

GEOTECHNICAL ASSESSMENT TO SUPPORT PROPOSED PLAN CHANGE 104 TOWNSEND ROAD AND 141 SOUTH BELT WAIMAKARIRI, RANGIORA

Engineers and Geologists



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Report prepared for:	Summerset Villages (Rangiora) Limited
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Report prepared by: Jen Kelly, Senior Engineering Geologist

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Report reviewed by: Titus Smith, Principal - Geotechnical Engineer, CPEng

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Report approved for issue by: Scott Vaughan, Managing Director, CPEng

Report reference: 170743-C

Date: 15 October 2019

Copies to: Summerset Villages (Rangiora) Limited 1 electronic copy

Riley Consultants Ltd 1 copy

Issue:	Details:	Date:
1.0	Geotechnical Due Diligence Assessment	1 February 2019
2.0	Geotechnical Assessment	7 August 2019
3.0	Geotechnical Assessment – Plan Change	20 September 2019
4.0	Geotechnical Assessment – Plan Change	15 October 2019





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1.0 Introduction

Riley Consultants Ltd (RILEY) has been engaged by Summerset Villages (Rangiora) Limited to undertake preliminary geotechnical site testing, analysis, and reporting for development of a 13.83ha greenfield site, located in south-west Rangiora at 104 Townsend Road and 141 South Belt.

It is understood that this report is to be submitted in support of a private plan change to amend parts of the Waimakariri District Plan (WDP) pursuant to Section 73(2) and Clauses 21(1) and 22 of the First Schedule to the Resource Management Act 1991 (RMA). The following report represents an update/reissue of RILEY Ref: 170743-C, Rev 2 prepared for Summerset Villages (Rangiora) Limited to support a boundary adjustment. No further investigations have been undertaken and geotechnical conclusions and recommendations remain unchanged from that report.

This report provides comment on geotechnical ground conditions, the potential for liquefaction to occur due to a large seismic event, and foundation options and approaches that could enable the future residential to meet the objectives of the RMA and the Building Code from a geotechnical perspective.

This report excludes consideration of flood hazard, which is addressed separately. This report should be read in conjunction with RILEY reports covering the environmental preliminary/detailed site investigation (refer RILEY Ref: 170743-B) and civil infrastructure servicing (refer RILEY Ref: 170743-A).

1.1 Summary

The geology and geotechnical condition of the site has been assessed and it is considered that there are no significant geotechnical barriers to prevent the site from being developed for residential purposes.

2.0 Site Description

2.1 Application Site

The location of the site is shown in Figure 1 below.



Figure 1: Plan Change Site Location



The site is located in the south-western area of Rangiora township, with the northern site boundary adjoining South Belt, and Townsend Road adjoining the western boundary. East of the site is Southbrook Park, and the southern boundary adjoins Southbrook Stream (which flows west to east).

The site slopes down very gently from the northwest to southeast. Site contours show an approximate ground surface elevation of RL 26.0m at the north-western boundary and a minimum elevation of approximately RL 22.0m at the south-eastern boundary (Lyttelton Vertical Datum (LVD)).

The majority of the site area is currently grassed, with a horse training track present at the northern end, adjacent to South Belt. There are two dwellings and numerous farm buildings located in the north-western corner of the site.

Medium density residential property is located to the north of the site, and a substantial new residential subdivision known as Townsend Fields is currently under construction to the north-west of the site. Southbrook Park is located to the east of the site, with the remainder of the site is bounded by rural land.

Vehicle access to the site is via two access points; one on the western boundary from Townsend Road and one from South Belt.

2.2 Background

The application site was previously part of a 23ha title that extended from South Belt, across Southbrook stream and south towards Ellis Road. An application to subdivide the property has been lodged with Waimakariri District Council (WDC) at the Southbrook stream, creating the application site north of the stream which is 13.83ha in area.

3.0 Proposal

This private plan change request proposes to amend the WDP to change the zoning of the site from the Residential 4B to Residential 2 zone and modify the existing planning maps covering the site with a new Outline Development Plan (ODP).

In its current status (Residential 4B), the site can be developed into approximately 13 sections comprising lifestyle blocks with dwellings. The proposed new provisions for the Residential 2 zone will allow for up to 150 sections (and dwellings). It is also proposed to incorporate within the zone some specific rules to provide for the construction of a retirement village. This would result in allowing a retirement village to be constructed on all or part of the site, or all or part of the site to be developed for typical residential dwellings (in accordance with the Residential 2 zone rules).

The ODP attached in Appendix F, shows key elements to be incorporated into future residential activity on the site. These include:

- the required location of future roading links to the existing transport network,
- the provision of an esplanade reserve adjacent to Southbrook Stream,
- the location and extent of a stormwater management area and
- the allowance for a specified area for a taller main retirement village building.

The intention of the ODP is to provide certainty regarding key requirements for any future residential activity on the site, whilst allowing flexibility as the detailed design phases evolve in the future.

4.0 Scope of Works

The scope of our proposed geotechnical investigation was based in part on recommendations from the Ministry of Business, Innovation and Employment (MBIE) Guidelines for Repairing and Rebuilding Houses affected by the Canterbury Earthquakes. The following works have been undertaken:

- Desktop study of available geotechnical information, including the review of published geological maps, New Zealand Geotechnical Database (NZGD), Geological and Nuclear Sciences (GNS) active fault database, and RILEY experience and knowledge of geotechnical characteristics of the area.
- Site walkover, service clearance and mark out of subsurface test locations.
- Geomorphological mapping of the site.
- Shallow subsurface geotechnical investigations including a total of 23 hand auger boreholes (HA), undertaken to a target depth of 3m below ground level (bgl), or refusal, with associated strength testing (shear vane and Scala penetrometer).
- Deep subsurface geotechnical investigations including two machine drilled boreholes (BH), undertaken to a target depth of 15m, and an additional four boreholes, undertaken to a target depth of 6m bgl. Refer to RILEY Dwg: 170743-1 in Appendix D for test locations, and Appendix A for test logs.
- Installation of a standpipe piezometer within five (of the six) machine boreholes.
- Geotechnical laboratory testing including determination of Atterberg limits (ASTM D 4318 test method), fines content (Test 2.8, NZS 4402:1986) and standard compaction test (ASTM D 698).
- Analysis of data and assessment of geotechnical hazards including seismicity, liquefaction and lateral spread potential, flooding and erosion.
- Provision of preliminary foundation options for possible single-storey residential-type dwellings and two-storey buildings.

 Provision for preliminary foundation options for larger buildings, such as a retirement village building.

5.0 Geology and Groundwater

The published geological map of the area as described in the Department of Scientific and Industrial Research map for Kaiapoi (Geological Map of New Zealand, S76, 1:63,360 Geological Maps, 1976), indicates the site has surface geology consisting of alluvial silts overlying older post-glacial fluviatile gravel, sand and silt deposits belonging to the Yaldhurst Member of the Springston Formation. This is consistent with the geological map of the area as described in the GNS geological QMAP for the area (Geology of the Christchurch Urban Area, 1:250,000 Geological Maps, 2008), which indicates the site has surface geology consisting of dominantly alluvial river deposits (brownish-grey river alluvium) belonging to the Yaldhurst Member of the Springston Formation.

A review of the NZGD indicates that no publicly available geotechnical testing is available within 150m of the site. One machine borehole has been undertaken approximately 400m north-west of the site and indicates subsurface ground conditions comprising stiff silt to 1m depth, underlain by medium dense sand and gravel mixtures to 2.5m depth, in turn underlain by medium dense to dense gravel to a target termination depth of 10.45m bgl. Groundwater was encountered at 1.7m bgl.

A review of the contours of depth to groundwater (in metres below ground) presented by Canterbury Maps, indicates the unconfined groundwater table is expected to be encountered between 1.0m and 2.5m depth across the site.

A review of Environment Canterbury (ECan) well data indicates there is a well located east of the site (MH35/9661). The borelog records ground conditions comprising topsoil, silt and clay bound gravel to 4.7m depth, underlain by interbedded clay/silt bound gravel and water bearing gravels to at least 50m depth.

Additional ECan wells in the area were assessed to gain insight into seasonal variations of the water table at the site. The most applicable wells, M35/0338 and M35/9001, are located approximately 140m to the south and 570m to the north-east of the site respectively. M35/0338 had been monitored between 20 September 1977 and 30 September 1987. The maximum recorded variation in groundwater level was 430mm. M35/9000 gives more recent data and has been monitored between 1 April 2001 and 29 November 2018. The maximum recorded variation was 1260mm.

Based on the reviewed data, seasonal low groundwater levels are expected around December and January. However, the 29 November 2018 reading, which was around two weeks prior to the date of the subsurface investigation, indicates that the relatively wet spring has resulted in the water table being at around the median level at the time of the investigation.

6.0 Site Investigation

Subsurface investigations were undertaken by RILEY and McMillan Drilling Ltd (overviewed by RILEY) between 17 December and 21 December 2018, comprising a site walkover, buried services clearance check and completion of 34 subsurface tests. Five hand dug test pits were carried out at the site to retrieve samples for geotechnical laboratory testing on 8 January 2019.

All soil samples were logged on-site by an engineering geologist in general accordance with the New Zealand Geotechnical Society (NZGS) Guidelines. The co-ordinates for all test locations were marked using a hand-held GPS.

The test logs and site plan detailing the test locations have been included in Appendix A and Appendix E respectively (refer RILEY Dwg: 170743-1).

6.1 Shallow Subsurface Investigations

A total of 23 hand auger boreholes (HA1 to HA23) were drilled to a target depth of 3m bgl, or refusal, using a 50mm diameter auger head. In-situ soil strength testing was undertaken by shear vane and Scala penetrometer as each borehole was progressed. Once logging had been carried out, the material was photographed and reinstated in the general order in which it was removed.

Five hand dug test pits (HP1 to HP5) were carried out at the site to retrieve samples for geotechnical laboratory testing. Table 1 summarises the samples collected for laboratory testing.

Table 1: Samples Retrieved for Laboratory Testing

ID	Location Depth of Sample BgI (m)		Samples
HP1	North-west of site	0.3m to 0.5m	SILT some gravel
HP2	South of site adjacent to HA14	0.3m to 0.5m	Clayey SILT
HP3	Adjacent to BH2	0.3m to 0.5m	Clayey SILT
HP4	Adjacent to BH4	0.3m to 0.5m	Clayey SILT
HP5	Adjacent to BH5	0.3m to 0.5m	Clayey SILT

6.2 Deep Subsurface Investigations

Six machine boreholes were undertaken at the site between 17 and 20 December 2018. Two machine boreholes (BH1 and BH2) were drilled to a target depth of 15m bgl and the remaining four machine boreholes (BH3 to BH6) were drilled to a target depth of 6m bgl, using a Geoprobe 8140LS rotary sonic drill rig – track mounted. HQ sized recovered core samples were logged, photographed and boxed by RILEY geologists. In-situ soil strength tests by standard penetration test (SPT (split spoon and/or solid cone)) were undertaken within all six BHs at approximately 1.5m intervals.

On completion of BH1 and BH3 to BH6, a standpipe piezometer was installed. The piezometers comprised 50mm PVC pipe, screened with a filter sand surround from approximately 12m to 15m bgl in BH1 and 4m to 6m bgl in BH3 to BH6. A bentonite seal extended from approximately 11m bgl to near ground surface in BH1 and approximately 3m in BH3 to BH6. Locked flush-mount toby boxes were then installed and held in place with quick mix concrete.

No piezometer was installed within BH2. This hole was backfilled with bentonite from 15.2m depth to the ground surface.

7.0 Laboratory Test Results

Testing has been undertaken on the five samples taken from the hand dug pits to obtain particle size distribution and the plasticity data. Compaction tests were also carried out to identify appropriate earthworks practices and preliminary requirements for filling. Test results are provided in Appendix C. A summary of the laboratory tests carried out on the samples is given Table 2.

Table 2: Summary of Laboratory Tests Carried out on Samples

Test	HP1	HP2	HP3	HP4	HP5
PSD	х	х	х		
Hydrometer			Х		
Atterberg Limits			х	х	Х
Compaction	х		х		х

7.1 Particle Size Distribution or Fines Content

As detailed in Table 2 three samples underwent particle size distribution (PSD) testing (one with hydrometer). Results are summarised in Table 3 and Figure 2 below, and are attached in Appendix C.

Table 3: Summary of Wet-sieve PSD Test Results

Sample		ole	Particle Size Distribution				
Pit ID	Depth Bgl (m)		Approximate	(PSD) F	Proportion	ns (%)	Material Description Based on PSD Results
	From	То	Mass (kg)	Silt/Clay	Sand	Gravel	
HP1	0.3	0.5	10	84	5	11	Silt with minor gravel and minor sand
HP2	0.3	0.5	10	90	4	6	Silt with minor gravel and trace sand
HP3	0.3	0.5	10	96	2	2	Silt with trace gravel and trace sand

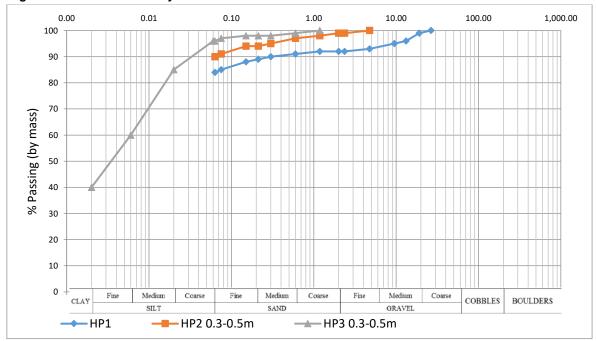


Figure 2: Plot of PSD and Hydrometer Test Results

As shown by the results, the fines content (FC) of the soil is between 84% to 96% between 0.3m to 0.5m bgl.

7.2 Plasticity Index

The sampled soil has a plasticity index (PI) of 16 to 20 (ML, low plasticity silt), based on the results of the Atterberg test, as detailed in Figure 3 below. With reference to the MBIE/NZGS Module 3 Geotechnical Engineering Code of Practice, soils with a PI of greater than 12 are considered not susceptible to liquefaction.

60 U Line A Line 50 CH 40 MH 30 CL 20 + HP3 0.3m to 0.5m 10 ML + HP4 0.3m to 0.5m + HP5 0.3m to 0.5m 0 30 0 10 20 40 50 60 70 80 90 100 Liquid Limit (LL or wL)

Figure 3: Plot of Material at 0.3m to 0.5m Deep on Plasticity Chart

7.3 Compaction

Standard Compaction testing was carried out on three samples. The results are summarised in Table 4.

Table 4: Summary of Compaction Test Results

Pit ID	Water Content as Received (%)	Maximum Dry Density (t/m³)	Optimum Water Content (%)
HP1	29.6	1.47	25.0
HP3	30.1	1.50	27.0
HP5	24.1	1.58	24.5

8.0 Geotechnical Assessment

8.1 Soil Description

Subsurface investigations confirmed the presence of a surficial layer of topsoil, underlain by Quaternary aged alluvial river deposits belonging to the Yaldhurst Member of the Springston Formation across the site, as described in detail below:

 Topsoil was encountered within all test locations from the ground surface to a maximum depth ranging between 0.1m and 0.35m bgl. The topsoil typically comprises brown silt with trace clay and rootlets.

Alluvium

- Silt/clay mixtures were encountered below topsoil within all test locations across the site, comprising silt and clay mixtures with trace sand to a maximum depth ranging between 0.45m and 1.7m depth. Strength of the soil ranged from loose to medium dense across the site with Scala penetrometer tests indicating blows of one to seven per 100mm penetration, but most typically in the range two to three blows per 100mm. Soil is logged as having low plasticity, though plasticity testing indicates that the material is sufficiently plastic to be considered non-liquefiable.
- Silty/sandy gravel was encountered below the abovementioned silt and clay mixtures, from between 0.45m and 1.7m bgl to a depth of at least 15.2m bgl, the maximum depth of investigation. Strength of the silty/sandy gravel is reasonably consistent, having been described as dense to very dense (based on SPT test results). SPT test results at 1.5m depth, near the start of the gravel zone in BH3, BH5 and BH6, indicated the soils are slightly less dense than the gravel at depth. This medium-dense gravel zone was not recorded at or below 3m depth.

Fill was encountered within HA22 (below topsoil) from between 0.2m and 0.4m depth. The fill comprised dark brown (mottled) organic silt with trace gravel and rootlets. Strength of the fill was described as firm (based on Scala penetrometer test results). We consider it likely the fill forms part of a service trench for a known sewer main which runs through the site in a north-west to south-east direction.

8.2 Design Parameters

Shear vane tests undertaken within the silt and clay mixtures overlying the gravels (at between approximately 0.6m bgl and 1.0m bgl), indicate vane shear strengths ranging between 112kPa and 230+ kPa, with the exception of HA23, which indicated a shear strength of 46kPa at 0.65m bgl.

Hand auger and Scala penetrometer results have been used to assess the density of the surficial silt/clay mixture while SPT results from machine boreholes have been used to assess the density of the underlying silty/sandy gravel. While the overlying silt/clay mixtures varied from loose to medium dense across the site, it is recommended that a loose soil with a Scala penetrometer blow count of two is assumed for preliminary assessments of dwelling foundation options and road subgrade requirements.

Based on the testing, preliminary soil parameters have been developed using empirical relationships:

- A bulk unit weight of 18kN/m³ and a friction angle of 32° is recommended for the silt/clay mixture.
- A unit weight of 21kN/m³ and a friction angle of 35° is recommended for the medium dense silty/sandy gravel.
- A unit weight of 22kN/m³ and a friction angle of 38° is recommended for the underlying dense silty/sandy gravel.

Preliminary soil parameters are summarised in Table 5 and Table 6.

Table 5: Soil Parameters from Test Data

Material		Unified Material Type	Scala Value (blows/100mm)	SPT N ₆₀	Density	Vane Shear Strength (kPa)
	Silt/clay mixture	ML	2	-	Loose	110
Alluvium	Silty/sandy gravel	GM	-	20	Medium Dense	-
	Silty/sandy gravel	GM	-	50+	Very Dense	-

Table 6: Assumed Values for Design

Material		Density γ (kN/m³)	Cohesion c' (kPa)	Friction Angle Φ' (deg)
Topsoil	Silt with trace clay	-	-	-
	Silt/clay mixture	18	0	32
Alluvium	Silty/sandy gravel	21	0	35
	Silty/sandy gravel	22	0	38

8.3 Seismic Design Parameters

Based on the geotechnical information for the site, and in accordance with NZS:1170.5, the site can be classified as having Class D soils, soft or deep soils. For Class D sites in the Canterbury Earthquake Region (defined as the jurisdictions of the Christchurch City Council, the Selwyn District Council, and the WDC) values of a_{max} and magnitude to be used for liquefaction triggering analyses have been prescribed by the MBIE Guidelines based on studies taking into account the short and medium term increase in seismic hazard for the Canterbury Region due to the elevated seismicity caused by the Canterbury Earthquake Sequence. These are reproduced in Table 7.

Table 7: MBIE Recommended Peak Ground Acceleration Values for Geotechnical Design

Importance Level (1) 2	SLS ₁ ⁽²⁾	SLS ₂ ⁽²⁾	ULS ⁽³⁾
Annual Probability of Exceedance	1/25	1/25	1/500
Moment Magnitude (M _w)	7.5	6.0	7.5
Peak Ground Acceleration	0.13g	0.19g	0.35g

Notes:

- Structure has been designated in terms of AS/NZS 1170 as Importance Level 2 structures. These include normal structures and structures not included in other importance levels.
- 2) SLS Serviceability Limit State. As of latest Guidance two SLS cases must be considered.
- ULS Ultimate Limit State.

8.4 Measured Groundwater Levels

Groundwater was not encountered within 19 of the 23 hand auger boreholes. The remaining four hand auger boreholes (HA1, HA7, HA10 and HA22) encountered groundwater at between 1.25m and 1.5m bgl at the northern and western end of the site, and at approximately 0.6m bgl in the south of the site, near the Southbrook Stream. Results are summarised in Table 8.

Table 8: Summary of Measured Groundwater in Hand Auger Tests

Test ID	Termination Depth	Water Table Depth (m)	Date
HA1	1.7m	1.5	18 December 2018
HA2	0.7m	Not encountered	17 December 2018
HA3	0.75m	Not encountered	18 December 2018
HA4	0.67m	Not encountered	17 December 2018
HA5	0.95m	Not encountered	20 December 2018
HA6	1.0m	Not encountered	20 December 2018
HA7	1.1m	Scala wet below 1.25	18 December 2018
HA8	0.7m	Not encountered	18 December 2018
HA9	1.25m	Not encountered	17 December 2018
HA10	1.1m	Scala wet below 1.50	17 December 2018
HA11	0.8m	Not encountered	20 December 2018
HA12	0.95m	Not encountered	20 December 2018
HA13	0.45m	Not encountered	18 December 2018
HA14	0.65m	Not encountered	21 December 2018
HA15	1.0m	Not encountered	21 December 2018
HA16	0.7m	Not encountered	21 December 2018
HA17	0.85m	Not encountered	21 December 2018
HA18	0.65m	Not encountered	21 December 2018
HA19	0.9m	Not encountered	21 December 2018
HA20	0.55m	Not encountered	21 December 2018
HA21	0.85m	Not encountered	21 December 2018
HA22	1.1m	0.6	21 December 2018
HA23	0.8m	Not encountered	21 December 2018

Groundwater monitoring piezometers were installed in boreholes BH1 and BH3 to BH6. Readings have been taken from these boreholes four times since they were installed. The results of the groundwater monitoring are shown in Table 9.

Groundwater levels were recorded within boreholes BH1 and BH3 to BH6 between approximately 0.9m to 1.8m bgl based on piezometer readings between 19 December 2018 and 2 August 2019.

It should be noted that when the groundwater measurements were taken in December 2018, there had been high rainfall recorded in area between the 19 December and 21 December. It should also be noted that the groundwater readings taken in December 2018 were taken immediately preceding the drilling works and that water was added to the hole to assist the drilling process. However, it is unlikely that the drilling water added to the hole will have had a significant impact upon the groundwater level due to the coarse-grained geology underlying the site.

Based on the levels recorded to date, there appears to be very little variation in the groundwater level between summer and winter.

Table 9: Piezometer Test Results

Test ID	Measured Groundwater Depth	Date
	1.23m	19 December 2018
DUA	1.26m	21 December 2018
BH1	1.28m	08 January 2019
	1.30m	02 August 2019
	1.41m	20 December 2018
BH3	1.71m	21 December 2018
рпэ	1.41m	08 January 2019
	1.57m	02 August 2019
	1.71m	20 December 2018
BH4	1.76m	21 December 2018
БП4	1.72m	08 January 2019
	1.82m	02 August 2019
	1.34m	19 December 2018
BH5	1.37m	21 December 2018
СПО	1.35m	08 January 2019
	1.44m	02 August 2019
	0.88m	20 December 2018
BH6	0.91m	21 December 2018
рпо	0.90m	08 January 2019
	0.95m	02 August 2019

The groundwater level typically grades from the north-west of the site towards the south-east, consistent with the slope of the ground surface (see Figure 4). However, in close vicinity of the stream the groundwater elevation decreases more rapidly to the south indicating that the groundwater is likely to be discharging into the drainage channel at the southern end of the site.

At the north-west corner of the site, groundwater levels appear to be locally constant at around RL 25.0m LVD. To the west of this area (i.e. upslope) are a series of stormwater ponds that appear to permanently contain water. It is possible that the stormwater ponds are acting to locally recharge the groundwater in the north-western portion of the site.

For the portion of the site that is at least 50m from the southern stream channel, a median groundwater level of 1.3m is considered appropriate for planning purposes. Within 50m of the stream, reduced ground levels are likely to result in somewhat shallower groundwater (see Figure 4) provides approximate groundwater contours for the site based on the data measured to date.



Figure 4: Preliminary Median Groundwater Contours from Site Observations

9.0 Geotechnical Considerations and Hazards

9.1 Bearing Capacity

For residential-type structures with shallow foundations, the MBIE Guidelines state that a geotechnical ultimate bearing capacity of 200kPa may be assumed for Scala penetrometer test results of two blows/100mm. NZS 3604:2011 states that a geotechnical ultimate bearing capacity of 300kPa may be assumed for five blows/100mm down to a depth equal to twice the width of the widest footing below the underside of the proposed footing and three at greater depths.

A review of the Scala penetrometer results indicates that a geotechnical ultimate bearing capacity of 200kPa is consistently available across the site from 0.35m bgl, with the exception of HA22, where 200kPa was not encountered until a depth of 0.8m bgl. A geotechnical ultimate bearing capacity of 300kPa is variable across the site (corresponding to the varying depth to gravel across the site).

9.2 Liquefaction

Liquefaction typically occurs in recent (i.e. typically less than 10,000-years old), normally consolidated silt and sand beneath the groundwater table. It is dependent on soil density, grain size, and soil composition.

As detailed in Section 8.1, the site is predominantly underlain by alluvial deposits, comprising a cap of silt and clay mixtures overlying silty and sandy gravels. A liquefaction assessment has been completed using the Idris and Boulanger (2014). No liquefaction is predicted by the assessment. The alluvial gravel mixtures (located below the water table) are sufficiently dense to be considered non-liquefiable, while the overlying silty materials are generally above groundwater level, and also have sufficiently plasticity to be considered non-liquefiable. Results of the liquefaction analysis is shown in Appendix D.

In accordance with the MBIE Guidelines, for a foundation technical category (TC) of TC1 to be applied, the SLS index settlement must be <15mm, and ULS index settlement <25mm. A review of the liquefaction analysis results indicates a TC1 classification is appropriate for the site.

9.3 Static Settlement

Consolidation and creep settlement are not considered to be a significant issue at the site as no significant organic content (with the exception of the fill at the location of HA22) or soft clays were identified during the geotechnical investigations.

9.4 Earthworks

The majority of cut to fill activities on site are likely to be within the silty materials encountered in the upper 0.45m to 1.7m of the soil profile. The silt is considered to be appropriate for use as engineered fill, however, care will be required to appropriately moisture condition the material prior to placement. There is the potential with compacted silty fill that a "rest" period is required following compaction of each lift, to allow the material to recover from the high internal pore pressures generated by the compaction process. This may be indicated by "weaving" of fill immediately following compaction.

It is recommended to undertake earthworks during the drier summer months to facilitate moisture conditioning of fill and minimise weaving of in-situ ground when fill is placed and compacted on it.

The relatively high groundwater level should be considered in the earthworks design particularly in the context of the depth of any proposed cuts across the site.

The fine to medium sand and silt mixtures encountered directly below topsoil are likely to be moderately susceptible to erosion if left exposed to rainfall runoff during construction. Earthworks should be staged to minimise exposure of stripped surfaces to weather.

10.0 Foundation Considerations

10.1 Residential Foundations

In TC1 zones, considering the construction is utilising lightweight materials (i.e. light cladding and roof etc.), Section 5 of the MBIE Guidelines recommends that NZS 3604:2011 solutions may be adopted provided there is "good ground" and they fall within the scope of the guidelines.

Testing across the site indicated that an ultimate bearing capacity of 300kPa was not available i.e. the NZS 3604:2011 criteria for "good ground" was not met. However, 200kPa is available once topsoil is removed.

Enhanced slab-on-grade foundation types are likely to be suitable, similar to the TC2 enhanced slab solutions (Option 1 to 4) set out in the MBIE Guidelines.

10.2 Foundations for Larger Buildings

Larger structures will require specific geotechnical foundation design. On the basis of the ground conditions encountered, it is anticipated that shallow foundation systems will be feasible for these larger buildings. This may involve undercutting of surficial silty soils and replacement with imported granular fill to transfer building loads to the dense gravels generally present at around 1.5m depth. Slab-on-grade foundation systems are likely to be feasible, as well as discrete pad and strip footings.

Deep foundation systems are unlikely to be necessary, but if required, significant pile capacity could be achieved with relatively shallow driven or bored piles.

11.0 Additional Development Considerations

11.1 Roads

Scala penetrometer blows measured in the near surface soils vary between one to seven. The soil varies from loose near the east and west of the site to medium dense centrally on the site. It is recommended to assume a loose soil with a Scala penetrometer blow count of two for preliminary design. The California bearing ration (CBR) for preliminary design has been calculated with reference to NZS 4404:2010 Section 3.3.3.2. A CBR of 3.5 may be assumed to be present below topsoil level for design of road subgrades.

11.2 Services

The median groundwater level has been assessed to be around 1.3m bgl for portions of the site at least 50m from the stream. There does not appear to be a significant seasonal variation based on the test data collected from the piezometers on site.

The location of the groundwater table should be considered during installation of services or excavation on-site. It is recommended to undertake trenching in the drier summer months.

11.3 Flood Management

The WDC District Plan Hazards Map indicates that areas of the site are at risk of inundation during flood events. The southern edge of the site along Southbrook Stream and adjacent to the eastern property boundary are considered a medium to high hazard indicating the site is susceptible to flooding during a 1 in 200-year (0.5% annual exceedance probability) flood event with flooding of up to 2.0m above the stream possible. The majority of the flooding hazard is located within approximately 50m of the stream and a large part of the site is considered at low risk.



Figure 5: Exert from Waimakariri District Council Flood Hazard Map

12.0 Conclusions

- Geotechnical investigations undertaken indicate the site is underlain by a layer of topsoil up to 0.35m thick underlain by a silt/clay alluvium mixture to a depth ranging between 0.45m to 1.7m bgl. Below this, silty/sandy gravel is encountered to a depth of at least 15.2m bgl. The encountered ground conditions are in general accordance with the regional geology.
- Groundwater is generally found below 1.3m bgl across the site, however, adjacent to Southbrook Stream groundwater is encountered as shallow as 0.65m bgl where the ground drops away towards the stream. Based on nearby well data our measured groundwater depths are assumed to be representative of a median groundwater level and very little seasonal variation may be expected.
- Liquefaction assessment has not identified a significant liquefaction hazard on-site. The site is considered to meet the requirements of TC1.
- Appropriate foundations types for residential properties may include slab-on-grade or shallow footing options as set out in NZS 3604:2011 and the MBIE Guidelines. Based on the indicated bearing capacities the NZS 3604:2011 definition of "good ground" was not met, indicating that residential foundations will require specific engineering design, or alternatively the enhanced slab foundation options provided for TC2 sites may be applied where ultimate bearing capacity of 200kPa is demonstrated.
- For larger buildings, shallow foundation systems are preferred. Allowance for removal and replacement of surficial silty soils should enable relatively high bearing capacities to be developed to support building loads.
- Preliminary design of road pavements may assume a CBR of 3.5 is available once topsoil is stripped.
- It is recommended that earthworks and trenching work be undertaken during summer, to minimise the potential for groundwater issues and to enable fill to be most readily moisture conditioned.
- The geotechnical investigation results show that the land subject to the plan change is appropriate for residential development with no significant geotechnical issues which would affect future development.

13.0 Limitation

This report has been prepared solely for the benefit of Summerset Villages (Rangiora) Limited as our client, with respect to the brief, and consent authorities in processing the consent(s). The reliance by other parties on the information or opinions contained in the report will, without our prior review and agreement in writing, be at such parties' sole risk.

Recommendations and opinions in this report are based on data from limited test positions. The nature and continuity of subsoil conditions away from the test positions are inferred, and it must be appreciated that actual conditions could vary considerably from the assumed model.

During excavation and construction, the site should be examined by an engineer or engineering geologist competent to judge whether the exposed subsoils are compatible with the inferred conditions on which the report has been based. It is possible that the nature of the exposed subsoils may require further investigation and the modification of the design based upon this report.

APPENDIX A **Borehole Logs**



22 Moorhouse Ave. Addington, Christchurch 8011 PO Box 4355, Christchurch 8140 Tel. 03 379 4402 Email: rileychch@riley.co.nz

Auckland:

PO Box 100253, North Shore, Auckland 0622 PO Box 100253, North Shore, Auckland 0745 Tel. 09 489 7872 Email: riley@riley.co.nz

GEOTECHNICAL AND **GEOLOGICAL INFORMATION**

SOIL TYPES AND SYMBOLS



FILL

TOPSOIL

SILT

SAND

GRAVEL

CLAY

PEAT

GROUNDWATER LEVEL

10,11,10

SCALA PENETROMETER LAST 3 NUMBER OF BLOWS PER 50mm INCREMENT

ROCK TYPES AND SYMBOLS



SANDSTONE



BASALT



SILTSTONE



TUFF



MUDSTONE

IGNIMBRITE



LIMESTONE

GREYWACKE

LINICONFINED

SOIL STRENGTH CLASSIFICATION

FINE GRAINED COHESIVE SOILS

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TERM	FIELD IDENTIFICATION	UNDRAINED SHEAR STRENGTH (KPa)
Very Soft (Vs)	Exudes between fingers when squeezed.	<12
Soft (S)	Easily indented by fingers.	12 – 25
Firm (F)	Indented only by strong finger pressure.	25 - 50
Stiff (St)	Indented by thumb pressure.	50 - 100
Very Stiff (VSt)	Indented by thumbnail.	100 - 200
Hard (H)	Difficult to indent by thumbnail.	200+

SPT & SCALA PENETROMETER RESULTS

TERM	SPT VALUE No. of BLOWS/300mm	SCALA PENETROMETER No. of BLOWS/100mm
very dense	>50	17+
dense	30 - 50	7 – 17
medium dense	10 - 30	3 - 7
loose	4 - 10	1 - 3
very loose	0 - 4	0 - 2

ROCK STRENGTH CLASSIFICATION

TERM		FIELD IDENTIFICATION	UNIAXIAL COMPRESSIVE STRENGTH (MPa)
Extremely weak	(EW)	Indented by thumbnail.	< 1
Very weak	(VW)	Crumbles under firm blows wit point of geological hammer. Can be peeled with pocket kn	
Weak	(W)	Difficult to peel with pocket k	nife. 5 - 20
Moderately strong	(MS)	Cannot be scraped or peeled with pocket knife.	20 - 50
Strong	(S)	More than one blow of geolog hammer to fracture.	ical 50 - 100
Very strong	(VS)	Many blows of geological hammer to break.	100 - 250
Extremely strong	(ES)	Can only be chipped with geological hammer.	250+

MOISTURE CONDITION

Dry (D)	Looks and feels dry; powdery and friable.
Moist (M)	Feels cool; darkened in colour; no free water when remoulded.
Wet (W)	Feels cool; darkened in colour; free water forms on hands.
Saturated (S)	Free water is present on sample.

SAMPLE TYPES

DRILLING METHOD

FIELD TESTS



UNDISTURBED



MACHINE AUGER DISTURBED



HAND AUGER DISTURBED



STANDARD PENETRATION TEST (solid cone)



STANDARD PENETRATION TEST (hollow cone)

OB OPEN BARREL

TT TRIPLE TUBE

WB

SH

RC

SPT

WASH BORE

UNDISTURBED SHELBY TUBE

ROCK CORE STANDARD

PENETRATION TEST

V SHEAR VANE (corrected to BS:1377) R REMOULDED STRENGTH

Ρ POCKET PENETROMETER

CH CLEGG HAMMER

INFORMATION BASED ON THE NZ GEOTECHNICAL SOCIETY INC. GUIDELINES FOR THE CLASSIFICATION AND DESCRIPTION OF SOIL AND ROCK FOR ENGINEERING PURPOSES

GEOLOGICALINFO.DWG REV. 3

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Projec		and Ge	ANTS ologists	Riley Consul 22 Moorhouse Ave Christchurch Tel: +643 3794402 Fax: +643 379440	2	Locatio	on: send Rd/s	South F	Sel+	Ponci	ioro			Hole	oositio			Αl	JG	ER L	No.:	
Job N	0.:)743		Start Date:		12-18	Ground	Level	(m L			Co-Ord		s (NZ	TM20	00):				F	IA07	
Client	:		elopmen		e. 10-	12-10		24.5 Hole De 1.25 r	epth	-		<u> </u>	1,50	6,267.	9 N	5,203,	4/8	.6		Sheet:	I of 1	
Elevation (m LINZ)	Depth (m)	Geological Unit		Geologica or to separate Geoformation sheet	otechnic	al and Ge		Legend		(F	(Pa		h	•	: / 50 m	m)	Groundwater	Soil Moisture	Samples	Т	ests	Instrument/
+24.50	. 0.35	(TOPSOIL)	SILT, tra	ce clay, organics ist; low plasticit	s; greyisi y; organi	n brown. "cs, rootlet	Very soft to		,		0 18	50 200	*	3 6	9	12 1:	9	E	ES0.1 \NOV	No. 1 1, 0, 0, 1, 1, 1, 0, 1, 1, 1, 2, 1, 2, 1, 1, 2, 2, 3, 4, 5		
	-	(YALDHURST MEMBER, SPRINGSTON FORMATION)	and yello plasticity MEMBE 0.50m G	nor to some clay wish-brown mo'r, sand, fine to m R, SPRINGSTOI rades to 'firm'.	ttling. "S ledium. (N FORM	oft"; moist YALDHUF	with orange t; low RST	× × × × × × × × × × × × × × × × × × ×	-	7	×							E	ES0.5 VOV		✓ V= 128 R= 43	
+23.50	1 ^{1.00}	(YALDHURST M	orange r	ravelly SILT, trac nottling. Medium edium, subroun	dense;	moist; dila	atant; gravel	l, ^X	-							1.00m				No. 2 2, 3, 15, 7, 3, 2, 3, 3, 5, 11, 13, 8, 8,		
+23.25	. 1.25		EOH @	1.25 m				× · · ×	1				•							12, 14		
-															·	1./5m				V		
▼ Soil W	=Peak, Moisturé	netroi mm ility T Hamr ne Sh R=Re	est ner ear Strenç esidual, o penetrate	Ugth (kPa) ↓ W ↓ W ↓ W ↓ W ↓ R	arge Dist 100 Und /ater Stri /ater Ris	urbed Sar urbed Sar isturbed S ke (1st, 2nd (1st, 2nd (minutes)	mple mple Sample and) d)	Slo Ra HOLE 1	ot En ow Se pid Ir FERM	counte eep (d	ered lepth (dep	n) oth) DUE T <u>C</u>	_	ollapse	1. C and 2. S she coh Sca 3. L 4. S	coordinate subject trength ar vane esive so la test rocated	tes a term: test voil stre esults	urvey s for o where ength s and ly kep	confirm cohesive availal terms indicatot lawn.	nation. re soil layers ble. Where are based o ted in quota		on ne,
satura	_{ated} mensi		; W = wet; in metre	10 ,	or:					Rig/F	- Plan	t Used: ger 70	<u></u>						L	ogged by		ed by

2	RICONS		ANTS	Riley Cons 22 Moorhouse Christchurch Tel: +643 379 Fax: +643 379	Ave 1402	Γ.								ND	A	UG	ER L		
Proje Sum		Rar	ngiora Du	ue Diligeno				/South E	Belt, Rar	ngiora	ı		e position: fer to Site	Plan.				lo.:	
Job N		0743	3	Start Da Finish D	ite: 18- Date: 18-	12-18 12-18	Grour	d Level 24.5	•	Z):			IZTM2000 0.3 N 5,2		3.7		H	408	
Clier W		Dev	elopment	ts Ltd				Hole De 0.70 n									Sheet: 1	of 1	
the Elevation (m LINZ)	Depth (m)	Geological Unit		Geologi r to separate ıformation sh		cal and Ge		Legend		(kPa	Strength) 50 200		Penetrometows / 50 mm)	Ground	Soil Moisture	Samples	Tes	sts	Instrument/ Backfill
+24.40	0.10	(TOPSOIL)	SILT, trac soft"; we	ce clay, orga t; low plastic	nics; greyis ity; organics	h brown. "\ s, rootlets.	Very soft t (TOPSOIL) <u>// //</u>		1		\					No. 1 0, 1, 1, 1, 2, 1, 2, 1, 1, 1, 1, 1,		
	-	(YALDHURST MEMBER, SPRINGSTON FORMATION)	SPRING:	ce clay, trace n-brown mott e to medium STON FORM rades to 'soft	IATION) ∶to firm'. Ve	ery stiff.		* * * * * * * * * * * * * * * * * * *								ES0.1 NOV	1, 1, 1, 1, 2, 1, 4, 9, 12, 14	V= 141 R= 59	
+23.80	0.70		0.00111 01	rades to men	ade minor ii	ne to med	ium sanu.	* ^ * ~		 	 								
A TOTAS SO-KANGIORA ALL LAGS, UF 3 SALIMBFIRMS AND THE TRANSPORT OF THE TOWNS OF BITT FLUCTURES OF BIT	- 1 		EOH @ C).70 m										Orff >					-
· • •	lanatio							GROUN	IDWATE	ER	<u> </u>	<u> </u>	Rem	arks					1
Scala Penetrometer - blows/50mm Permeability Test Schmidt Hammer Insitu Vane Shear Strength (kPa) V=Peak, R=Residual, Soil Wois Unable to penetrate D = dry; M = moist; W = wet; S = Small Disturbed Sample Large Disturbed Sample U100 Undisturbed Sample Undisturbed Sample Undisturbed Sample U100 Undisturbed Sample									ot Encou w Seep pid Inflov ERMINA et depth	(dept w (dep	h) oth) DUE TO	: Collap	and su 2. Stre shear v cohesi Scala t 3. Loca mound 4. First	bject to singth term vane test ve soil strest resulated next ls.	survey ns for wher rength ts and to sa	confirm cohesive availal terms in dindicate with terms in	s based on hanation. We soil layers able. Where no are based on ted in quotation and new mear south enoring gravel (as	are based of shear van correlation marks. ar horse du	on ne, i with ung
All c		ons le 1:	in metre:	S Contra	actor:						t Used:	mm					Logged by:		ed by:

Projec		and Ge	ANTS	Riley Consulta 22 Moorhouse Ave Christchurch Tel: +643 3794402 Fax: +643 3794403	Locati		/South B	elt, Rangio	ra		HANI osition: to Site Plan		AUG	SER LO	OG				
lob N	o.:	0743		Start Date: Finish Date	17-12-18			(m LINZ):	Co-Ordin	ates (NZT				HA09					
Client We		Deve	elopment	s Ltd			Hole De	epth:		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	,,		Sheet: 1 of 1						
(m LINZ)	Depth (m)	Geological Unit		r to separate Geo	Description otechnical and Gefor further information		Legend	Soil Shea (kF	Pa)	(blows	enetrometer / 50 mm)	Groundwater	Samples	Tes	sts				
24.30		(TOPSOIL)	0.02m G	ce clay, organics; ; organics, rootlef rades to moist. rades to minor cla	, dark brown. "So ts. (TOPSOIL) ay.	ft"; dry; low		50 100	150 200	3 6	9 12 16 		ES0.1 NOV	No. 1 2, 1, 0, 1, 1, 1, 1, 1, 1, 2, 2, 1, 2, 1, 2, 1, 2, 1, 0, 4					
4.00	0.30		SILT, mir and yello plasticity MEMBER	nor to some clay, wish-brown mott ; sand, fine to me R, SPRINGSTON	trace sand; grey ling. "Soft"; mois edium. (YALDHU FORMATION)	with orang t; low RST	× —												
		(YALDHURST MEMBER, SPRINGSTON FORMATION)	0.50m G	rades to 'firm'.			*						ES0.5 NOV						
_	-1	(YALDHURST MEMBER, S	1.00m G	rades to very stiff rades to include r led, greywacke	: minor gravel, fine	to medium		Δ		*	1.00m		ES0.9 NOV	No. 2 4, 4, 4, 3, 4, 6, 11, 14,	, V= 164 R= 39				
3.05	. 1.25				minor to some sa , as above; sand,		× × × × × × × × × × × × × × × × × × ×							14					
			EOH @	1.25 m							1.45m			V					
<u> </u>	anatio			•	and District	ma m ! -	GROUN	IDWATER			Remarks								
D P Soil W	=Peak, Moisture	mm ility T Hamr ne Sh R=Re	est	Lar U11 th (kPa) ↓ Wa ↓ Wa ↓ Ris	nall Disturbed Sarge Disturbed Sar 00 Undisturbed Sar ater Strike (1st, 2 ater Rise (1st, 2n se Time (minutes	mple Sample nd) d) and	Slov Rap HOLE T	t Encounter w Seep (de oid Inflow (d ERMINATE et depth X	pth) lepth) D DUE T <u>O:</u>	Collapse	and subject 2. Strength shear vane cohesive so	to surv terms f test wh il stren	ey confiner for cohes nere avail gth term	ons based on harmation. iive soil layers a lable. Where no s are based on ated in quotatio	are based or shear vane correlation v				
atura	ated	ons	in metre	10 1 1	or:				ant Used:		<u> </u>			Logged by:	Checked				

Projec		and Ge	NTS T	Christchurch Fel: +643 379440 Fax: +643 37944 e Diligence	03	Locatio		South F	elt, Rangio	ra		position:		AU	GER I	No.:			
Summerset Rangiora Due Diligence Tow Job No.: Start Date: 17-12-18 170743 Finish Date: 17-12-18					12-18	1	d Level	(m LINZ):	Co-Ordin	nates (NZ	TM2000):			ŀ	HA10				
Client: Welhom Developments Ltd						24.00 Hole De 1.10 n	epth:	<u> </u>	,500,523.	0 N 5,203	5,513	.0	Sheet: 1 of 2						
00.12 Elevation	Depth (m)	Geological Unit		Geologica to separate G formation shee	eotechnic	cal and Ge		Legend	,	r Strength Pa)	(blows	enetrometer s / 50 mm) 9 12	Groundwater	Soil Moisture	odilibro Odilibro	Tests			
23.75	- 0.25	(TOPSOIL)	low plasti	e clay, organic city; organics, or to some cla wish-brown m	rootlets.	(TOPSOIL)	\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\		150 200	3 6	9 12	15	ES0.	No. 1 1, 1, 2, 2, 2, 1, 2, 2, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,		TOXOXOXOXOX Instrument		
		(YALDHURST MEMBER, SPRINGSTON FORMATION)	plasticity; MEMBER 0.40m Gr	sand, fine to r s, SPRINGSTC ades to "stiff".	nedium.	YALDHUF ATION)	RST	X X X X X X X X X X						ES0.	5	∨ V= 203 R= 46			
-	-	(YALDHURST MEMB	0.80m Gr	ades to light g	rey with c	orange mo	ttling.	× × × × × × × × × × × × × × × × × × ×					 						
22.95	1.05		Sandy silf Very dens greywack	ty GRAVEL; liç se; moist; grav e; sand, fine to	jht grey w el, fine to coarse.	— — — Vith orange medium,	e mottling. subrounde	N N N N N N N N N N						ES1. NOV	No. 2 9, 10, 7, 8, 7, 9, 7, 6, 9, 6, 7, 7, 5, 6, 5, 8, 9, 12, 20				
Expla	- - -	ıs:						GROUN	IDWATER			Remari			V				
Scala Penetrometer - blows/50mm Permeability Test Schmidt Hammer Insitu Vane Shear Strength (kPa) V=Peak, R=Residual, Soil Wolff Length (kPa) Soil Wolff Length (kPa) D = dry; M = moist; W = wet; S = Small Disturbed Sample Large Disturbed Sample U100 Undisturbed Sample U100 Undisturbed Sample Water Strike (1st, 2nd) Water Rise (1st, 2nd) and Rise Time (minutes)							mple ample am)	X No Slo	ot Encounter w Seep (de bid Inflow (de ERMINATE et depth X	pth) lepth) D DUE T <u>O:</u>	Collapse	1. Coordir and subje 2. Strengt shear van cohesive: Scala test 3. Located 4. Scala re	nates a ct to so h term e test v soil str result d on tio	urvey con s for coh where av ength ten s and ind ly kept la	tions based or nfirmation. esive soil laye vailable. Where ms are based dicated in quot awn. .50m on extrac	on ne,			

Tropierations: Tropierations: Calculation Calculat	2		LE SULTAN and Geolo	22 M Chri Tel:	ey Consideration of the consid	ve 102								HAN	ID	Αl	JG	ER L	OG	
South Permittender Final Parts Final			Donai						d/Courth I	Dalt Dan	aioro							N	lo.:	
Client: Wethom Developments Ltd Hole Depth: 1.10 m		lo.:			Start Dat	e: 17-	12-18		nd Level	(m LINZ		Co-Ordina	ates (NZT	M2000):				Н	410	
Span Sp		nt:				ate: 17-	12-18		Hole D	epth:		E 1,	566,523.0	N 5,203	3,513	3.6				
Explanations: Solid Personnet - Leave Districted Sample Solid Personnet - Leave Districted Sample X Not Encountered Remarks Rem				pments I	Ltd					T					_	Φ.		2	of 2	
Explanations: Small Disturbed Sample Lace D	EC Cm LINZ	Depth (m	Geological U	(refer to	separate (Geotechnic	cal and Ge		Legend		(kPa)	(blows	/ 50 mm)	Groundwate	Soil Moistur	Samples	Tes	sts	Instrument/ Backfill
Explanations: Scala Penetrometer - Small Disturbed Sample Large Disturbed Sample Large Disturbed Sample Large Disturbed Sample Large Disturbed Sample A blows/50mm Not Encountered Remarks 1. Coordinates and elevations based on hand-held GPS and subject to survey confirmation		- -2 -												2.00m				*		-
Explanations: Scala Penetrometer - Small Disturbed Sample Large Disturbed Sample Large Disturbed Sample A blows/50mm Large Disturbed Sample Large Disturbed Sample A Not Encountered Small Disturbed Sample A Not Encountered Small Disturbed Sample A Not Encountered		-3																		-
V=Peak, R=Residual, Soil Wosturable to penetrate D = dry M = moist; W = wet; S = Water Rise (1st, 2nd) and HOLE TERMINATED DUE TO: Target depth X Refusal Collapse	Exp V	Scala Pe blows/50 Permeat Schmidt Insitu Va V=Peak,	enetrome Imm bility Test Hamme ne Shea R=Resid	t r r Strength (dual,	(kPa) ±	Large Disi U100 Und Water Str Water Ris	turbed San listurbed S ike (1st, 2nd se (1st, 2nd	nple ample ad)	X N Slo	ot Encour ow Seep apid Inflow TERMINA	ntered (depti v (dep	n) oth) DUE TO:		1. Coordinand subjection 2. Strength shear van cohesive Scala test 3. Located	nates a ct to so th term e test soil st t resul d on ti	survey on s for construction where rength ts and dy kep	confirr cohesi availa terms indica t lawn	mation. ve soil layers a able. Where no are based on ated in quotation.	are based of shear van correlation on marks.	on ne.

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Job N	0.:	743		Start Dat Finish Da	e: 20-	12-18			(m LINZ):	Co-Ordi	nates (NZ	TM2000):				H	411	
Client We	<u>:</u>		elopment		aic. 20-	12-10		Hole De 0.80 n	epth:		1,566,607.	1 10 5,20	J3,33	.,		Sheet:	of 1	
(m LINZ)	Depth (m)	Geological Unit		Geologic to separate (formation she	Geotechnic	al and Ge		Legend	(kl	r Strength	(blows	enetrometer s / 50 mm)	Ground	Soil Moisture	Samples	Tes	sts	/tacas atou
22.25	0.15	(TOPSOIL)	SILT, trac soft"; moi (TOPSOII	e clay, organi st; low plastic _)	ics; dark bi city; organi	rown. "Ver cs, rootlets	ry soft to s.	<u>// //</u>		150 200 	3 6	9 12 	15		,	No. 1 0, 1, 1, 1, 1, 1, 2, 2, 2, 3, 2, 3, 2, 3, 3, 3, 8,		公司公司公司公司
		AATION)	and yello plasticity; MEMBEF	or to some cl wish-brown m sand, fine to R, SPRINGSTo ades to "stiff"	nottling. "So medium. (ON FORM	oft"; moist	; low	ge							ES0.1 NOV	12, 15		
_		(YALDHURST MEMBER, SPRINGSTON FORMATION)	0.60m Gr	ades to light ç	grey with o	range mot	ttling.	× × × × × × × × × × × × × × × × × × ×							ES0.5 NOV	\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	. V= 172 R= 43	
1.60	0.80			ades to included, greywack			avel,	× × ×							ES0.75 NOV			0 V 0 V N
-	-1											0.95	m			•		
▼ S ▼ P ∨ S	anatior cala Per lows/500 ermeab chmidt I	netro mm lity T	est	th (kPa)	Small Dist Large Dist U100 Undi Water Stri	urbed San isturbed S ke (1st, 2r	nple ample ad)	X No	IDWATER of Encounter w Seep (de loid Inflow (d	epth)		and subj 2. Streng shear va cohesive	linates ject to s gth tern ne test e soil st	survens for whe rengt	y confir r cohes re avail th terms	ns based on ha mation. ive soil layers a able. Where nc s are based on	are based or shear vand correlation	n e,
<u>Soil \ </u> D = d	ry; M = ı	ble to	esidual, o penetrate :; W = wet;	$\bar{\Sigma}$	Water Ris Rise Time				ERMINATE		: Collapse				_	, "		_
satur All di	mensi	ons e 1:	in metres	Contra	ctor:					ant Used: Auger 70 r						Logged by: AvD	Checke	

Welhorn Developments Ltd Geological Description (refer to separate Geotechnical and Geological information has better further information) SILT trace day, organics, dark brown. Yery soft to separate Geotechnical and Geological information has better further information) SILT trace day, organics, dark brown. Yery soft to separate Geotechnical and Geological information has better further information and Geological information makes the further information and Geological in	Projec		and Ge	ANTS cologists	22 Moorhous Christchurch Fel: +643 37 Fax: +643 37	794402 794403	Location		/South !	Belt	Rand	iora			le po	sition:		A	.UC	SER L	No.:					
Cilient: Well-born Developments Ltd Geological Description (refer to separate Cestechnical and Geological provided in the separate Cestec		0.:			Start D	Date: 20)-12-18	1	nd Level	(m l				nates (l	NZTN	//2000):	- 1		Н	A12					
Explanations: Solit Solit	-	:				Date: 20	-12-10		Hole D	epth	:			,500,0	94.5	IN 5,2	203,33	5.4		Sheet:	neet: 1 of 1					
SILT, trace day, organics; dark brown. "Vary soft to soft misst low plaintoly, organics, contells." 21.35 0.15 SILT, minor to some alay, trace sand, previath variage and yellowieth-brown notifing. Soft most to well currently and fine to medium. (YALDHURST MEMBER. SPRINGSTON FORMATTON) SILT minor to some alay, trace sand, previath variage and yellowieth-brown notifing. Soft most to well currently and fine to medium. (YALDHURST MEMBER. SPRINGSTON FORMATTON) SILT minor to some alay, trace sand, previath variage and yellowieth-brown notifing. Soft most to well and plaintolly. The sand, fine to medium. (YALDHURST MEMBER. SPRINGSTON FORMATTON) SILT minor to some alay, trace sand, previath variage and yellowieth-brown notifing. Soft most to well and plaintolly. The sand, fine to medium. (YALDHURST MEMBER. SPRINGSTON FORMATTON) SILT minor to some alay, trace sand, previath variage and yellowieth-brown notifing. Soft most to well and yellowieth-brown notified. Soft most to well and yellowieth-brown notifi		Depth (m)	Seological Unit		to separat	te Geotechr	nical and Ge		Legend		(1	kPa)	Ū	(bl	ows / :	50 mm)	er afewballough	Soil Moisture	Samples	Т	ests	Instrument/				
SRIT, minor to some clay trace sand; grey with orange and yellowish-town motting. SPIT most to wet (surface infiltration after rain); low to medium plasticity; sand, filter to medium plastici		0.15		soft"; moi	st; low pla	ganics; dark sticity; orga	brown. "Ve nics, rootlet	ry soft to	<u>/</u> <u>\</u>	. ,									ES0.1	No. 1 0, 0, 1, 1, 1, 1, 1, 1, 1, 2, 1, 1, 2, 1, 1, 2, 2, 3,						
20.55 0.95 0.95 m Solution of the tomedium signal subrounded, greywacke. EOH @ 0.95 m Explanations: GROUNDWATER Remarks	_		(NO	(surface i sand, fine	nfiltration a to mediur	after rain); Ic m. (YALDHl	w to mediu	ım plasticit	ty; × × × × × × × × × × × × × × × × × × ×	-									NOV	8,8						
20.55 0.95 Grades to include trace to minor fine to medium x x x x x x x x x x x x x x x x x x x	-		(YALDHURST MEMBER, SPRINGSTON FORMATI	0.60m Lig	ght grey wi	ith orange m	nottling. Ver	y stiff.	× × × × × × × × × × × × × × × × × × ×			 							ES0.5 NOV		✓ V= 167 ✓ R= 34					
Explanations: GROUNDWATER Remarks	20.55	0.95						e to mediu	× × × × × × × × × × × × × × × × × × ×	- - - -							 		ES0.9 NOV							
	-	-1		еон @ 0	.95 М															No. 2 11, 12, 10						
	-	-																								
												İ	 	Ì	1							\perp				
▼ Scala Penetrometer -	S bl P S In V	cala Pe lows/50 ermeab chmidt situ Var =Peak,	netro mm ility T Hamr ne Sh R=Re	est ner ear Strengt		Large Di U100 Un Water S Water R	sturbed San ndisturbed S trike (1st, 2ndise (1st, 2ndise)	mple Sample nd) d) and	X N Slo	ot En ow Se apid II TERN	eep (conflow	ered depth (depth) JE T <u>O</u> :	_		1. Coor and su 2. Strei shear v	rdinates bject to ngth ten ane tes ve soil s	surve ns fo t whe treng	ey confi or cohes ere avai oth term	irmation. sive soil layers ilable. Where is are based o	are based no shear va n correlatio	on ne,				
D = dry; M = moist; W = wet; S = Target depth X Refusal Collapse	D = d	ry; M =	moist	; W = wet;	S =	·			Targ	get de				Colla	pse					Logged by	: Check	_				

Projec		and Ge	ANTS Tologists	Riley Cons 22 Moorhouse A Christchurch Fel: +643 3794 Fax: +643 3794	402 4403	Location						HANI		AU	IGI		OG	
Sumi Job N	lo.:			e Diligeno	te: 18-	-12-18			elt, Rangio (m LINZ):	1	Refer ates (NZT	to Site Plar M2000):	n.			H/	A 13	
Clien	t:)743 Devi	elopment	Finish D	ate: 18-	-12-18		23.20 Hole De 0.45 n	epth:	E 1,	566,374.5	N 5,203,	418	.2	-	Sheet:	of 1	
Elevation (m LINZ)	Depth (m)	Geological Unit	(refer	Geologic to separate formation she	Geotechni	ical and Ge		Puegen	Soil Shea (kF			netrometer / 50 mm)	Groundwater	Soil Moisture	Samples	Tes		Backfill
+23.20	- 0.15	ON) (TOPSOIL)	SILT, min	e clay, organics city; organics or to some c wish-brown n	lay, trace s	(TOPSOIL	with orang	\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	30 100 				3	ESI NO	0.1 V	No. 1 2, 2, 2, 2, 2, 3, 3, 3, 2, 9, 16, 13, 16		FOND STATE
+22.75	SILT, minor to some clay, and yellowish-brown moti medium plasticity, sand, i MEMBER, SPRINGSTON O.45 Q Refusal on inferred cobble EOH @ 0.45 m					medium. (\	YALDHURS	× × × × × × × × × × × × × × × × × × ×			+							FCFCFCFCFCFCFCFCFCFCFCFCFCFCFCFCFCFCFC
	-		EOH @ 0	.45 m												\		
	-1																	
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	_						1											_
▼ E b b c c c c c c c c c c c c c c c c c	/=Peak, Voisture	netro mm ility T Hami ne Sh R=Re	est mer ear Strengt esidual, o penetrate	th (kPa) $\frac{1}{2}$	Large Dis U100 Und Water Str Water Ris	sturbed Sar sturbed Sar disturbed S rike (1st, 2nd se (1st, 2nd e (minutes)	mple Sample nd) d) and	X No Slo	IDWATER of Encounter w Seep (de oid Inflow (c ERMINATE et depth X	pth) lepth) D DUE T <u>O:</u>	Collapse	and subject 2. Strength	ates a t to su terms	urvey co	onfirma hesive	ation.	nd hand GPS re based Scala ss.	<u> </u>
satur	_{ated} imensi		; W = wet; in metres	10 (actor:			rarg	Rig/Pla	ant Used:					L	ogged by:	Checked b	y:

Projec		and Ge	ANTS =	Riley Consulta Moorhouse Av Christchurch Fel: +643 379444 Fax: +643 37944	02 03	Locatio		110	oolt D	al				osition:		A	UG	ER L	OG lo.:	
Job N	o.:			e Diligence Start Date	e: 21-	12-18		I/South E nd Level	(m LINZ	<u> </u>	Co-Ordi	nates	(NZT	to Site I M2000)	:			Н	414	
Clien	t:	0743 Deve	elopment	Finish Da	ite: 21-	12-18		26.7 Hole De 0.65 r	epth:		E´	1,566,	464.6	5 N 5,2	03,422	2.0		Sheet:	of 1	
Elevation (m LINZ)	Depth (m)	Geological Unit	(refe	Geologica to separate G formation she	eotechni	cal and Ge		Legend		(kPa)	(blows	netromete / 50 mm)	Sround	Soil Moisture	Samples	Tes	sts	Instrument/ Backfill
+26.70	-	(TOPSOIL)	soft"; mo (TOPSOI	e clay, organi st; low plastic -) ades to "firm".	ity; organ	prown. "Ve ics, rootlet	ry soft to	7 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2		00 15	50 200 	3	6	9 12	15 0		ES0.1 \NOV	No. 1 0, 1, 1, 1, 0, 1, 2, 1, 2, 1, 2, 2, 1, 5, 12, 8, 8, 16		
+26.40	- 0.30	YALDHURST MEMBER, SPRINGSTON FORMATION)	SILT, mir and yello plasticity; MEMBEF	or to some cla wish-brown m sand, fine to i k, SPRINGSTO	sand; grey irm"; mois (YALDHUI IATION)	with oran tt; low RST	ge × × × × × × × × × × × × × × × × × × ×									S90.5				
+26.05	- 0.65	YALDHURST N		ades to includ sand. Very stif		lay and tra	ace fine to	× × ×	Δ	 x 					1		ES0.5 NOV		, V= 134 R= 36	
	-1 -1 -														 			V		
₩ s ₩ F V S III	′=Peak, WoistUre	enetro mm bility T Hami ne Sh R=Re able t	est mer near Streng esidual, o penetrate	h (kPa)	arge Dis J100 Und Water Str Water Ris	turbed San turbed San disturbed S rike (1st, 2nd se (1st, 2nd e (minutes	mple Sample nd) d) and	X No Slo	NDWATE of Encoun w Seep (pid Inflow FERMINA et depth	tered (depth (dep	n) oth) DUE T <u>O</u>	_	lapse	and sub 2. Strer shear v cohesiv	dinates a oject to s ogth term ane test re soil st	survey ns for wher rengtl	confir cohesi e availa h terms	ns based on hamation. ve soil layers a able. Where no are based on ated in quotation	are based of shear var correlation	on ne,
satur	_{ated} imensi		in metres	10 1	ctor:		ļ	raig	Rig		t Used:		iapa c][Logged by: RBW	Checke	

Projec		and Ge	ANTS Tologists F	Riley Cor 2 Moorhouse christchurch fel: +643 37 ax: +643 37	e Ave 94402 794403	Locatio						position:		AU	GER L	No.:	
Sumr Job N	0.:		ngiora Du	Start D)ate:	21-12-18			elt, Rangio (m LINZ):	1		r to Site Pla TM2000):	n.		⊢ н	IA15	
Client	<u> </u>	743			Date:	21-12-18		Hole De	epth:	E 1	,566,544.	2 N 5,203	,436	.4	Sheet:		
			elopments	s Lta				0.70 m	1				-	Φ		of 1	\equiv
Elevation (m LINZ)	Depth (m)	Geological Unit		to separat	te Geoted	escription chnical and Ge further informa		Legend	`	r Strength Pa)		enetrometer s / 50 mm) 9 12 1	വ Groundwater	Soil Moisture	Od	ests	Instrument/ Backfill
+24.45	. 0.25	(TOPSOIL)	low plastic	city; organ	ics, rootle	ark brown. "Sof ets. (TOPSOIL))				•			ES0. NOV	No. 1 1, 1, 1, 1, 1, 2, 2, 2, 3, 3, 3, 3, 4, 6, 13, 20		
		(YALDHURST MEMBER, SPRINGSTON FORMATION)	plasticity;	sand, fine , SPRING	to mediu STON FO	ice sand; grey g. "Stiff"; moist; im. (YALDHUF DRMATION)	with orang ; low RST	e			-						
+24.00	0.70	(YALDHURST MEN	0.60m Gra	ades to ver	ry stiff.			× × × × × × ×	Y		 		 	ESO. NOV	5	∨ V= 195 R= 49	
	-1 -1														•		
b D P V S Ir	=Peak,	netror mm ility To Hamn ne Sh R=Re	est ner ear Strengtl	h (kPa)	Large U100 Water	Disturbed San Disturbed San Undisturbed S r Strike (1st, 2rr r Rise (1st, 2nc Time (minutes)	mple ample am)	X No	IDWATER It Encounter W Seep (de	pth) depth)		and subjec 2. Strength shear vane cohesive so	ates a t to su terms test v	urvey con s for coh where av ength ten	tions based on nfirmation. esive soil layers ailable. Where ms are based of dicated in quotal	are based on shear van on correlation	on ie,
D = d	ry; M = l	moist	; W = wet; s	S =	tractor:	. ,		Targe	et depth X	Refusal ant Used:	Collapse				Logged by	: Checke	ed by

Projec		and Ge	ANTS Tologists	Riley Cor 2 Moorhouse Christchurch fel: +643 379 fax: +643 37	94402 94403	Location						Hole p	osition:		A	UC	SER L	OG	
Job N	o.:		ngiora Du	Start D	ate: 2	1-12-18			elt, Rang (m LINZ):	Co-Ord		s (NZT	to Site F M2000)	:			H	A 16	
Client	t:)743 Deve	elopment		Date: 2	1-12-18		20.90 Hole De 0.70 n	epth:	E	1,566	5,624.5	N 5,2	03,45	3.1		Sheet:	of 1	
Elevation (m LINZ)	Depth (m)	Geological Unit	(refer	Geolog to separat	e Geotech	scription nnical and Ge urther informa		Legend	Soil She	ar Strengt (Pa)	"		netromete / 50 mm) 9 12	Groundwater	Soil Moisture	Samples	Tes		Instrument/ Backfill
-20.65	- 0.25	ORMATION) (TOPSOIL)	SILT, min and yellov plasticity;	/ plasticity;	clay, trace mottling.	k brown. "Vei rootlets. (TO e sand; grey "Firm"; mois n. (YALDHUF RMATION)	with orang	\(\frac{1}{2}\frac{1}{								ES0.1 NOV	No. 1 1, 0, 1, 1, 0, 1, 2, 1, 2, 1, 2, 4, 10, 10, 8, 7, 8		
+20.20	- 0.70	(YALDHURST MEMBER, SPRINGSTON FORMATION)	0.45m Gr 0.60m Ve 0.65m Sa	•	oft".			× × × × × × × × × × × × × × × × × × ×	A				0.60) 		ES0.5 NOV	V ,	, V= 136 R= 45	
-	- - 1 -													 			No. 2 10, 10, 11		
	-																		
▼ s	anatior Scala Pe lows/50 Permeab	netro mm ility T	est	•	Large D	Disturbed Sar Disturbed Sar Indisturbed S	mple	X No	IDWATER of Encounter w Seep (c	ered			and sub 2. Stren	dinates oject to s ogth tern	surve ns fo	y confi r cohes	ons based on harmation. sive soil layers a	are based o	on
Ir V <u>Soil</u> D = d satur	nsitu Vai /=Peak, ////////////////////////////////////	ne Sh R=Re able to moist	ear Strengt	S =	Water f	Strike (1st, 2r Rise (1st, 2nd me (minutes)	d) and	HOLE T	et depth X	ED DUE T	Co	ollapse	Scala te	est resul ted near ttempt a	lts ar r alig aban	nd indic nment doned	s are based on tated in quotation of sewer mains due to encounter fill).	on marks. s. Initial har	nd I

Projec				Fax: +643 37944 ue Diligence		Location Towns		South E	selt, Rangio	ora		position: er to Site Pla	an.				lo.:	
Job N		743	3	Start Date Finish Da		2-18 2-18	Groun	d Level 22.10	(m LINZ):			TM2000): .6 N 5,203	3,470	0.0		H	417	
Client We		Deve	elopmen	ts Ltd		•		Hole De 0.85 n								Sheet: 1	of 1	
(m LINZ)	Depth (m)	Geological Unit		Geologic er to separate G nformation she	Seotechnica	al and Geo		Legend	(k	ar Strength Pa)		enetrometer s / 50 mm)	Groundwater	Soil Moisture	Samples	Tes	sts	
21.90	0.20	(TOP SOIL)	SILT, tra	ce clay, organititicity; organics,	cs; dark bro rootlets. (T	own. "Soft OPSOIL)	"; moist;	\(\frac{1}{2}\) \(\frac{1}{2}\	30 100 			9 12			ES0.1 NOV	No. 1 1, 1, 1, 0, 2, 1, 1, 2, 2, 2, 1, 2, 6, 6, 6, 13		
_	-	(NC	and yello	nor to some cla owish-brown m /; sand, fine to R, SPRINGSTO	ottling. "Firr medium. (Y	m"; moist; 'ALDHUR	low	×			/							
_	-	(YALDHURST MEMBER, SPRINGSTON FORMATION)	0.40m G	Grades to claye	y .			× × × × × × × × × × × × × × × × × × ×					 		E90.5			
		(YALDHURST MEMBEI		Grades to very s	tiff.			×							ES0.5 NOV		, V= 138 R= 43	
.25	0.85							× × × × × × × ×							ES0.85 NOV			
	- 1		EOH @	0.00 III							† 	0.95m	 			V		
	-																	
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-	-												 					
Fxpla	anatior	ns.						GROUN	IDWATER			Remari	ke ke					=
▼ S V P V S Ir	cala Pe lows/50 ermeab chmidt situ Vai =Peak,	netro mm ility T Hamr ne Sh R=Re	est ner lear Strenç esidual,	gth (kPa)	Small Distu Large Distu U100 Undis Water Strik Water Rise	rbed Sam sturbed Sa e (1st, 2nd (1st, 2nd	iple ample d)	X No	ot Encounte w Seep (de pid Inflow (epth) depth)		1. Coordin and subject 2. Strength shear vand cohesive s	ates ct to s h term e test soil st	surve ns for whe rengt	y confir cohesi re availa th terms	ns based on hamation. ive soil layers able. Where no are based on atted in quotation	are based of shear var correlation	or ne
<u>Soil</u>	Moisturé Iry; M =	ible to	penetrat ; W = wet	-	Rise Time (minutes)			et depth X	D DUE TO:	Collapse	e						_
satur VII di			in metre	S Contrac	ctor:				Rig/P Hand	lant Used:						Logged by:	Checke	

Job No.).: 170		igiora Du				on: oond Dd	/Court 5	olt Demi	oro		osition: to Site Pla				N	0.:	
Well (w INZ) +24.60 - +24.35				Start Da	ite: 2	1-12-18	1	nd Level	elt, Rangi (m LINZ):	Co-Ordin	nates (NZT	TM2000):				HA	18	
- +24.35 - +24.35			elopments	Finish D	Date: 2	1-12-18		24.60 Hole De 0.65 n	epth:	E1	,566,478.	5 N 5,203	3,362	3	8	Sheet:	of 1	
+24.35	Depth (m)	Geological Unit	(refer	Geologi to separate	Geotech	scription nnical and Ge urther informa		Legend	(k	ar Strength Pa)	(blows	enetrometer / 50 mm)	Groundwater	Soil Moisture	Samples	Test	'S	Instrument/ Backfill
+23.95	0.25	(TOPSOIL)	low plastic	city; organic	s, rootlet	k brown. "Sot s. (TOPSOIL)	\(\frac{1}{1}\) \(\frac{1}\) \(\frac{1}\) \(\frac{1}\) \(\frac{1}\) \(\frac{1}{1}\) \(\frac{1}\) \(\frac\	50 100	0 150 200 	3 6	9 12	15	ES NO	0.1 V	No. 1 1, 1, 1, 0, 2, 1, 1, 1, 2, 1, 2, 3, 2, 3, 3, 2, 3, 7, 11, 22		
+23.95		(YALDHURST MEMBER, SPRINGSTON FORMATION)	plasticity; MEMBER	wish-brown is sand, fine to sand, fine to sand, fine to sand, fine to sand fine to	o mediun TON FOF	e sand; grey "Firm"; mois n. (YALDHUF RMATION)	t; low	× × × × × × × × × × × × × × × × × × ×						ES NO	0.5 V		W= 157	SECTION SECTIO
	0.65	(YALDI	0.60m Grasand. Ver		ıde trace	to minor fine	e to mediu	X X X	A 	k) 					~	V= 157 R= 46	
-	1											1						
blov Per Sch Insi	ala Per ows/50r ermeabi chmidt l	netroi mm lity To Hamn	ner	•	Large D U100 U	Disturbed Sar Disturbed Sar Indisturbed S	mple sample	X No	IDWATER of Encounter of Seep (do of Inflow (ered epth)		and subje 2. Strengt shear van cohesive	nates a ct to s h term e test	urvey o s for co where a ength to	onfirma bhesive availabl erms ai	soil layers ar e. Where no re based on c	e based of shear vand orrelation	n e,
Soil Mo D = dry saturate All dim	Peak,	R=Re	ear Strengt esidual,	1	Water F	Rise (1st, 2nd me (minutes)	d) and	ш .		ED DUE TO:		Scala test	resuit	s and ii	ndicate	d in quotatior	marks.	

	RI CONS Engineers		ANTS	Riley Co 22 Moorhou Christchurch Tel: +643 3 Fax: +643 3	nse Ave 1 794402	ai ils	Locatio	on:							Hole p	ositio	n:		A	UG	SER L	OG	
Sumr Job N		Rar	ngiora Du	e Dilige Start I		21-	Towns	1	d/South				o-Ordi		Refer			n.			н	A19	
	170	743	1		Date:			Cioui	25.	70					,556.7			359	.7			713	
Client We		Deve	elopment	s Ltd					Hole [0.90		h:										Sheet: 1	of 1	
Elevation (m LINZ)	Depth (m)	Geological Unit		r to separa		technic	iption al and Ge er informa		Legend	5 5	Soil She (F	kPa)	Ū		cala Pe (blows	/ 50 m		Groundwater	Soil Moisture	Samples	Te	sts	Instrument/ Backfill
+25.40	. 0.30	(TOPSOIL)	SILT, trac soft"; mo (TOPSOI	ist; low pla	ganics; asticity;	dark br organi	rown. "Ver	y soft to s.	<u>\\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ </u>	\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\										ES0.1 NOV	No. 1 1, 1, 0, 1, 0, 1, 2, 2, 2, 2, 2, 2, 2, 2, 3, 3, 4, 10, 14, 20		
-	-	TON FORMATION)	plasticity MEMBER	; sand, fin R, SPRINO	e to med SSTON	dium. (FORM	and; grey iff"; moist YALDHUF ATION) plasticity.	RST	× -: × -: × -: × -: × -: × -: × -: × -:	× × × × ×						 							
		(YALDHURST MEMBER, SPRINGSTON FORMATION)		rades to w	·		e sand.		× - : : : : : : : : : : : : : : : : : :	× × × × ×			 			 				ES0.5 NOV		, V= 184 R= 50	
+24.80	0.90		greywacl	e.	nclude tr	race fin	e gravel, s	subround	× -	×				•									
-	-1		ЕОН @ 0																		•		
▼ S ▼ P ∨ S In	=Peak,	netroi mm ility T Hamr ne Sh R=Re	est ner ear Streng esidual,		☐ Larg ☐ U10 1 ☐ Wa	ge Dist 00 Undi iter Stri iter Ris	urbed Sar urbed Sar sturbed S ke (1st, 2r e (1st, 2nc	nple ample ad)	X N SI	Not E low :	WATER Encounte Seep (d	ered lepth (dept	h)			1. C and 2. S shea	subject trength ar vane esive so	ates a t to si term test v	urvey s for whei engt	y confir cohes re avail h term:	ons based on himation. ive soil layers a able. Where no s are based on ated in quotation	are based of shear var correlation	on ne,
D = d	ry; M =	-	penetrate ; W = wet;		☑ Rise	e time	(minutes)	<u> </u>			depth X	_	_	_	llapse				_				
satur All di	mensi	ons le 1:	in metre	Cor	ntracto	r:					Rig/F Hand		Used:								Logged by:	Checke	

Projec		and Ge	ANTS Toologists F	Riley Cons 2 Moorhouse Christchurch fel: +643 3794 fax: +643 379	Ave 4402 94403	Locatio	on:					osition:		Αl	JG	ER L	OG
Sumr Job N		Rar	ngiora Du	e Diligeno Start Da		Towns 1-12-18	1		elt, Rangio (m LINZ):		Refer	to Site Pla	an.			Н	A20
	170)743	3	Finish D				20.50)		566,642.7		3,365	5.5			
Client We		Deve	elopment	s Ltd				Hole De 0.55 n								Sheet: 1	of 1
Elevation (m LINZ)	Depth (m)	Geological Unit			Geotech	scription nical and Ge rther informa		Legend	Soil Shear (kF			netrometer / 50 mm) 9 12	Groundwater	Soil Moisture	Samples	Tes	rts instrument/
+20.25	- 0.25		soft"; moi (TOPSOIL SILT, min and yellov plasticity;	st; low plast) or to some ovish-brown	clay, trace mottling.	e sand; grey "Stiff"; moist i(YALDHUR	with oranç	\(\frac{1}{2}\) \(\frac{1}2\) \(\frac{1}{2}\)			,			EN	S0.1 \ OV	No. 1 1, 0, 1, 1, 1, 2, 2, 4, 3, 6, 13, 19	
+19.95	- 0.55	(YALDHURST MEMBER, SPRINGSTON FORMAT		ades to "ver		ŕ		×								\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	
	-																
	-																
V Soil V Soil V D = d	=Peak, Moisturé lry; M = ated	netro mm ility T Hamr ne Sh R=Re able to moist	est mer ear Strengt	S =	Large D U100 Un Water S Water F Rise Tin	isturbed Sar isturbed Sar ndisturbed S Strike (1st, 2n Rise (1st, 2nd ne (minutes)	mple Sample and)	X No Slo	IDWATER of Encounter of Seep (de oid Inflow (de EERMINATE of depth X	pth) lepth) D DUE T <u>O:</u>	Collapse	and subje 2. Strengt	nates a	survey as for o	confirm cohesiv indicat	s based on ha nation. re soil layers a ted in quotatio	re based on

	CONS Engineers		ANTS	Riley C 22 Moorh Christchul Tel: +643 Fax: +643	ouse Ave rch 3 379440	2	Locatio	on:						ـ ا		HA esition		D .	Α	UG	SER L	OG	
		Rar	ngiora Du	ue Dilig	gence		Towns	send Ro			lt, Rangi			R	efer t	o Site	Plan	۱.					
Job N)743	3		t Date sh Dat		-12-18 -12-18	Grou		el (r .70	n LINZ):	Co		nates (1 ,566,7				391	.1		H	A21	
Client We		Deve	elopmen	ts Ltd				1	Hole 0.55		th:										Sheet: 1	of 1	
07.12 Elevation	Depth (m)	Geological Unit		r to sepa	arate Ge	eotechni	cription ical and Ge her informa		-	Legend	Soil Shea (k	(Pa)				etrome 50 mn		Groundwater	Soil Moisture	Samples	Tes	sts	Instrument/ Backfill
+21.70	0.20	(TOP SOIL)	SILT, tra soft"; mc (TOPSO	ist; low	organic plasticit	s; dark l	brown. "Ve nics, rootlet	ry soft to s.	<u>1/2</u> 1/2	\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	 		 	, 	 	9				ES0.1 NOV	No. 1 1, 0, 1, 1, 1, 2, 1, 2, 4, 3, 3, 5, 7, 5, 3, 3, 2, 2, 1, 2		
-		(FILL)	gravel; g Firm to s	rey with tiff; mois , fibrous	orange st; low p ; gravel,	and yell	sand, organ lowish-brow r; sand, fine medium, s	wn mottlir e to mediu	ng. × aum; × aum	× × ×													
+21.15	- 0.55		0.45m G	rades to	gravelly	y; wet to	saturated		<u>x</u> - x-	<u>×</u> <u>×</u>										ES0.5			
FZ 1.15	. 0.55		Gravel g		edium to	o coarse	e.					İ	i	\	<u> </u>	Ì				NOV			
-	-1															 					No. 2 2, 7, 3, 4, 7, 4, 3, 2, 3, 4		-
	-															 		•			V		
_	anatior		meter -		• •	mall Die	sturbed Sar	mple			WATER						marks			I "			NDC
b P Y S Ir V	lows/50 ermeab chmidt isitu Vai =Peak, 70sturé	mm ility T Hamr ne Sh R=Re able to	est mer lear Streng esidual, o penetrate	e		arge Dis I100 Und Vater St Vater Ri	sturbed Sar sturbed Sar disturbed S rike (1st, 2r se (1st, 2nd e (minutes)	mple Sample and)	HOLE	Slow Rapi E TE	Seep (dd Inflow (epth) (depth ED DU) JE T <u>O:</u>	_	ine e	and s	ubject ength	to so	urvey s for	confir	ns based on ha mation. ive soil layers a ated in quotatio	are based o	
satur	ated		; W = wet;		ontroc	tor:			Га	arget	depth X			Colla	pse						Loggical Ex-	Charles	
All di		ons le 1:	in metre 10	s C	ontrac	iOl".						Plant U Auge									Logged by: RBW	Checke	

Projec		and Ge	ANTS cologists	Riley Cons 22 Moorhouse A Christchurch Fel: +643 3794 Fax: +643 379	Ave 4402 4403	Location		South F	Belt, Rangio	ora		position:		AU	JGI	ER LO	OG lo.:	
Job N	o.:)743		Start Da	ate: 21	-12-18	1	d Level	(m LINZ):	Co-Ordin	ates (Nz	ZTM2000)):			HA	A22	
Client We	:		elopment		Jale. Z	1-12-10		19.5 Hole De 1.10 r	epth:	E1	,500,053	3.5 N 5,2	03,321	.4	;	Sheet:	of 1	
(m LINZ)	Depth (m)	Geological Unit		Geologi to separate formation sh	Geotechi	nical and Ge		Legend	(kl	r Strength Pa)	(blov	Penetromete vs / 50 mm) 6 9 12	Sround	Soil Moisture	Samples	Tes	sts	Instrument/
		(TOPSOIL)	to firm"; r	e clay, organoist; low pla edium, subro	asticity; oi ounded, gi	ganics, root reywacke (T	tlets; grave 'OPSOIL)				*			ES NO	0.1 V	No. 1 1, 0, 2, 1, 2, 1, 2, 1, 1, 1, 0, 0, 1, 0, 1, 1, 1, 1, 1		
9.20	0.30		with oran moist; lov to mediu		wish-brow sand, fine ed to rour	n mottling.	"Firm";	×o×										363636
-		moist; low plasticity; sand, fine to me to medium, subrounded to rounded MEMBER FORMATION). \[\begin{align*} \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \				nics, fibrous DHURST ME	s to EMBER,	ery	Δ ×				 	ES NO	0.5 V	~	V= 38 R= 10	
8.40	-1 <u>1.10</u>			ades to incluinor fine gra		to some sa	nd, and				· · · · · · · · · · · · · · · · · · ·		om 			No. 2 3, 9, 7, 6, 7, 8, 9, 10, 16, 11		
	-				### Total Property of the Control of				\									
<u> </u>	anation				0			GROUN	NDWATER			Rem						_
bl P Soil K	=Peak, Moisturé	mm ility T Hamr ne Sh R=Re able to	est ner ear Streng	<u>1</u>	Large Di U100 Ur Water S Water R	isturbed Sar isturbed Sar ndisturbed S trike (1st, 2nd tise (1st, 2nd ne (minutes)	mple Sample and)	Slo X Ra HOLE 1		epth) depth 0.6 m D DUE TO:) Collaps	and sul 2. Strer shear v cohesiv Scala to	oject to s ngth term ane test ve soil str	urvey on s for co where a rength to	onfirma hesive availab erms a	s based on ha ation. e soil layers a ble. Where no are based on ed in quotatio	re based of shear van correlation	n e,
satura	nensi		in metres	10 (actor:				Rig/Pl	ant Used:					L	ogged by:	Checke	

Projec			ANTS ologists	Riley Cons 22 Moorhouse A Christchurch Tel: +643 3794 Fax: +643 379	Ave 1402 14403	Location		d10		M4 D				Hole	pos	ition:			ΑI	UG	ER L	OG No.:	
Job N	O.:	Ran 0743		Start Da	ate:	21-12-18 21-12-18		nd Leve	el (ı	m LINZ	<u> </u>	Co-Ord		s (NZ	TM		:				Н	A23	
Clien	t:		elopment		лаце.	21-12-10		Hole 1		oth:		E	1,56	6,746	.4	N 5,2	03,3	00.	2		Sheet: 1	of 1	
Elevation (m LINZ)	Depth (m)	Geological Unit		r to separate	Geote	escription echnical and Ge		7000	Legend		(kP	Strengtha)	וו	Scala F (blow	s / 50) mm)	er 15	Groundwater	Soil Moisture	Samples	Тє	ests	Instrument/
20.25	- 0.25	(TOPSOIL)	0.20m G SILT, mir gravel; gr "Soft to fi organics	rades to 'soft nor to some cey with oran, rm; moist; lo fibrous; grav	t to very clay, tra ge and w plas vel, sul	ark brown. "Ve rs, rootlets. (TC y soft'. ace sand, organ y yellowish-brov ticity; sand, fin- brounded to su PRINGSTON Fr	nics and wn mottline to medibangular.	\(\frac{1}{\structure} \) \(\fracture \) \(\frac{1}{\structure} \) \(\frac{1}{\structure} \	\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\			130 200	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \			9 12	15		E 6	ES0.1 \NOV	No. 1 0, 0, 1, 0, 1, 2, 1, 1, 2, 1, 1, 1, 1, 1, 1, 1, 3, 4, 5, 4		
19.70	- 0.80	(YALDHURST MEMBER, SPRINGSTON FORMATION)		rades to clay inor orange r	•			× × × × × × × × × × × × × × × × × × ×	× × × × × × × × × × × × × × × × × × ×	 	 - - - - - - -								E	ES0.5 NOV		V= 112 R= 36	
	-1 -		ЕОН @ (0.80 m												1.00 1.00 1.00 1.1.1.1.1.1.1.1.1.1.1.1.1	•				No. 2 12, 14, 14		
	-																						
▼ Soil OD = co	=Peak, Moisture Iry; M = ated	metror mm Hamm Hamm ne Sh R=Re able to	est ner ear Streng	S =	U100 Wate Wate Rise	Il Disturbed Sar e Disturbed Sar I Undisturbed S er Strike (1st, 2) er Rise (1st, 2n Time (minutes)	mple Sample and)	X S S S S S S S S S S S S S S S S S S S	Not Slow Rapi E TE	t depth	ntere (dep / (de XTEI	oth)	С	ollaps	3 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	and sub 2. Strer shear v cohesiv	dinate oject to ogth te ane te ve soil	o su erms est w stre	rvey for here ength	confirm cohesive availa terms dindica	s based on hation. we soil layers ble. Where nare based or ted in quotati	are based to shear van correlatio on marks.	on ane, on wit

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Job N	No.:)743		Start	t Date sh Da	e: (08-01	1-19	Grou	nd L		el (LI	`	_			(NZ	TM2	(2000): N 5,203,530	n 6		F	IP1
Clien	nt:	evelopm			,,, <u>D</u>					Нс		Depth	1:			1,50	10,21	5.1	14 3,203,330	0.0		Sheet:	of 1
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+26.80	_	SILT, mi	nor to so	ome cl	ay, tra	ce sai	rootle	ey with moist;		, <u>\</u> \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	× ×	₩8€€	55 5/5	######################################	¥ø%₩						HP1-0	.25-0.5	
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	Shoring/Support: Stability: O.3m A D A D C C SAMPLES AND TESTING Grab Sample (Disturbed) Sulk Sample (Disturbed) Scala Penetrometer (blows/50 Insitu Vane Shear Strength (kl P: Peak; R: Residual; UTP: Unable to penetrate Lab Testing: PSD: particle size OMC: optimum moisture cont max dry density; Disp: dispers								ws/50mm ws/50mm gth (kPa): e le size dis cont.; ME) [None Slow Rapid TER	Inflow MINAT t depth		Vater S Vater I īme (n	Rise ninute: se	1. st 2. la 3. 4.	Coolurvey Hand b test	arks rdinates and elevat confirmation. d pit located betwee ing, ngth terms based o ples may contain tr	en HA n stre	1 and H	IA7, undertaken sting in nearby H	for soil sampling and
All c	dimensi	ons in m	netres	1	ontrac		ty, L	210p. ul	Spoidivity	1 -				Plant d Exc								Logged by:	Checked by: CFC

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Job N	lo.:	743		Sta	rt Date	e: (08-0	1-19		ınd l		el (LI	NZ):	_			(NZ	TM2	2000): N 5,203,42			H	IP2
Clien		evelopr	nents l							Н		Depth	1:			1,00	70,10	7.0	14 0,200,42			Sheet:	of 1
Elevation (m LINZ)	Depth (m)	(r	efer to se	eparat	ogical te Geote sheet fo	echnic	cal and	d Geolo	ogical n)		Legend	Weathering		eld Stre	Ĭ	rc	(type	, orien	rescription tation, spacing, rsistence aperture, ling etc)	Groundwater	Samples		Tests
+26.50	0.20	SILT, m	ninor to s	some (clay, tra	ace sa	nd; gr	ey with	stiff"; dry SOIL) orange low MEMBEF	<u>√</u>	× × × × ×	#6f\$a									HP1-0	.25-0.5	
+26.20 https://doi.org/10.1000	20 0.50 EOH @ 0.50 m										×												
SKE	TCH/PP	HOTOS									- + - + - + - + - + - + - + - + - + - +								SITE MAP				0 m 100 m 200 m 1:10,000
Shorir Stabili	-			• 550	Grab	Samp	le (Dis	TESTIN sturbed sturbed))		H	None	GROU!	1	Vater :		1. sı	Coo	arks rdinates and elevat confirmation.				S and subject to
	C Lab Testing, PSD. particle size of OMC: optimum moisture cont.; I max dry density; Disp: dispersivi									st.	X	Rapid <u>TER</u>	Inflow MINAT t depth		Collap Machi	ninutes se ne limi	s) 2. te 3. 4.	Hand sting. Stree	d pit located adjace	on stre	ngth tes	sting in nearby H from above tops	A/BH. oil.
All d	All dimensions in metres Scale 1:10 Contractor:													Plant d Exc								Logged by: AvD	Checked by: CFC

2		ULTAN	Y 22 CI TS Te	2 Moort hristchu el: +64	Consumouse Avarch 3 37944	/e 02	S											11	NSPEC	T ;	101	N PIT	LOG
Proje		Rangio	ora Due	e Dilio	gence	<u> </u>		Locati Town	on: send Rd	l/Sou	th B	elt F	Rang	iora					osition: to Site Plan.			١	No.:
Job N	lo.:	743		Star	rt Dat	e: (0-80	1-19	Grour	nd Le		(LIN	<u> </u>				(NZ	ГМ2	2000): N 5,203,51	 73		Н	IP3
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Elevation (m LINZ)	Depth (m)	(re	efer to se	eparate		echnic	al and	d Geolo		Legend	b	Weathering		d Stre	Ŭ	ro	(type,	, orien	escription tation, spacing, sistence aperture, ing etc)	Groundwater	Samples		Tests
+24.40	0.20	SILT, m	inor to s	ome c	clay, tra	ace sa	nd; gro	ey with	stiff"; dry SOIL) orange ow MEMBER,	× * •		34565	5/5/5/1	75	₩ % ₩						HP1-0	.25-0.5	
+ 1 TOUR US US US US US US US US US US US US US	EOH @ 0.50 m - 1 - 1 - 1 - 1									x x	<u> </u>												-
SKE SKE	TCH/PP	HOTOS		- - - - - - - - - -									 						SITE MAP				0 m 100 m 200 m 1:10,000
	Lab Testing. P3D. particle size OMC: optimum moisture cont.;									. L	SI Ra :	one ow Se apid Ir	eep nflow		Vater S Vater F ime (n <u>JE TO</u> Collap	Rise ninutes	1. st 2. te 3. 4.	Cool Irvey Hand sting Strei	arks rdinates and elevat confirmation. d pit located adjace gth terms based of ples may contain to	ent to I	BH2, un	dertaken for soil	S and subject to sampling and lab A/BH.
All d									spersivity					Plant	Used	l:						Logged by:	Checked by: CFC

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Job N	lo.:	0743		a DC	St	art	Date	e:		01-1	9	Groun	nd L	.eve	el (L		<u> </u>				s (N	IZTM:	2000):			Н	IP4
Clien		0743)		FI	nisr	ı Da	ile:	08-	01-1	9				2m Depi	th:			t	= 1,	066,	660.3	8 N 5,203,61	1.3		Sheet:	
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+21.00	0.20												71	<u>\ \ </u>													
	-	SIL [*] and plas SPF	T, min yello sticity RING	nor to owish- r; sand STON	some browing d, fine	e cla n mo e to n	y, tra ottlino nedic TION	ice sa g. Ve um. (and; ry st YAL	grey v iff; mo DHUF	with coist; Ic	range w IEMBER,	×	×													
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	C max dry density; Disp: dispersiv							persivity	<u> </u> L		, well		Rin/F	Plant	Use							Logged by:	Checked b				
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														id Inf		_	Time (UE TO		ites)	3. Str 4. Sa	ength terms based on ples may contain t	n stre race n	ngth tes naterial	sting in nearby HA from above topso	VBH. oil.	
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All d	C max dry density; Disp: dispers All dimensions in metres Scale 1:10 Contractor:													Plant d Exc	Use							Logged by: AvD	Checked b			

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	oject umm		et Ra	angiora D	ue Diligence	- 1	catio wns		l/South Belt,	Rangio	ra		Hole po Refer t	sition: o Site Plan.				0.:
Jo	b No		074	3	Start Date: Finish Date:	18-12-1 19-12-1		Groui	nd Level (m 23.70	LINZ):	Со		nates (NZTN 1,566,522	//2000) : N 5,203,465			В	H1
	lient: /elhc)eve	lopments	Ltd				Hole Depth 15.20 m):	An	gle fro	om Horiz.:	Direction: -90° NZTM2	2000	Sheet:	1 (of 2
Туре	Run	Fluid & Water	Piezometer	(refer to	ological Descript separate Geotechni ical Information she urther information)	cal and	Legend	Weathering	Field Strength	evation	Depth (m)	Symbolic Defect Log	Average Defect Spacing (mm)	Defect Desci (type, orientation, s roughness, persis aperture, infilling etc)	pacing,	TCR (SCR) RQD (%)	Samples	Tests
	0.00			"Very sof organics CLAY; liq mottling. plastic (\ SPRING:	ace organics; dark to the content of	orown. stic; //	0	######################################	0.83 0.83 0.84	+23.35 +23.35 +22.80	- - - - - - 1		000			118		
	1.52			mottled of moist; gr subangu medium. Fine to mand silt, "Dense";	rey and brown. Der avel, subrounded to ar, grewacke; sand	nse;	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0			+21.86 +21.50	- -2					102		SPT 1.52 m 10, 6, 8, 10, 11, 14; N = 43
SONIC GEOPROBE 8140LC (150Hz)	3.04			some sill "Dense to and sand	e to coarse GRAVE , minor cobbles; bro o very dense"; mois , as above.	own. or t; gravel v	000000000000000000000000000000000000000			: 1	- -3 - - - - - - - - - -					105		SPT 3.04 m 7, 9, 12, 10, 11, 14; N = 47
SONIC GEO	4.56	<u> </u>		4.50m G	ades to saturated.						- - - - - - - - - - - - -					118 ()		SPT 4.56 m 7, 8, 10, 12, 14, 14; N = 50
	6.08										- - - - - - - - - - - - - - - - - - -					105		SPT 6.08 m 11, 14, 16, 16, 14, 14; N = 60
	7.60					0.4	0 0				- - - - -					102		SPT 7.60 m 35, 25; N > 50
Relation Relations Relatio	athered athered ative R ak, mod R - Tota R - Soli D - Roo	s Weat (SW), (HW), (cock St derately al Core d Core ck Qua defect	rength / stror Reco Reco lity Des	rately weather letely weather - extremely was, strong, very every exignation layed as Dip/		Water	onite t on Test Strike	t: Flow Type (1st, 2nd .	Drill arisings or collapsed hole Filter material be/Adopted Value)						hand-he confirm 2. No confirm 3. SPT cone us 4. Water	rdinates and eld GPS an nation. core loss. Re y exceeds re hammer eff sed unless i	d sub ecover un ler ficiend indica ring d	ations based or ject to survey red core sampl 19th by 5-10%. cy 93.8%; solid ted on log. Irilling influence
A	ll dir		sions	s in metre	Contractor				Core Boxes: 0	Rig/Pl			(McMillan)	Driller:		Logged	by:	Checked by CFC

	2			EY TANTS Geologists	22 Mo Christ Tel: +	y Consultants corhouse Ave church 643 3794402 +643 3794403								DRILL	НС	LE I	_0	G
	roje		ent R	andiora I		iligence	Locati		d/South Belt,	Rangio	nra			osition: to Site Plan.			N	0.:
_		lo.:	17074		St	_	3-12-18	_	nd Level (m		_		nates (NZT	M2000):			В	H1
	lien Vell	nt:		lopment		mism Date. Te)-12-10		23.70 Hole Depth 15.20 m	1:	An		om Horiz.:	2 N 5,203,465 Direction: -90° NZTM2	2000	Sheet:		of 2
Type	Si B	Fluid & Water	Piezometer	(refer to Geolo	separa	ral Description ate Geotechnical a formation sheet formation)	gend gend	Weathering	Field Strengt	evation	Depth (m)	Symbolic Defect Log	Average Defect Spacing (mm)	Defect Descr (type, orientation, s roughness, persist aperture, infilling etc)	pacing,	TCR (SCR) RQD (%)	Samples	Tests
	7.6	60		some si	ine to coll, mind to very id, as a ued)	oarse GRAVEL, or cobbles; brown dense"; moist; gr bove.		.	1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1		- - - - - - - -					102		
	9.1	12						·			-10					100		SPT 9.12 m 10, 9, 10, 10, 10, 16; N = 46
GEOPROBE 8140LC (150Hz)	10.	64						.			- - - - - - - - - - - - - - - -					118		SPT 10.64 m 15, 27, 35, 25/65mm; N > 50
SONIC GEOPRE	12.	16				— — — — — dium SAND; Very dense; mois	×	·		+11.54 	- 12 - 12 					118		SPT 12.16 m 14, 20, 20, 26, 14/20 mm; N > 50
	13.	68		some si	It, mind ery dens	oarse GRAVEL, or cobbles; brown se; moist; gravel a	and Q X X X X X X X X X X X X X X X X X X	>		+10.02	- - - - - - - - - - - - - - - - - - -					100		SPT 13.68 m 24, 22, 22, 28, 10/20 mm; N > 50
- SS 54-7071 HO				EOH @	15.20 ı	m	0 /× % & 8	-		+8.50	- - - - - - - - - - -							SPT 15.20 m 30, 21, 25, 28, 7/15 mm; N > 50
Ro	ck Ma	ass We	ions:	g: unweather	red (UW)	, slightly	Backfill:	D SA	Drill arisings						1.0		mark	
we we we scale and scale a	ather ather ather lative ak, m R - To R - S D - R itude	ed (SV ed (HV ed (RV Rock noderat otal Co folid Co Rock Qi of defe	V), mode V), comp V) Strength ely stroit ore Reco ore Reco uality De	erately weath n - extremely ng, strong, very overy sesignation layed as Dip	nered (M) ered (CV weak, ve ery stron	W), highly V), residually ery weak,	Water Stri	st: Flow Ty ke (1st, 2nd	or collapsed hole Filter material pe/Adopted Value						hand-h confirm 2. No o typicall 3. SPT cone u 4. Wat	eld GPS ar nation. core loss. R ly exceeds hammer e sed unless	ecove run ler fficien indica uring c	Irilling influence
		limer		s in metr	res	Contractor: McMillan Drill	-		Core Boxes: 0	Rig/Pl Geopr			(McMillan)	Driller:	I L	Logged DDH	- 1	Checked by:

R				E Y	22 Moorho Christchur Tel: +643	rch	ts								DRILL	НО	LE I	_0	G
	oject umm		et Ra	angiora Di	ue Dilig	jence		catio		d/South Belt,	Rangio	ra		Hole po	osition: to Site Plan.			N	0.:
Jo	b No).: 17	074	3		t Date: sh Date:	17-12-1 18-12-1	18 18	Grou	nd Level (m 24.40	LINZ):	Со-		nates (NZTI 1,566,561	M2000): N 5,203,517			В	H2
1 -	ient: /elhc)eve	lopments	Ltd					Hole Depth 15.20 m	I.	Ang		om Horiz.:	Direction: -90° NZTM2	2000	Sheet:		of 2
Туре	Run	Fluid & Water	Piezometer	(refer to s Geologi	eparate (Description Geotechnics mation sheeter commation)	al and	Legend	Weathering	Field Strengtl	evation	Depth (m)	Symbolic Defect Log	Average Defect Spacing (mm)	Defect Descr (type, orientation, s roughness, persist aperture, infilling etc)	pacing,	TCR (SCR) RQD (%)	Samples	Tests
		1 -		SILT, min and orang plasticity SPRINGS	or clay; nge. "Soft" (YALDHU) TON FO to coan inor silt; oist; grav	orown. "Soft ty (TOPSOII mottled light ; moist; low JRST MEM RMATION) — — — see GRAVEL brownish-g- vel, subroun acke; sand,	t grey		20 ± 20 ± 20 ± 20 ± 20 ± 20 ± 20 ± 20 ±	A S S S S S S S S S S S S S S S S S S S	#24.20 +24.20 +23.70 +23.70	-1	S	500			0		SPT 1.52 m 7, 7, 8, 8, 9, 9; N = 34
SONIC GEOPROBE 8140LC (150Hz)		1				very dense.	ced.				 	-3					0		SPT 3.04 m 10, 13, 15, 14, 15, 13; N = 57 SPT 4.56 m 8, 9, 14, 14, 12, 14; N = 54
Roonic GEOI							•										0		SPT 6.08 m 11, 20, 27, 23, 10/35mm; N > 50
				7.92m - 9	.12m Gra	ades to silty	/.	0 V.				- - - 8					0		10, 27, 25, 25, 10/20 mm; N > 50
Relation wear Relation wear Relation Re	thered thered ative R k, mod R - Tota R - Soli D - Roo	s Weat (SW), (HW), (cock St derately al Core d Core ck Qua defect	rength / stron Reco Reco lity De s displ	very signation layed as Dip/D	red (MW), ed (CW), r eak, very v r strong	highly residually	Backfi Ben Grod Luge Wate Wate	ill: tonite ut on Tes	t: Flow Type (1st, 2nd (1st, 2nd)	Drill arisings or collapsed hole Filter material pe/Adopted Value)) and Rise						hand-h confirm 2. No c typicall 3. SPT cone u: 4. Wate	rdinates an eld GPS ar nation. ore loss. R y exceeds i hammer e sed unless	ecove run ler fficien indica uring c	ations based on ject to survey red core sample ogth by 5-10%. cy 93.8%; solid ated on log. Irilling influence
A	ll din		sions ale 1	s in metre		ontractor: cMillan D				Core Boxes: 0	Rig/Pla Geopre			(McMillan)	Driller:		Logged AvD	- 1	Checked by CFC

				LY TANTS	Riley Consultants 22 Moorhouse Ave Christchurch Tel: +643 3794402 Fax: +643 3794403								DRILL	НО	LE I	LO	G
	rojec		et Ra		e Diligence	Location		d/South Belt,	Rangio	nra			osition: to Site Plan.			N	0.:
-	ob No	o.:	7074		_	12-18	_	arcedarr Bert, and Level (m 24.40		1		nates (NZT				В	H2
	Client Welh	:		lopments				Hole Depth 15.20 m	1:	An		om Horiz.:	Direction: -90° NZTM20	000	Sheet		of 2
				Geol	ogical Description				$\overline{\top}_{\underline{a}}$		g		•				
Tvpe	Run	Fluid & Water	Piezometer	Geologic	eparate Geotechnical ar all Information sheet for ther information)	pued Pier	Weathering	Field Strengt	evation	Depth (m)	Symbolic Defect Log	Average Defect Spacing (mm)	Defect Descrip (type, orientation, spe roughness, persiste aperture, infilling etc)	acing,	TCR (SCR) RQD (%)	Samples	Tests
						0,	\$\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	S S S S S S S S S S S S S S S S S S S			0,	20 100					
				trace to m Dense; mo	to coarse GRAVEL, inor silt; brownish-grey. pist; gravel, subrounded r, grewacke; sand, fine	to 0.0	.		 	- - - - - - 9					0		
				10.04m - 1	0.64m Grades to silty.					-10					0		SPT 9.12 m 9, 12, 17, 20, 21, 5mm; N > 50
E 8140LC (150Hz)									 	- - - - - - - - - - - - - - - - - - -					0		SPT 10.64 m 12, 20, 20, 27, 13/20 mm; N > 50
13:28 Produced by gin I Professional Sonic GEOPROBE 8140LC (159Hz)				12.16m Gi	ades to include trace c	000		111111		- 12 - 12 13					0		SPT 12.16 m 10, 9, 13, 17, 17, 13/45mm; N > 50
3-1 NZ LB 13:GLB LOG MLEY CHCH DH 170743 SS-KANGIOKA ALL LOGS.GFJ < CLTAMINGFIRS> ZZUJZUJZUJ 13:Z8 Produced by gin i Professional できたが、 高級の できた 1 ML LD 15:CH				14.60m - 1	5.20m Grades to silty.					- 14					0		SPT 13.68 m 20, 40; N > 50
70/43 SS-KANGIOKA AL				EOH @ 15	5.20 m	· <i>O</i> s			+9.20 	- 16							SPT 15.20 m 22, 24, 40, 20/20mm; N > 50
									1	-			7.				
RO WE WE 13. GEB LOG KILEY CF WE WE WE SO KILEY CF RO WE WE SO KILEY CF RO WE WE WE WE WE WE WE WE WE WE WE WE WE	eathered eathered elative F eak, mod CR - Tot CR - Sol QD - Ro	ss Wead (SW dd (HW dd (RW Rock Stall Corrected	athering), mode), comp) strength ly stror e Reco e Reco ality De	i - extremely we ng, strong, very every every esignation layed as Dip/Di	(UW), slightly bed (MW), slightly d (CW), residually lak, very weak, strong	Water Strik	st: Flow Ty ke (1st, 2nd	Drill arisings or collapsed hole Filter material pe/Adopted Value d)						hand-he confirm 2. No co typically 3. SPT cone us 4. Wate	dinates an eld GPS ar ation. ore loss. R y exceeds hammer e sed unless	nd sub Recove run lei fficien indica uring d	ations based on ject to survey red core sample 19th by 5-10%. cy 93.8%; solid 1ted on log. Irilling influenced
<u>3</u> =		men		s in metres	- -	ng		Core Boxes: 0	Rig/P Geopr			(McMillan)	Driller:		Logged AvD	-	Checked by: CFC

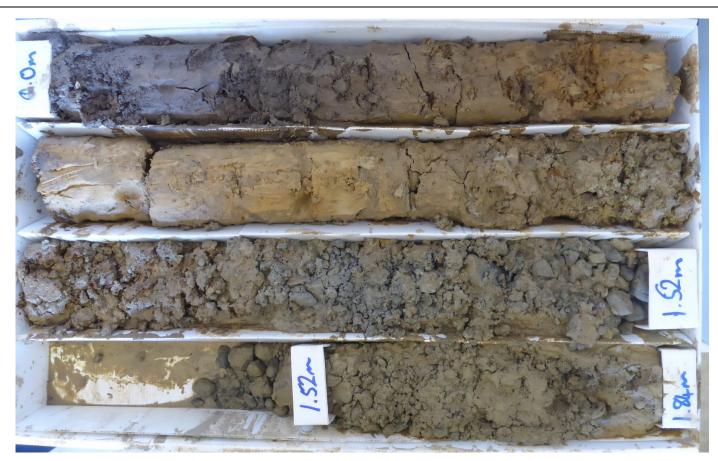
	ojec	t:	s and C	Geologists	Fel: +643 3794402 Fax: +643 3794403 Te Diligence	Location Towns		d/South Belt,	Rangio	ra		Hole po		OLE		lo.:
_	b No	D.:	074			12-18 12-18	Grou	nd Level (m l 24.40	_INZ):	Со-		ates (NZTN 1.566.367	M2000): N 5,203,588		В	H3
	lient Velh		evel	opments	Ltd			Hole Depth 6.08 m		Anç		m Horiz.:	Direction: -90° NZTM2000	Sheet		of 1
Type	Run	Fluid & Water	Piezometer	(refer to se	ogical Description eparate Geotechnical and Information sheet for their information)		Weathering	Field Strength	evation	Depth (m)	Symbolic Defect Log	Average Defect Spacing (mm)	Defect Description (type, orientation, spacing, roughness, persistence aperture, infilling etc)	TCR (SCR RQD (%)	Samples	Tests
SONIC GEOPROBE 8140LC (150Hz)		1 = = = = = = = = = = = = = = = = = = =		SILT, minc and orang plasticity; (YALDHUI SPRINGS) 0.80m Grafine to meritace to medium disubrounde grewacke; Gravelly siminor clay low plastic Sandy fine trace to medium.	or clay; brown. "Soft"; plasticity (TOPSOIL) or clay; mottled light gree. "Soft"; moist; low slightly dilatant. RST MEMBER, TON FORMATION) des to sandy SILT; sandium. to coarse GRAVEL, nor silt; brownish-grey. ense; moist; gravel, do to subangular, sand, fine to medium. Ity fine to medium SAN. "Medium dense"; moist; trivity; dilatant. to coarse GRAVEL, nor silt; brownish-grey. erv dense; moist; graved to angular (broken grewacke; sand, fine to des to saturated.	X			+24.15 +23.35 +23.35 +22.70 +22.30			000 000		0		SPT 1.52 m 4, 5, 4, 4, 3, 4; N = 15 SPT 3.04 m 12, 14, 15, 13, 12, 11; N = 51 SPT 4.56 m 6, 10, 10, 12, 11, 12; N = 45
Roo wea	ck Mas athere athere	d (SW),	ns:	EOH @ 6.	Bi	ackfill:		Drill arisings or collapsed hole Filter material					hand confi	oordinates ar l-held GPS a rmation.	ınd sub	ations based o ject to survey
Rel wea TCF SCI RQ Attit	ative F ak, mo R - Tot R - So D - Ro tude of	Rock Str derately al Core lid Core ck Qua	Recordity Design display	g, strong, very very very signation ayed as Dip/Di	ak, very weak, strong	Lugeon Te Water Strik Water Rise	e (1st, 2nd (1st, 2nd	pe/Adopted Value					2. No typic 3. SF cone 4. W	core loss. F ally exceeds T hammer e used unless	run lei efficien s indica during d	drilling influenc

Project:		nd Ge	ologists Fa	e: +643 3794402 e: +643 3794403 e: Diligence	Location		d/South Belt,	Rangio	ra		Hole po	sition: o Site Plan.		N	0.:
Job No.:				Start Date: 20-1 Finish Date: 20-1	2-18		and Level (m l				ates (NZTN			В	H4
Client: Welhom	n De	velc	ppments L	td			Hole Depth 6.08 m	:	An		m Horiz.:	Direction: -90° NZTM2000	Sheet		of 1
Type	Fluid & Water	Piezometer	(refer to sep	gical Description parate Geotechnical and Il Information sheet for her information)	Legend	Weathering	Field Strength	evation	Depth (m)	Symbolic Defect Log	Average Defect Spacing (mm)	Defect Description (type, orientation, spacing, roughness, persistence aperture, infilling etc)	TCR (SCR RQD (%)	Samples	Tests
SONIC GEOPROBE 8140LC (150Hz)			"Very soft"; organics, ro organics, ro organics, ro organics, ro organics, ro CLAY; brow "Firm"; mois (YALDHUR: SPRINGSTI SITY of the second of the second or second o	e organics; dark brown. moist; high plasticity; ottlets (TOPSOIL) In with grey mottling. st; highly plastic ST MEMBER, ON FORMATION) coarse SAND with l; greyish-brown. see to dense; moist; ounded to subangular, trated; gravel and sand coarse SAND with l; greyish-brown. see in oist; ounded to subangular, see GRAVEL with some lt; orange-brown. Very rated; gravel, to subangular, see GRAVEL with some lt; orange-brown. Very rated; gravel and sand, coarse SAND with l; greyish-brown. pse; moist; gravel, to subangular, coarse SAND with l; greyish-brown. pse; gravel, subrounded ar, greywacke. see GRAVEL with some lt; orange-brown. Dense ravel and sand, as					-1-23355		000 000		0		SPT 1.52 m 11, 14, 11, 14, 14, 11; N = 50 SPT 3.04 m 8, 8, 13, 13, 15, 13; N = 54 SPT 4.56 m 7, 6, 8, 8, 8, 10; N = 34
weathered (S' weathered (H weathered (R Relative Rock	ation: Weather Weather Weather Weather Weather Weather Weather	S: sring: oderample	unweathered (Italy weathered letely weathered extremely wea strong, very s	JW), slightly (MW), highly (CW), residually k, very weak, trong	Ckfill: Bentonite	st: Flow Ty	Drill arisings or collapsed hole Filter material		7			hand confi 2. No typic 3. SF	oordinates ar l-held GPS a rmation. o core loss. F ally exceeds	nd sub Recove run ler efficien	ations based of ject to survey red core samp ogth by 5-10% cy 93.8%; soli

ľ				LY	Riley Consulta 22 Moorhouse Ave Christchurch Tel: +643 3794402 Fax: +643 3794403	nts									DRILL	НО	LE I	LO	G
	oject umm		et Ra	ngiora Du	ie Diligence	I .	catio		d/South Be	elt, F	Rangio	·a		Hole po	osition: to Site Plan.			N	0.:
Jo	b No).: 17	7074	3	Start Date: Finish Date:	19-12-1 19-12-1	8 8	Grou	nd Level (22.40		INZ):	Co-		ates (NZTI 1,566,694	M2000): N 5,203,361			В	H5
1 -	lient: Velho)evel	opments	Ltd				Hole De 6.08 m			Ang	gle fro	m Horiz.:	Direction: -90° NZTM2	2000	Sheet:		of 1
Туре	Run	Fluid & Water	Piezometer	(refer to se Geologic	ogical Descript eparate Geotechnical Information she trther information)	cal and	Legend	Weathering	Field Stree		Elevation (m LINZ)	Depth (m)	Symbolic Defect Log	Average Defect Spacing (mm)	Defect Descr (type, orientation, s roughness, persist aperture, infilling etc)	oacing,	TCR (SCR) RQD (%)	Samples	Tests
SONIC GEOPROBE 8140LC (150Hz)				Clayey SIL orange. "S (YALDHUI SPRINGS 0.60m Graorange mo orange m	e sand, trace clay wnish grey. "Very prounded to subara; sand, fine to me to coarse GRAVI inor silt; brownish; coarse did to subarquid to subarquid to subarquid to subarquid to subarquid to subarquid to subangular, si coarse GRAVI inor silt; brownish; gravel, si do subangular, si sand, fine to me addes to fine to coa some sand, mino own. Indes to trace silt; coarse s	ey and saticity) // with see; soarse, and, fine stiff; coarse, and dium.			100 NSA 100 NS		+22.20 +20.90 +19.90 +19.70	-1 -2 -3 4 7		000			0		SPT 1.52 m 5, 5, 4, 5, 5, 6; N = 20 SPT 3.04 m 10, 12, 15, 15, 16, 14; N = 60 SPT 4.56 m 6, 11, 12, 15, 17, 17; N = 61
Rel wea TCF SCI RQ	athered athered athered ative R ak, mod R - Tota R - Soli D - Roo	s Wear I (SW), I (HW), I (RW) Cock St derately al Core id Core ick Qua	rength / strong Recover Recovers	etely weathere - extremely we g, strong, very very very signation	ed (MW), highly d (CW), residually eak, very weak, strong	Wate	onite it on Tes	st: Flow Ty e (1st, 2nd	Drill arisings or collapsed ho Filter material pe/Adopted Val d)			- 8				hand-h confirm 2. No c typicall 3. SPT cone u: 4. Wate	rdinates an eld GPS ar nation. ore loss. R y exceeds hammer e sed unless er added di	nd sub Recove run ler fficien indica uring c	ations based or ject to survey red core sampl 19th by 5-10%. cy 93.8%; solid ted on log. Irilling influence
Attit	ection a	and Tre	nd/Plu	in metre					Core	()	Rig/Pla			(McMillan)	Driller: Paul		Logged	depth by:	

C	E	ngineer	SUL7	E Y ANTS	Riley Consult. 22 Moorhouse Ave Christchurch Tel: +643 3794402 Fax: +643 3794403									DRILL	НО	LE I		
	oject umm		t Ra	ıngiora Du	e Diligence		ocation Fowns		d/South Belt,	Rangio	ra		Hole po Refer to	sition: o Site Plan.				0.:
Jo	b No		074	3	Start Date: Finish Date			Grou	nd Level (m 23.70	LINZ):	Co-		ates (NZTN 1,566,309	//2000) : N 5,203,425			В	H6
_	lient: /elhc		evel	opments	Ltd				Hole Depth 6.08 m	1:	An	gle fro	m Horiz.:	Direction: -90° NZTM2	000	Sheet:		of 1
Туре	Run	Fluid & Water	Piezometer	(refer to se	ogical Descrip eparate Geotechi al Information strther information	nical and neet for	Legend	Weathering	Field Strengtl	evation	Depth (m)	Symbolic Defect Log	Average Defect Spacing (mm)	Defect Descri (type, orientation, sp roughness, persiture, aperture, infilling etc)	acing,	TCR (SCR) RQD (%)	Samples	Tests
SONIC GEOPROBE 8140LC (150Hz)		1 1 -		"Soft"; mo organics, longanics, l	ides to sandy with rel, fine to coarse d, greywacke sa to coarse GRA\mottled grey and sittle grey and fine to me. ND, minor fine to bles; orange-browel and sand, as arse GRAVEL, stor silt; brownish-yery dense; grave bove.	ttlling. N) ace fine h minor h, ind as l brown. bunded, iddium. o coarse wn. s above.	00 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		S NO S NO S NO S NO S NO S NO S NO S NO	+23.30 +23.30 +23.30 +21.86 +21.25 +21.25	3 4 		000			0		SPT 1.52 m 11, 6, 6, 4, 6, 8; N = 24 SPT 3.04 m 7, 7, 6, 9, 11, 11; N = 37 SPT 4.56 m 7, 20, 20, 20/70mm; N > 50
E Roce wea	Synla	natio	nne:			Desti	fill.									D-	moul.	
Rela wea TCF SCF RQI Attit	athered athered ative R ak, mod R - Tota R - Soli D - Roo	s Weat (SW), (HW), (cock Stillerately al Core d Core ck Qua defect	rength stron Reco Reco ity De s displ	 etely weathers extremely weg, strong, very very very signation ayed as Dip/D 	ed (MW), highly ad (CW), residually eak, very weak, strong	Gri	entonite out geon Tes ster Strik	st: Flow Type (1st, 2nd (1st, 2nd)	Drill arisings or collapsed hole Filter material pe/Adopted Value)						hand-he confirm 2. No c typically 3. SPT cone us 4. Wate	dinates an eld GPS ar lation. ore loss. R y exceeds hammer e sed unless	nd sub Recove run ler fficien indica uring c	ations based on ject to survey red core sample igth by 5-10%. cy 93.8%; solid ited on log. Irilling influence
Α	ll dir		ions ale 1	in metre:	Contracto McMillan				Core Boxes: 0	Rig/Pla Geopre			McMillan)	Driller:		Logged DDH	- 1	Checked by CFC

APPENDIX B **Machine Borehole Photographs**





				_	
Client / Project:	SUMMERSET GROUP HOLDINGS LTD SUMMERSET RANGIORA DUE DILIGENCE	Hole ID:	BH1		
Project.	MACHINE BOREHOLE CORE PHOTOS	Date:	18-1	9 DEC 2018	
Notes:	Drill sampling method: McMillan SONIC Geoprobe 8140LC (150Hz)			and 2 of 8	
	Markers: start/end of run and SPT split-spoon sample in metres; "CL" indicates core loss in metres; brackets indicate run split between boxes; SPT blows/75mm.			0.00m	
		Depth To (m): 3.96m		3.96m	
Project No.	170743	Interval (m):		3.96m	







Client /	SUMMERSET GROUP HOLDINGS LTD SUMMERSET RANGIORA DUE DILIGENCE	Hole ID:			
Project:	MACHINE BOREHOLE CORE PHOTOS	Date:	18-1	19 DEC 2018	
Notes:	Drill sampling method: McMillan SONIC Geoprobe 8140LC (150Hz)	tes D. (I. f		and 4 of 8	
	Markers: start/end of run and SPT split-spoon sample in metres; "CL" indicates core loss in metres; brackets indicate run split between boxes; SPT blows/75mm.			3.96m	
		Depth To (m): 7.9		7.92m	
Project No.	170743	Interval (m):		3.96m	

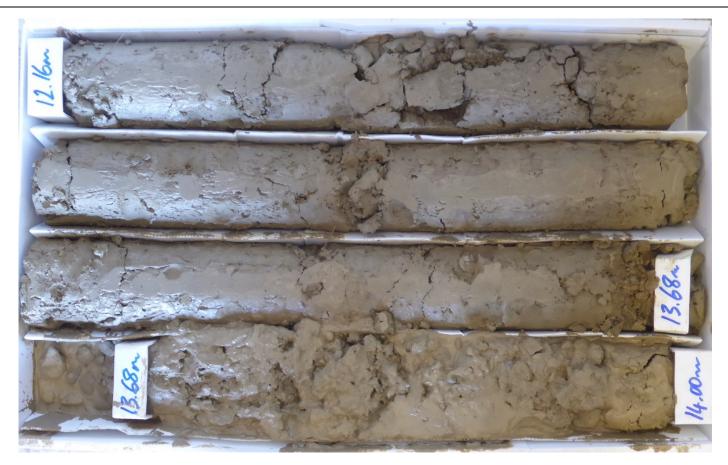






Client /	SUMMERSET GROUP HOLDINGS LTD SUMMERSET RANGIORA DUE DILIGENCE	Hole ID:	BH1		
Project:	MACHINE BOREHOLE CORE PHOTOS	Date:	18-1	19 DEC 2018	
Notes:	Drill sampling method: McMillan SONIC Geoprobe 8140LC (150Hz)	D. att. Same (a)		and 6 of 8	
	Markers: start/end of run and SPT split-spoon sample in metres; "CL" indicates core loss in metres; brackets indicate run split between boxes; SPT blows/75mm.			7.92m	
		Depth To (m):		12.16m	
Project No.	170743	Interval (m):		4.24m	







Client /	SUMMERSET GROUP HOLDINGS LTD SUMMERSET RANGIORA DUE DILIGENCE	Hole ID:		BH1	
Project:	MACHINE BOREHOLE CORE PHOTOS	Date:	18-1	9 DEC 2018	Su
Notes:	Drill sampling method: McMillan SONIC Geoprobe 8140LC (150Hz)	Box No(s).		and 8 of 8	301
	Markers: start/end of run and SPT split-spoon sample in metres; "CL" indicates core loss in metres; brackets indicate run split between boxes; SPT blows/75mm.	Depth from (m):	12.16m	
		Depth To (m)):	15.20m	
Project No.	170743	Interval (m):		3.04m	

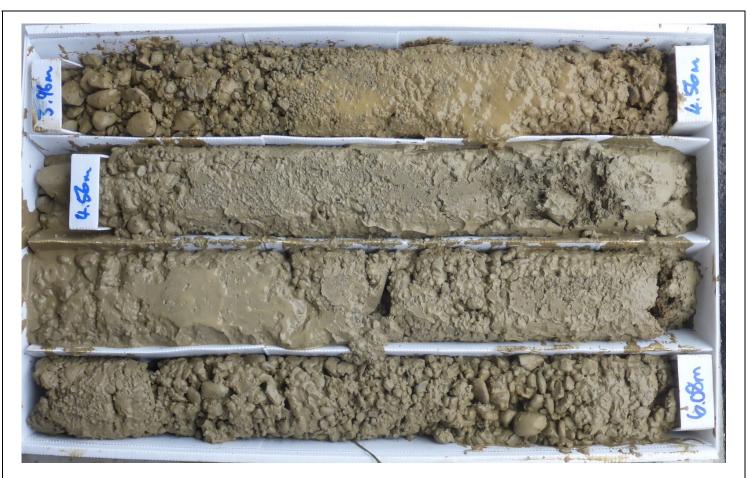






Client / Project:	SUMMERSET GROUP HOLDINGS LTD SUMMERSET RANGIORA DUE DILIGENCE	Hole ID:			
Project.	MACHINE BOREHOLE CORE PHOTOS	Date:	17-1	18 DEC 2018	
Notes:	Drill sampling method: McMillan SONIC Geoprobe 8140LC (150Hz) Markers: start/end of run and SPT split-spoon sample in metres; "CL" indicates core loss in metres; brackets indicate run split between boxes; SPT blows/75mm.	Box No(s).		and 2 of 8	`
		Depth from (m):	0.00m	
		Depth To (m): 3.9		3.96m	
Project No.	170743	Interval (m):		3.96m	







+	1		1		
Client /	SUMMERSET GROUP HOLDINGS LTD	Hole ID:	Hole ID:		
Project:	SUMMERSET RANGIORA DUE DILIGENCE MACHINE BOREHOLE CORE PHOTOS	Date:	17-1	8 DEC 2018	Sum
Notes:	Markers: start/end of run and SPT split-spoon sample in metres: "CL" indicates	Box No(s).	3	and 4 of 8	Juil
		Depth from (m):		3.96m	JR
		Depth To (m)):	7.92m	
Project No.	170743	Interval (m):		3.96m	CON







Client /	SUMMERSET GROUP HOLDINGS LTD SUMMERSET RANGIORA DUE DILIGENCE	Hole ID:	BH2	
Project:	MACHINE BOREHOLE CORE PHOTOS	Date:	17-1	18 DEC 2018
Notes:	Drill sampling method: McMillan SONIC Geoprobe 8140LC (150Hz)			and 6 of 8
	Markers: start/end of run and SPT split-spoon sample in metres; "CL" indicates core loss in metres; brackets indicate run split between boxes; SPT blows/75mm.	Depth from (m):		7.92m
		Depth To (m):		12.16m
Project No.	170743	Interval (m):	4.24m	







Client /	SUMMERSET GROUP HOLDINGS LTD SUMMERSET RANGIORA DUE DILIGENCE	Hole ID:	BH2		
Project:	MACHINE BOREHOLE CORE PHOTOS	Date:	17-1	18 DEC 2018	1
Notes:	Drill sampling method: McMillan SONIC Geoprobe 8140LC (150Hz)			and 8 of 8	
	Markers: start/end of run and SPT split-spoon sample in metres; "CL" indicates core loss in metres; brackets indicate run split between boxes; SPT blows/75mm.	Depth from (m):		12.16m	li
		Depth To (m): 15.20		15.20m	l
Project No.	170743	Interval (m): 3.04		3.04m	







Client /	SUMMERSET GROUP HOLDINGS LTD SUMMERSET RANGIORA DUE DILIGENCE	Hole ID:		ВН3	
Project:	MACHINE BOREHOLE CORE PHOTOS	Date:	18	DEC 2018	Summerset
Notes:	Drill sampling method: McMillan SONIC Geoprobe 8140LC (150Hz)	Box No(s).	1	and 2 of 3	
	Markers: start/end of run and SPT split-spoon sample in metres; "CL" indicates core loss in metres; brackets indicate run split between boxes; SPT blows/75mm.	Depth from (m):	0.00m	RILEY
		Depth To (m)):	3.96m	
Project No.	170743	Interval (m):		3.96m	CONSULTANTS



Client /	SUMMERSET GROUP HOLDINGS LTD SUMMERSET RANGIORA DUE DILIGENCE	Hole ID:	ВН3		
Project:	MACHINE BOREHOLE CORE PHOTOS	Date:	18	DEC 2018	
Notes:	Drill sampling method: McMillan SONIC Geoprobe 8140LC (150Hz)	Box No(s).		3 of 3	
	 Markers: start/end of run and SPT split-spoon sample in metres; "CL" indicates core loss in metres; brackets indicate run split between boxes; SPT blows/75mm. 	Depth from (m):		3.96m	
		Depth To (m)):	6.08m	
Project No.	170743	Interval (m):		2.12m	





Client /	SUMMERSET GROUP HOLDINGS LTD SUMMERSET RANGIORA DUE DILIGENCE	Hole ID:		ВН4				
Project:	MACHINE BOREHOLE CORE PHOTOS	Date:	20	DEC 2018	Summerset			
Notes:	Drill sampling method: McMillan SONIC Geoprobe 8140LC (150Hz)	Box No(s).	1	and 2 of 3				
	 Markers: start/end of run and SPT split-spoon sample in metres; "CL" indicates core loss in metres; brackets indicate run split between boxes; SPT blows/75mm. 	Depth from (m		0.00m	RILEY			
		Depth To (m):	3.96m				
Project No.	170743	Interval (m):		3.96m	CONSULTANTS			



Client /	SUMMERSET GROUP HOLDINGS LTD SUMMERSET RANGIORA DUE DILIGENCE	Hole ID:		ВН4
Project:	MACHINE BOREHOLE CORE PHOTOS	Date:	20	DEC 2018
Notes:	Drill sampling method: McMillan SONIC Geoprobe 8140LC (150Hz)	Box No(s).		3 of 3
	Markers: start/end of run and SPT split-spoon sample in metres; "CL" indicates core loss in metres; brackets indicate run split between boxes; SPT blows/75mm.	Depth from (m):	3.96m
		Depth To (m)	:	6.08m
Project No.	170743	Interval (m):		2.12m







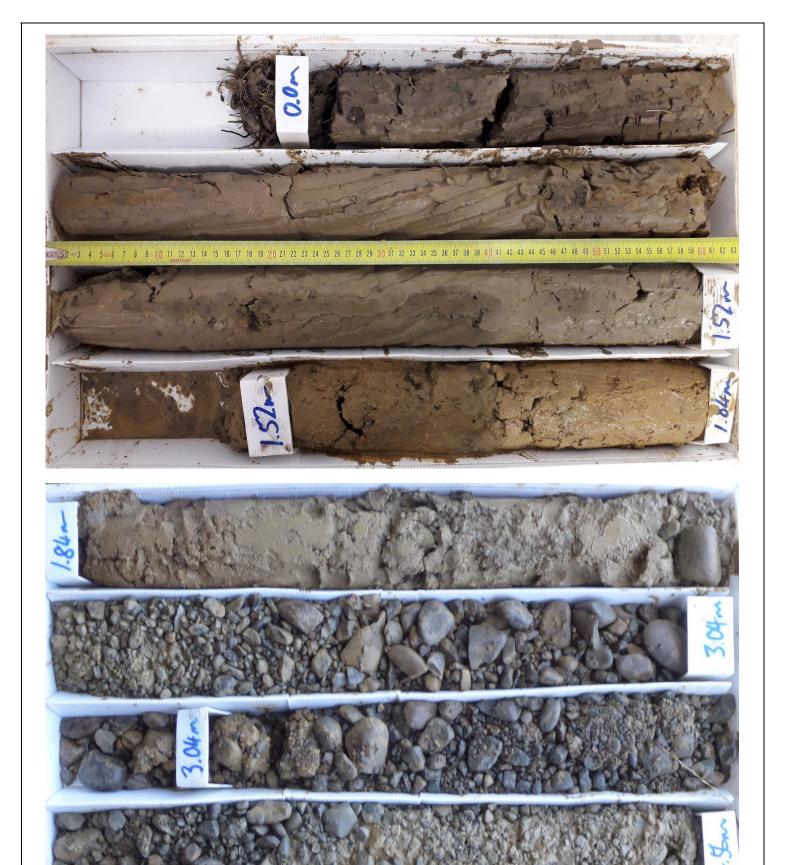
Client / Project:	SUMMERSET GROUP HOLDINGS LTD SUMMERSET RANGIORA DUE DILIGENCE	Hole ID:		BH5
Project.	MACHINE BOREHOLE CORE PHOTOS	Date:	19	DEC 2018
Notes:	Drill sampling method: McMillan SONIC Geoprobe 8140LC (150Hz)	Box No(s).	1	and 2 of 3
	Markers: start/end of run and SPT split-spoon sample in metres; "CL" indicates core loss in metres; brackets indicate run split between boxes; SPT blows/75mm.	Depth from (m):	0.00m
		Depth To (m)	:	3.96m
Project No.	170743	Interval (m):	·	3.96m





Client /	SUMMERSET GROUP HOLDINGS LTD SUMMERSET RANGIORA DUE DILIGENCE	Hole ID:		ВН5
Project:	MACHINE BOREHOLE CORE PHOTOS	Date:	19	DEC 2018
Notes:	Drill sampling method: McMillan SONIC Geoprobe 8140LC (150Hz)	Box No(s).		3 of 3
	Markers: start/end of run and SPT split-spoon sample in metres; "CL" indicates core loss in metres; brackets indicate run split between boxes; SPT blows/75mm.	Depth from (m):	3.96m
		Depth To (m)	:	6.08m
Project No.	170743	Interval (m):		2.12m





Client / Project:	SUMMERSET GROUP HOLDINGS LTD SUMMERSET RANGIORA DUE DILIGENCE	Hole ID:		ВН6	
Project:	MACHINE BOREHOLE CORE PHOTOS	Date:	20	DEC 2018	Summerset
Notes:	Drill sampling method: McMillan SONIC Geoprobe 8140LC (150Hz)	Box No(s).	1	and 2 of 3	
	Markers: start/end of run and SPT split-spoon sample in metres; "CL" indicates core loss in metres; brackets indicate run split between boxes; SPT blows/75mm.	Depth from (m):	0.00m	DRII FY
		Depth To (m)):	4.56m	
Project No.	170743	Interval (m):		4.56m	CONSULTANTS



Client /	SUMMERSET GROUP HOLDINGS LTD SUMMERSET RANGIORA DUE DILIGENCE	Hole ID:		ВН6
Project:	MACHINE BOREHOLE CORE PHOTOS	Date:	20	DEC 2018
Notes:	Drill sampling method: McMillan SONIC Geoprobe 8140LC (150Hz)	Box No(s).		3 of 3
	 Markers: start/end of run and SPT split-spoon sample in metres; "CL" indicates core loss in metres; brackets indicate run split between boxes; SPT blows/75mm. 	Depth from (m):	4.56m
		Depth To (m)	:	6.08m
Project No.	170743	Interval (m):		1.52m



APPENDIX C

Laboratory Test Results

Page 1 of 7 Pages

Reference No: 19/022

Date: 15 January 2019

TEST REPORT – WELHOM DEVELOPMENTS INVESTIGATIONS

Client Details:	Riley Consultants Ltd, P.O. Box 4355, Christchurch	Attention:	A. van Dusschoten
Job Description:	Welhom Developments Investigations, cnr Townsend and	South Belt Road, Rang	giora
Sample Description:	SILT with minor gravel and minor sand	Client Order No:	170743
Sample Source:	HP1 @ 0.3m - 0.5m	Sample Label No:	N/A
Date & Time Sampled:	Unknown	Sampled By:	Unknown
Sample Method:	Bulk Disturbed *	Date Received:	9-Jan-19

	986, Test 2.8.1)	4				,	0.075	0.212	0.60	236	9.50	19.0 26.5 37.5	150 150 150 150	200
Test Sieve (mm)	% Passing (by mass)		100											
63.0			90				-	-	4	•			Hill	
37.5			80				-			. []]				
26.5	100										HF	·1 @	0.3m	- 0.5m
19.0	99		70	Ш							1	TŤ		
13.2	96	mass)	60						Ш.					
9.50	95	(a)	50											
4.75	93	% Passing (by mass)	30											
2.36	92	% Ps	40						Ш					
2.00	92		30			Ш								
1.18	92		20											
0.60	91		20											
0.30	90		10				111							
0.212	89		0											
0.150	88		0,001 CLAY	Fine	0,01 Medium	Course	0.1 Fine	Medium	Course	Fine	10 Medium	Conrse	COBBLES	BOULDERS
0.075	85				SILT			SAND			GRAVEL			
0.063	84		The san	ple was	s received i	n a natur	al state. T	he perce	ntage pass	ing the t	53μm test .	sieve wa:	s obtained	by differenc

WATER CONTEN	T RESULT - NZS 4402:1986, Test 2.1	
Water Content: ("All In" As Received)	29.6 %	
Note: The sample was received in a natural state.		

Note:

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Tested By: L.T. Smith

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Checked By: emples





Page 2 of 7 Pages

Reference No: 19/022

Date: 15 January 2019

TEST REPORT - WELHOM DEVELOPMENTS INVESTIGATIONS

Client Details:	Riley Consultants Ltd, P.O. Box 4355, Christchurch	Attention:	A. van Dusschoten
Job Description:	Welhom Developments Investigations, cnr Townsend and	South Belt Road, Rang	iora
Sample Description:	SILT with minor gravel and minor sand	Client Order No:	170743
Sample Source:	HP1 @ 0.3m to 0.5m	Sample Label No:	N/A
Date & Time Sampled:	Unknown	Sampled By:	Unknown
Sample Method:	Bulk Disturbed *	Date Received:	9-Jan-19

8/ D		1.48				10%		5%		0% A	r Volds I	ine		
% Retained (+19.0mm Fraction)	1.0 %	1.40				1		1		\				
Water Content: ("All In" As Received)	29.6 %	1.47		Q			0000		V.					
Maximum Dry Density: (-19.0mm Fraction)	1.47 t/m³	1.46				Park		1	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \		\setminus			
Optimum Water Content: (-19.0mm Fraction)	25.0 %	Density (Vm³)			0									
otes:		, Dens						+	9		+			
• The sample was received state.	in a natural	rn Ç					1							
The material tested in the Compaction test was the a 19.0mm test sieve. The air voids lines were	fraction passing	1,42					1			i ii b				
an assumed solid density		1.41												-
		1,40	19	20 21	22	23 24	1 15	NK 1	7 28 2	9 30	31 32	33	14 35	
		1.00	(MARK)		0 0			ator Cor	itent (%)	F. 500	240 25	- 30- 1	H 35	

Note:

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Page 3 of 7 Pages

Reference No: 19/022

Date: 15 January 2019

TEST REPORT – WELHOM DEVELOPMENTS INVESTIGATIONS

Client Details:	Riley Consultants Ltd, P.O. Box 4355, Christchurch	Att	ention:	A. van Dusschoten
Job Description:	Welhom Developments Investigations, cnr Townsend and	South Belt Ro	ad, Rangi	ora
Sample Description:	SILT with minor sand and trace of gravel	Client Order	· No:	170743
Sample Source:	HP2 @ 0.3m - 0.5m	Sample Labo	el No:	N/A
Date & Time Sampled:	Unknown	Sampled By:		Unknown
Sample Method:	Bulk Disturbed *	Date Receive	d:	9-Jan-19

	IZE ANALYSIS 986, Test 2.8.1)								0.063	150	0.212	2	09'0	1.18	2.36	4.75		3.2	9.0	5.7	20.0	100	000			
Test Sieve	% Passing		100		-	ш	_		33	6	3 6	11		_	40	7		6 1	- ^	(A)	100		~	Τ1	111	n
(mm)	(by mass)	-							1	-	مسنام	-				П					Ш				Ш	
53.0		1	90		П			Ш	T P			11	Ш		П	Н	Ħf		t	П	Ħ	İ	П	#	Ħ	Ħ
37.5			80					Ш	Ш				Ш			Ш	Ш							Ш	Ш	
26.5																		HF	2	(a)	0.:	3m -	- 0	.51	m]
19.0			70 -		Ħ			Н	Ш		Ħ	Ħ	Ħ		П	Ħ	T			Ť	III			T	Ш	f
13.2		mass)	60						Ш			+		-	Н	H	Щ.		H	Н	Ш	-	Н	#	Щ	H.
9.50		ş	50														Ш			7						ı
4.75	100	% Passing (by							Ш										ľ					П		ı
2.36	99	\\ \%	40 -		+			Н	Ħ		H	Ħ	Ш		H	H	Ш			H	Ħ			\forall	Н	
2.00	99		30 -		-			Ш	Ш		Н	4	Ш		Н	Щ	Щ				Ш		Ц	Щ	Ш	
1.18	98		20 -												Ш					Ш	Ш					
0.60	97		203													П				П	П			П		
0.30	95		10	\vdash	+			\vdash			H	\dagger	Ш		H	+	H		H	+	+		\forall	+	Н	
0.212	94		0										Ш		Ц	Ш								Ш	Ш	
0.150	94	1	0.0	CLAY _	Fine	0.0 Med	dian.	Coarse		0.1 Fine	Me	dium	-	Oarse	Fi	oe .	,	10 editan	C	oarse	_	100	no	VIII C		1000
0.075	91	1				SI						ND						VAET				BBLES		ULDI		_
0.063	90	1	Th	e samp	ole was	s recei	ved ii	n a nati	ural s	tate. I	he p	ercei	ntag	e pas	sing I	he o	ί3μ <i>ι</i> .	n test	siev	e wa:	s ob	tained i	by d	iffer	enc	e.
3,000	70	1_																								

WATER CONTENT RESULT - NZS 4402:1986, Test 2.1						
Water Content: ("All In" As Received)	27.8 %					
Note: The sample was received in a natural state.						

Note:

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Page 4 of 7 Pages

Reference No: 19/022

Date: 15 January 2019

TEST REPORT - WELHOM DEVELOPMENTS INVESTIGATIONS

Client Details:	Riley Consultants Ltd, P.O. Box 4355, Christchurch	Attention:	A. van Dusschoten
Job Description:	Welhom Developments Investigations, cnr Townsend and	South Belt Road, Ran	giora
Sample Description:	Clayey SILT with trace of sand	Client Order No:	170743
Sample Source:	HP3 @ 0.3m - 0.5m	Sample Label No:	N/A
Date & Time Sampled:	Unknown	Sampled By:	Unknown
Sample Method:	Bulk Disturbed *	Date Received:	9-Jan-19

											_		_	_			_					_				_	
PARTICLE SIZ (NZS 4402:1986, T			100	6							0.063	0.150	0.212) (1)	09.0	1.18	2.00	4.75		13.2	19.0	37.5	63.0	106	200		
Test Sieve (mm)	% Passing (by mass)		90							0	-0-		-0-														
37.5]	-			Ш	Ш		1					Ш				П			П	П				Ш	
26.5			80		Ш	Ш	Щ	9	4	Ш	Ш				Ш			Ш	Ш		Ш	Ш	Ш	1/ 1	1	Ш	Ш
19.0					Ш	Ш	lii	1							Ш					НЕ	2		0	3m	· -	0.5	m
13.2		j	70	1	Н	4	Ш	/_	\perp	Ш	Ш		ш	Ш	Ш			4	ļĻ,				111		-	U.S	-
9.50					Ш	Ш	И			Ш	Ш			Ш	Ш		П	Ш	HI		Н	Ш			1	Ш	
4.75		1855	60	-	Н	1	7	-	\vdash	Ш	-		Н	Ш	Щ	_	11	4	Ш		Н	Ш	11,		4	Н	1411
2.36		% Passing (by mass)			П	1									Ш				Ш			П	Ш				
2.00] <u></u>	50	+-	+	4	1111	-	+			-	-	Н	- -	-		++	1	-	Н	++	114	-	+	Н	
1.18	100	issi			1			l						Ш	Ш		Ш	П	Ш		Ш	Ш		1			
0.60	99	% P.	40	+	$^{\prime}$	+	Ш		Н		₩	-	+	Н	₩		+	++	Ш	-	H	++	Hi	-	+	H	-144
0.30	98	l °`		"	Н	11	Ш						П	Ш	Ш			Ш	Ш		Н		Ш			Ш	
0.212	98		30	1	Ħ	++	1111		Н	+	Ħ	H	Н	+	+++		+	+	ш		H	++	₩		+	H	1111
0.150	98					Ш	Ш				Ш		П		Ш				Ш		П	Ш	Ш				
0.075	97		20		Ħ	Ħ	Ш		П	П	Ш		П	Ħ	Ħf		Ħ	Ħ	Ш		Ħ	#	#		$^{+}$	Ħ	1111
0.063	96		10	L	Ш	Ш	Ш				1				Ш		Ш			ď.	Ш	Ш	Ш				
Fraction Size	Interpolated % Passing		0																								
60 μm	96		0	001		ine	-	01 ediun	To	oarse	-). L Fine	1	edium		1 cause	Τ.		1	0 dian	La		T	100			1000
20 µm	85			CLAY	-	uie .		ELT	1	oarse		rnie		AND	1.5	onse	r	ine	_	AVEL	Co	arse	cc	BBLES	SE	ЮИС	ERS
6 µт	60																									diffe	rence.
2 µm	40			he pH	-	-			-								•	•					•				
PARTI	CLE SIZE ANAL	YSI	S &	HYI	RC	MI	CTI	ER A	NA	\L\	(SIS	S RI	ESU	LT	S - :	NZS	44(2:19	986	, Te	st 2	.8.1	&	2.8.	4		
Description	Fraction Ran			%	Wit	hin	Ra	nge				escr					Fra	actio	on I	Rang	ge		0,	6 W	ith:	in R	ange
Coarse Gravel	60.0mm to 20.0											ine					200	μm	to	60 µ	ım				2	2	
Medium Gravel	20.0mm to 6.0		_			\E						oar						_		20 д					_	1	
Fine Gravel	6.0mm to 2.00		-			۰						ediu				\perp				6 µr						5	
Coarse Sand	2.00mm to 600					1			_			Fine		t			6	_		μn	1					0	
Medium Sand	600 µm to 200	μm	\perp			1	_					Cl	ay					< 2	2 μι	n					4	0	

WATER CONTENT & PLASTICITY INDEX RESULTS - NZS 4402:1986, Test 2.1, 2.2, 2.3 & 2.4							
Water Content: ("All In" As Received) 30.1 %							
Liquid Limit: (LL)	50						
Plastic Limit: (PL)	30						
Plasticity Index: (PI)	20						
Note: The sample was received in a natural state. The plasticity inde	x material tested was whole soil.						

Note:

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Tests indicated as Not Accredited are outside the scope of the laboratory's accreditation



Date: 10 to 15-Jan-19



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Reference No: 19/022

Date: 15 January 2019

TEST REPORT – WELHOM DEVELOPMENTS INVESTIGATIONS

Client Details:	Riley Consultants Ltd, P.O. Box 4355, Christchurch		Attention:	A. van Dusschoten
Job Description:	Welhom Developments Investigations, cnr Townsend and	South Belt	Road, Rangi	ora
Sample Description:	Clayey SILT with trace of sand	Client Or	der No:	170743
Sample Source:	HP3 @ 0.3m - 0.5m	Sample L	abel No:	N/A
Date & Time Sampled:	Unknown	Sampled 1	By:	Unknown
Sample Method:	Bulk Disturbed *	Date Rece	ived:	9-Jan-19

0/ D-4-!I		1.51	10%	5%		0% Air Voids Line	
% Retained (+19.0mm Fraction)	0.0 %						
Water Content: ("All In" As Received)	30.1 %	1,50		8	5		
Maximum Dry Density:	1.50 t/m ³	1.48					
Optimum Water Content:	27.0 %	(日) 1.47			1	. \	
Notes:		Dry. Density (1/m²)		1		\	
 The sample was receive state. 	d in a natural	1.45					
 The material tested in the Compaction test was wh 		1,44			Ì		
 The air voids lines were an assumed solid densit 		1,43				\ \	
		1,42					
		1.41	22 23	24 25 26	27 28	29 30 31	32 33 34
				V	Valer Content (

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Reference No: 19/022

Date: 15 January 2019

TEST REPORT – WELHOM DEVELOPMENTS INVESTIGATIONS

Client Details:	Riley Consultants Ltd, P.O. Box 4355, Christchurch	Attention:	A. van Dusschoten						
Job Description:	elhom Developments Investigations, cnr Townsend and South Belt Road, Rangiora								
Sample Description:	Clayey SILT with minor sand	Client Order No:	170743						
Sample Source:	HP4 @ 0.3m - 0.5m	Sample Label No:	N/A						
Date & Time Sampled:	Unknown	Sampled By:	Unknown						
Sample Method:	Bulk Disturbed *	Date Received:	9-Jan-19						

WATER CONTENT & PLASTICITY INDEX RESULTS - NZS 4402:1986, Test 2.1, 2.2, 2.3 & 2.4								
Water Content: ("All In" As Received) 27.9 %								
Liquid Limit: (LL)	47							
Plastic Limit: (PL)	31							
Plasticity Index: (PI)	16							
Note: The sample was received in a natural state. The plasticity index me	nterial tested was whole soil.							

Note:

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Date: 15 January 2019

TEST REPORT – WELHOM DEVELOPMENTS INVESTIGATIONS

Client Details:	Riley Consultants Ltd, P.O. Box 4355, Christchurch	Attention:	A. van Dusschoten						
Job Description:	Velhom Developments Investigations, cnr Townsend and South Belt Road, Rangiora								
Sample Description:	Clayey SILT with minor sand	Client Order No:	170743						
Sample Source:	HP5 @ 0.3m - 0.5m	Sample Label No:	N/A						
Date & Time Sampled:	Unknown	Sampled By:	Unknown						
Sample Method:	Bulk Disturbed *	Date Received:	9-Jan-19						

% Retained		1.60	10%		5%	0% Air Voids Line
(+19.0mm Fraction)	0.0 %	1.59				
Water Content: ("All In" As Received)	24.1 %	1.59			1	
Maximum Dry Density:	1.58 t/m³	1,57			0-	
Optimum Water Content:	24.5 %	Density (t/m³)				
lotes:		1,55				
The sample was received state.	d in a natural	D 1'84				
The material tested in the Compaction test was wh	ole soil.	1.53				
 The air voids lines were an assumed solid density 		1.52				
		1,51				
		1.50	19 20	21 22	23	24 25 26 27 28 29
					Wate	er Content (%)

WATER CONTENT & PLASTICITY INDEX RESULTS - NZS 4402:1986, Test 2.1, 2.2, 2.3 & 2.4								
Water Content: ("All In" As Received) 24.1 %								
Liquid Limit: (LL)	44							
Plastic Limit: (PL)	27							
Plasticity Index: (PI)	17							
Note: The sample was received in a natural state. The plasticity index ma	terial tested was whole soil.							

Note:

- Information contained in this report which is Not IANZ Accredited relates to the sample descriptions based on NZ Geotechnical Society Guidelines 2005, sample method * and sampling.
- . This report may not be reproduced except in full.

Tested By:

L.T. Smith

Date: 10 to 15-Jan-19

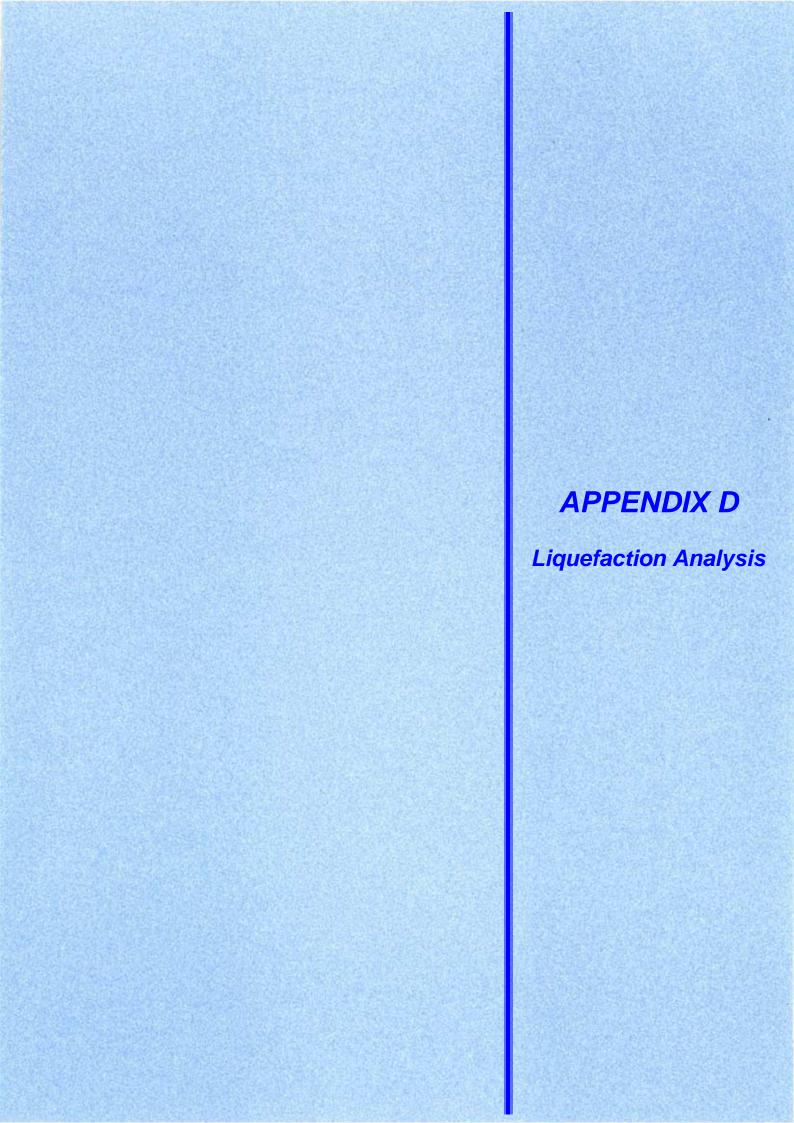
Checked By:

d By: emples

Approved Signatory

A.P. Julius Laboratory Manager

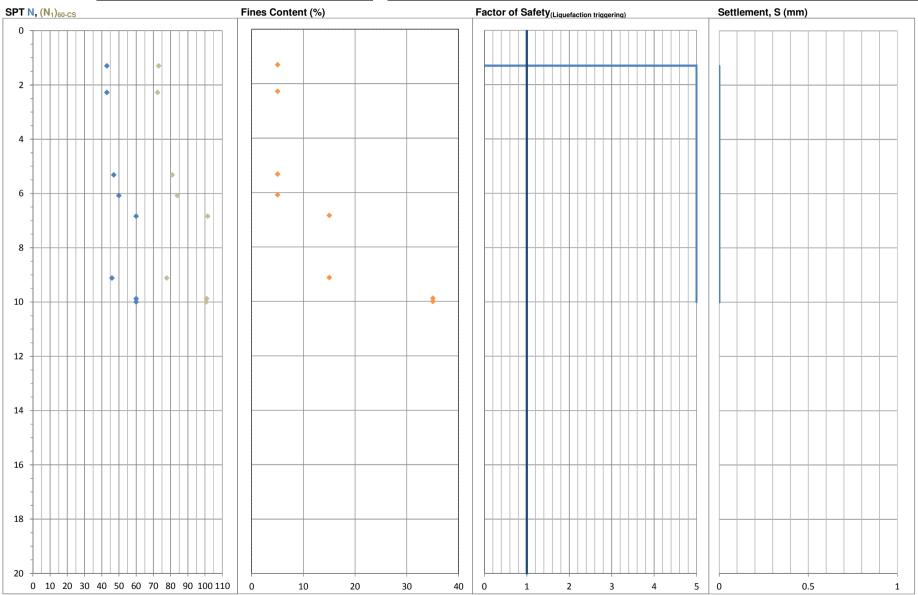






Test: BH1
Project: Summerset Rangiora File: 170743 Water table depth: 1.3 m

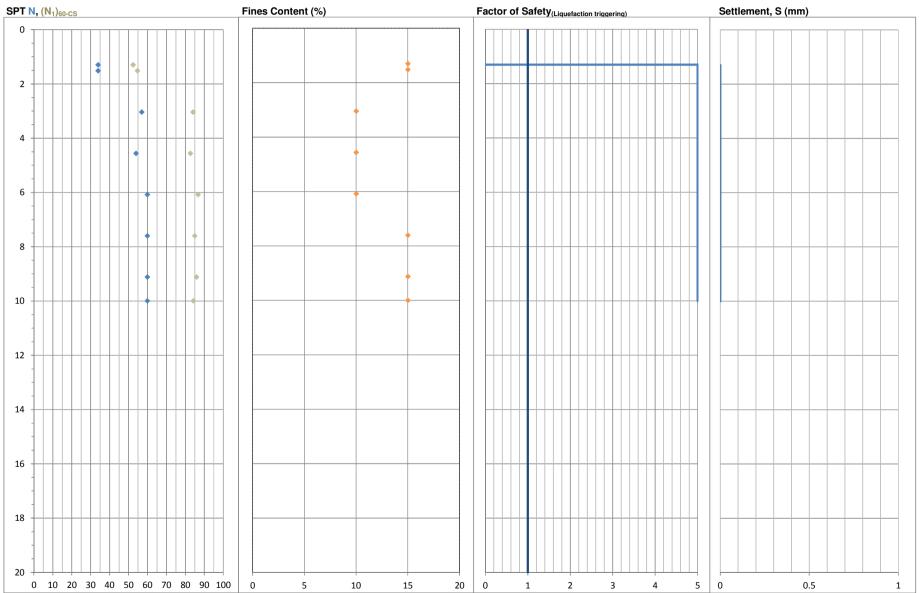
SLS1 Mw 7.5 PGA 0.13 g S 0 mm S_{Index} 0 mm LSN 0 LSN SLS2 Mw 6 PGA 0.19 g S 0 SIndex 0 mm 0 mm **ULS** Mw 7.5 S S_{Index} 0 mm LSN 0 PGA 0.35 g 0 mm





Test: 170743
Project: Summerset Rangiora File: BH2 Water table depth: 1.3 m

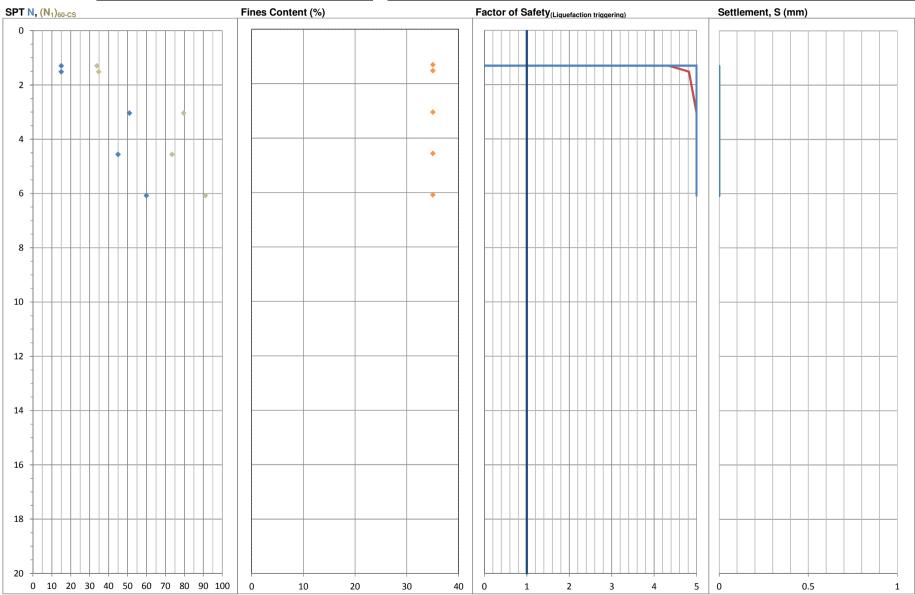
SLS1 Mw 7.5 PGA 0.13 g S 0 mm S_{Index} 0 mm LSN 0 S LSN SLS2 Mw 6 PGA 0.19 g 0 S_{Index} 0 mm 0 mm **ULS** Mw 7.5 S S_{Index} 0 mm LSN 0 PGA 0.35 g 0 mm





Test: BH3
Project: Summerset Rangiora File: 170743 Water table depth: 1.3 m

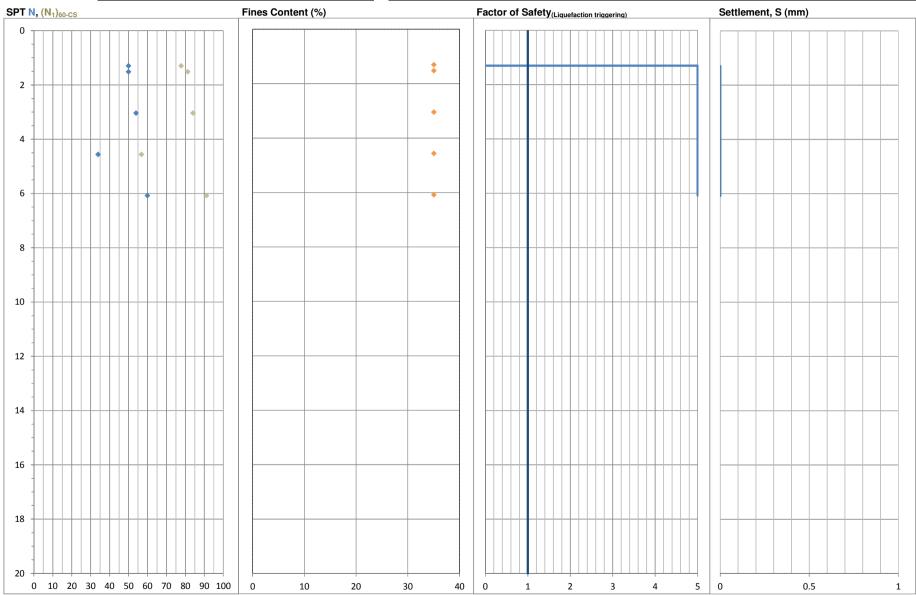
SLS1 Mw 7.5 PGA 0.13 g S 0 mm S_{Index} 0 mm LSN 0 LSN SLS2 Mw 6 PGA 0.19 g S 0 S_{Index} 0 mm 0 mm **ULS** Mw 7.5 S S_{Index} 0 mm LSN 0 PGA 0.35 g 0 mm





Test: BH4
Project: Summerset Rangiora File: 170743 Water table depth: 1.3 m

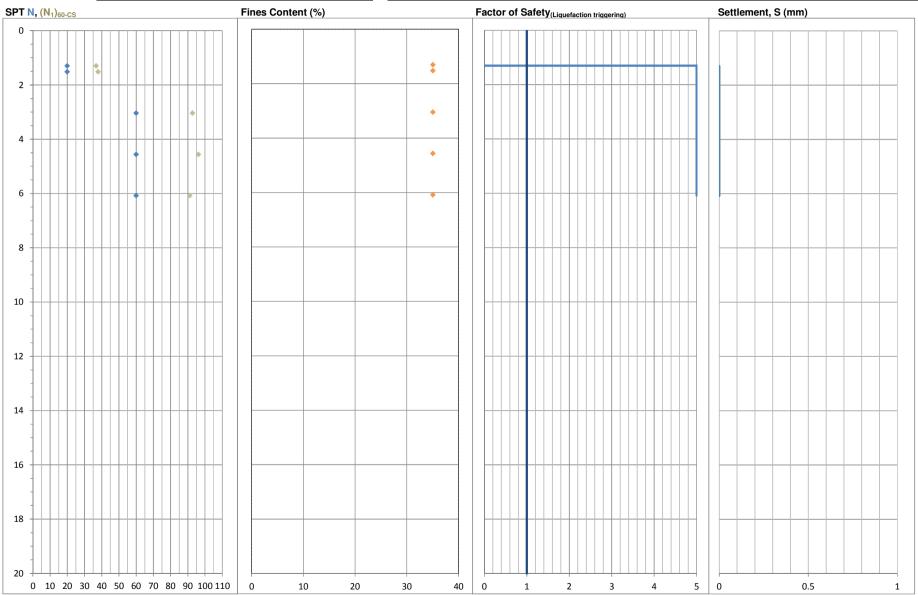
SLS1 Mw 7.5 PGA 0.13 g S 0 mm S_{Index} 0 mm LSN 0 S LSN SLS2 Mw 6 PGA 0.19 g 0 S_{Index} 0 mm 0 mm **ULS** Mw 7.5 S S_{Index} 0 mm LSN 0 PGA 0.35 g 0 mm





Test: BH5
Project: Summerset Rangiora File: 170743 Water table depth: 1.3 m

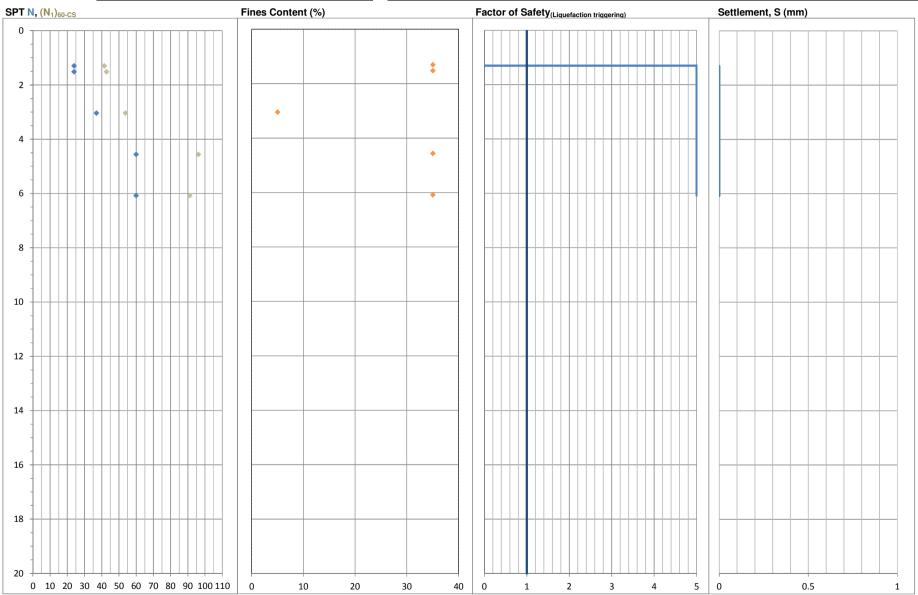
SLS1 Mw 7.5 PGA 0.13 g S 0 mm S_{Index} 0 mm LSN 0 S LSN SLS2 Mw 6 PGA 0.19 g 0 S_{Index} 0 mm 0 mm **ULS** Mw 7.5 S S_{Index} 0 mm LSN 0 PGA 0.35 g 0 mm

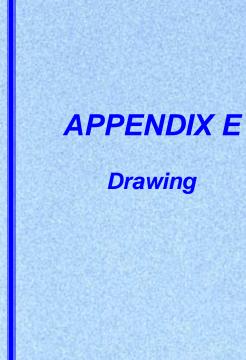




Test: BH6
Project: Summerset Rangiora File: 170743 Water table depth: 1.3 m

SLS1 Mw 7.5 PGA 0.13 g S 0 mm S_{Index} 0 mm LSN 0 LSN SLS2 Mw 6 PGA 0.19 g S 0 SIndex 0 mm 0 mm **ULS** Mw 7.5 S S_{Index} 0 mm LSN 0 PGA 0.35 g 0 mm







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					DESIGN	DES CHECK	APPROVED FOR ISSUE	_
					AVD	LAK		İ
					DRAWN	CAD CHECK	T. SMITH	ı
	2	07.08.19	SITE HATCH	LS	FY	RBT		i
	1	31.07.19	REPORT ISSUE	FY	DATE D	RAWN	ISSUE DATE	i
l	RFV	DATE	ISSUF	BY	20.11.1	18	7 / 8 / 19	



CLIENT	SUMMERSET VILLAGES (RANGIORA) LIMITED
ADDRESS	104 TOWNSEND ROAD & 141 SOUTH BELT, RANGIORA
PROJECT	SUMMERSET RANGIORA
SHEET TITLE	GEOTECHNICAL INVESTIGATION LOCATION PLAN

FOR C	CNSTRUCTION
	CADFILE 170743-1

4	CADFILE			
	170743-1			
ACEN7	SCALE (A3)	ORIG.	SHEET	SIZE
ACENZ	1:2000	A3		
SO 9001	DRAWING No.	REV.		
√GCS	170743-1		2	2

APPENDIX F Outline Development Plan

