphic Log	Soil description in accordance with *Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes*, NZ Geotechnical Society Inc., 2005	Groundwater Level (m)	Depth (m)	In-situ Field Testing: Shear Strength (kPa) (Peak / Remoulded, 0)	Dynamic Cone Penetrometer: Depth (m)	Blow Count	Scala Blow Count / 100mm (0 5 10 15 20)
TOPSOIL			SILT, some fine to medium sand, brown, very stiff, non-plastic, trace fine to coarse rounded to subrounded gravel inclusions [TOPSOIL]	NOT ENCOUNTERED			-0.1	2	
							-0.2	5	
							-0.3	5	
							-0.4	10	
LOESS	0.5		Fine to coarse rounded to subrounded gravelly SILT, minor to some fine to medium sand, grey, hard, moist [LOESS DEPOSITS]		0.5		-0.5	20+	
							-0.6		
							-0.7		
							-0.8		
							-0.9		
RIVER DEPOSITS	1.0		Fine to coarse sandy fine to coarse rounded to subrounded GRAVEL, brown and grey mottles, tightly packed, moist to wet, trace rounded to subrounded cobble inclusions [RIVER GRAVELS]		1.0		-1.0		
							-1.1		
							-1.2		
							-1.3		
							-1.4		
	1.5				1.5		-1.5		
							-1.6		
							-1.7		
							-1.8		
							-1.9		
	2.0				2.0		-2.0		
							-2.1		
							-2.2		
							-2.3		
							-2.4		
	2.5				2.5		-2.5		
							-2.6		
							-2.7		
							-2.8		
							-2.9		
	3.0				3.0		-3.0		
			End of Testpit 3.0m [TARGET DEPTH]				-3.1		
							-3.2		
							-3.3		
							-3.4		
	3.5				3.5		-3.5		
							-3.6		
							-3.7		
							-3.8		
							-3.9		
	4.0				4.0		-4.0		
							-4.1		
							-4.2		
							-4.3		
							-4.4		
	4.5				4.5		-4.5		
							-4.6		
							-4.7		
							-4.8		
							-4.9		
	5.0				5.0		-5.0		

In-situ field testing in accordance with the following Standards:

Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

LandTech CONSULTING	Client: Rupert Jack & Catherine Elizabeth Wright Project: Geotechnical Investigation for Proposed Land Use Change Address: Cnr Creyke & West Coast Roads (Section 1 SO 1227), Darfield	Testpit No.	TP10
		Sheet No.	1 of 1

Excavator Type:	9T Digger	Project No:	LTCL17312	Logged By:	L Stewart
Excavated By:	Francis Ward Ltd.	Coordinates:	NZTM2000 E1529948 N5184090	Shear Vane No:	NA
Date Started:	19-Dec-17	Ground Conditions:	Near level/undulating, pasture	Calibration Factor:	NA
Date Finished:	19-Dec-17	Groundwater Level (m):	Not Encountered	Calibration Date:	NA

Stratigraphy	Depth (m)	Graphic Log	Soil description in accordance with *Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes*, NZ Geotechnical Society Inc., 2005
TS	0.0		SILT, minor fine to medium sand, trace fine to coarse rounded to subrounded gravel, brown, very stiff, moist, non-plastic [TOPSOIL]
RIVER DEPOSITS	0.5		Fine to coarse rounded to subrounded GRAVEL, some fine to coarse sand, minor silt, yellowish grey, tightly packed, moist [RIVER DEPOSITS] trace rounded to subrounded cobble inclusions
	1.0		Fine to coarse sandy fine to coarse rounded to subrounded GRAVEL, brownish grey, tightly packed, moist, trace rounded to subrounded cobble inclusions
	1.5		
	2.0		Fine to coarse rounded to subrounded GRAVEL, some fine to coarse sand, brownish grey, tightly packed, moist, trace rounded to subrounded cobble inclusions
	2.5		Fine to coarse sandy fine to coarse rounded to subrounded GRAVEL, brownish grey, tightly packed, moist to wet
	3.0		End of Testpit 3.0m [TARGET DEPTH]
	3.5		
	4.0		
	4.5		
	5.0		

Groundwater Level (m): NOT ENCOUNTERED

In-situ Field Testing

Shear Strength (kPa)

Peak:

Remoulded:

0

Dynamic Cone Penetrometer

Scala Blow Count / 100mm

0 5 10 15 20

Depth (m)	Blow Count
-0.1	3
-0.2	3
-0.3	5
-0.4	20+
-0.5	
-0.6	
-0.7	
-0.8	
-0.9	
-1.0	
-1.1	
-1.2	
-1.3	
-1.4	
-1.5	
-1.6	
-1.7	
-1.8	
-1.9	
-2.0	
-2.1	
-2.2	
-2.3	
-2.4	
-2.5	
-2.6	
-2.7	
-2.8	
-2.9	
-3.0	
-3.1	
-3.2	
-3.3	
-3.4	
-3.5	
-3.6	
-3.7	
-3.8	
-3.9	
-4.0	
-4.1	
-4.2	
-4.3	
-4.4	
-4.5	
-4.6	
-4.7	
-4.8	
-4.9	
-5.0	

In-situ field testing in accordance with the following Standards:

Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

LandTech CONSULTING	Client: Rupert Jack & Catherine Elizabeth Wright Project: Geotechnical Investigation for Proposed Land Use Change Address: Cnr Creyke & West Coast Roads (Section 1 SO 1227), Darfield	Testpit No.	TP11
		Sheet No.	1 of 1

Excavator Type:	9T Digger	Project No:	LTCL17312	Logged By:	L Stewart
Excavated By:	Francis Ward Ltd.	Coordinates:	NZTM2000 E1530221 N5184042	Shear Vane No:	NA
Date Started:	19-Dec-17	Ground Conditions:	Near level/undulating, pasture	Calibration Factor:	NA
Date Finished:	19-Dec-17	Groundwater Level (m):	Not Encountered	Calibration Date:	NA

Stratigraphy	Depth (m)	Graphic Log	Soil description in accordance with *Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes* , NZ Geotechnical Society Inc., 2005
TOPSOIL	0.0		SILT, some fine to medium sand, brown, very stiff, dry, non-plastic, trace fine to coarse rounded to subrounded gravel inclusions [TOPSOIL]
LOESS	0.5		SILT, minor fine to medium sand, yellowish brown, very stiff to hard, moist, non-plastic, trace fine to coarse rounded to subrounded gravel inclusions [LOESS DEPOSITS]
RIVER DEPOSITS	1.0		Silty fine to coarse rounded to subrounded GRAVEL, yellowish grey, tightly packed, moist, trace rounded to subrounded cobble inclusions [RIVER DEPOSITS]
	1.5		Fine to coarse sandy fine to coarse rounded to subrounded GRAVEL, minor silt, grey, tightly packed, moist
	2.0		trace rounded to subrounded boulder inclusion
	2.5		
	3.0		
	3.5		End of Testpit 3.0m [TARGET DEPTH]
	4.0		
	4.5		
	5.0		

Groundwater Level (m): NOT ENCOUNTERED

In-situ Field Testing

Shear Strength (kPa)

Peak:

Remoulded:

0

Dynamic Cone Penetrometer

Depth (m)	Blow Count	Scala Blow Count / 100mm
-0.1	3	
-0.2	5	
-0.3	6	
-0.4	5	
-0.5	6	
-0.6	20+	
-0.7		
-0.8		
-0.9		
-1.0		
-1.1		
-1.2		
-1.3		
-1.4		
-1.5		
-1.6		
-1.7		
-1.8		
-1.9		
-2.0		
-2.1		
-2.2		
-2.3		
-2.4		
-2.5		
-2.6		
-2.7		
-2.8		
-2.9		
-3.0		
-3.1		
-3.2		
-3.3		
-3.4		
-3.5		
-3.6		
-3.7		
-3.8		
-3.9		
-4.0		
-4.1		
-4.2		
-4.3		
-4.4		
-4.5		
-4.6		
-4.7		
-4.8		
-4.9		
-5.0		

0 5 10 15 20

In-situ field testing in accordance with the following Standards:

Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

LandTech CONSULTING	Client: Rupert Jack & Catherine Elizabeth Wright Project: Geotechnical Investigation for Proposed Land Use Change Address: Cnr Creyke & West Coast Roads (Section 1 SO 1227), Darfield	Testpit No.	TP12
		Sheet No.	1 of 1

Excavator Type:	9T Digger	Project No:	LTCL17312	Logged By:	L Stewart
Excavated By:	Francis Ward Ltd.	Coordinates:	NZTM2000 E1529232 N5184036	Shear Vane No:	NA
Date Started:	19-Dec-17	Ground Conditions:	Near level/undulating, pasture	Calibration Factor:	NA
Date Finished:	19-Dec-17	Groundwater Level (m):	Not Encountered	Calibration Date:	NA

Stratigraphy	Depth (m)	Graphic Log	Soil description in accordance with *Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes*, NZ Geotechnical Society Inc., 2005
TOPSOIL	0.0		SILT, trace fine to medium sand, brown, very stiff, moist, non-plastic [TOPSOIL]
RIVER DEPOSITS	0.5		Silty fine to coarse rounded to subrounded GRAVEL, minor fine to coarse sand, yellowish grey, tightly packed, moist [RIVER DEPOSITS]
	1.0		Fine to coarse sandy fine to coarse rounded to subrounded GRAVEL, brownish grey, tightly packed, moist, trace rounded to subrounded cobble inclusions
	1.5		
	2.0		
	2.5		
	3.0		
	3.5		End of Testpit 3.0m [TARGET DEPTH]
	4.0		
	4.5		
	5.0		

Groundwater Level (m): NOT ENCOUNTERED

In-situ Field Testing

Shear Strength (kPa) — Peak: ● Remoulded: ○ (0)

Dynamic Cone Penetrometer

Depth (m)	Blow Count	Scala Blow Count / 100mm (0 5 10 15 20)
-0.1	3	
-0.2	5	
-0.3	6	
-0.4	12	
-0.5	20+	
-0.6 to -5.0		

In-situ field testing in accordance with the following Standards:

Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

LandTech CONSULTING	Client: Rupert Jack & Catherine Elizabeth Wright Project: Geotechnical Investigation for Proposed Land Use Change Address: Cnr Creyke & West Coast Roads (Section 1 SO 1227), Darfield	Testpit No.	TP13
		Sheet No.	1 of 1

Excavator Type:	9T Digger	Project No:	LTCL17312	Logged By:	L Stewart
Excavated By:	Francis Ward Ltd.	Coordinates:	NZTM2000 E1529431 N5184006	Shear Vane No:	NA
Date Started:	19-Dec-17	Ground Conditions:	Near level/undulating, pasture	Calibration Factor:	NA
Date Finished:	19-Dec-17	Groundwater Level (m):	Not Encountered	Calibration Date:	NA

Stratigraphy	Depth (m)	Graphic Log	Soil description in accordance with *Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes*, NZ Geotechnical Society Inc., 2005	Groundwater Level (m)	Depth (m)	In-situ Field Testing: Shear Strength (kPa) (Peak: / Remoulded:, 0)	In-situ Field Testing: Dynamic Cone Penetrometer Depth (m)	Blow Count	Scala Blow Count / 100mm (0 5 10 15 20)
LOESS			SILT, minor fine to medium sand, trace fine to coarse rounded to subrounded gravel, yellowish brown, very stiff, moist, non-plastic [LOESS DEPOSITS]	NOT ENCOUNTERED			-0.1	5	
							-0.2	4	
							-0.3	8	
							-0.4	13	
RIVER DEPOSITS	0.5		Silty fine to coarse rounded to subrounded GRAVEL, yellowish grey, tightly packed, moist, trace rounded to subrounded cobble inclusions [RIVER DEPOSITS]		0.5		-0.5	20+	
							-0.6		
							-0.7		
							-0.8		
							-0.9		
	1.0		Fine to coarse sandy fine to coarse rounded to subrounded GRAVEL, grey, tightly packed, moist to wet, trace rounded to subrounded cobble inclusions		1.0		-1.0		
							-1.1		
							-1.2		
							-1.3		
							-1.4		
	1.5				1.5		-1.5		
							-1.6		
							-1.7		
							-1.8		
							-1.9		
	2.0				2.0		-2.0		
							-2.1		
							-2.2		
							-2.3		
							-2.4		
	2.5		trace rounded to subrounded boulder inclusion		2.5		-2.5		
							-2.6		
							-2.7		
							-2.8		
							-2.9		
	3.0				3.0		-3.0		
			End of Testpit 3.0m [TARGET DEPTH]				-3.1		
							-3.2		
							-3.3		
							-3.4		
	3.5				3.5		-3.5		
							-3.6		
							-3.7		
							-3.8		
							-3.9		
	4.0				4.0		-4.0		
							-4.1		
							-4.2		
							-4.3		
							-4.4		
	4.5				4.5		-4.5		
							-4.6		
							-4.7		
							-4.8		
							-4.9		
	5.0				5.0		-5.0		

In-situ field testing in accordance with the following Standards:

Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

LandTech CONSULTING	Client: Rupert Jack & Catherine Elizabeth Wright Project: Geotechnical Investigation for Proposed Land Use Change Address: Cnr Creyke & West Coast Roads (Section 1 SO 1227), Darfield	Testpit No.	TP14
		Sheet No.	1 of 1

Excavator Type:	9T Digger	Project No:	LTCL17312	Logged By:	L Stewart
Excavated By:	Francis Ward Ltd.	Coordinates:	NZTM2000 E1529656 N5183976	Shear Vane No:	NA
Date Started:	19-Dec-17	Ground Conditions:	Near level/undulating, pasture	Calibration Factor:	NA
Date Finished:	19-Dec-17	Groundwater Level (m):	Not Encountered	Calibration Date:	NA

Stratigraphy	Depth (m)	Graphic Log	Soil description in accordance with *Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes*, NZ Geotechnical Society Inc., 2005
TOPSOIL	0.0		SILT, minor fine sand, trace fine to coarse rounded to subrounded gravel, brown, very stiff, moist, non-plastic [TOPSOIL]
RIVER DEPOSITS	0.5		Silty fine to coarse rounded to subrounded GRAVEL, some fine to coarse sand, grey, tightly packed, moist [RIVER DEPOSITS]
	1.0		moist to wet
	1.5		
	2.0		
	2.5		
	3.0		End of Testpit 3.0m [TARGET DEPTH]
	3.5		
	4.0		
	4.5		
	5.0		

Groundwater Level (m): NOT ENCOUNTERED

In-situ Field Testing

Shear Strength (kPa)

Peak:

Remoulded:

0

Dynamic Cone Penetrometer

Depth (m)	Blow Count	Scala Blow Count / 100mm (0 5 10 15 20)
-0.1	2	
-0.2	4	
-0.3	7	
-0.4	20+	
-0.5		
-0.6		
-0.7		
-0.8		
-0.9		
-1.0		
-1.1		
-1.2		
-1.3		
-1.4		
-1.5		
-1.6		
-1.7		
-1.8		
-1.9		
-2.0		
-2.1		
-2.2		
-2.3		
-2.4		
-2.5		
-2.6		
-2.7		
-2.8		
-2.9		
-3.0		
-3.1		
-3.2		
-3.3		
-3.4		
-3.5		
-3.6		
-3.7		
-3.8		
-3.9		
-4.0		
-4.1		
-4.2		
-4.3		
-4.4		
-4.5		
-4.6		
-4.7		
-4.8		
-4.9		
-5.0		

In-situ field testing in accordance with the following Standards:

Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

LandTech CONSULTING	Client: Rupert Jack & Catherine Elizabeth Wright Project: Geotechnical Investigation for Proposed Land Use Change Address: Cnr Creyke & West Coast Roads (Section 1 SO 1227), Darfield	Testpit No.	TP15
		Sheet No.	1 of 1

Excavator Type:	9T Digger	Project No:	LTCL17312	Logged By:	L Stewart
Excavated By:	Francis Ward Ltd.	Coordinates:	NZTM2000 E1529948 N5183939	Shear Vane No:	NA
Date Started:	19-Dec-17	Ground Conditions:	Near level/undulating, pasture	Calibration Factor:	NA
Date Finished:	19-Dec-17	Groundwater Level (m):	Not Encountered	Calibration Date:	NA

Stratigraphy	Depth (m)	Graphic Log	Soil description in accordance with *Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes*, NZ Geotechnical Society Inc., 2005
TS	0.0		Fine to medium sandy SILT, trace fine to coarse rounded to subrounded gravel, brown, very stiff, dry, non-plastic [TOPSOIL]
LOESS	0.5		Fine to coarse rounded to subrounded gravelly SILT, some fine to medium and, yellowish brown, very stiff to hard, dry to moist, non-plastic [LOESS DEPOSITS]
RIVER DEPOSITS	0.5		Fine to coarse rounded to subrounded GRAVEL, some silt, minor to some fine to coarse sand, grey, tightly packed, moist [RIVER DEPOSITS]
	1.0		some fine to coarse sand to sandy, minor silt
	1.5		trace cobble inclusions, moist to wet
	2.0		minor fine to coarse sand, trace silt
	2.5		some fine to coarse sand to sandy
	3.0		End of Testpit 3.0m [TARGET DEPTH]
	3.5		
	4.0		
	4.5		
	5.0		

Groundwater Level (m): NOT ENCOUNTERED

In-situ Field Testing

Shear Strength (kPa)

Peak:

Remoulded:

0

Dynamic Cone Penetrometer

Depth (m)	Blow Count	Scala Blow Count / 100mm (0 5 10 15 20)
-0.1	2	
-0.2	4	
-0.3	5	
-0.4	20+	
-0.5		
-0.6		
-0.7		
-0.8		
-0.9		
-1.0		
-1.1		
-1.2		
-1.3		
-1.4		
-1.5		
-1.6		
-1.7		
-1.8		
-1.9		
-2.0		
-2.1		
-2.2		
-2.3		
-2.4		
-2.5		
-2.6		
-2.7		
-2.8		
-2.9		
-3.0		
-3.1		
-3.2		
-3.3		
-3.4		
-3.5		
-3.6		
-3.7		
-3.8		
-3.9		
-4.0		
-4.1		
-4.2		
-4.3		
-4.4		
-4.5		
-4.6		
-4.7		
-4.8		
-4.9		
-5.0		

In-situ field testing in accordance with the following Standards:

Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001

LandTech CONSULTING	Client: Rupert Jack & Catherine Elizabeth Wright Project: Geotechnical Investigation for Proposed Land Use Change Address: Cnr Creyke & West Coast Roads (Section 1 SO 1227), Darfield	Testpit No.	TP16
		Sheet No.	1 of 1

Excavator Type:	9T Digger	Project No:	LTCL17312	Logged By:	L Stewart
Excavated By:	Francis Ward Ltd.	Coordinates:	NZTM2000 E1530108 N5183969	Shear Vane No:	NA
Date Started:	19-Dec-17	Ground Conditions:	Near level/undulating, pasture	Calibration Factor:	NA
Date Finished:	19-Dec-17	Groundwater Level (m):	Not Encountered	Calibration Date:	NA

Stratigraphy	Depth (m)	Graphic Log	Soil description in accordance with *Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes*, NZ Geotechnical Society Inc., 2005	Groundwater Level (m)	Depth (m)
TOPSOIL			SILT, minor fine to medium sand, brown, very stiff, dry, non-plastic, trace fine to coarse rounded to subrounded gravel inclusions [TOPSOIL]		
LOESS	0.5		SILT, some fine to medium sand, trace fine to coarse rounded to subrounded gravel, yellowish brown, hard, moist, non-plastic [LOESS DEPOSITS]		0.5
RIVER DEPOSITS	1.0		Fine to coarse rounded to subrounded GRAVEL, some fine to coarse sand, some silt, trace rounded to subrounded cobbles, grey, tightly packed, moist [RIVER DEPOSITS]	NOT ENCOUNTERED	1.0
	1.5		Fine to coarse sandy fine to coarse rounded to subrounded GRAVEL, grey, tightly packed, moist, trace rounded to subrounded cobble inclusions [RIVER DEPOSITS]		1.5
	2.0		minor silt		2.0
	2.5				2.5
	3.0				3.0
	3.5		End of Testpit 3.0m [TARGET DEPTH]		3.5
	4.0				4.0
	4.5				4.5
	5.0				5.0

In-situ Field Testing

Shear Strength (kPa)

Peak:

Remoulded:

0

Dynamic Cone Penetrometer

Depth (m)	Blow Count	Scala Blow Count / 100mm (0 5 10 15 20)
-0.1	4	
-0.2	5	
-0.3	4	
-0.4	3	
-0.5	3	
-0.6	10	
-0.7	20 +	
-0.8		
-0.9		
-1.0		
-1.1		
-1.2		
-1.3		
-1.4		
-1.5		
-1.6		
-1.7		
-1.8		
-1.9		
-2.0		
-2.1		
-2.2		
-2.3		
-2.4		
-2.5		
-2.6		
-2.7		
-2.8		
-2.9		
-3.0		
-3.1		
-3.2		
-3.3		
-3.4		
-3.5		
-3.6		
-3.7		
-3.8		
-3.9		
-4.0		
-4.1		
-4.2		
-4.3		
-4.4		
-4.5		
-4.6		
-4.7		
-4.8		
-4.9		
-5.0		

In-situ field testing in accordance with the following Standards:

Scala Penetrometer Testing: NZS 4402:1988, Test 6.5.2, Dynamic Cone Penetrometer

Shear Vane Testing: Guideline for Hand Held Shear Vane Test, NZGS, August 2001