RILEY CONSULTANTS

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

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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

Contents

Appendices

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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 Bgl (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	x	x	x		
Hydrometer			x		
Atterberg Limits			x	x	x
Compaction	x		x		x

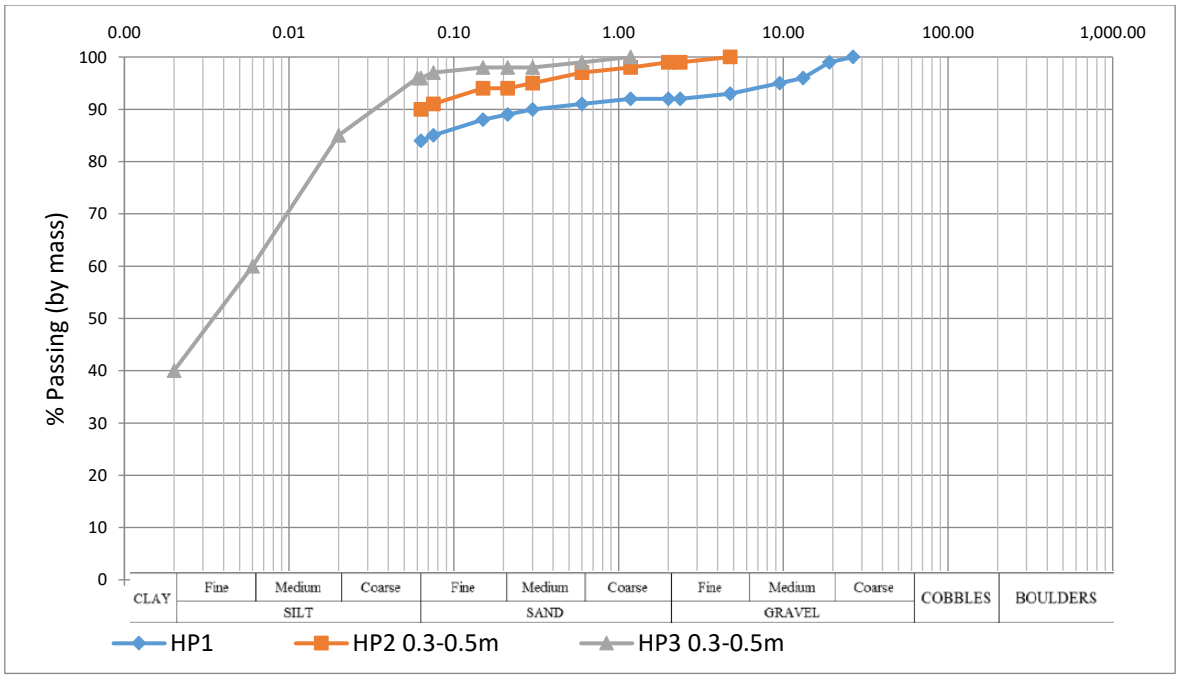
7.1 Particle Size Distribution or Fines Content

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

Pit ID	Sample			Particle Size Distribution (PSD) Proportions (%)			Material Description Based on PSD Results
	Depth Bgl (m)		Approximate Mass (kg)				
	From	To		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

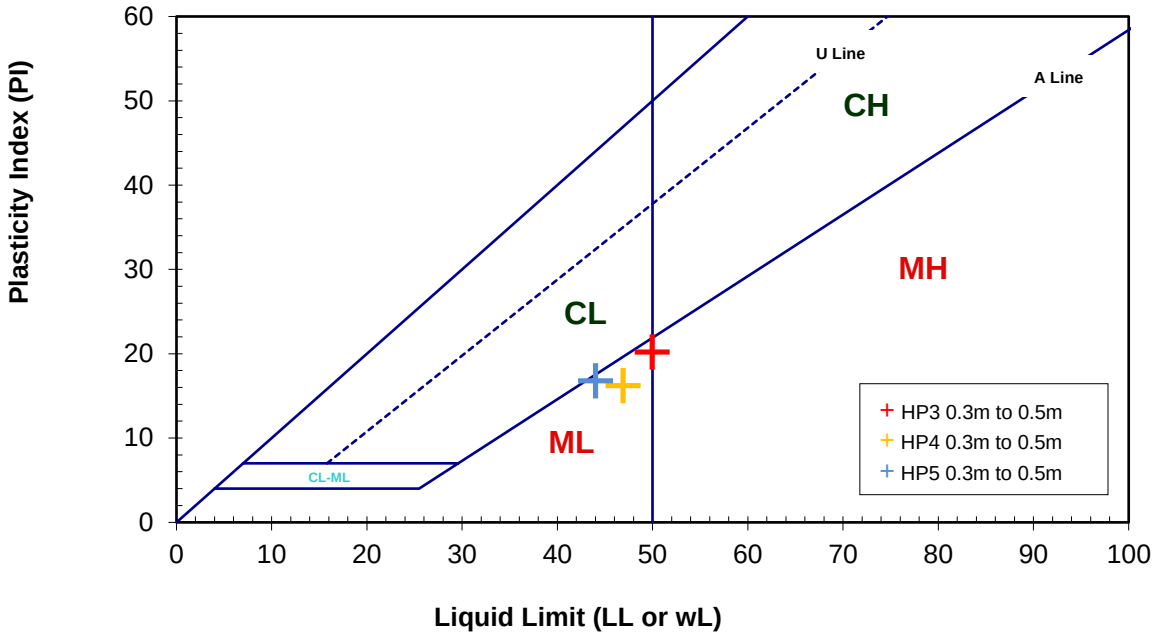


As shown by the results, the fines content (FC) of the soil is between 84% to 96% between 0.3m to 0.5m bgl.

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.

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/m^3)	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/m^3 and a friction angle of 32° is recommended for the silt/clay mixture.
- A unit weight of 21kN/m^3 and a friction angle of 35° is recommended for the medium dense silty/sandy gravel.
- A unit weight of 22kN/m^3 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)
Alluvium	Silt/clay mixture	ML	2	-	Loose	110
	Silty/sandy gravel	GM	-	20	Medium Dense	-
	Silty/sandy gravel	GM	-	50+	Very Dense	-

Table 6: Assumed Values for Design

Material		Density γ (kN/m^3)	Cohesion c' (kPa)	Friction Angle Φ' (deg)
Topsoil	Silt with trace clay	-	-	-
Alluvium	Silt/clay mixture	18	0	32
	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:
1) 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.
3) 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
BH1	1.23m	19 December 2018
	1.26m	21 December 2018
	1.28m	08 January 2019
	1.30m	02 August 2019
BH3	1.41m	20 December 2018
	1.71m	21 December 2018
	1.41m	08 January 2019
	1.57m	02 August 2019
BH4	1.71m	20 December 2018
	1.76m	21 December 2018
	1.72m	08 January 2019
	1.82m	02 August 2019
BH5	1.34m	19 December 2018
	1.37m	21 December 2018
	1.35m	08 January 2019
	1.44m	02 August 2019
BH6	0.88m	20 December 2018
	0.91m	21 December 2018
	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

RILEY CONSULTANTS

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

Auckland:
4 Fred Thomas Drive, Takapuna, 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


SILTSTONE


MUDSTONE


LIMESTONE


BASALT


TUFF


IGNIMBRITE


GREYWACKE

SOIL STRENGTH CLASSIFICATION

FINE GRAINED COHESIVE SOILS

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	UNCONFINED UNIAXIAL COMPRESSIVE STRENGTH (MPa)
Extremely weak	(EW)	Indented by thumbnail.	< 1
Very weak	(VW)	Crumbles under firm blows with point of geological hammer. Can be peeled with pocket knife.	1 – 5
Weak	(W)	Difficult to peel with pocket knife.	5 – 20
Moderately strong	(MS)	Cannot be scraped or peeled with pocket knife.	20 – 50
Strong	(S)	More than one blow of geological hammer to fracture.	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


UNDISTURBED


MACHINE AUGER DISTURBED

D
HAND AUGER DISTURBED


STANDARD PENETRATION TEST (solid cone)


STANDARD PENETRATION TEST (hollow cone)

DRILLING METHOD

OB	OPEN BARREL
TT	TRIPLE TUBE
WB	WASH BORE
SH	UNDISTURBED SHELBY TUBE
RC	ROCK CORE
SPT	STANDARD PENETRATION TEST

FIELD TESTS

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

RILEY CONSULTANTS
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HAND AUGER LOG

Project:	Location:	Hole position:	No.:
Summerset Rangiora Due Diligence	Townsend Rd/South Belt, Rangiora	Refer to Site Plan.	HA01

Job No.:	Start Date: / Finish Date:	Ground Level (m LINZ):	Co-Ordinates (NZTM2000):
170743	18-12-18 / 18-12-18	24.80	E 1,566,258.7 N 5,203,556.2

Client:	Hole Depth:	Sheet:
Welhom Developments Ltd	1.70 m	1 of 1

Elevation (m LINZ)	Depth (m)	Geological Unit	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)
+24.80			
		(TOPSOIL)	SILT, trace clay, organics; dark brown. "Soft to very soft"; dry to moist; low plasticity; organics, rootlets. (TOPSOIL)
+24.50	0.30		
		(YALDHURST MEMBER, SPRINGSTON FORMATION)	SILT, minor to some clay, trace sand; light grey and orange mottling. Soft; moist; low plasticity; sand, fine to medium. (YALDHURST MEMBER, SPRINGSTON FORMATION) 0.45m Grades to 'firm'. 0.50m Light grey with orange mottling. 0.60m Grades to very stiff. 1.00m Grades to hard.
+23.30	1.50		
			Sandy fine to medium GRAVEL, trace clay. Dense; saturated; gravel, subrounded; greywacke; sand, fine to medium. 1.60m GRades to 'very dense'.
+23.10	1.70		
			EOH @ 1.70 m

Soil Shear Strength (kPa): 50 100 150 200
Scala Penetrometer (blows / 50 mm): 3 6 9 12 15
Groundwater: 1.00m, 1.70m
Soil Moisture
Samples: ES0.1 NOV; ES0.5 NOV; ES0.9 NOV
Tests: No. 1 1, 0, 1, 1, 1, 0, 1, 1, 1, 1, 2, 1, 2, 1, 1, 2, 1, 1, 1, 2; V= 184 R= 46; No. 2 1, 2, 2, 2, 2, 2, 2, 1, 4, 4, 7, 9, 20; V= 230
Instrument/ Backfill

Explanations:

- Scala Penetrometer - blows/50mm
- Permeability Test
- Schmidt Hammer
- Insitu Vane Shear Strength (kPa) V=Peak, R=Residual, UTP=Unable to penetrate
- Small Disturbed Sample
- Large Disturbed Sample
- U100 Undisturbed Sample
- Water Strike (1st, 2nd ...)
- Water Rise (1st, 2nd ...) and Rise Time (minutes)

Soil Moisture:
D = dry; M = moist; W = wet; S = saturated

GROUNDWATER

- [X] Not Encountered
- [ ] Slow Seep (depth)
- [ ] Rapid Inflow (depth)

HOLE TERMINATED DUE TO:
[ ] Target depth [X] Refusal [ ] Collapse

Remarks

1. Coordinates and elevations based on hand-held GPS and subject to survey confirmation.
2. Strength terms for cohesive soil layers are based on shear vane test where available. Where no shear vane, cohesive soil strength terms are based on correlation with Scala test results and indicated in quotation marks.

All dimensions in metres Scale 1:10	Contractor:	Rig/Plant Used: Hand Auger 70 mm	Logged by: RBW	Checked by: CFC

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HAND AUGER LOG

Project:	Location:	Hole position:	No.:
Summerset Rangiora Due Diligence	Townsend Rd/South Belt, Rangiora	Refer to Site Plan.	HA02

Job No.:	Start Date: / Finish Date:	Ground Level (m LINZ):	Co-Ordinates (NZTM2000):
170743	17-12-18 / 17-12-18	25.80	E 1,566,352.6 N 5,203,576.7

Client:	Hole Depth:	Sheet:
Welhom Developments Ltd	0.70 m	1 of 1

Elevation (m LINZ)	Depth (m)	Geological Unit	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)
+25.80			
		(TOPSOIL)	SILT, trace clay, organics; dark brown. "Stiff"; dry to moist; low plasticity; organics, rootlets. (TOPSOIL)
			0.15m Grades to include minor fine gravel, subrounded, greywacke.
+25.55	0.25		
		(YALDHURST MEMBER, SPRINGSTON FORMATION)	SILT, minor to some clay, trace sand; light grey and orange mottling. Firm to stiff; moist; low plasticity; sand, fine to medium. (YALDHURST MEMBER, SPRINGSTON FORMATION)
			0.45m Grades to 'stiff'.
			0.60m Auger grating on inferred gravel (none recovered).
+25.10	0.70		
			EOH @ 0.70 m
	1		

Legend

Soil Shear Strength (kPa): 50 100 150 200

Scala Penetrometer (blows / 50 mm): 3 6 9 12 15

0.35m

Groundwater

Soil Moisture

Samples: ES0.1 NOV; ES0.5 NOV

Tests: No. 1 3, 2, 2, 2, 2, 2, 1, 2, 2, 3, 2, 3, 2, 3, 12, 13, 14; V= 230

Instrument/ Backfill

Explanations:

- Scala Penetrometer - blows/50mm
- Permeability Test
- Schmidt Hammer
- Insitu Vane Shear Strength (kPa) V=Peak, R=Residual, UTP=Unable to penetrate
- Small Disturbed Sample
- Large Disturbed Sample
- U100 Undisturbed Sample
- Water Strike (1st, 2nd ...)
- Water Rise (1st, 2nd ...) and Rise Time (minutes)

Soil Moisture: D = dry; M = moist; W = wet; S = saturated

GROUNDWATER

- [X] Not Encountered
- [ ] Slow Seep (depth)
- [ ] Rapid Inflow (depth)

HOLE TERMINATED DUE TO:

- [ ] Target depth
- [X] Refusal
- [ ] Collapse

Remarks

1. Coordinates and elevations based on hand-held GPS and subject to survey confirmation.
2. Strength terms for cohesive soil layers are based on shear vane test where available. Where no shear vane, cohesive soil strength terms are based on correlation with Scala test results and indicated in quotation marks.

All dimensions in metres Scale 1:10	Contractor:	Rig/Plant Used: Hand Auger 70 mm	Logged by: AvD	Checked by: CFC

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Fax: +643 3794403

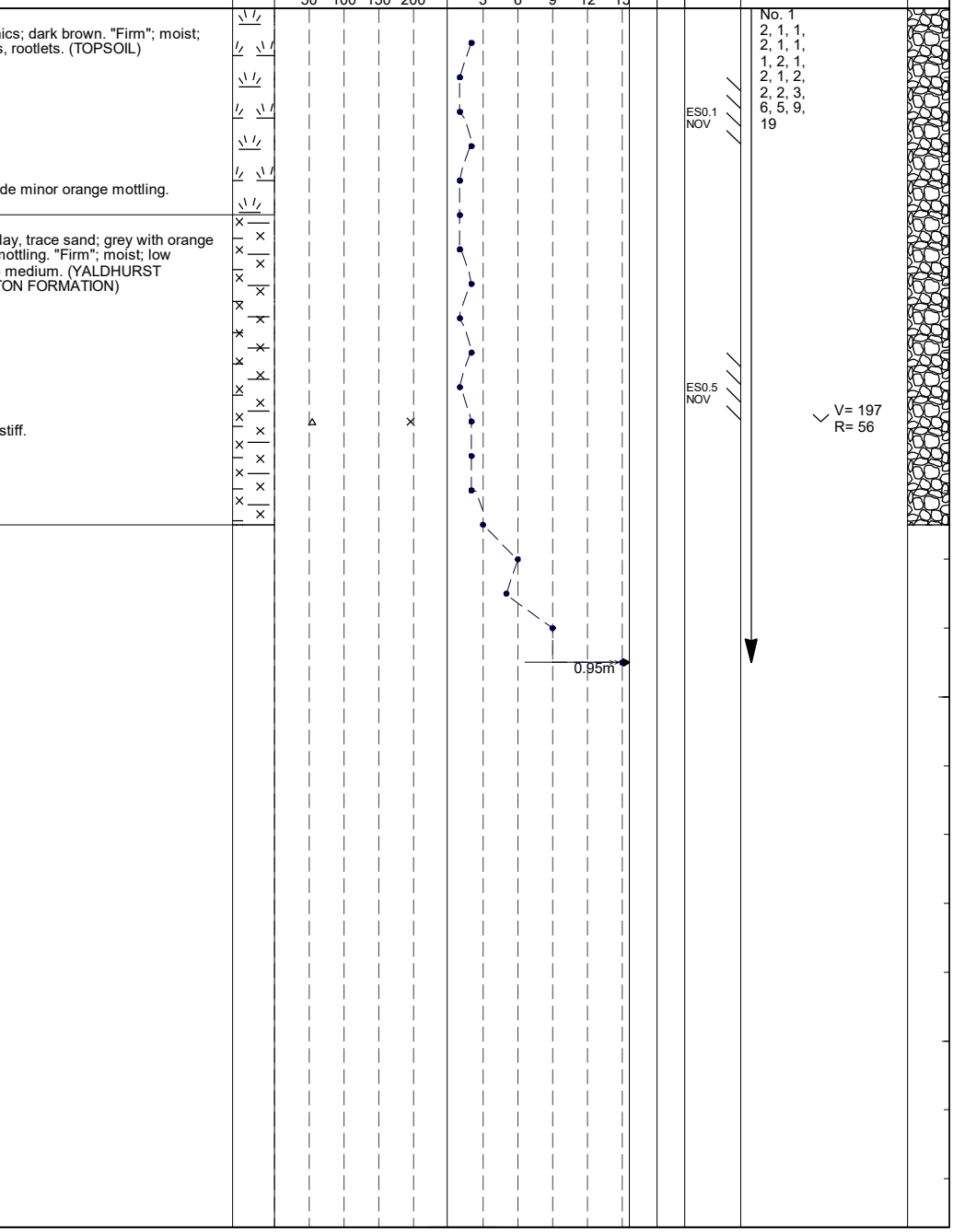
HAND AUGER LOG

Project:	Location:	Hole position:	No.:
Summerset Rangiora Due Diligence	Townsend Rd/South Belt, Rangiora	Refer to Site Plan.	HA03

Job No.:	Start Date: / Finish Date:	Ground Level (m LINZ):	Co-Ordinates (NZTM2000):
170743	18-12-18 / 18-12-18	24.40	E 1,566,431.0 N 5,203,581.4

Client:	Hole Depth:	Sheet:
Welhom Developments Ltd	0.75 m	1 of 1

Elevation (m LINZ)	Depth (m)	Geological Unit	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)
+24.40		(TOPSOIL)	SILT, trace clay, organics; dark brown. "Firm"; moist; low plasticity; organics, rootlets. (TOPSOIL)
			0.25m Grades to include minor orange mottling.
+24.10	0.30	(YALDHURST MEMBER, SPRINGSTON FORMATION)	SILT, minor to some clay, trace sand; grey with orange and yellowish-brown mottling. "Firm"; moist; low plasticity; sand, fine to medium. (YALDHURST MEMBER, SPRINGSTON FORMATION)
			0.60m Grades to very stiff.
+23.65	0.75		EOH @ 0.75 m
	1		



Explanations:

- Scala Penetrometer - blows/50mm
- Permeability Test
- Schmidt Hammer
- Insitu Vane Shear Strength (kPa) V=Peak, R=Residual, UTP=Unable to penetrate
- Small Disturbed Sample
- Large Disturbed Sample
- U100 Undisturbed Sample
- Water Strike (1st, 2nd ...)
- Water Rise (1st, 2nd ...) and Rise Time (minutes)

Soil Moisture:
D = dry; M = moist; W = wet; S = saturated

GROUNDWATER

- [X] Not Encountered
- [ ] Slow Seep (depth)
- [ ] Rapid Inflow (depth)

HOLE TERMINATED DUE TO:
[ ] Target depth [X] Refusal [ ] Collapse

Remarks

1. Coordinates and elevations based on hand-held GPS and subject to survey confirmation.
2. Strength terms for cohesive soil layers are based on shear vane test where available. Where no shear vane, cohesive soil strength terms are based on correlation with Scala test results and indicated in quotation marks.

All dimensions in metres Scale 1:10	Contractor:	Rig/Plant Used: Hand Auger 70 mm	Logged by: AvD	Checked by: CFC

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HAND AUGER LOG

Project:	Location:	Hole position:	No.:
Summerset Rangiora Due Diligence	Townsend Rd/South Belt, Rangiora	Refer to Site Plan.	HA04

Job No.:	Start Date: / Finish Date:	Ground Level (m LINZ):	Co-Ordinates (NZTM2000):
170743	17-12-18 / 17-12-18	23.70	E 1,566,509.8 N 5,203,591.9

Client:	Hole Depth:	Sheet:
Welhom Developments Ltd	0.70 m	1 of 1

Elevation (m LINZ)	Depth (m)	Geological Unit	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)
+23.70			
		(TOPSOIL)	SILT, trace clay, organics; dark brown. "Firm"; moist; low plasticity; organics, rootlets. (TOPSOIL)
			0.20m Grades to 'stiff'.
+23.45	0.25		
		(YALDHURST MEMBER, SPRINGSTON FORMATION)	SILT, minor to some clay, trace sand; grey with orange and yellowish-brown mottling. Very stiff; moist; low plasticity; sand, fine to medium. (YALDHURST MEMBER, SPRINGSTON FORMATION)
			0.60m Grades to hard.
+23.00	0.70		
			EOH @ 0.70 m
	1		

Legend

Soil Shear Strength (kPa): 50 100 150 200

Scala Penetrometer (blows / 50 mm): 3 6 9 12 15

Groundwater

Soil Moisture

Samples: ES0.1 NOV; ES0.5 NOV

Tests: No. 1 2, 1, 2, 1, 2, 3, 2, 3, 4, 3, 3, 3, 3, 4, 16, 20; V= 230

Instrument/ Backfill

0.80m

Explanations:

- Scala Penetrometer - blows/50mm
- Permeability Test
- Schmidt Hammer
- Insitu Vane Shear Strength (kPa) V=Peak, R=Residual, UTP=Unable to penetrate
- Small Disturbed Sample
- Large Disturbed Sample
- U100 Undisturbed Sample
- Water Strike (1st, 2nd ...)
- Water Rise (1st, 2nd ...) and Rise Time (minutes)

Soil Moisture: D = dry; M = moist; W = wet; S = saturated

GROUNDWATER

- [X] Not Encountered
- [ ] Slow Seep (depth)
- [ ] Rapid Inflow (depth)

HOLE TERMINATED DUE TO:

- [ ] Target depth
- [X] Refusal
- [ ] Collapse

Remarks

1. Coordinates and elevations based on hand-held GPS and subject to survey confirmation.
2. Strength terms for cohesive soil layers are based on shear vane test where available. Where no shear vane, cohesive soil strength terms are based on correlation with Scala test results and indicated in quotation marks.

All dimensions in metres Scale 1:10	Contractor:	Rig/Plant Used: Hand Auger 70 mm	Logged by: AvD	Checked by: CFC

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HAND AUGER LOG

Project:	Location:	Hole position:	No.:
Summerset Rangiora Due Diligence	Townsend Rd/South Belt, Rangiora	Refer to Site Plan.	HA05

Job No.:	Start Date: / Finish Date:	Ground Level (m LINZ):	Co-Ordinates (NZTM2000):
170743	20-12-18 / 20-12-18	22.90	E 1,566,584.7 N 5,203,613.4

Client:	Hole Depth:	Sheet:
Welhom Developments Ltd	0.95 m	1 of 1

Elevation (m LINZ)	Depth (m)	Geological Unit	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)
+22.90		(TOPSOIL)	SILT, trace clay, organics; dark brown. "Very stiff"; dry to moist; low plasticity; organics, rootlets. (TOPSOIL)
			0.20m Grades to 'soft'.
+22.65	0.25	(YALDHURST MEMBER, SPRINGSTON FORMATION)	SILT, minor to some clay, trace sand; light grey and orange mottling. "Soft" moist to wet; low plasticity; sand, fine to medium. (YALDHURST MEMBER, SPRINGSTON FORMATION)
			0.40m Grades to 'firm'.
			0.80m Grades to 'stiff'.
+21.95	0.95		0.90m Grades to include some gravel and sand; light grey with orange mottling; gravel, medium, subrounded, greywacke; sand, fine to medium.
	1		EOH @ 0.95 m

Soil Shear Strength (kPa): 50 100 150 200

Scala Penetrometer (blows / 50 mm): 3 6 9 12 15

0.95m

1.25m

Groundwater

Soil Moisture

Samples: ES0.1 NOV; ES0.5 NOV; ES0.9 NOV

Tests:
No. 1
0, 0, 1,
0, 1, 1,
1, 1, 2,
1, 1, 2,
2, 1, 2,
1, 2, 2,
4

No. 2
4, 6, 5,
9, 12,
17

Instrument/ Backfill

Explanations:

- Scala Penetrometer - blows/50mm
- Permeability Test
- Schmidt Hammer
- Insitu Vane Shear Strength (kPa) V=Peak, R=Residual, UTP=Unable to penetrate
- Small Disturbed Sample
- Large Disturbed Sample
- U100 Undisturbed Sample
- Water Strike (1st, 2nd ...)
- Water Rise (1st, 2nd ...) and Rise Time (minutes)

Soil Moisture:
D = dry; M = moist; W = wet; S = saturated

GROUNDWATER

- [X] Not Encountered
- [ ] Slow Seep (depth)
- [ ] Rapid Inflow (depth)

HOLE TERMINATED DUE TO:
[ ] Target depth [X] Refusal [ ] Collapse

Remarks

1. Coordinates and elevations based on hand-held GPS and subject to survey confirmation.
2. Strength terms for cohesive soil layers are based on Scala test results and indicated in quotation marks.

All dimensions in metres Scale 1:10	Contractor:	Rig/Plant Used: Hand Auger 70 mm	Logged by: AvD	Checked by: CFC

RILEY AGS 3_1 NZ LIB 13.GLB Log RILEY CHCH HA 170743 SS-RANGIORA ALL LOGS.GPJ <<DrawingFile>> 21/01/2019 14:40 Produced by gINT Professional

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HAND AUGER LOG

Project:	Location:	Hole position:	No.:
Summerset Rangiora Due Diligence	Townsend Rd/South Belt, Rangiora	Refer to Site Plan.	HA06

Job No.:	Start Date: / Finish Date:	Ground Level (m LINZ):	Co-Ordinates (NZTM2000):
170743	20-12-18 / 20-12-18	21.30	E 1,566,673.8 N 5,203,632.4

Client:	Hole Depth:	Sheet:
Welhom Developments Ltd	1.00 m	1 of 2

Elevation (m LINZ)	Depth (m)	Geological Unit	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)
+21.30			
+21.15	0.15	(TOPSOIL)	SILT, trace clay, organics; greyish brown. "Very soft"; moist; low plasticity; organics, rootlets and roots (<2mm) (TOPSOIL)
		(YALDHURST MEMBER, SPRINGSTON FORMATION)	SILT, minor to some clay, trace sand; grey with orange and yellowish-brown mottling. Very soft; moist; low plasticity; sand, fine to medium. (YALDHURST MEMBER, SPRINGSTON FORMATION) 0.20m Grades to 'firm'. 0.55m Trace charcoal, black. 0.60m Grades to hard. 0.90m Trace fine to medium gravel, rounded, greywacke.
+20.30	1.00		EOH @ 1.00 m

Legend

Soil Shear Strength (kPa): 50 100 150 200

Scala Penetrometer (blows / 50 mm): 3 6 9 12 15

1.00m

Groundwater

Soil Moisture

Samples: ES0.1 NOV; ES0.5 NOV; ES0.95 NOV

Tests:
No. 1
1, 0, 1,
0, 1, 1,
2, 1, 2,
1, 1, 2,
2, 1, 2,
2, 1, 2,
2, 8

V= 230

No. 2
6, 8,
10, 9,
10, 9,
6, 9, 8,
8, 9, 7,
5, 4, 7,
8, 6, 5,
6, 5

Instrument/ Backfill

Explanations:

- Scala Penetrometer - blows/50mm
- Permeability Test
- Schmidt Hammer
- Insitu Vane Shear Strength (kPa) V=Peak, R=Residual, UTP=Unable to penetrate
- Small Disturbed Sample
- Large Disturbed Sample
- U100 Undisturbed Sample
- Water Strike (1st, 2nd ...)
- Water Rise (1st, 2nd ...) and Rise Time (minutes)

Soil Moisture:
D = dry; M = moist; W = wet; S = saturated

GROUNDWATER

- [X] Not Encountered
- [ ] Slow Seep (depth)
- [ ] Rapid Inflow (depth)

HOLE TERMINATED DUE TO:
[ ] Target depth [X] Refusal [ ] Collapse

Remarks

1. Coordinates and elevations based on hand-held GPS and subject to survey confirmation.
2. Strength terms for cohesive soil layers are based on shear vane test where available. Where no shear vane, cohesive soil strength terms are based on correlation with Scala test results and indicated in quotation marks.

All dimensions in metres Scale 1:10	Contractor:	Rig/Plant Used: Hand Auger 70 mm	Logged by: AvD	Checked by: CFC

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HAND AUGER LOG

Project:	Location:	Hole position:	No.:
Summerset Rangiora Due Diligence	Townsend Rd/South Belt, Rangiora	Refer to Site Plan.	HA06

Job No.:	Start Date: / Finish Date:	Ground Level (m LINZ):	Co-Ordinates (NZTM2000):
170743	20-12-18 / 20-12-18	21.30	E 1,566,673.8 N 5,203,632.4

Client:	Hole Depth:	Sheet:
Welhom Developments Ltd	1.00 m	2 of 2

Elevation (m LINZ)	Depth (m)	Geological Unit	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)	Legend	Soil Shear Strength (kPa)	Scala Penetrometer (blows / 50 mm)	Groundwater	Soil Moisture	Samples	Tests	Instrument/ Backfill
+19.53					50 100 150 200	3 6 9 12 15					
	2					2.00m					
	3										

Explanations:

- Scala Penetrometer - blows/50mm
- Permeability Test
- Schmidt Hammer
- Insitu Vane Shear Strength (kPa) V=Peak, R=Residual, UTP=Unable to penetrate
- Small Disturbed Sample
- Large Disturbed Sample
- U100 Undisturbed Sample
- Water Strike (1st, 2nd ...)
- Water Rise (1st, 2nd ...) and Rise Time (minutes)

Soil Moisture:
D = dry; M = moist; W = wet; S = saturated

GROUNDWATER

- [X] Not Encountered
- [ ] Slow Seep (depth)
- [ ] Rapid Inflow (depth)

HOLE TERMINATED DUE TO:
[ ] Target depth [X] Refusal [ ] Collapse

Remarks

1. Coordinates and elevations based on hand-held GPS and subject to survey confirmation.
2. Strength terms for cohesive soil layers are based on shear vane test where available. Where no shear vane, cohesive soil strength terms are based on correlation with Scala test results and indicated in quotation marks.

All dimensions in metres Scale 1:10	Contractor:	Rig/Plant Used: Hand Auger 70 mm	Logged by: AvD	Checked by: CFC

RILEY CONSULTANTS
Engineers and Geologists
Riley Consultants
22 Moorhouse Ave
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Tel: +643 3794402
Fax: +643 3794403

HAND AUGER LOG

Project:	Location:	Hole position:	No.:
Summerset Rangiora Due Diligence	Townsend Rd/South Belt, Rangiora	Refer to Site Plan.	HA07

Job No.:	Start Date: / Finish Date:	Ground Level (m LINZ):	Co-Ordinates (NZTM2000):
170743	18-12-18 / 18-12-18	24.50	E 1,566,267.9 N 5,203,478.6

Client:	Hole Depth:	Sheet:
Welhom Developments Ltd	1.25 m	1 of 1

Elevation (m LINZ)	Depth (m)	Geological Unit	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)
+24.50			
		(TOPSOIL)	SILT, trace clay, organics; greyish brown. "Very soft to soft"; moist; low plasticity; organics, rootlets (TOPSOIL)
+24.15	0.35		
		(YALDHURST MEMBER, SPRINGSTON FORMATION)	SILT, minor to some clay, trace sand; grey with orange and yellowish-brown mottling. "Soft"; moist; low plasticity; sand, fine to medium. (YALDHURST MEMBER, SPRINGSTON FORMATION) 0.50m Grades to 'firm'. 0.70m Grades to very stiff.
+23.50	1.00		
			Sandy gravelly SILT, trace clay; light greyish brown with orange mottling. Medium dense; moist; dilatant; gravel, fine to medium, subrounded, greywacke; sand, fine to coarse.
+23.25	1.25		
			EOH @ 1.25 m

Legend

Soil Shear Strength (kPa): 50 100 150 200

Scala Penetrometer (blows / 50 mm): 3 6 9 12 15

1.00m

1.75m

Groundwater

Soil Moisture

Samples: ES0.1 NOV; ES0.5 NOV

Tests: No. 1 1, 0, 0, 1, 1, 1, 0, 1, 1, 1, 2, 1, 2, 1, 1, 2, 2, 3, 4, 5; V= 128 R= 43; No. 2 2, 3, 15, 7, 3, 2, 3, 3, 5, 11, 13, 8, 8, 12, 14

Instrument/ Backfill

Explanations:

- Scala Penetrometer - blows/50mm
- Permeability Test
- Schmidt Hammer
- Insitu Vane Shear Strength (kPa) V=Peak, R=Residual, UTP=Unable to penetrate
- Small Disturbed Sample
- Large Disturbed Sample
- U100 Undisturbed Sample
- Water Strike (1st, 2nd ...)
- Water Rise (1st, 2nd ...) and Rise Time (minutes)

Soil Moisture: D = dry; M = moist; W = wet; S = saturated

GROUNDWATER

- [X] Not Encountered
- [ ] Slow Seep (depth)
- [ ] Rapid Inflow (depth)

HOLE TERMINATED DUE TO:

- [ ] Target depth
- [X] Refusal
- [ ] Collapse

Remarks

1. Coordinates and elevations based on hand-held GPS and subject to survey confirmation.
2. Strength terms for cohesive soil layers are based on shear vane test where available. Where no shear vane, cohesive soil strength terms are based on correlation with Scala test results and indicated in quotation marks.
3. Located on tidy kept lawn.
4. Scala device wet below 1.25m on extraction.

All dimensions in metres Scale 1:10	Contractor:	Rig/Plant Used: Hand Auger 70 mm	Logged by: AvD	Checked by: CFC

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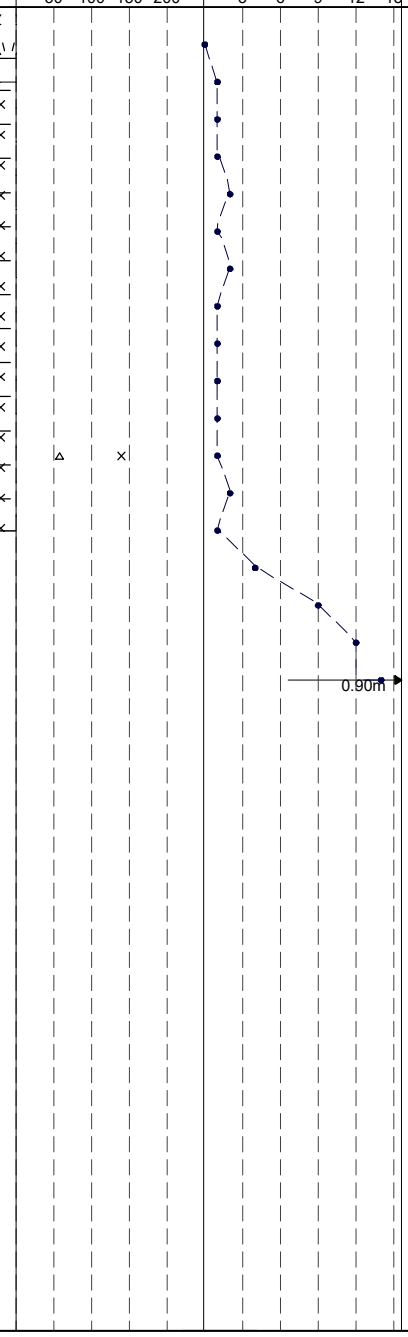
HAND AUGER LOG

Project:	Location:	Hole position:	No.:
Summerset Rangiora Due Diligence	Townsend Rd/South Belt, Rangiora	Refer to Site Plan.	HA08

Job No.:	Start Date: / Finish Date:	Ground Level (m LINZ):	Co-Ordinates (NZTM2000):
170743	18-12-18 / 18-12-18	24.50	E 1,566,360.3 N 5,203,503.7

Client:	Hole Depth:	Sheet:
Welhom Developments Ltd	0.70 m	1 of 1

Elevation (m LINZ)	Depth (m)	Geological Unit	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)	Legend
+24.50				
+24.40	0.10	(TOPSOIL)	SILT, trace clay, organics; greyish brown. "Very soft to soft"; wet; low plasticity; organics, rootlets. (TOPSOIL)	
+23.80	0.70	(YALDHURST MEMBER, SPRINGSTON FORMATION)	SILT, trace clay, trace sand; grey with orange and yellowish-brown mottling. "Soft"; moist; low plasticity; sand, fine to medium. (YALDHURST MEMBER, SPRINGSTON FORMATION) 0.20m Grades to 'soft to firm'. Very stiff. 0.60m Grades to include minor fine to medium sand.	
	1		EOH @ 0.70 m	



Groundwater | Soil Moisture

Samples: ES0.1 NOV; ES0.5 NOV

Tests: No. 1 — 0, 1, 1, 1, 2, 1, 2, 1, 1, 1, 1, 1, 2, 1, 4, 9, 12, 14; V= 141 R= 59

Instrument/ Backfill

Explanations:

- Scala Penetrometer - blows/50mm
- Permeability Test
- Schmidt Hammer
- Insitu Vane Shear Strength (kPa) V=Peak, R=Residual, UTP=Unable to penetrate
- Small Disturbed Sample
- Large Disturbed Sample
- U100 Undisturbed Sample
- Water Strike (1st, 2nd ...)
- Water Rise (1st, 2nd ...) and Rise Time (minutes)

Soil Moisture: D = dry; M = moist; W = wet; S = saturated

GROUNDWATER

- [X] Not Encountered
- [ ] Slow Seep (depth)
- [ ] Rapid Inflow (depth)

HOLE TERMINATED DUE TO:

- [ ] Target depth
- [X] Refusal
- [ ] Collapse

Remarks

1. Coordinates and elevations based on hand-held GPS and subject to survey confirmation.
2. Strength terms for cohesive soil layers are based on shear vane test where available. Where no shear vane, cohesive soil strength terms are based on correlation with Scala test results and indicated in quotation marks.
3. Located next to sawdust mound and near horse dung mounds.
4. First hand auger attempt near south end of gate abandoned due to encountering gravel (assumed fill).

All dimensions in metres Scale 1:10	Contractor:	Rig/Plant Used: Hand Auger 70 mm	Logged by: AvD	Checked by: CFC

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HAND AUGER LOG

Project:	Location:	Hole position:	No.:
Summerset Rangiora Due Diligence	Townsend Rd/South Belt, Rangiora	Refer to Site Plan.	HA09

Job No.:	Start Date: / Finish Date:	Ground Level (m LINZ):	Co-Ordinates (NZTM2000):
170743	17-12-18 / 17-12-18	24.30	E 1,566,444.0 N 5,203,508.5

Client:	Hole Depth:	Sheet:
Welhom Developments Ltd	1.25 m	1 of 1

Elevation (m LINZ)	Depth (m)	Geological Unit	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)
+24.30		(TOPSOIL)	SILT, trace clay, organics; dark brown. "Soft"; dry; low plasticity; organics, rootlets. (TOPSOIL) 0.02m Grades to moist. 0.05m Grades to minor clay.
+24.00	0.30	(YALDHURST MEMBER, SPRINGSTON FORMATION)	SILT, minor to some clay, trace sand; grey with orange and yellowish-brown mottling. "Soft"; moist; low plasticity; sand, fine to medium. (YALDHURST MEMBER, SPRINGSTON FORMATION) 0.50m Grades to 'firm'. 0.90m Grades to very stiff. 1.00m Grades to include minor gravel, fine to medium, subrounded, greywacke 1.15m Grades to include minor to some sand, trace gravel; non plastic; gravel, as above; sand, fine.
+23.05	1.25		EOH @ 1.25 m

Soil Shear Strength (kPa): 50 100 150 200
Scala Penetrometer (blows / 50 mm): 3 6 9 12 15
1.00m
1.45m
Groundwater
Soil Moisture
Samples: ES0.1 NOV; ES0.5 NOV; ES0.9 NOV
Tests: No. 1 2, 1, 0, 1, 1, 1, 1, 1, 1, 2, 2, 1, 2, 1, 2, 1, 0, 4
V= 164 R= 39
No. 2 4, 4, 4, 3, 4, 6, 11, 14, 14
Instrument/ Backfill

Explanations:

- Scala Penetrometer - blows/50mm
- Permeability Test
- Schmidt Hammer
- Insitu Vane Shear Strength (kPa) V=Peak, R=Residual, UTP=Unable to penetrate
- Small Disturbed Sample
- Large Disturbed Sample
- U100 Undisturbed Sample
- Water Strike (1st, 2nd ...)
- Water Rise (1st, 2nd ...) and Rise Time (minutes)

Soil Moisture: D = dry; M = moist; W = wet; S = saturated

GROUNDWATER

- [X] Not Encountered
- [ ] Slow Seep (depth)
- [ ] Rapid Inflow (depth)

HOLE TERMINATED DUE TO:
[ ] Target depth [X] Refusal [ ] Collapse

Remarks

1. Coordinates and elevations based on hand-held GPS and subject to survey confirmation.
2. Strength terms for cohesive soil layers are based on shear vane test where available. Where no shear vane, cohesive soil strength terms are based on correlation with Scala test results and indicated in quotation marks.

All dimensions in metres Scale 1:10	Contractor:	Rig/Plant Used: Hand Auger	Logged by: RBW	Checked by: CFC

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HAND AUGER LOG

Project:	Location:	Hole position:	No.:
Summerset Rangiora Due Diligence	Townsend Rd/South Belt, Rangiora	Refer to Site Plan.	HA10

Job No.:	Start Date: / Finish Date:	Ground Level (m LINZ):	Co-Ordinates (NZTM2000):
170743	17-12-18 / 17-12-18	24.00	E 1,566,523.0 N 5,203,513.6

Client:	Hole Depth:	Sheet:
Welhom Developments Ltd	1.10 m	1 of 2

Elevation (m LINZ)	Depth (m)	Geological Unit	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)
+24.00			
		(TOPSOIL)	SILT, trace clay, organics; dark brown. "Firm"; moist; low plasticity; organics, rootlets. (TOPSOIL)
+23.75	0.25		
		(YALDHURST MEMBER, SPRINGSTON FORMATION)	SILT, minor to some clay, trace sand; grey with orange and yellowish-brown mottling. "Firm"; moist; low plasticity; sand, fine to medium. (YALDHURST MEMBER, SPRINGSTON FORMATION)
			0.40m Grades to "stiff".
			0.60m Grades to hard.
			0.80m Grades to light grey with orange mottling.
	1		
+22.95	1.05		
+22.90	1.10		Sandy silty GRAVEL; light grey with orange mottling. Very dense; moist; gravel, fine to medium, subrounded, greywacke; sand, fine to coarse.
			EOH @ 1.10 m

Legend

Soil Shear Strength (kPa): 50 100 150 200

Scala Penetrometer (blows / 50 mm): 3 6 9 12 15

1.00m

Groundwater

Soil Moisture

Samples

ES0.1 NOV

ES0.5 NOV

ES1.0 NOV

Tests

No. 1
1, 1, 2,
2, 1, 2,
2, 1, 2,
2, 2, 2,
2, 2, 2,
2, 2, 2,
2, 2

V= 203
R= 46

No. 2
9, 10,
7, 8, 7,
9, 7, 6,
9, 6, 7,
7, 5, 6,
5, 8, 9,
12, 20

Instrument/ Backfill

Explanations:

- Scala Penetrometer - blows/50mm
- Permeability Test
- Schmidt Hammer
- Insitu Vane Shear Strength (kPa) V=Peak, R=Residual, UTP=Unable to penetrate
- Small Disturbed Sample
- Large Disturbed Sample
- U100 Undisturbed Sample
- Water Strike (1st, 2nd ...)
- Water Rise (1st, 2nd ...) and Rise Time (minutes)

Soil Moisture:
D = dry; M = moist; W = wet; S = saturated

GROUNDWATER

- [X] Not Encountered
- [ ] Slow Seep (depth)
- [ ] Rapid Inflow (depth)

HOLE TERMINATED DUE TO:
[ ] Target depth [X] Refusal [ ] Collapse

Remarks

1. Coordinates and elevations based on hand-held GPS and subject to survey confirmation.
2. Strength terms for cohesive soil layers are based on shear vane test where available. Where no shear vane, cohesive soil strength terms are based on correlation with Scala test results and indicated in quotation marks.
3. Located on tidy kept lawn.
4. Scala rod wet below 1.50m on extraction.

All dimensions in metres Scale 1:10	Contractor:	Rig/Plant Used: Hand Auger	Logged by: RBW	Checked by: CFC

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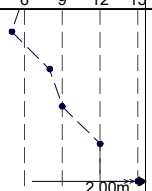
HAND AUGER LOG

Project:	Location:	Hole position:	No.:
Summerset Rangiora Due Diligence	Townsend Rd/South Belt, Rangiora	Refer to Site Plan.	HA10

Job No.:	Start Date: / Finish Date:	Ground Level (m LINZ):	Co-Ordinates (NZTM2000):
170743	17-12-18 / 17-12-18	24.00	E 1,566,523.0 N 5,203,513.6

Client:	Hole Depth:	Sheet:
Welhom Developments Ltd	1.10 m	2 of 2

Elevation (m LINZ)	Depth (m)	Geological Unit	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)	Legend	Soil Shear Strength (kPa)	Scala Penetrometer (blows / 50 mm)	Groundwater	Soil Moisture	Samples	Tests	Instrument/ Backfill
+22.23					50 100 150 200	3 6 9 12 15					



Explanations:

- Scala Penetrometer - blows/50mm
- Permeability Test
- Schmidt Hammer
- Insitu Vane Shear Strength (kPa) V=Peak, R=Residual, UTP=Unable to penetrate
- Small Disturbed Sample
- Large Disturbed Sample
- U100 Undisturbed Sample
- Water Strike (1st, 2nd ...)
- Water Rise (1st, 2nd ...) and Rise Time (minutes)

Soil Moisture:
D = dry; M = moist; W = wet; S = saturated

GROUNDWATER

- [X] Not Encountered
- [ ] Slow Seep (depth)
- [ ] Rapid Inflow (depth)

HOLE TERMINATED DUE TO:
[ ] Target depth [X] Refusal [ ] Collapse

Remarks

1. Coordinates and elevations based on hand-held GPS and subject to survey confirmation.
2. Strength terms for cohesive soil layers are based on shear vane test where available. Where no shear vane, cohesive soil strength terms are based on correlation with Scala test results and indicated in quotation marks.
3. Located on tidy kept lawn.
4. Scala rod wet below 1.50m on extraction.

All dimensions in metres Scale 1:10	Contractor:	Rig/Plant Used: Hand Auger	Logged by: RBW	Checked by: CFC

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HAND AUGER LOG

Project:	Location:	Hole position:	No.:
Summerset Rangiora Due Diligence	Townsend Rd/South Belt, Rangiora	Refer to Site Plan.	HA11

Job No.:	Start Date: / Finish Date:	Ground Level (m LINZ):	Co-Ordinates (NZTM2000):
170743	20-12-18 / 20-12-18	22.40	E 1,566,607.1 N 5,203,537.7

Client:	Hole Depth:	Sheet:
Welhom Developments Ltd	0.80 m	1 of 1

Elevation (m LINZ)	Depth (m)	Geological Unit	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)
+22.40			
+22.25	0.15	(TOPSOIL)	SILT, trace clay, organics; dark brown. "Very soft to soft"; moist; low plasticity; organics, rootlets. (TOPSOIL)
		(YALDHURST MEMBER, SPRINGSTON FORMATION)	SILT, minor to some clay, trace sand; grey with orange and yellowish-brown mottling. "Soft"; moist; low plasticity; sand, fine to medium. (YALDHURST MEMBER, SPRINGSTON FORMATION) 0.30m Grades to "stiff". 0.60m Grades to light grey with orange mottling.
+21.60	0.80		0.75m Grades to include minor medium gravel, subrounded, greywacke. Very stiff.
	1		EOH @ 0.80 m

Legend

Soil Shear Strength (kPa): 50 100 150 200

Scala Penetrometer (blows / 50 mm): 3 6 9 12 15

0.95m

Groundwater

Soil Moisture

Samples: ES0.1 NOV; ES0.5 NOV; ES0.75 NOV

Tests: No. 1 — 0, 1, 1, 1, 1, 1, 2, 2, 2, 3, 2, 3, 2, 3, 3, 3, 8, 12, 15; V= 172 R= 43

Instrument/ Backfill

Explanations:

- Scala Penetrometer - blows/50mm
- Permeability Test
- Schmidt Hammer
- Insitu Vane Shear Strength (kPa) V=Peak, R=Residual, UTP=Unable to penetrate
- Small Disturbed Sample
- Large Disturbed Sample
- U100 Undisturbed Sample
- Water Strike (1st, 2nd ...)
- Water Rise (1st, 2nd ...) and Rise Time (minutes)

Soil Moisture: D = dry; M = moist; W = wet; S = saturated

GROUNDWATER

- [X] Not Encountered
- [ ] Slow Seep (depth)
- [ ] Rapid Inflow (depth)

HOLE TERMINATED DUE TO:

- [ ] Target depth
- [X] Refusal
- [ ] Collapse

Remarks

1. Coordinates and elevations based on hand hand GPS and subject to survey confirmation.
2. Strength terms for cohesive soil layers are based on shear vane test where available. Where no shear vane, cohesive soil strength terms are based on correlation with Scala test results and indicated in quotation marks.

All dimensions in metres Scale 1:10	Contractor:	Rig/Plant Used: Hand Auger 70 mm	Logged by: AvD	Checked by: CFC

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HAND AUGER LOG

Project:	Location:	Hole position:	No.:
Summerset Rangiora Due Diligence	Townsend Rd/South Belt, Rangiora	Refer to Site Plan.	HA12

Job No.:	Start Date: / Finish Date:	Ground Level (m LINZ):	Co-Ordinates (NZTM2000):
170743	20-12-18 / 20-12-18	21.50	E 1,566,694.5 N 5,203,555.4

Client:	Hole Depth:	Sheet:
Welhom Developments Ltd	0.95 m	1 of 1

Elevation (m LINZ)	Depth (m)	Geological Unit	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)
+21.50			
+21.35	0.15	(TOPSOIL)	SILT, trace clay, organics; dark brown. "Very soft to soft"; moist; low plasticity; organics, rootlets. (TOPSOIL)
		(YALDHURST MEMBER, SPRINGSTON FORMATION)	SILT, minor to some clay, trace sand; grey with orange and yellowish-brown mottling. "Soft"; moist to wet (surface infiltration after rain); low to medium plasticity; sand, fine to medium. (YALDHURST MEMBER, SPRINGSTON FORMATION)
			0.60m Light grey with orange mottling. Very stiff.
+20.55	0.95		0.90m Grades to include trace to minor fine to medium gravel, subrounded, greywacke.
	1		EOH @ 0.95 m

Legend

Soil Shear Strength (kPa): 50 100 150 200

Scala Penetrometer (blows / 50 mm): 3 6 9 12 15

Groundwater

Soil Moisture

Samples: ES0.1 NOV; ES0.5 NOV; ES0.9 NOV

Tests: No. 1 0, 0, 1, 1, 1, 1, 1, 1, 1, 2, 1, 1, 2, 1, 1, 2, 2, 3, 8, 8; V= 167 R= 34; No. 2 11, 12, 10; 1.00m; 1.15m

Instrument/ Backfill

Explanations:

- Scala Penetrometer - blows/50mm
- Permeability Test
- Schmidt Hammer
- Insitu Vane Shear Strength (kPa) V=Peak, R=Residual, UTP=Unable to penetrate
- Small Disturbed Sample
- Large Disturbed Sample
- U100 Undisturbed Sample
- Water Strike (1st, 2nd ...)
- Water Rise (1st, 2nd ...) and Rise Time (minutes)

Soil Moisture: D = dry; M = moist; W = wet; S = saturated

GROUNDWATER

- [X] Not Encountered
- [ ] Slow Seep (depth)
- [ ] Rapid Inflow (depth)

HOLE TERMINATED DUE TO:

- [ ] Target depth
- [X] Refusal
- [ ] Collapse

Remarks

1. Coordinates and elevations based on hand hand GPS and subject to survey confirmation.
2. Strength terms for cohesive soil layers are based on shear vane test where available. Where no shear vane, cohesive soil strength terms are based on correlation with Scala test results and indicated in quotation marks.

All dimensions in metres Scale 1:10	Contractor:	Rig/Plant Used: Hand Auger 70 mm	Logged by: AvD	Checked by: CFC

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HAND AUGER LOG

Project:	Location:	Hole position:	No.:
Summerset Rangiora Due Diligence	Townsend Rd/South Belt, Rangiora	Refer to Site Plan.	HA13

Job No.:	Start Date: / Finish Date:	Ground Level (m LINZ):	Co-Ordinates (NZTM2000):
170743	18-12-18 / 18-12-18	23.20	E 1,566,374.5 N 5,203,418.2

Client:	Hole Depth:	Sheet:
Welhom Developments Ltd	0.45 m	1 of 1

Elevation (m LINZ)	Depth (m)	Geological Unit	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)
+23.20			
+23.05	0.15	(TOPSOIL)	SILT, trace clay, organics; dark brown. "Stiff"; moist; low plasticity; organics, rootlets. (TOPSOIL)
+22.75	0.45	(YALDHURST MEMBER, SPRINGSTON FORMATION)	SILT, minor to some clay, trace sand; grey with orange and yellowish-brown mottling. "Stiff"; moist; low to medium plasticity; sand, fine to medium. (YALDHURST MEMBER, SPRINGSTON FORMATION)
			Refusal on inferred cobble. EOH @ 0.45 m

Legend

Soil Shear Strength (kPa): 50 100 150 200

Scala Penetrometer (blows / 50 mm): 3 6 9 12 15

0.65m

Groundwater

Soil Moisture

Samples: ES0.1 NOV

Tests: No. 1 2, 2, 2, 2, 2, 3, 3, 3, 2, 9, 16, 13, 16

Instrument/ Backfill

1

Explanations:

- Scala Penetrometer - blows/50mm
- Permeability Test
- Schmidt Hammer
- Insitu Vane Shear Strength (kPa) V=Peak, R=Residual, UTP=Unable to penetrate
- Small Disturbed Sample
- Large Disturbed Sample
- U100 Undisturbed Sample
- Water Strike (1st, 2nd ...)
- Water Rise (1st, 2nd ...) and Rise Time (minutes)

Soil Moisture: D = dry; M = moist; W = wet; S = saturated

GROUNDWATER

- [X] Not Encountered
- [ ] Slow Seep (depth)
- [ ] Rapid Inflow (depth)

HOLE TERMINATED DUE TO:

- [ ] Target depth
- [X] Refusal
- [ ] Collapse

Remarks

1. Coordinates and elevations based on hand hand GPS and subject to survey confirmation.
2. Strength terms for cohesive soil layers are based Scala test results and indicated in quotation marks.

All dimensions in metres Scale 1:10	Contractor:	Rig/Plant Used: Hand Auger 70 mm	Logged by: AvD	Checked by: CFC

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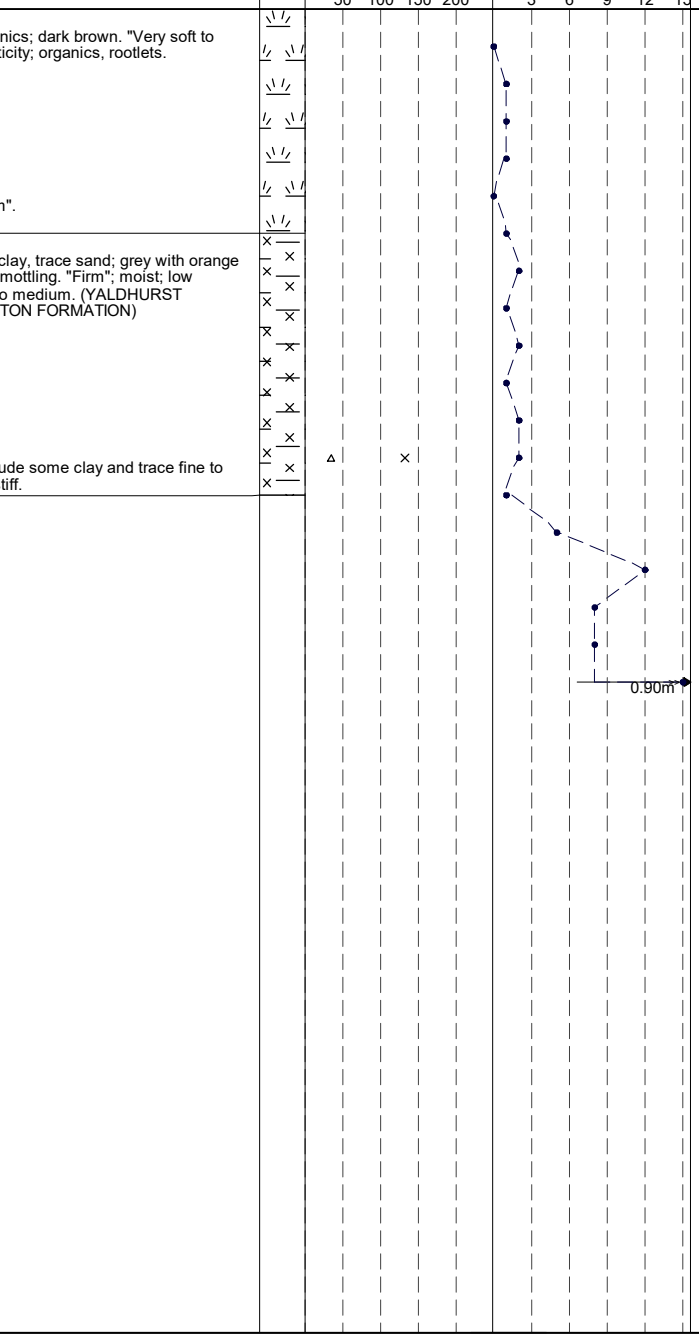
HAND AUGER LOG

Project:	Location:	Hole position:	No.:
Summerset Rangiora Due Diligence	Townsend Rd/South Belt, Rangiora	Refer to Site Plan.	HA14

Job No.:	Start Date: / Finish Date:	Ground Level (m LINZ):	Co-Ordinates (NZTM2000):
170743	21-12-18 / 21-12-18	26.70	E 1,566,464.6 N 5,203,422.0

Client:	Hole Depth:	Sheet:
Welhom Developments Ltd	0.65 m	1 of 1

Elevation (m LINZ)	Depth (m)	Geological Unit	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)
+26.70		(TOPSOIL)	SILT, trace clay, organics; dark brown. "Very soft to soft"; moist; low plasticity; organics, rootlets. (TOPSOIL)
+26.40	0.30	YALDHURST MEMBER, SPRINGSTON FORMATION	0.25m Grades to "firm". SILT, minor to some clay, trace sand; grey with orange and yellowish-brown mottling. "Firm"; moist; low plasticity; sand, fine to medium. (YALDHURST MEMBER, SPRINGSTON FORMATION)
+26.05	0.65		0.60m Grades to include some clay and trace fine to medium sand. Very stiff. EOH @ 0.65 m



Samples: ES0.1 NOV; ES0.5 NOV

Tests: No. 1 — 0, 1, 1, 1, 0, 1, 2, 1, 2, 1, 2, 2, 1, 5, 12, 8, 8, 16; V= 134 R= 36

Groundwater; Soil Moisture; Instrument/Backfill

Explanations:

- Scala Penetrometer - blows/50mm
- Permeability Test
- Schmidt Hammer
- Insitu Vane Shear Strength (kPa) V=Peak, R=Residual, UTP=Unable to penetrate
- Small Disturbed Sample
- Large Disturbed Sample
- U100 Undisturbed Sample
- Water Strike (1st, 2nd ...)
- Water Rise (1st, 2nd ...) and Rise Time (minutes)

Soil Moisture: D = dry; M = moist; W = wet; S = saturated

GROUNDWATER

- [X] Not Encountered
- [ ] Slow Seep (depth)
- [ ] Rapid Inflow (depth)

HOLE TERMINATED DUE TO:

- [ ] Target depth
- [X] Refusal
- [ ] Collapse

Remarks

1. Coordinates and elevations based on hand hand GPS and subject to survey confirmation.
2. Strength terms for cohesive soil layers are based on shear vane test where available. Where no shear vane, cohesive soil strength terms are based on correlation with Scala test results and indicated in quotation marks.

All dimensions in metres Scale 1:10	Contractor:	Rig/Plant Used: Hand Auger	Logged by: RBW	Checked by: CFC

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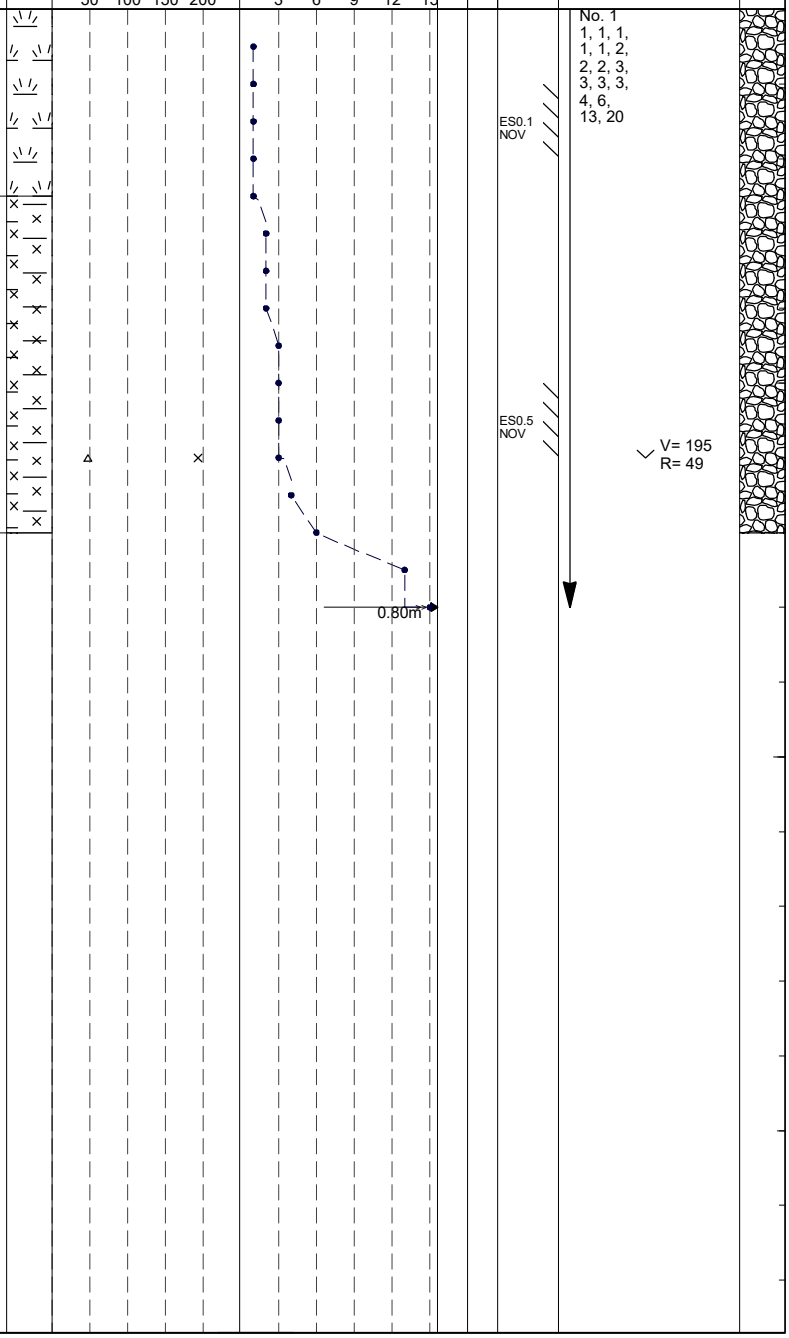
HAND AUGER LOG

Project:	Location:	Hole position:	No.:
Summerset Rangiora Due Diligence	Townsend Rd/South Belt, Rangiora	Refer to Site Plan.	HA15

Job No.:	Start Date: / Finish Date:	Ground Level (m LINZ):	Co-Ordinates (NZTM2000):
170743	21-12-18 / 21-12-18	24.70	E 1,566,544.2 N 5,203,436.4

Client:	Hole Depth:	Sheet:
Welhom Developments Ltd	0.70 m	1 of 1

Elevation (m LINZ)	Depth (m)	Geological Unit	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)
+24.70			
+24.45	0.25	(TOPSOIL)	SILT, trace clay, organics; dark brown. "Soft"; moist; low plasticity; organics, rootlets. (TOPSOIL)
+24.00	0.70	(YALDHURST MEMBER, SPRINGSTON FORMATION)	SILT, minor to some clay, trace sand; grey with orange and yellowish-brown mottling. "Stiff"; moist; low plasticity; sand, fine to medium. (YALDHURST MEMBER, SPRINGSTON FORMATION) 0.50m Grades to some clay. 0.60m Grades to very stiff.
	1		EOH @ 0.70 m



Explanations:

- Scala Penetrometer - blows/50mm
- Permeability Test
- Schmidt Hammer
- Insitu Vane Shear Strength (kPa) V=Peak, R=Residual, UTP=Unable to penetrate
- Small Disturbed Sample
- Large Disturbed Sample
- U100 Undisturbed Sample
- Water Strike (1st, 2nd ...)
- Water Rise (1st, 2nd ...) and Rise Time (minutes)

Soil Moisture:
D = dry; M = moist; W = wet; S = saturated

GROUNDWATER

- [X] Not Encountered
- [ ] Slow Seep (depth)
- [ ] Rapid Inflow (depth)

HOLE TERMINATED DUE TO:
[ ] Target depth [X] Refusal [ ] Collapse

Remarks

1. Coordinates and elevations based on hand hand GPS and subject to survey confirmation.
2. Strength terms for cohesive soil layers are based on shear vane test where available. Where no shear vane, cohesive soil strength terms are based on correlation with Scala test results and indicated in quotation marks.

All dimensions in metres Scale 1:10	Contractor:	Rig/Plant Used: Hand Auger	Logged by: RBW	Checked by: CFC

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HAND AUGER LOG

Project:	Location:	Hole position:	No.:
Summerset Rangiora Due Diligence	Townsend Rd/South Belt, Rangiora	Refer to Site Plan.	HA16

Job No.:	Start Date: / Finish Date:	Ground Level (m LINZ):	Co-Ordinates (NZTM2000):
170743	21-12-18 / 21-12-18	20.90	E 1,566,624.5 N 5,203,453.1

Client:	Hole Depth:	Sheet:
Welhom Developments Ltd	0.70 m	1 of 1

Elevation (m LINZ)	Depth (m)	Geological Unit	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)
+20.90			
+20.65	0.25	(TOPSOIL)	SILT, trace clay, organics; dark brown. "Very soft"; moist; low plasticity; organics, rootlets. (TOPSOIL)
+20.20	0.70	(YALDHURST MEMBER, SPRINGSTON FORMATION)	SILT, minor to some clay, trace sand; grey with orange and yellowish-brown mottling. "Firm"; moist; low plasticity; sand, fine to medium. (YALDHURST MEMBER, SPRINGSTON FORMATION) 0.45m Grades to "soft". 0.60m Very stiff. 0.65m Sand, fine.
	1		EOH @ 0.70 m

Legend

Soil Shear Strength (kPa): 50 100 150 200

Scala Penetrometer (blows / 50 mm): 3 6 9 12 15

0.60m

1.15m

Groundwater

Soil Moisture

Samples: ES0.1 NOV; ES0.5 NOV

Tests: No. 1 1, 0, 1, 1, 0, 1, 2, 1, 2, 1, 0, 1, 1, 2, 4, 10, 10, 8, 7, 8; V= 136 R= 45; No. 2 10, 10, 11

Instrument/ Backfill

Explanations:

- Scala Penetrometer - blows/50mm
- Permeability Test
- Schmidt Hammer
- Insitu Vane Shear Strength (kPa) V=Peak, R=Residual, UTP=Unable to penetrate
- Small Disturbed Sample
- Large Disturbed Sample
- U100 Undisturbed Sample
- Water Strike (1st, 2nd ...)
- Water Rise (1st, 2nd ...) and Rise Time (minutes)

Soil Moisture: D = dry; M = moist; W = wet; S = saturated

GROUNDWATER

- [X] Not Encountered
- [ ] Slow Seep (depth)
- [ ] Rapid Inflow (depth)

HOLE TERMINATED DUE TO:

- [ ] Target depth
- [X] Refusal
- [ ] Collapse

Remarks

1. Coordinates and elevations based on hand-held GPS and subject to survey confirmation.
2. Strength terms for cohesive soil layers are based on shear vane test where available. Where no shear vane, cohesive soil strength terms are based on correlation with Scala test results and indicated in quotation marks.
3. Located near alignment of sewer mains. Initial hand auger attempt abandoned due to encountering gravel (assumed sewer pipe backfill).

All dimensions in metres Scale 1:10	Contractor:	Rig/Plant Used: Hand Auger	Logged by: RBW	Checked by: CFC

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HAND AUGER LOG

Project:	Location:	Hole position:	No.:
Summerset Rangiora Due Diligence	Townsend Rd/South Belt, Rangiora	Refer to Site Plan.	HA17

Job No.:	Start Date: / Finish Date:	Ground Level (m LINZ):	Co-Ordinates (NZTM2000):
170743	21-12-18 / 21-12-18	22.10	E 1,566,713.6 N 5,203,470.0

Client:	Hole Depth:	Sheet:
Welhom Developments Ltd	0.85 m	1 of 1

Elevation (m LINZ)	Depth (m)	Geological Unit	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)
+22.10			
+21.90	0.20	(TOPSOIL)	SILT, trace clay, organics; dark brown. "Soft"; moist; low plasticity; organics, rootlets. (TOPSOIL)
		(YALDHURST MEMBER, SPRINGSTON FORMATION)	SILT, minor to some clay, trace sand; grey with orange and yellowish-brown mottling. "Firm"; moist; low plasticity; sand, fine to medium. (YALDHURST MEMBER, SPRINGSTON FORMATION) 0.40m Grades to clayey. 0.60m Grades to very stiff. 0.70m Less mottled.
+21.25	0.85		EOH @ 0.85 m
	1		

Legend

Soil Shear Strength (kPa): 50 100 150 200

Scala Penetrometer (blows / 50 mm): 3 6 9 12 15

0.95m

Groundwater

Soil Moisture

Samples: ES0.1 NOV; ES0.5 NOV; ES0.85 NOV

Tests: No. 1
1, 1, 1,
0, 2, 1,
1, 2, 2,
2, 1, 2,
2, 1, 2,
6, 6, 6,
13

V= 138
R= 43

Instrument/ Backfill

Explanations:

- Scala Penetrometer - blows/50mm
- Permeability Test
- Schmidt Hammer
- Insitu Vane Shear Strength (kPa) V=Peak, R=Residual, UTP=Unable to penetrate
- Small Disturbed Sample
- Large Disturbed Sample
- U100 Undisturbed Sample
- Water Strike (1st, 2nd ...)
- Water Rise (1st, 2nd ...) and Rise Time (minutes)

Soil Moisture:
D = dry; M = moist; W = wet; S = saturated

GROUNDWATER

- [X] Not Encountered
- [ ] Slow Seep (depth)
- [ ] Rapid Inflow (depth)

HOLE TERMINATED DUE TO:
[ ] Target depth [X] Refusal [ ] Collapse

Remarks

1. Coordinates and elevations based on hand hand GPS and subject to survey confirmation.
2. Strength terms for cohesive soil layers are based on shear vane test where available. Where no shear vane, cohesive soil strength terms are based on correlation with Scala test results and indicated in quotation marks.

All dimensions in metres Scale 1:10	Contractor:	Rig/Plant Used: Hand Auger	Logged by: RBW	Checked by: CFC

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HAND AUGER LOG

Project:	Location:	Hole position:	No.:
Summerset Rangiora Due Diligence	Townsend Rd/South Belt, Rangiora	Refer to Site Plan.	HA18

Job No.:	Start Date: / Finish Date:	Ground Level (m LINZ):	Co-Ordinates (NZTM2000):
170743	21-12-18 / 21-12-18	24.60	E 1,566,478.5 N 5,203,362.3

Client:	Hole Depth:	Sheet:
Welhom Developments Ltd	0.65 m	1 of 1

Elevation (m LINZ)	Depth (m)	Geological Unit	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)
+24.60			
		(TOPSOIL)	SILT, trace clay, organics; dark brown. "Soft"; moist; low plasticity; organics, rootlets. (TOPSOIL)
			0.20m Grades to "firm".
+24.35	0.25		
		(YALDHURST MEMBER, SPRINGSTON FORMATION)	SILT, minor to some clay, trace sand; grey with orange and yellowish-brown mottling. "Firm"; moist; low plasticity; sand, fine to medium. (YALDHURST MEMBER, SPRINGSTON FORMATION)
			0.50m Grades to "stiff".
+23.95	0.65		0.60m Grades to include trace to minor fine to medium sand. Very stiff.
			EOH @ 0.65 m
	1		

Legend

Soil Shear Strength (kPa): 50 100 150 200

Scala Penetrometer (blows / 50 mm): 3 6 9 12 15

1.00m

Groundwater

Soil Moisture

Samples: ES0.1 NOV; ES0.5 NOV

Tests: No. 1
1, 1, 1,
0, 2, 1,
1, 1, 2,
1, 2, 3,
2, 3, 3,
2, 3, 7,
11, 22

V= 157
R= 46

Instrument/ Backfill

Explanations:

- Scala Penetrometer - blows/50mm
- Permeability Test
- Schmidt Hammer
- Insitu Vane Shear Strength (kPa) V=Peak, R=Residual, UTP=Unable to penetrate
- Small Disturbed Sample
- Large Disturbed Sample
- U100 Undisturbed Sample
- Water Strike (1st, 2nd ...)
- Water Rise (1st, 2nd ...) and Rise Time (minutes)

Soil Moisture:
D = dry; M = moist; W = wet; S = saturated

GROUNDWATER

- [X] Not Encountered
- [ ] Slow Seep (depth)
- [ ] Rapid Inflow (depth)

HOLE TERMINATED DUE TO:
[ ] Target depth [X] Refusal [ ] Collapse

Remarks

1. Coordinates and elevations based on hand hand GPS and subject to survey confirmation.
2. Strength terms for cohesive soil layers are based on shear vane test where available. Where no shear vane, cohesive soil strength terms are based on correlation with Scala test results and indicated in quotation marks.

All dimensions in metres Scale 1:10	Contractor:	Rig/Plant Used: Hand Auger	Logged by: RBW	Checked by: CFC

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HAND AUGER LOG

Project:	Location:	Hole position:	No.:
Summerset Rangiora Due Diligence	Townsend Rd/South Belt, Rangiora	Refer to Site Plan.	HA19

Job No.:	Start Date: / Finish Date:	Ground Level (m LINZ):	Co-Ordinates (NZTM2000):
170743	21-12-18 / 21-12-18	25.70	E 1,566,556.7 N 5,203,359.7

Client:	Hole Depth:	Sheet:
Welhom Developments Ltd	0.90 m	1 of 1

Elevation (m LINZ)	Depth (m)	Geological Unit	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)
+25.70			
+25.40	0.30	(TOPSOIL)	SILT, trace clay, organics; dark brown. "Very soft to soft"; moist; low plasticity; organics, rootlets. (TOPSOIL)
		(YALDHURST MEMBER, SPRINGSTON FORMATION)	SILT, minor to some clay, trace sand; grey with orange and yellowish-brown mottling. "Stiff"; moist; low plasticity; sand, fine to medium. (YALDHURST MEMBER, SPRINGSTON FORMATION) 0.50m Grades to clayey; medium plasticity. 0.60m Grades to very stiff. 0.70m Grades to include trace fine sand.
+24.80	0.90		0.85m Grades to include trace fine gravel, subrounded greywacke.
	1		EOH @ 0.90 m

Legend

Soil Shear Strength (kPa): 50 100 150 200

Scala Penetrometer (blows / 50 mm): 3 6 9 12 15

1.00m

Groundwater

Soil Moisture

Samples: ES0.1 NOV; ES0.5 NOV

Tests: No. 1
1, 1, 0,
1, 0, 1,
2, 2, 2,
2, 2, 2,
2, 2, 3,
3, 4,
10, 14,
20

V= 184
R= 50

Instrument/ Backfill

Explanations:

- Scala Penetrometer - blows/50mm
- Permeability Test
- Schmidt Hammer
- Insitu Vane Shear Strength (kPa) V=Peak, R=Residual, UTP=Unable to penetrate
- Small Disturbed Sample
- Large Disturbed Sample
- U100 Undisturbed Sample
- Water Strike (1st, 2nd ...)
- Water Rise (1st, 2nd ...) and Rise Time (minutes)

Soil Moisture:
D = dry; M = moist; W = wet; S = saturated

GROUNDWATER

- [X] Not Encountered
- [ ] Slow Seep (depth)
- [ ] Rapid Inflow (depth)

HOLE TERMINATED DUE TO:
[ ] Target depth [X] Refusal [ ] Collapse

Remarks

1. Coordinates and elevations based on hand hand GPS and subject to survey confirmation.
2. Strength terms for cohesive soil layers are based on shear vane test where available. Where no shear vane, cohesive soil strength terms are based on correlation with Scala test results and indicated in quotation marks.

All dimensions in metres Scale 1:10	Contractor:	Rig/Plant Used: Hand Auger	Logged by: RBW	Checked by: CFC

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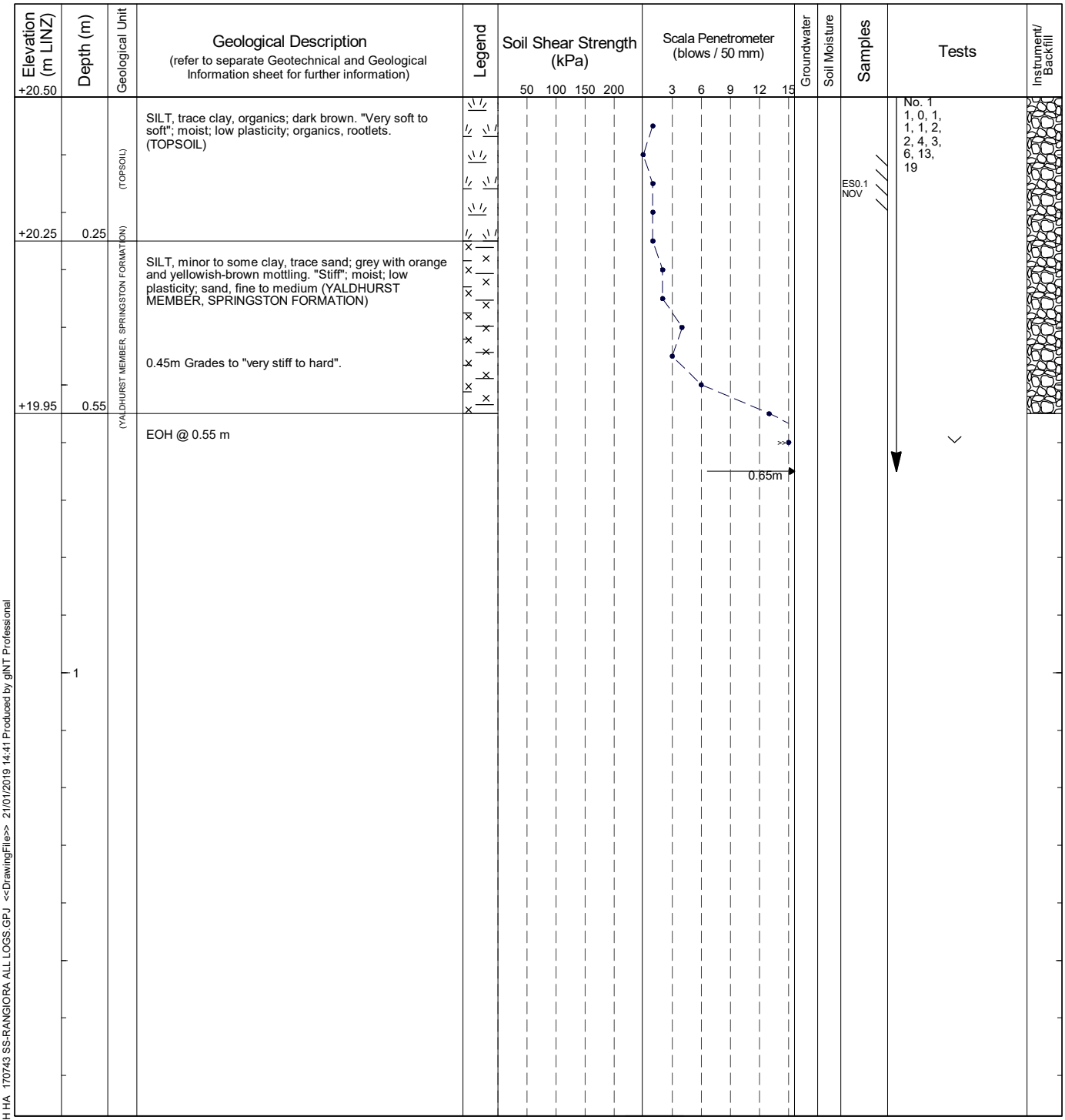
HAND AUGER LOG

Project:	Location:	Hole position:	No.:
Summerset Rangiora Due Diligence	Townsend Rd/South Belt, Rangiora	Refer to Site Plan.	HA20

Job No.:	Start Date: / Finish Date:	Ground Level (m LINZ):	Co-Ordinates (NZTM2000):
170743	21-12-18 / 21-12-18	20.50	E 1,566,642.7 N 5,203,365.5

Client:	Hole Depth:	Sheet:
Welhom Developments Ltd	0.55 m	1 of 1

Elevation (m LINZ)	Depth (m)	Geological Unit	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)
+20.50			
+20.25	0.25	(TOPSOIL)	SILT, trace clay, organics; dark brown. "Very soft to soft"; moist; low plasticity; organics, rootlets. (TOPSOIL)
+19.95	0.55	(YALDHURST MEMBER, SPRINGSTON FORMATION)	SILT, minor to some clay, trace sand; grey with orange and yellowish-brown mottling. "Stiff"; moist; low plasticity; sand, fine to medium (YALDHURST MEMBER, SPRINGSTON FORMATION) 0.45m Grades to "very stiff to hard". EOH @ 0.55 m



Explanations:

- Scala Penetrometer - blows/50mm
- Permeability Test
- Schmidt Hammer
- Insitu Vane Shear Strength (kPa) V=Peak, R=Residual, UTP=Unable to penetrate
- Small Disturbed Sample
- Large Disturbed Sample
- U100 Undisturbed Sample
- Water Strike (1st, 2nd ...)
- Water Rise (1st, 2nd ...) and Rise Time (minutes)

Soil Moisture:
D = dry; M = moist; W = wet; S = saturated

GROUNDWATER

- [X] Not Encountered
- [ ] Slow Seep (depth)
- [ ] Rapid Inflow (depth)

HOLE TERMINATED DUE TO:
[ ] Target depth [X] Refusal [ ] Collapse

Remarks

1. Coordinates and elevations based on hand hand GPS and subject to survey confirmation.
2. Strength terms for cohesive soil layers are based on Scala test results and indicated in quotation marks.

All dimensions in metres Scale 1:10	Contractor:	Rig/Plant Used: Hand Auger	Logged by: RBW	Checked by: CFC

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HAND AUGER LOG

Project:	Location:	Hole position:	No.:
Summerset Rangiora Due Diligence	Townsend Rd/South Belt, Rangiora	Refer to Site Plan.	HA21

Job No.:	Start Date: / Finish Date:	Ground Level (m LINZ):	Co-Ordinates (NZTM2000):
170743	21-12-18 / 21-12-18	21.70	E 1,566,728.9 N 5,203,391.1

Client:	Hole Depth:	Sheet:
Welhom Developments Ltd	0.55 m	1 of 1

Elevation (m LINZ)	Depth (m)	Geological Unit	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)
+21.70			
+21.50	0.20	(TOPSOIL)	SILT, trace clay, organics; dark brown. "Very soft to soft"; moist; low plasticity; organics, rootlets. (TOPSOIL)
+21.15	0.55	(FILL)	SILT, minor to some clay, trace sand, organics and gravel; grey with orange and yellowish-brown mottling. Firm to stiff; moist; low plasticity; sand, fine to medium; organics, fibrous; gravel, fine to medium, subrounded to subangular. (FILL) 0.45m Grades to gravelly; wet to saturated
	1		Gravel grades medium to coarse. EOH @ 0.55 m

Legend

Soil Shear Strength (kPa): 50 100 150 200

Scala Penetrometer (blows / 50 mm): 3 6 9 12 15

1.00m

1.50m

Groundwater

Soil Moisture

Samples: ES0.1 NOV; ES0.5 NOV

Tests: No. 1 1, 0, 1, 1, 1, 2, 1, 2, 4, 3, 3, 5, 7, 5, 3, 3, 2, 2, 1, 2

No. 2 2, 7, 3, 4, 7, 4, 3, 2, 3, 4

Instrument/ Backfill

Explanations:

- Scala Penetrometer - blows/50mm
- Permeability Test
- Schmidt Hammer
- Insitu Vane Shear Strength (kPa) V=Peak, R=Residual, UTP=Unable to penetrate
- Small Disturbed Sample
- Large Disturbed Sample
- U100 Undisturbed Sample
- Water Strike (1st, 2nd ...)
- Water Rise (1st, 2nd ...) and Rise Time (minutes)

Soil Moisture: D = dry; M = moist; W = wet; S = saturated

GROUNDWATER

- [X] Not Encountered
- [ ] Slow Seep (depth)
- [ ] Rapid Inflow (depth)

HOLE TERMINATED DUE TO:

- [ ] Target depth
- [X] Refusal
- [ ] Collapse

Remarks

1. Coordinates and elevations based on hand hand GPS and subject to survey confirmation.
2. Strength terms for cohesive soil layers are based on Scala test results and indicated in quotation marks.

All dimensions in metres Scale 1:10	Contractor:	Rig/Plant Used: Hand Auger	Logged by: RBW	Checked by: CFC

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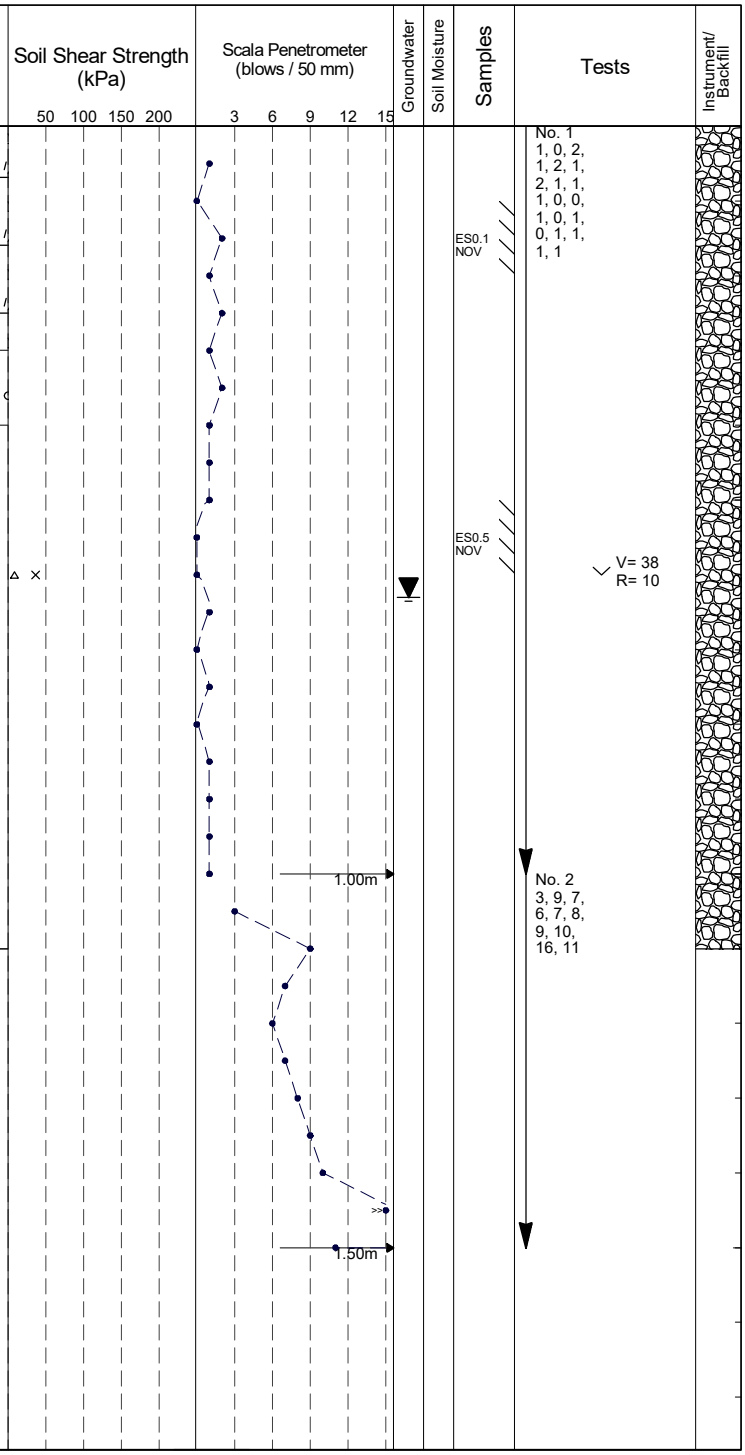
HAND AUGER LOG

Project:	Location:	Hole position:	No.:
Summerset Rangiora Due Diligence	Townsend Rd/South Belt, Rangiora	Refer to Site Plan.	HA22

Job No.:	Start Date: / Finish Date:	Ground Level (m LINZ):	Co-Ordinates (NZTM2000):
170743	21-12-18 / 21-12-18	19.50	E 1,566,653.5 N 5,203,321.4

Client:	Hole Depth:	Sheet:
Welhom Developments Ltd	1.10 m	1 of 1

Elevation (m LINZ)	Depth (m)	Geological Unit	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)
+19.50		(TOPSOIL)	SILT, trace clay, organics and gravel; dark brown. "Soft to firm"; moist; low plasticity; organics, rootlets; gravel, fine to medium, subrounded, greywacke (TOPSOIL)
			0.25m Grades to include yellowish-brown mottling.
+19.20	0.30		
			Gravelly SILT, minor to some sand, trace gravel; grey with orange and yellowish-brown mottling. "Firm"; moist; low plasticity; sand, fine to medium; gravel, fine to medium, subrounded to rounded (YALDHURST MEMBER FORMATION).
+19.10	0.40		0.35m 'Soft to very soft".
		(YALDHURST MEMBER, SPRINGSTON FORMATION)	SILT, minor clay, trace organics; dark grey. "Soft to very soft"; moist; low plasticity; organics, fibrous to amorphous, weak odour. (YALDHURST MEMBER, SPRINGSTON FORMATION)
			0.60m Grades to firm.
			0.75m 50mm lenses of dark brown fibrous PEAT.
	1		1.00m Grades to include minor to some sand, and trace to minor fine gravel.
+18.40	1.10		
			EOH @ 1.10 m



Explanations:

- Scala Penetrometer - blows/50mm
- Permeability Test
- Schmidt Hammer
- Insitu Vane Shear Strength (kPa) V=Peak, R=Residual, UTP=Unable to penetrate
- Small Disturbed Sample
- Large Disturbed Sample
- U100 Undisturbed Sample
- Water Strike (1st, 2nd ...)
- Water Rise (1st, 2nd ...) and Rise Time (minutes)

Soil Moisture:
D = dry; M = moist; W = wet; S = saturated

GROUNDWATER

- [ ] Not Encountered
- [ ] Slow Seep (depth)
- [X] Rapid Inflow (depth 0.6 m)

HOLE TERMINATED DUE TO:
[ ] Target depth [X] Refusal [ ] Collapse

Remarks

1. Coordinates and elevations based on hand hand GPS and subject to survey confirmation.
2. Strength terms for cohesive soil layers are based on shear vane test where available. Where no shear vane, cohesive soil strength terms are based on correlation with Scala test results and indicated in quotation marks.

All dimensions in metres Scale 1:10	Contractor:	Rig/Plant Used: Hand Auger	Logged by: RBW	Checked by: CFC

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HAND AUGER LOG

Project:	Location:	Hole position:	No.:
Summerset Rangiora Due Diligence	Townsend Rd/South Belt, Rangiora	Refer to Site Plan.	HA23

Job No.:	Start Date: / Finish Date:	Ground Level (m LINZ):	Co-Ordinates (NZTM2000):
170743	21-12-18 / 21-12-18	20.50	E 1,566,746.4 N 5,203,300.2

Client:	Hole Depth:	Sheet:
Welhom Developments Ltd	0.80 m	1 of 1

Elevation (m LINZ)	Depth (m)	Geological Unit	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)
+20.50			
		(TOPSOIL)	SILT, trace clay, organics; dark brown. "Very soft"; moist; low plasticity; organics, rootlets. (TOPSOIL)
+20.25	0.25		0.20m Grades to 'soft to very soft'.
		(YALDHURST MEMBER, SPRINGSTON FORMATION)	SILT, minor to some clay, trace sand, organics and gravel; grey with orange and yellowish-brown mottling. "Soft to firm; moist; low plasticity; sand, fine to medium; organics, fibrous; gravel, subrounded to subangular. (YALDHURST MEMBER, SPRINGSTON FORMATION)
			0.60m Grades to clayey. Very stiff.
+19.70	0.80		0.75m Minor orange mottling.
			EOH @ 0.80 m

Legend

Soil Shear Strength (kPa): 50 100 150 200

Scala Penetrometer (blows / 50 mm): 3 6 9 12 15

1.00m

1.15m

Groundwater

Soil Moisture

Samples: ES0.1 NOV; ES0.5 NOV

Tests: No. 1 0, 0, 1, 0, 1, 2, 1, 1, 2, 1, 1, 1, 1, 1, 1, 1, 3, 4, 5, 4; V= 112 R= 36; No. 2 12, 14, 14

Instrument/ Backfill

Explanations:

- Scala Penetrometer - blows/50mm
- Permeability Test
- Schmidt Hammer
- Insitu Vane Shear Strength (kPa) V=Peak, R=Residual, UTP=Unable to penetrate
- Small Disturbed Sample
- Large Disturbed Sample
- U100 Undisturbed Sample
- Water Strike (1st, 2nd ...)
- Water Rise (1st, 2nd ...) and Rise Time (minutes)

Soil Moisture: D = dry; M = moist; W = wet; S = saturated

GROUNDWATER

- [X] Not Encountered
- [ ] Slow Seep (depth)
- [ ] Rapid Inflow (depth)

HOLE TERMINATED DUE TO:

- [ ] Target depth
- [X] Refusal
- [ ] Collapse

Remarks

1. Coordinates and elevations based on hand hand GPS and subject to survey confirmation.
2. Strength terms for cohesive soil layers are based on shear vane test where available. Where no shear vane, cohesive soil strength terms are based on correlation with Scala test results and indicated in quotation marks.

All dimensions in metres Scale 1:10	Contractor:	Rig/Plant Used: Hand Auger	Logged by: RBW	Checked by: CFC

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INSPECTION PIT LOG

Project:	Location:	Hole position:	No.:
Summerset Rangiora Due Diligence	Townsend Rd/South Belt, Rangiora	Refer to Site Plan.	HP1

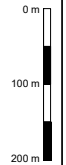
Job No.:	Start Date: / Finish Date:	Ground Level (LINZ):	Co-Ordinates (NZTM2000):
170743	08-01-19 / 08-01-19	27.0m	E 1,566,279.7 N 5,203,530.6

Client:	Hole Depth:	Sheet:
Welhom Developments Ltd	0.50 m	1 of 1

Elevation (m LINZ)	Depth (m)	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)	Legend	Weathering (RS, CW, MW, SW, UW)	Field Strength Soil (VS/VL, S/MD, St/D, VSt/VD, F/E) Rock (VW, W, MS, S, ES)	Defect Description (type, orientation, spacing, roughness, persistence aperture, infilling etc)	Groundwater	Samples	Tests
+27.00									
+26.80	0.20	SILT, some gravel trace clay, organics; dark brown. "Firm to stiff"; dry to moist; low plasticity; gravel, fine to medium, subrounded, greywacke; organics, rootlets. (TOPSOIL)							
+26.50	0.50	SILT, minor to some clay, trace sand; grey with orange and yellowish-brown mottling. Very stiff; moist; low plasticity; sand, fine to medium. (YALDHURST MEMBER, SPRINGSTON FORMATION)						HP1-0.25-0.5	
	1	EOH @ 0.50 m							

SKETCH/PHOTOS:

SITE MAP



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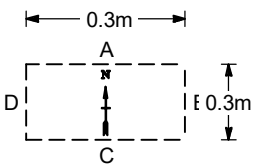
Shoring/Support:
Stability:



SAMPLES AND TESTING
- Grab Sample (Disturbed)
- Bulk Sample (Disturbed)
- Scala Penetrometer (blows/50mm)
- Insitu Vane Shear Strength (kPa): P: Peak; R: Residual; UTP: Unable to penetrate
- Lab Testing: PSD: particle size dist. OMC: optimum moisture cont.; MDD: max dry density; Disp: dispersivity

GROUNDWATER
- [X] None
- [ ] Slow Seep
- [ ] Rapid Inflow
- Water Strike
- Water Rise
- Time (minutes)

TERMINATION DUE TO
- [X] Target depth
- [ ] Refusal
- [ ] Collapse
- [ ] Machine limit

Remarks
1. Coordinates and elevations based on hand hand GPS and subject to survey confirmation.
2. Hand pit located between HA1 and HA7, undertaken for soil sampling and lab testing.
3. Strength terms based on strength testing in nearby HA/BH.
4. Samples may contain trace material from above topsoil.

All dimensions in metres Scale 1:10	Contractor:	Rig/Plant Used: Hand Excavation	Logged by: AvD	Checked by: CFC

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INSPECTION PIT LOG

Project:	Location:	Hole position:	No.:
Summerset Rangiora Due Diligence	Townsend Rd/South Belt, Rangiora	Refer to Site Plan.	HP2

Job No.:	Start Date: / Finish Date:	Ground Level (LINZ):	Co-Ordinates (NZTM2000):
170743	08-01-19 / 08-01-19	26.7m	E 1,566,464.6 N 5,203,422.0

Client:	Hole Depth:	Sheet:
Welhom Developments Ltd	0.50 m	1 of 1

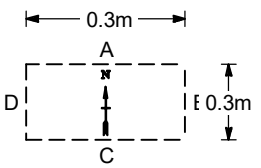
Elevation (m LINZ)	Depth (m)	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)	Legend	Weathering (RS, CW, MW, SW, UW)	Field Strength Soil (VS/VL, S/MD, St/D, VSt/VD, F/E) Rock (VW, W, MS, S, EW)	Defect Description (type, orientation, spacing, roughness, persistence aperture, infilling etc)	Groundwater	Samples	Tests
+26.70									
+26.50	0.20	SILT, trace clay, organics; dark brown. "Firm to stiff"; dry to moist; low plasticity; organics, rootlets. (TOPSOIL)							
+26.20	0.50	SILT, minor to some clay, trace sand; grey with orange and yellowish-brown mottling. Very stiff; moist; low plasticity; sand, fine to medium. (YALDHURST MEMBER, SPRINGSTON FORMATION)						HP1-0.25-0.5	
	1	EOH @ 0.50 m							

SKETCH/PHOTOS:

SITE MAP

1:10,000

Shoring/Support:
Stability:



SAMPLES AND TESTING
- Grab Sample (Disturbed)
- Bulk Sample (Disturbed)
- Scala Penetrometer (blows/50mm)
- Insitu Vane Shear Strength (kPa): P: Peak; R: Residual; UTP: Unable to penetrate
- Lab Testing: PSD: particle size dist. OMC: optimum moisture cont.; MDD: max dry density; Disp: dispersivity

GROUNDWATER
- [X] None
- [ ] Slow Seep
- [ ] Rapid Inflow
- Water Strike
- Water Rise
- Time (minutes)

TERMINATION DUE TO
- [X] Target depth
- [ ] Refusal
- [ ] Collapse
- [ ] Machine limit

Remarks
1. Coordinates and elevations based on hand hand GPS and subject to survey confirmation.
2. Hand pit located adjacent to BH1, undertaken for soil sampling and lab testing.
3. Strength terms based on strength testing in nearby HA/BH.
4. Samples may contain trace material from above topsoil.

All dimensions in metres Scale 1:10	Contractor:	Rig/Plant Used: Hand Excavation	Logged by: AvD	Checked by: CFC

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INSPECTION PIT LOG

Project:	Location:	Hole position:	No.:
Summerset Rangiora Due Diligence	Townsend Rd/South Belt, Rangiora	Refer to Site Plan.	HP3

Job No.:	Start Date: / Finish Date:	Ground Level (LINZ):	Co-Ordinates (NZTM2000):
170743	08-01-19 / 08-01-19	24.4m	E 1,566,561.3 N 5,203,517.3

Client:	Hole Depth:	Sheet:
Welhom Developments Ltd	0.50 m	1 of 1

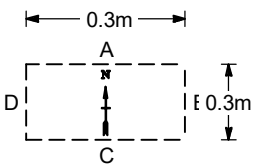
Elevation (m LINZ)	Depth (m)	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)	Legend	Weathering (RS CW MW SW UW)	Field Strength Soil (VS/VL S F/MD St/D VSt/VD) Rock (EW VW W MS S VS)	Defect Description (type, orientation, spacing, roughness, persistence aperture, infilling etc)	Groundwater	Samples	Tests
+24.40									
+24.20	0.20	SILT, trace clay, organics; dark brown. "Firm to stiff"; dry to moist; low plasticity; organics, rootlets. (TOPSOIL)							
+23.90	0.50	SILT, minor to some clay, trace sand; grey with orange and yellowish-brown mottling. Very stiff; moist; low plasticity; sand, fine to medium. (YALDHURST MEMBER, SPRINGSTON FORMATION)						HP1-0.25-0.5	
	1	EOH @ 0.50 m							

SKETCH/PHOTOS:

SITE MAP

1:10,000

Shoring/Support:
Stability:



SAMPLES AND TESTING
- Grab Sample (Disturbed)
- Bulk Sample (Disturbed)
- Scala Penetrometer (blows/50mm)
- Insitu Vane Shear Strength (kPa): P: Peak; R: Residual; UTP: Unable to penetrate
- Lab Testing: PSD: particle size dist. OMC: optimum moisture cont.; MDD: max dry density; Disp: dispersivity

GROUNDWATER
- [X] None
- [ ] Slow Seep
- [ ] Rapid Inflow
- Water Strike
- Water Rise
- Time (minutes)

TERMINATION DUE TO
- [X] Target depth
- [ ] Refusal
- [ ] Collapse
- [ ] Machine limit

Remarks
1. Coordinates and elevations based on hand hand GPS and subject to survey confirmation.
2. Hand pit located adjacent to BH2, undertaken for soil sampling and lab testing.
3. Strength terms based on strength testing in nearby HA/BH.
4. Samples may contain trace material from above topsoil.

All dimensions in metres Scale 1:10	Contractor:	Rig/Plant Used: Hand Excavation	Logged by: AvD	Checked by: CFC

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INSPECTION PIT LOG

Project:	Location:	Hole position:	No.:
Summerset Rangiora Due Diligence	Townsend Rd/South Belt, Rangiora	Refer to Site Plan.	HP4

Job No.:	Start Date: / Finish Date:	Ground Level (LINZ):	Co-Ordinates (NZTM2000):
170743	08-01-19 / 08-01-19	21.2m	E 1,566,660.3 N 5,203,611.3

Client:	Hole Depth:	Sheet:
Welhom Developments Ltd	0.50 m	1 of 1

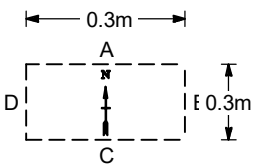
Elevation (m LINZ)	Depth (m)	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)	Legend	Weathering (RS, CW, MW, SW, UW)	Field Strength Soil (VS/VL, S/MD, St/D, VSt/VD, F/E) Rock (VW, W, MS, S, ES)	Defect Description (type, orientation, spacing, roughness, persistence aperture, infilling etc)	Groundwater	Samples	Tests
+21.20									
+21.00	0.20	SILT, trace clay, organics; dark brown. "Firm to stiff"; dry to moist; low plasticity; organics, rootlets. (TOPSOIL)							
+20.70	0.50	SILT, minor to some clay, trace sand; grey with orange and yellowish-brown mottling. Very stiff; moist; low plasticity; sand, fine to medium. (YALDHURST MEMBER, SPRINGSTON FORMATION)						HP1-0.25-0.5	
	1	EOH @ 0.50 m							

SKETCH/PHOTOS:

SITE MAP

1:10,000

Shoring/Support:
Stability:



SAMPLES AND TESTING
- Grab Sample (Disturbed)
- Bulk Sample (Disturbed)
- Scala Penetrometer (blows/50mm)
- Insitu Vane Shear Strength (kPa): P: Peak; R: Residual; UTP: Unable to penetrate
- Lab Testing: PSD: particle size dist. OMC: optimum moisture cont.; MDD: max dry density; Disp: dispersivity

GROUNDWATER
- [X] None
- [ ] Slow Seep
- [ ] Rapid Inflow
- Water Strike
- Water Rise
- Time (minutes)

TERMINATION DUE TO
- [X] Target depth
- [ ] Refusal
- [ ] Collapse
- [ ] Machine limit

Remarks
1. Coordinates and elevations based on hand hand GPS and subject to survey confirmation.
2. Hand pit located adjacent to BH4, undertaken for soil sampling and lab testing.
3. Strength terms based on strength testing in nearby HA/BH.
4. Samples may contain trace material from above topsoil.

All dimensions in metres Scale 1:10	Contractor:	Rig/Plant Used: Hand Excavation	Logged by: AvD	Checked by: CFC

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INSPECTION PIT LOG

Project:	Location:	Hole position:	No.:
Summerset Rangiora Due Diligence	Townsend Rd/South Belt, Rangiora	Refer to Site Plan.	HP5

Job No.:	Start Date: / Finish Date:	Ground Level (LINZ):	Co-Ordinates (NZTM2000):
170743	08-01-19 / 08-01-19	22.4m	E 1,566,694.2 N 5,203,361.3

Client:	Hole Depth:	Sheet:
Welhom Developments Ltd	0.50 m	1 of 1

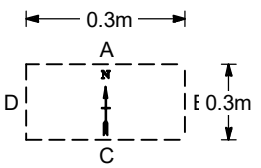
Elevation (m LINZ)	Depth (m)	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)	Legend	Weathering (RS CW MW SW UW)	Field Strength Soil (VS/VL S F/MD St/D VSt/VD) Rock (EW VW W MS S EXS)	Defect Description (type, orientation, spacing, roughness, persistence aperture, infilling etc)	Groundwater	Samples	Tests
+22.40									
+22.20	0.20	SILT, trace clay, organics; dark brown. "Firm to stiff"; dry to moist; low plasticity; organics, rootlets. (TOPSOIL)							
+21.90	0.50	SILT, minor to some clay, trace sand; grey with orange and yellowish-brown mottling. Very stiff; moist; low plasticity; sand, fine to medium. (YALDHURST MEMBER, SPRINGSTON FORMATION)						HP1-0.25-0.5	
	1	EOH @ 0.50 m							

SKETCH/PHOTOS:

SITE MAP

1:10,000

Shoring/Support:
Stability:



SAMPLES AND TESTING
- Grab Sample (Disturbed)
- Bulk Sample (Disturbed)
- Scala Penetrometer (blows/50mm)
- Insitu Vane Shear Strength (kPa): P: Peak; R: Residual; UTP: Unable to penetrate
- Lab Testing: PSD: particle size dist. OMC: optimum moisture cont.; MDD: max dry density; Disp: dispersivity

GROUNDWATER
- [X] None
- [ ] Slow Seep
- [ ] Rapid Inflow
- Water Strike
- Water Rise
- Time (minutes)

TERMINATION DUE TO
- [X] Target depth
- [ ] Refusal
- [ ] Collapse
- [ ] Machine limit

Remarks
1. Coordinates and elevations based on hand hand GPS and subject to survey confirmation.
2. Hand pit located adjacent to BH5, undertaken for soil sampling and lab testing.
3. Strength terms based on strength testing in nearby HA/BH.
4. Samples may contain trace material from above topsoil.

All dimensions in metres Scale 1:10	Contractor:	Rig/Plant Used: Hand Excavation	Logged by: AvD	Checked by: CFC

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DRILL HOLE LOG

Project:	Location:	Hole position:	No.:
Summerset Rangiora Due Diligence	Townsend Rd/South Belt, Rangiora	Refer to Site Plan.	BH1

Job No.:	Start Date: / Finish Date:	Ground Level (m LINZ):	Co-Ordinates (NZTM2000):
170743	18-12-18 / 19-12-18	23.70	E 1,566,522 N 5,203,465

Client:	Hole Depth:	Angle from Horiz.:	Direction:	Sheet:
Welhom Developments Ltd	15.20 m		-90° NZTM2000	1 of 2

Type	Run	Fluid & Water	Piezometer	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)	Legend	Weathering (RS CW MW SW UW)	Field Strength Soil | Rock (VS/VL F/MD St/D VSt/VD VF/H W S s VS ES)	Elevation (m LINZ)	Depth (m)	Symbolic Defect Log	Average Defect Spacing (mm) (500 100 20)	Defect Description (type, orientation, spacing, roughness, persistence aperture, infilling etc)	TCR (SCR) RQD (%)	Samples	Tests
SONIC GEOPROBE 8140LC (150Hz)	0.00			CLAY, trace organics; dark brown. "Very soft"; moist; highly plastic; organics, rootlets (TOPSOIL)				+23.35							
				CLAY; light brown with grey mottling. "Firm"; moist; highly plastic (YALDHURST MEMBER, SPRINGSTON FORMATION)				+22.80	1				118 ()		
	1.52			Sandy fine to coarse GRAVEL; mottled grey and brown. Dense; moist; gravel, subrounded to subangular, grewacke; sand, fine to medium.				+21.86	2				102 ()		SPT 1.52 m 10, 6, 8, 10, 11, 14; N = 43
				Fine to medium SAND, some gravel and silt, minor cobbles; brown. "Dense"; moist; gravel, as above.				+21.50							
	3.04			Sandy fine to coarse GRAVEL, some silt, minor cobbles; brown. "Dense to very dense"; moist; gravel and sand, as above.					3				105 ()		SPT 3.04 m 7, 9, 12, 10, 11, 14; N = 47
				3.90m Grades to orange brown; wet					4						
	4.56			4.50m Grades to saturated.					5				118 ()		SPT 4.56 m 7, 8, 10, 12, 14, 14; N = 50
	6.08								6				105 ()		SPT 6.08 m 11, 14, 16, 16, 14, 14; N = 60
	7.60								7				102 ()		SPT 7.60 m 35, 25; N > 50

Explanations:

Rock Mass Weathering: unweathered (UW), slightly weathered (SW), moderately weathered (MW), highly weathered (HW), completely weathered (CW), residually weathered (RW)

Relative Rock Strength - extremely weak, very weak, weak, moderately strong, strong, very strong

TCR - Total Core Recovery
SCR - Solid Core Recovery
RQD - Rock Quality Designation
Attitude of defects displayed as Dip/Dip Direction and Trend/Plunge

Backfill:

- Bentonite
- Grout
- Drill arisings or collapsed hole
- Filter material
- Lugeon Test: Flow Type/Adopted Value
- Water Strike (1st, 2nd ...)
- Water Rise (1st, 2nd ...) and Rise
- Time (minutes)

Remarks

1. Coordinates and elevations based on hand-held GPS and subject to survey confirmation.
2. No core loss. Recovered core sample typically exceeds run length by 5-10%.
3. SPT hammer efficiency 93.8%; solid cone used unless indicated on log.
4. Water added during drilling influenced initial water strike depth.

All dimensions in metres Scale 1:50	Contractor: McMillan Drilling	Core Boxes: 0	Rig/Plant Used: Geoprobe Sonic (McMillan)	Driller: Paul	Logged by: DDH	Checked by: CFC

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DRILL HOLE LOG

Project:	Location:	Hole position:	No.:
Summerset Rangiora Due Diligence	Townsend Rd/South Belt, Rangiora	Refer to Site Plan.	BH1

Job No.:	Start Date: / Finish Date:	Ground Level (m LINZ):	Co-Ordinates (NZTM2000):
170743	18-12-18 / 19-12-18	23.70	E 1,566,522 N 5,203,465

Client:	Hole Depth:	Angle from Horiz.:	Direction:	Sheet:
Welhom Developments Ltd	15.20 m		-90° NZTM2000	2 of 2

Type	Run	Fluid & Water	Piezometer	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)	Legend	Weathering (RS CW MW SW UW)	Field Strength Soil | Rock (VS/VL F/MD St/D VSt/VD VW W MS S VS ES)	Elevation (m LINZ)	Depth (m)	Symbolic Defect Log	Average Defect Spacing (mm) (500 100 20)	Defect Description (type, orientation, spacing, roughness, persistence aperture, infilling etc)	TCR (SCR) RQD (%)	Samples	Tests
SONIC GEOPROBE 8140LC (150Hz)	7.60			7.95m Some cobbles. Sandy fine to coarse GRAVEL, some silt, minor cobbles; brown. "Dense to very dense"; moist; gravel and sand, as above. *(continued)* 8.90m Some clay.					9				102 ()		
	9.12														SPT 9.12 m 10, 9, 10, 10, 10, 16; N = 46
									10				100 ()		
	10.64														SPT 10.64 m 15, 27, 35, 25/65mm; N > 50
									11				118 ()		
	12.16			Silty fine to medium SAND; brownish grey. Very dense; moist.				+11.54	12						SPT 12.16 m 14, 20, 20, 26, 14/20 mm; N > 50
									13				118 ()		
	13.68			Sandy fine to coarse GRAVEL, some silt, minor cobbles; brownish grey. Very dense; moist; gravel and sand, as above.				+10.02	14						SPT 13.68 m 24, 22, 22, 28, 10/20 mm; N > 50
													100 ()		
				EOH @ 15.20 m				+8.50	15						SPT 15.20 m 30, 21, 25, 28, 7/15 mm; N > 50

Explanations:

Rock Mass Weathering: unweathered (UW), slightly weathered (SW), moderately weathered (MW), highly weathered (HW), completely weathered (CW), residually weathered (RW)

Relative Rock Strength - extremely weak, very weak, weak, moderately strong, strong, very strong

TCR - Total Core Recovery
SCR - Solid Core Recovery
RQD - Rock Quality Designation
Attitude of defects displayed as Dip/Dip Direction and Trend/Plunge

Backfill:

- Bentonite
- Drill arisings or collapsed hole
- Grout
- Filter material
- Lugeon Test: Flow Type/Adopted Value
- Water Strike (1st, 2nd ...)
- Water Rise (1st, 2nd ...) and Rise
- Time (minutes)

Remarks

1. Coordinates and elevations based on hand-held GPS and subject to survey confirmation.
2. No core loss. Recovered core sample typically exceeds run length by 5-10%.
3. SPT hammer efficiency 93.8%; solid cone used unless indicated on log.
4. Water added during drilling influenced initial water strike depth.

All dimensions in metres Scale 1:50	Contractor: McMillan Drilling	Core Boxes: 0	Rig/Plant Used: Geoprobe Sonic (McMillan)	Driller: Paul	Logged by: DDH	Checked by: CFC

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DRILL HOLE LOG

Project:	Location:	Hole position:	No.:
Summerset Rangiora Due Diligence	Townsend Rd/South Belt, Rangiora	Refer to Site Plan.	BH2

Job No.:	Start Date: / Finish Date:	Ground Level (m LINZ):	Co-Ordinates (NZTM2000):
170743	17-12-18 / 18-12-18	24.40	E 1,566,561 N 5,203,517

Client:	Hole Depth:	Angle from Horiz.:	Direction:	Sheet:
Welhom Developments Ltd	15.20 m		-90° NZTM2000	1 of 2

Type	Run	Fluid & Water	Piezometer	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)	Legend	Weathering (RS CW MW SW UW)	Field Strength Soil | Rock (VS/VL F/MD St/D VSt/VD VW W MS S VS ES)	Elevation (m LINZ)	Depth (m)	Symbolic Defect Log	Average Defect Spacing (mm) (500 100 20)	Defect Description (type, orientation, spacing, roughness, persistence aperture, infilling etc)	TCR (SCR) RQD (%)	Samples	Tests
SONIC GEOPROBE 8140LC (150Hz)				SILT, minor clay; brown. "Soft"; moist; low plasticity (TOPSOIL)				+24.20							
				SILT, minor clay; mottled light grey and orange. "Soft"; moist; low plasticity (YALDHURST MEMBER, SPRINGSTON FORMATION)				+23.70					()		
		1 ▽		Sandy fine to coarse GRAVEL, trace to minor silt; brownish-grey. Dense; moist; gravel, subrounded to subangular, grewacke; sand, fine to medium.					1						SPT 1.52 m 7, 7, 8, 8, 9, 9; N = 34
									2				()		
				3.00m Grades to very dense.					3						SPT 3.04 m 10, 13, 15, 14, 15, 13; N = 57
		1 ▽		3.40m GRAVEL, loosely-packed.					4				()		
									5						SPT 4.56 m 8, 9, 14, 14, 12, 14; N = 54
									6				()		
									7						SPT 6.08 m 11, 20, 27, 23, 10/35mm; N > 50
				7.92m - 9.12m Grades to silty.					8				()		SPT 7.60 m 10, 27, 25, 25, 10/20 mm; N > 50

Explanations:

Rock Mass Weathering: unweathered (UW), slightly weathered (SW), moderately weathered (MW), highly weathered (HW), completely weathered (CW), residually weathered (RW)

Relative Rock Strength - extremely weak, very weak, weak, moderately strong, strong, very strong

TCR - Total Core Recovery
SCR - Solid Core Recovery
RQD - Rock Quality Designation
Attitude of defects displayed as Dip/Dip Direction and Trend/Plunge

Backfill:

- Bentonite
- Grout
- Drill arisings or collapsed hole
- Filter material
- Lugeon Test: Flow Type/Adopted Value
- Water Strike (1st, 2nd ...)
- Water Rise (1st, 2nd ...) and Rise
- Time (minutes)

Remarks

1. Coordinates and elevations based on hand-held GPS and subject to survey confirmation.
2. No core loss. Recovered core sample typically exceeds run length by 5-10%.
3. SPT hammer efficiency 93.8%; solid cone used unless indicated on log.
4. Water added during drilling influenced initial water strike depth.

All dimensions in metres Scale 1:51	Contractor: McMillan Drilling	Core Boxes: 0	Rig/Plant Used: Geoprobe Sonic (McMillan)	Driller: Paul	Logged by: AvD	Checked by: CFC

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DRILL HOLE LOG

Project:	Location:	Hole position:	No.:
Summerset Rangiora Due Diligence	Townsend Rd/South Belt, Rangiora	Refer to Site Plan.	BH2

Job No.:	Start Date: / Finish Date:	Ground Level (m LINZ):	Co-Ordinates (NZTM2000):
170743	17-12-18 / 18-12-18	24.40	E 1,566,561 N 5,203,517

Client:	Hole Depth:	Angle from Horiz.:	Direction:	Sheet:
Welhom Developments Ltd	15.20 m		-90° NZTM2000	2 of 2

Type	Run	Fluid & Water	Piezometer	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)	Legend	Weathering (RS, CW, MW, SW, UW)	Field Strength Soil | Rock (VS/VL, S/F/MD, St/D, VSt/VD, VW, W, MS, S, VS, ES)	Elevation (m LINZ)	Depth (m)	Symbolic Defect Log	Average Defect Spacing (mm) (500, 100, 20)	Defect Description (type, orientation, spacing, roughness, persistence aperture, infilling etc)	TCR (SCR) RQD (%)	Samples	Tests
SONIC GEOPROBE 8140LC (150Hz)				Sandy fine to coarse GRAVEL, trace to minor silt; brownish-grey. Dense; moist; gravel, subrounded to subangular, grewacke; sand, fine to medium. *(continued)*					9				()		SPT 9.12 m 9, 12, 17, 20, 21, 5mm; N > 50
				10.04m - 10.64m Grades to silty.					10				()		SPT 10.64 m 12, 20, 20, 27, 13/20 mm; N > 50
				12.16m Grades to include trace clay					11				()		SPT 12.16 m 10, 9, 13, 17, 17, 13/45mm; N > 50
				14.60m - 15.20m Grades to silty.					12				()		SPT 13.68 m 20, 40; N > 50
									13				()		
				EOH @ 15.20 m				+9.20	14						SPT 15.20 m 22, 24, 40, 20/20mm; N > 50
									15						
									16						

Explanations:

Rock Mass Weathering: unweathered (UW), slightly weathered (SW), moderately weathered (MW), highly weathered (HW), completely weathered (CW), residually weathered (RW)

Relative Rock Strength - extremely weak, very weak, weak, moderately strong, strong, very strong

TCR - Total Core Recovery
SCR - Solid Core Recovery
RQD - Rock Quality Designation
Attitude of defects displayed as Dip/Dip Direction and Trend/Plunge

Backfill:

- Bentonite
- Drill arisings or collapsed hole
- Grout
- Filter material
- Lugeon Test: Flow Type/Adopted Value
- Water Strike (1st, 2nd ...)
- Water Rise (1st, 2nd ...) and Rise
- Time (minutes)

Remarks

1. Coordinates and elevations based on hand-held GPS and subject to survey confirmation.
2. No core loss. Recovered core sample typically exceeds run length by 5-10%.
3. SPT hammer efficiency 93.8%; solid cone used unless indicated on log.
4. Water added during drilling influenced initial water strike depth.

All dimensions in metres Scale 1:51	Contractor: McMillan Drilling	Core Boxes: 0	Rig/Plant Used: Geoprobe Sonic (McMillan)	Driller: Paul	Logged by: AvD	Checked by: CFC

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DRILL HOLE LOG

Project:	Location:	Hole position:	No.:
Summerset Rangiora Due Diligence	Townsend Rd/South Belt, Rangiora	Refer to Site Plan.	BH3

Job No.:	Start Date: / Finish Date:	Ground Level (m LINZ):	Co-Ordinates (NZTM2000):
170743	18-12-18 / 18-12-18	24.40	E 1,566,367 N 5,203,588

Client:	Hole Depth:	Angle from Horiz.:	Direction:	Sheet:
Welhom Developments Ltd	6.08 m		-90° NZTM2000	1 of 1

Type	Run	Fluid & Water	Piezometer	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)	Legend	Weathering (RS CW MW SW UW)	Field Strength Soil | Rock (VS/VL F/MD St/D VSt/VD H/EH VW W MS S VS ES)	Elevation (m LINZ)	Depth (m)	Symbolic Defect Log	Average Defect Spacing (mm) (500 100 20)	Defect Description (type, orientation, spacing, roughness, persistence aperture, infilling etc)	TCR (SCR) RQD (%)	Samples	Tests
SONIC GEOPROBE 8140LC (150Hz)				SILT, minor clay; brown. "Soft"; moist; low plasticity (TOPSOIL)				+24.15	0						
				SILT, minor clay; mottled light grey and orange. "Soft"; moist; low plasticity; slightly dilatant. (YALDHURST MEMBER, SPRINGSTON FORMATION) 0.80m Grades to sandy SILT; sand, fine to medium.				+23.35	1				()		
				Sandy fine to coarse GRAVEL, trace to minor silt; brownish-grey. Medium dense; moist; gravel, subrounded to subangular, grewacke; sand, fine to medium.				+22.70							SPT 1.52 m 4, 5, 4, 4, 3, 4; N = 15
				Gravelly silty fine to medium SAND, minor clay. "Medium dense"; moist; low plasticity; dilatant.				+22.30	2				()		
				Sandy fine to coarse GRAVEL, trace to minor silt; brownish-grey. Dense to very dense; moist; gravel, subrounded to angular (broken cobbles), grewacke; sand, fine to medium. 3.04m Grades to saturated.					3						SPT 3.04 m 12, 14, 15, 13, 12, 11; N = 51
									4				()		
									5						SPT 4.56 m 6, 10, 10, 12, 11, 12; N = 45
								+18.32	6				()		
				EOH @ 6.08 m					7						SPT 6.08 m 12, 15, 20, 23, 17; N > 50
									8						

Explanations:

Rock Mass Weathering: unweathered (UW), slightly weathered (SW), moderately weathered (MW), highly weathered (HW), completely weathered (CW), residually weathered (RW)

Relative Rock Strength - extremely weak, very weak, weak, moderately strong, strong, very strong

TCR - Total Core Recovery
SCR - Solid Core Recovery
RQD - Rock Quality Designation
Attitude of defects displayed as Dip/Dip Direction and Trend/Plunge

Backfill:

- Bentonite
- Drill arisings or collapsed hole
- Grout
- Filter material
- Lugeon Test: Flow Type/Adopted Value
- Water Strike (1st, 2nd ...)
- Water Rise (1st, 2nd ...) and Rise
- Time (minutes)

Remarks

1. Coordinates and elevations based on hand-held GPS and subject to survey confirmation.
2. No core loss. Recovered core sample typically exceeds run length by 5-10%.
3. SPT hammer efficiency 93.8%; solid cone used unless indicated on log.
4. Water added during drilling influenced initial water strike depth.

All dimensions in metres Scale 1:51	Contractor: McMillan Drilling	Core Boxes: 0	Rig/Plant Used: Geoprobe Sonic (McMillan)	Driller: Paul	Logged by: AvD	Checked by: CFC

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DRILL HOLE LOG

Project:	Location:	Hole position:	No.:
Summerset Rangiora Due Diligence	Townsend Rd/South Belt, Rangiora	Refer to Site Plan.	BH4

Job No.:	Start Date: / Finish Date:	Ground Level (m LINZ):	Co-Ordinates (NZTM2000):
170743	20-12-18 / 20-12-18	21.20	E 1,566,660 N 5,203,611

Client:	Hole Depth:	Angle from Horiz.:	Direction:	Sheet:
Welhom Developments Ltd	6.08 m		-90° NZTM2000	1 of 1

Type	Run	Fluid & Water	Piezometer	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)	Legend	Weathering (RS CW MW SW UW)	Field Strength Soil | Rock (VS/VL S/FM St/D VSt/VD VF/H W MS S VS ES)	Elevation (m LINZ)	Depth (m)	Symbolic Defect Log	Average Defect Spacing (mm) (500 100 20)	Defect Description (type, orientation, spacing, roughness, persistence aperture, infilling etc)	TCR (SCR) RQD (%)	Samples	Tests
SONIC GEOPROBE 8140LC (150Hz)				CLAY, trace organics; dark brown. "Very soft"; moist; high plasticity; organics, rootlets (TOPSOIL)				+20.95	0				()		
				CLAY; brown with grey mottling. "Firm"; moist; highly plastic (YALDHURST MEMBER, SPRINGSTON FORMATION)				+19.68	1						
				Silty fine to coarse SAND with minor gravel; greyish-brown. Medium dense to dense; moist; gravel, subrounded to subangular, greywacke.				+19.36							SPT 1.52 m 11, 14, 11, 14, 14, 11; N = 50
				Fine to coarse GRAVEL with some sand and silt; orange-brown. "Loose"; saturated; gravel and sand, as above.				+18.75	2				()		
				Silty fine to coarse SAND with minor gravel; greyish-brown. Medium dense; moist; gravel, subrounded to subangular, greywacke.				+18.16	3						SPT 3.04 m 8, 8, 13, 13, 15, 13; N = 54
				Fine to coarse GRAVEL with some sand and silt; orange-brown. Very dense; saturated; gravel and sand, as above.				+17.60							
				Silty fine to coarse SAND with minor gravel; greyish-brown. "Loose"; moist; gravel, subrounded to subangular, greywacke.				+17.24	4				()		
				Fine to coarse GRAVEL with some sand and silt; orange-brown. Dense; saturated; gravel and sand, as above.											SPT 4.56 m 7, 6, 8, 8, 8, 10; N = 34
				4.50m Grades very dense.				+15.12	5						
				EOH @ 6.08 m					6						SPT 6.08 m 15, 20, 30, 24, 6/10 mm; N > 50
									7						
									8						

Explanations:

Rock Mass Weathering: unweathered (UW), slightly weathered (SW), moderately weathered (MW), highly weathered (HW), completely weathered (CW), residually weathered (RW)

Relative Rock Strength - extremely weak, very weak, weak, moderately strong, strong, very strong

TCR - Total Core Recovery
SCR - Solid Core Recovery
RQD - Rock Quality Designation
Attitude of defects displayed as Dip/Dip Direction and Trend/Plunge

Backfill:

- Bentonite
- Drill arisings or collapsed hole
- Grout
- Filter material
- Lugeon Test: Flow Type/Adopted Value
- Water Strike (1st, 2nd ...)
- Water Rise (1st, 2nd ...) and Rise
- Time (minutes)

Remarks

1. Coordinates and elevations based on hand-held GPS and subject to survey confirmation.
2. No core loss. Recovered core sample typically exceeds run length by 5-10%.
3. SPT hammer efficiency 93.8%; solid cone used unless indicated on log.
4. Water added during drilling influenced initial water strike depth.

All dimensions in metres Scale 1:51	Contractor: McMillan Drilling	Core Boxes: 0	Rig/Plant Used: Geoprobe Sonic (McMillan)	Driller: Paul	Logged by: DDH	Checked by: CFC

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DRILL HOLE LOG

Project:	Location:	Hole position:	No.:
Summerset Rangiora Due Diligence	Townsend Rd/South Belt, Rangiora	Refer to Site Plan.	BH5

Job No.:	Start Date: / Finish Date:	Ground Level (m LINZ):	Co-Ordinates (NZTM2000):
170743	19-12-18 / 19-12-18	22.40	E 1,566,694 N 5,203,361

Client:	Hole Depth:	Angle from Horiz.:	Direction:	Sheet:
Welhom Developments Ltd	6.08 m		-90° NZTM2000	1 of 1

Type	Run	Fluid & Water	Piezometer	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)	Legend	Weathering (RS CW MW SW UW)	Field Strength Soil | Rock (VS/VL S/LND St/D VSt/VD VW/F W MS S VS ES)	Elevation (m LINZ)	Depth (m)	Symbolic Defect Log	Average Defect Spacing (mm) (500 100 20)	Defect Description (type, orientation, spacing, roughness, persistence aperture, infilling etc)	TCR (SCR) RQD (%)	Samples	Tests
SONIC GEOPROBE 8140LC (150Hz)				SILT, minor clay; brown. "Soft"; moist; low plasticity (TOPSOIL)				+22.20	0						
				Clayey SILT; mottled light grey and orange. "Soft"; moist; low plasticity (YALDHURST MEMBER, SPRINGSTON FORMATION) 0.60m Grades to light grey with orange mottling.				+20.90	1				()		
				Silty sandy GRAVEL; brownish-grey. Medium dense; moist to wet; gravel, fine to coarse, subrounded, greywacke; sand, fine to medium.				+19.90	2						SPT 1.52 m 5, 5, 4, 5, 5, 6; N = 20
				SILT, some sand, trace clay and gravel; brownish grey. "Very stiff"; gravel, subrounded to subangular, greywacke; sand, fine to medium.				+19.70	3				()		SPT 3.04 m 10, 12, 15, 15, 16, 14; N = 60
				Sandy fine to coarse GRAVEL, trace to minor silt; brownish-grey. Very dense; moist; gravel, subrounded to subangular, greywacke; sand, fine to medium. 3.04m Grades to fine to coarse GRAVEL, some sand, minor silt; greyish brown. 3.96m Grades to trace silt; dark brown. 4.56m Grades to light brownish-grey.				+16.32	4				()		SPT 4.56 m 6, 11, 12, 15, 17, 17; N = 61
				EOH @ 6.08 m					5				()		SPT 6.08 m 10, 13, 17, 21, 23; N > 50
									6						
									7						
									8						

Explanations:

Rock Mass Weathering: unweathered (UW), slightly weathered (SW), moderately weathered (MW), highly weathered (HW), completely weathered (CW), residually weathered (RW)

Relative Rock Strength - extremely weak, very weak, weak, moderately strong, strong, very strong

TCR - Total Core Recovery
SCR - Solid Core Recovery
RQD - Rock Quality Designation
Attitude of defects displayed as Dip/Dip Direction and Trend/Plunge

Backfill:

- Bentonite
- Drill arisings or collapsed hole
- Grout
- Filter material
- Lugeon Test: Flow Type/Adopted Value
- Water Strike (1st, 2nd ...)
- Water Rise (1st, 2nd ...) and Rise
- Time (minutes)

Remarks

1. Coordinates and elevations based on hand-held GPS and subject to survey confirmation.
2. No core loss. Recovered core sample typically exceeds run length by 5-10%.
3. SPT hammer efficiency 93.8%; solid cone used unless indicated on log.
4. Water added during drilling influenced initial water strike depth.

All dimensions in metres Scale 1:51	Contractor: McMillan Drilling	Core Boxes: 0	Rig/Plant Used: Geoprobe Sonic (McMillan)	Driller: Paul	Logged by: AvD	Checked by: CFC

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DRILL HOLE LOG

Project:	Location:	Hole position:	No.:
Summerset Rangiora Due Diligence	Townsend Rd/South Belt, Rangiora	Refer to Site Plan.	BH6

Job No.:	Start Date: / Finish Date:	Ground Level (m LINZ):	Co-Ordinates (NZTM2000):
170743	20-12-19 / 20-12-19	23.70	E 1,566,309 N 5,203,425

Client:	Hole Depth:	Angle from Horiz.:	Direction:	Sheet:
Welhom Developments Ltd	6.08 m		-90° NZTM2000	1 of 1

Type	Run	Fluid & Water	Piezometer	Geological Description (refer to separate Geotechnical and Geological Information sheet for further information)	Legend	Weathering (RS CW MW SW UW)	Field Strength Soil | Rock (VS/VL S/LND St/D VSt/VD VW/W MS S VS ES)	Elevation (m LINZ)	Depth (m)	Symbolic Defect Log	Average Defect Spacing (mm) (500 100 20)	Defect Description (type, orientation, spacing, roughness, persistence aperture, infilling etc)	TCR (SCR) RQD (%)	Samples	Tests
SONIC GEOPROBE 8140LC (150Hz)				CLAY, trace organics; dark brown. "Soft"; moist; highly plastic; organics, rootlets (TOPSOIL)				+23.30	0						
				CLAY; brown with grey mottling. "Firm"; moist; highly plastic (YALDHURST MEMBER, SPRINGSTON FORMATION) 0.90m Grades to include trace fine to medium sand. 1.40m Grades to sandy with minor travel; gravel, fine to coarse, subrounded, greywacke sand as above.				+22.18	1				()		
				Sandy fine to coarse GRAVEL, some silt; mottled grey and brown. Dense; moist; gravel, subrounded, grewacke; sand, fine to medium.				+21.86							SPT 1.52 m 11, 6, 6, 4, 6, 8; N = 24
				Clayey SAND, minor fine to coarse gravel/cobbles; orange-brown. Dense; gravel and sand, as above.				+21.25	2				()		
				Fine to coarse GRAVEL, some sand, minor silt; brownish-grey. Dense to very dense; gravel and sand, as above.					3						SPT 3.04 m 7, 7, 6, 9, 11, 11; N = 37
									4				()		
									5						SPT 4.56 m 7, 20, 20, 20/70mm; N > 50
								+17.62	6				()		
				EOH @ 6.08 m					7						SPT 6.08 m 11, 20, 18, 18, 15, 17; N = 68
									8						

Explanations:

Rock Mass Weathering: unweathered (UW), slightly weathered (SW), moderately weathered (MW), highly weathered (HW), completely weathered (CW), residually weathered (RW)

Relative Rock Strength - extremely weak, very weak, weak, moderately strong, strong, very strong

TCR - Total Core Recovery
SCR - Solid Core Recovery
RQD - Rock Quality Designation
Attitude of defects displayed as Dip/Dip Direction and Trend/Plunge

Backfill:

- Bentonite
- Drill arisings or collapsed hole
- Grout
- Filter material
- Lugeon Test: Flow Type/Adopted Value
- Water Strike (1st, 2nd ...)
- Water Rise (1st, 2nd ...) and Rise
- Time (minutes)

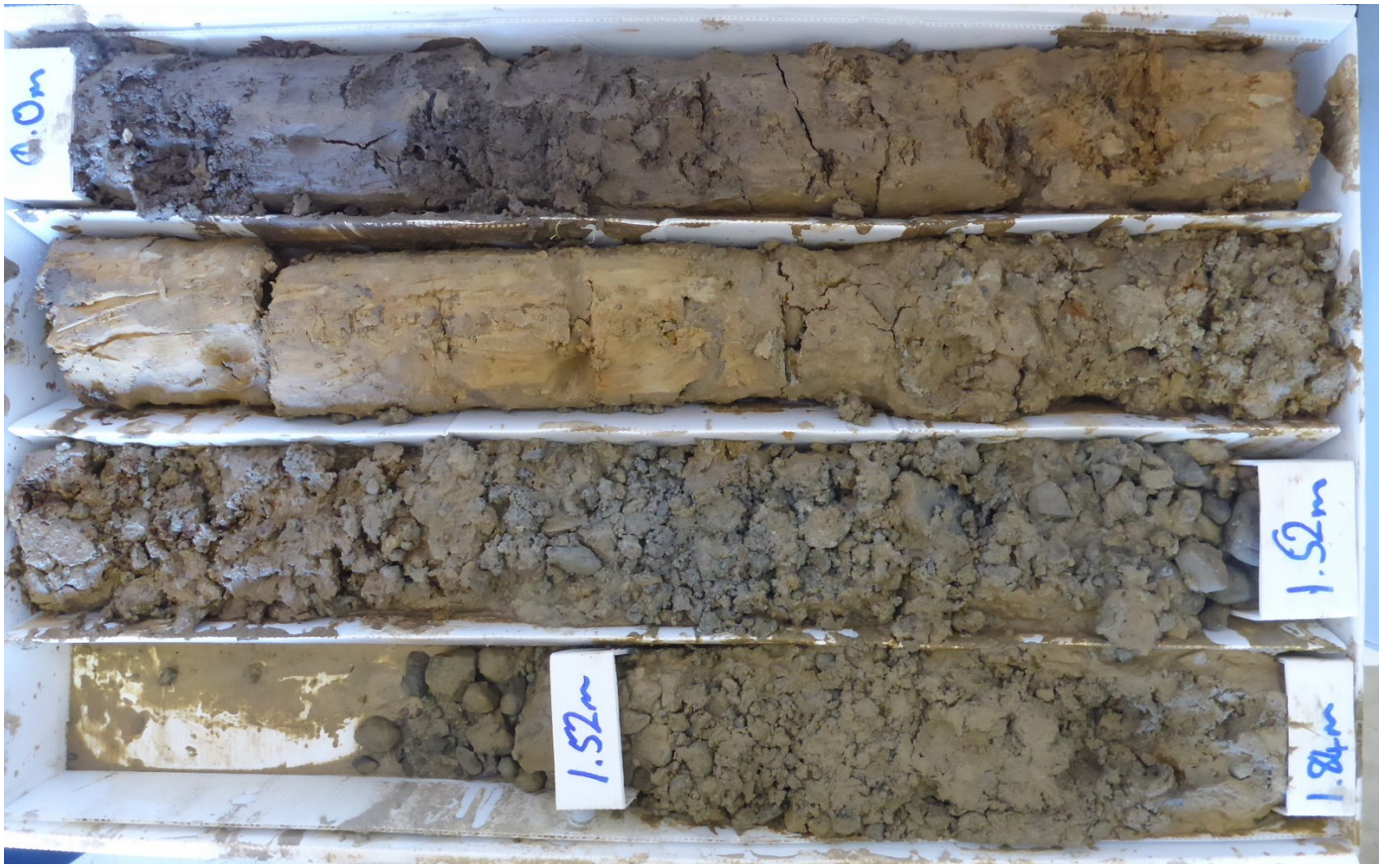
Remarks

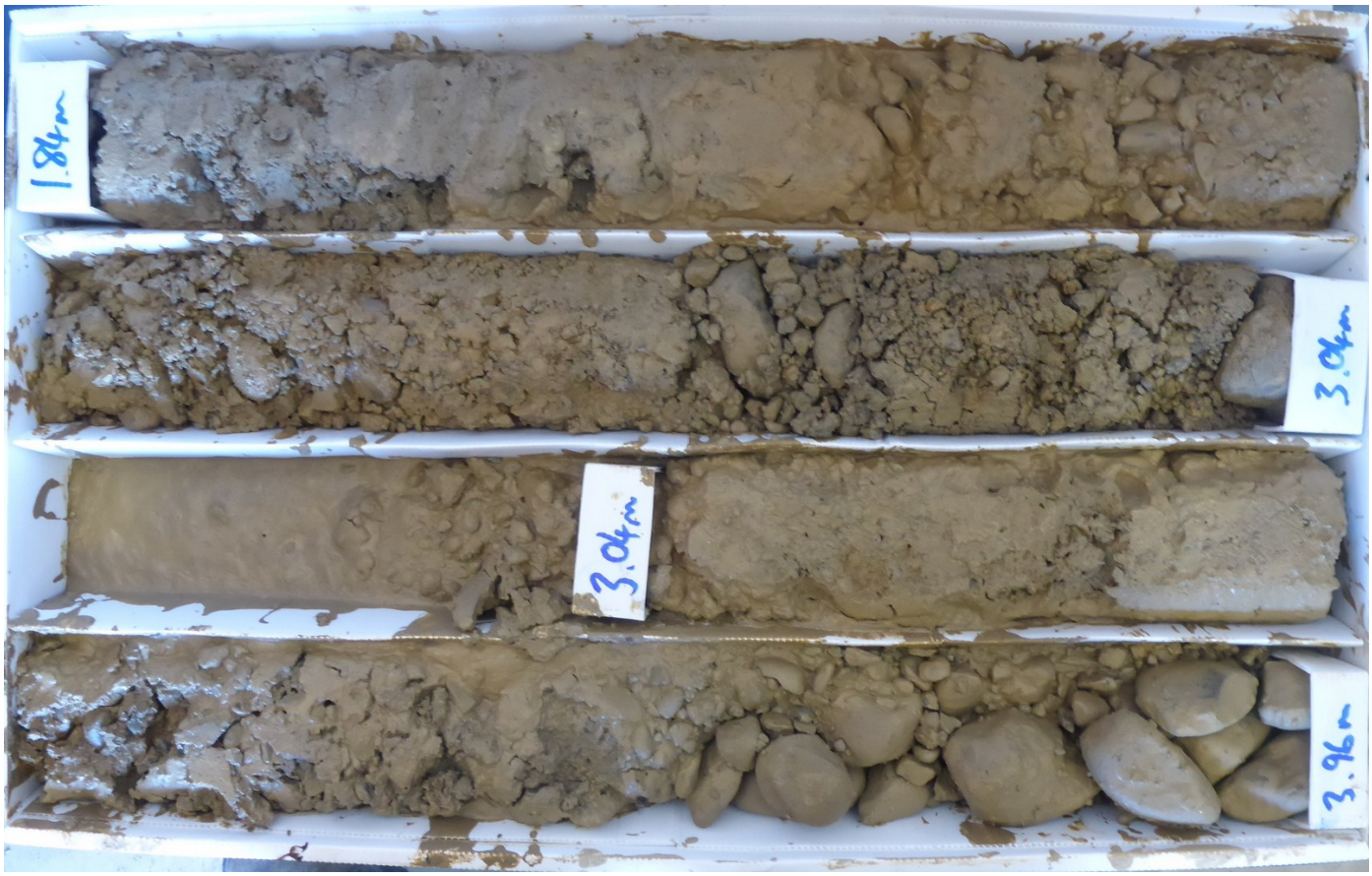
1. Coordinates and elevations based on hand-held GPS and subject to survey confirmation.
2. No core loss. Recovered core sample typically exceeds run length by 5-10%.
3. SPT hammer efficiency 93.8%; solid cone used unless indicated on log.
4. Water added during drilling influenced initial water strike depth.

All dimensions in metres Scale 1:51	Contractor: McMillan Drilling	Core Boxes: 0	Rig/Plant Used: Geoprobe Sonic (McMillan)	Driller: Paul	Logged by: DDH	Checked by: CFC

APPENDIX B

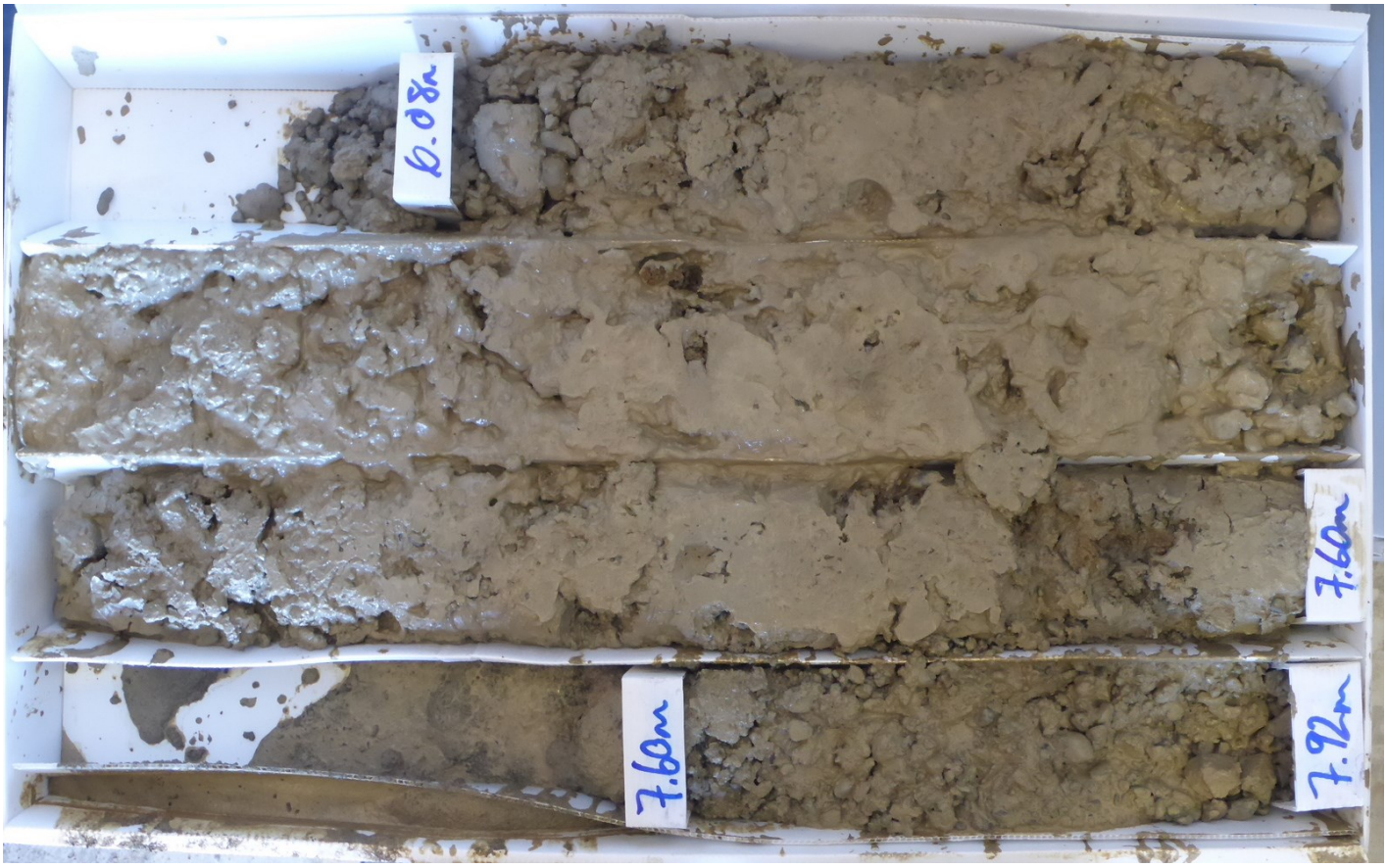
Machine Borehole Photographs





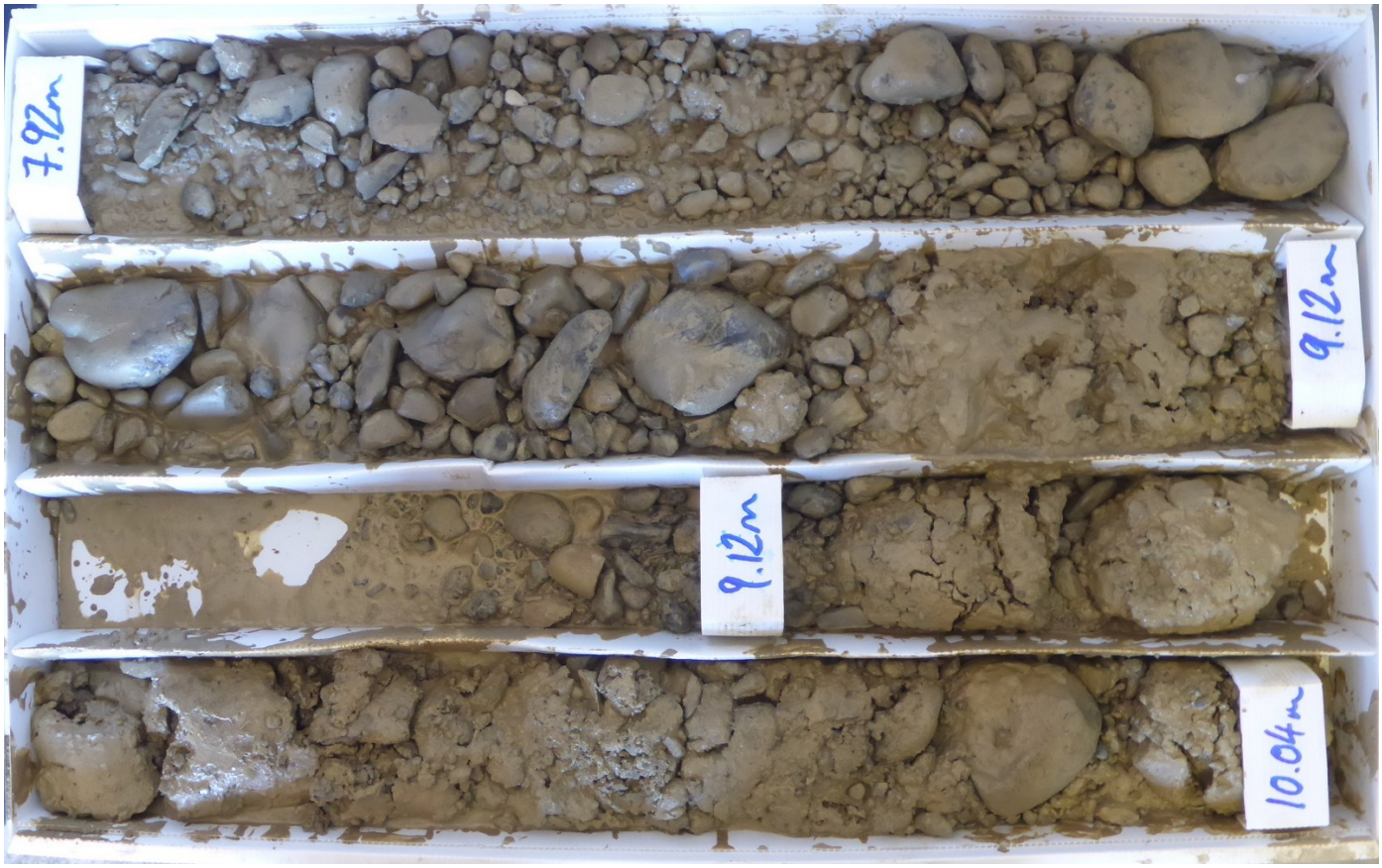
Client / Project:	SUMMERSET GROUP HOLDINGS LTD SUMMERSET RANGIORA DUE DILIGENCE MACHINE BOREHOLE CORE PHOTOS	**Hole ID:**	**BH1**	Summerset RILEY CONSULTANTS
		Date:	18-19 DEC 2018	
Notes:	1. Drill sampling method: McMillan SONIC Geoprobe 8140LC (150Hz) 2. Markers: start/end of run and SPT split-spoon sample in metres; "CL" indicates core loss in metres; brackets indicate run split between boxes; SPT blows/75mm.	**Box No(s).**	1 and 2 of 8	
		Depth from (m):	0.00m	
		Depth To (m):	3.96m	
Project No.	170743	**Interval (m):**	3.96m	

Date printed 10 January 2019



Client / Project:	SUMMERSET GROUP HOLDINGS LTD SUMMERSET RANGIORA DUE DILIGENCE MACHINE BOREHOLE CORE PHOTOS	**Hole ID:**	**BH1**	Summerset RILEY CONSULTANTS
Notes:	1. Drill sampling method: McMillan SONIC Geoprobe 8140LC (150Hz) 2. 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.	**Date:**	18-19 DEC 2018	
		Box No(s).	3 and 4 of 8	
		Depth from (m):	3.96m	
		Depth To (m):	7.92m	
Project No.	170743	**Interval (m):**	3.96m	

Date printed 10 January 2019

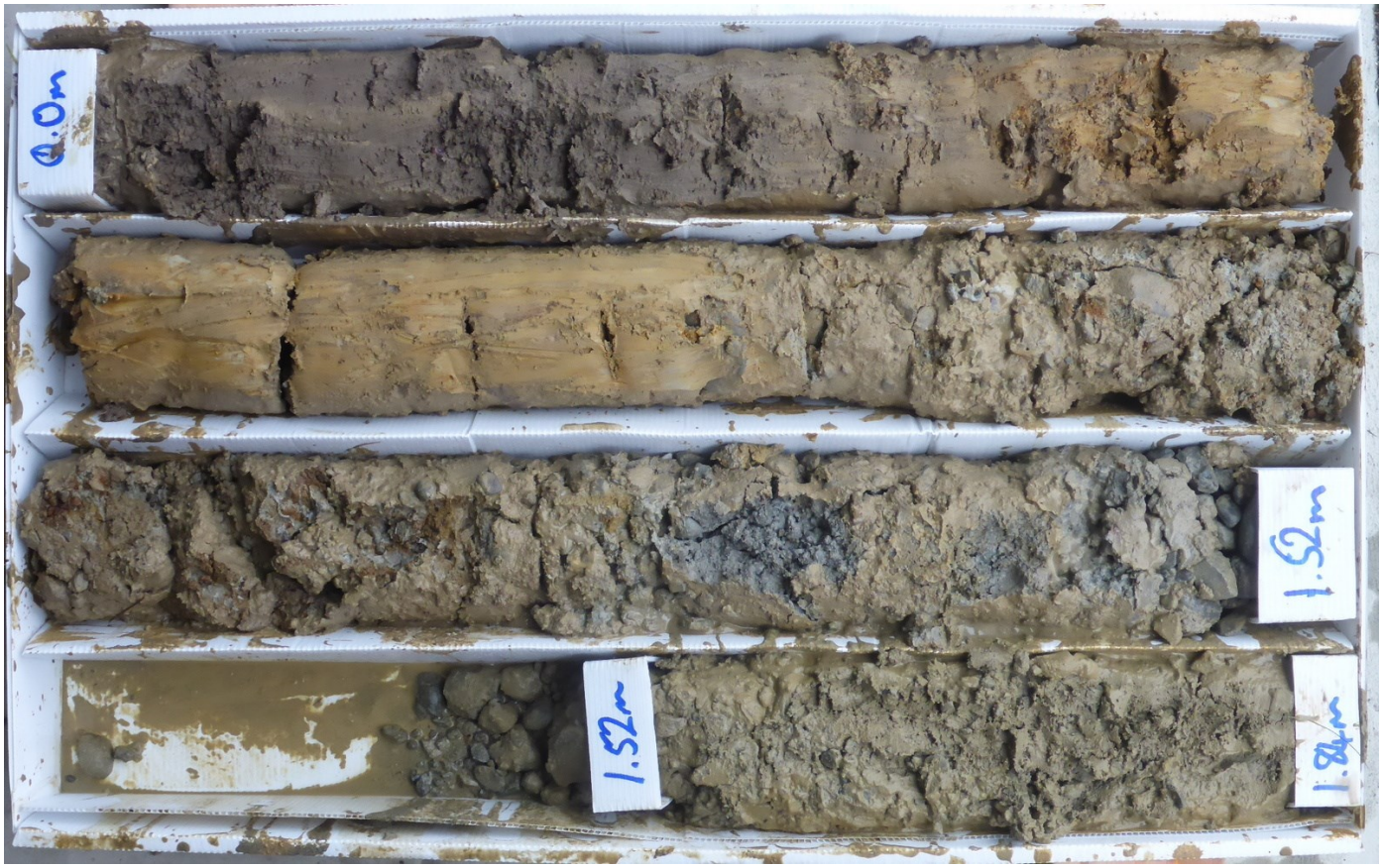


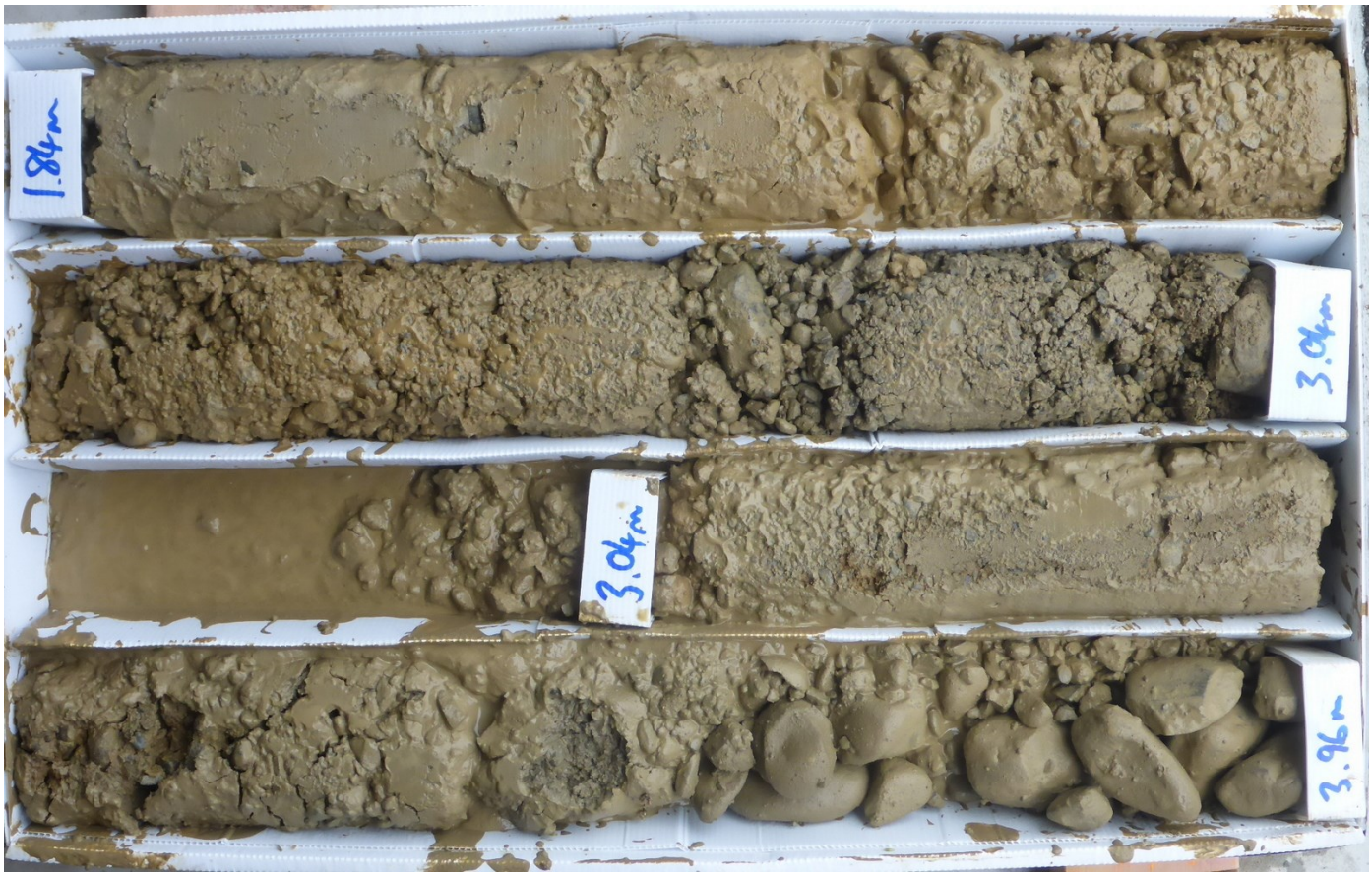
Client / Project:	SUMMERSET GROUP HOLDINGS LTD SUMMERSET RANGIORA DUE DILIGENCE MACHINE BOREHOLE CORE PHOTOS	**Hole ID:**	**BH1**	Summerset RILEY CONSULTANTS
		Date:	18-19 DEC 2018	
Notes:	1. Drill sampling method: McMillan SONIC Geoprobe 8140LC (150Hz) 2. Markers: start/end of run and SPT split-spoon sample in metres; "CL" indicates core loss in metres; brackets indicate run split between boxes; SPT blows/75mm.	**Box No(s).**	5 and 6 of 8	
		Depth from (m):	7.92m	
		Depth To (m):	12.16m	
Project No.	170743	**Interval (m):**	4.24m	

Date printed 10 January 2019

Client / Project:	SUMMERSET GROUP HOLDINGS LTD SUMMERSET RANGIORA DUE DILIGENCE MACHINE BOREHOLE CORE PHOTOS	**Hole ID:**	**BH1**	Summerset
		Date:	18-19 DEC 2018	
Notes:	1. Drill sampling method: McMillan SONIC Geoprobe 8140LC (150Hz) 2. 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).**	7 and 8 of 8	
		Depth from (m):	12.16m	RILEY CONSULTANTS
		Depth To (m):	15.20m	
Project No.	170743	**Interval (m):**	3.04m	

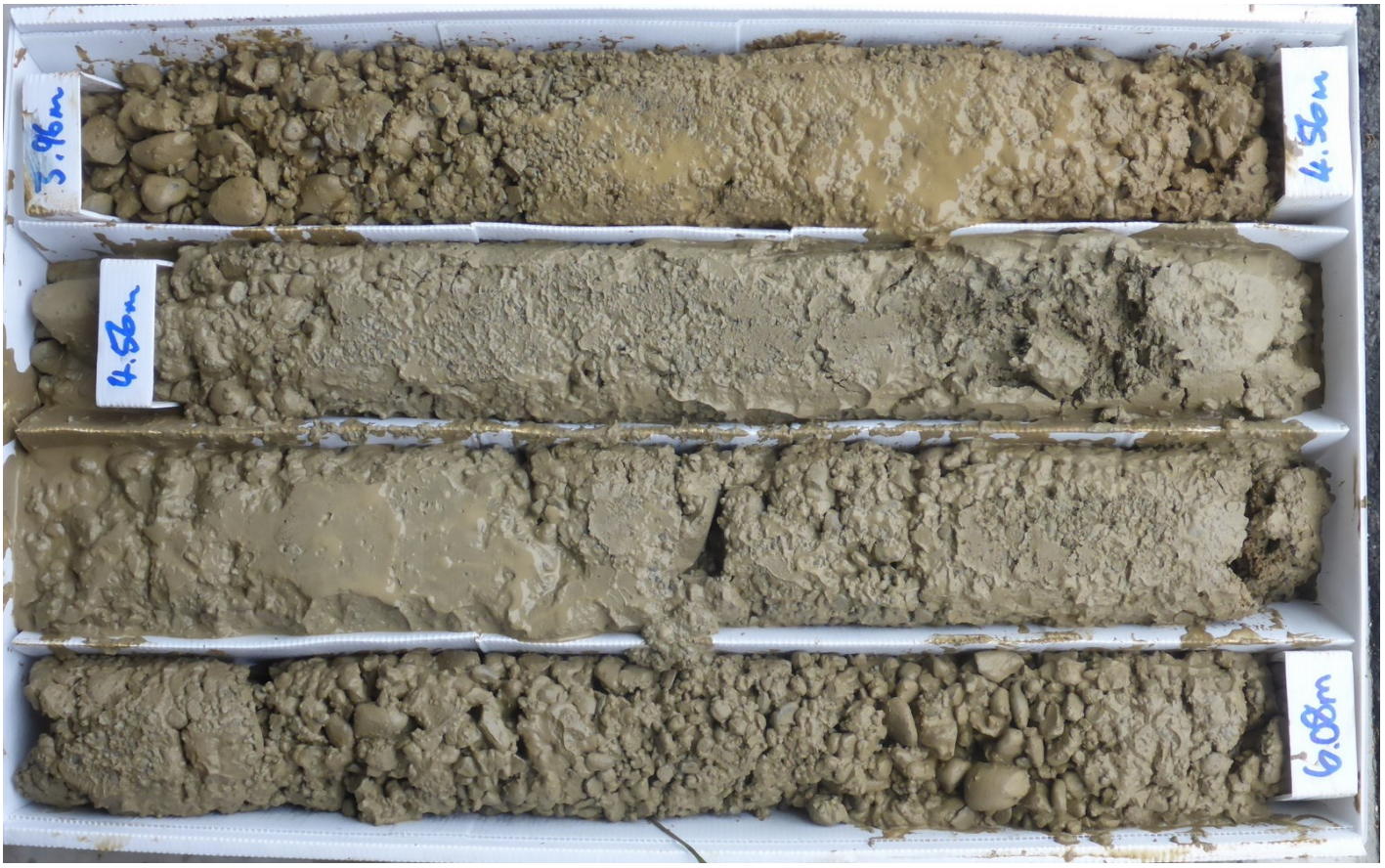
Date printed 10 January 2019

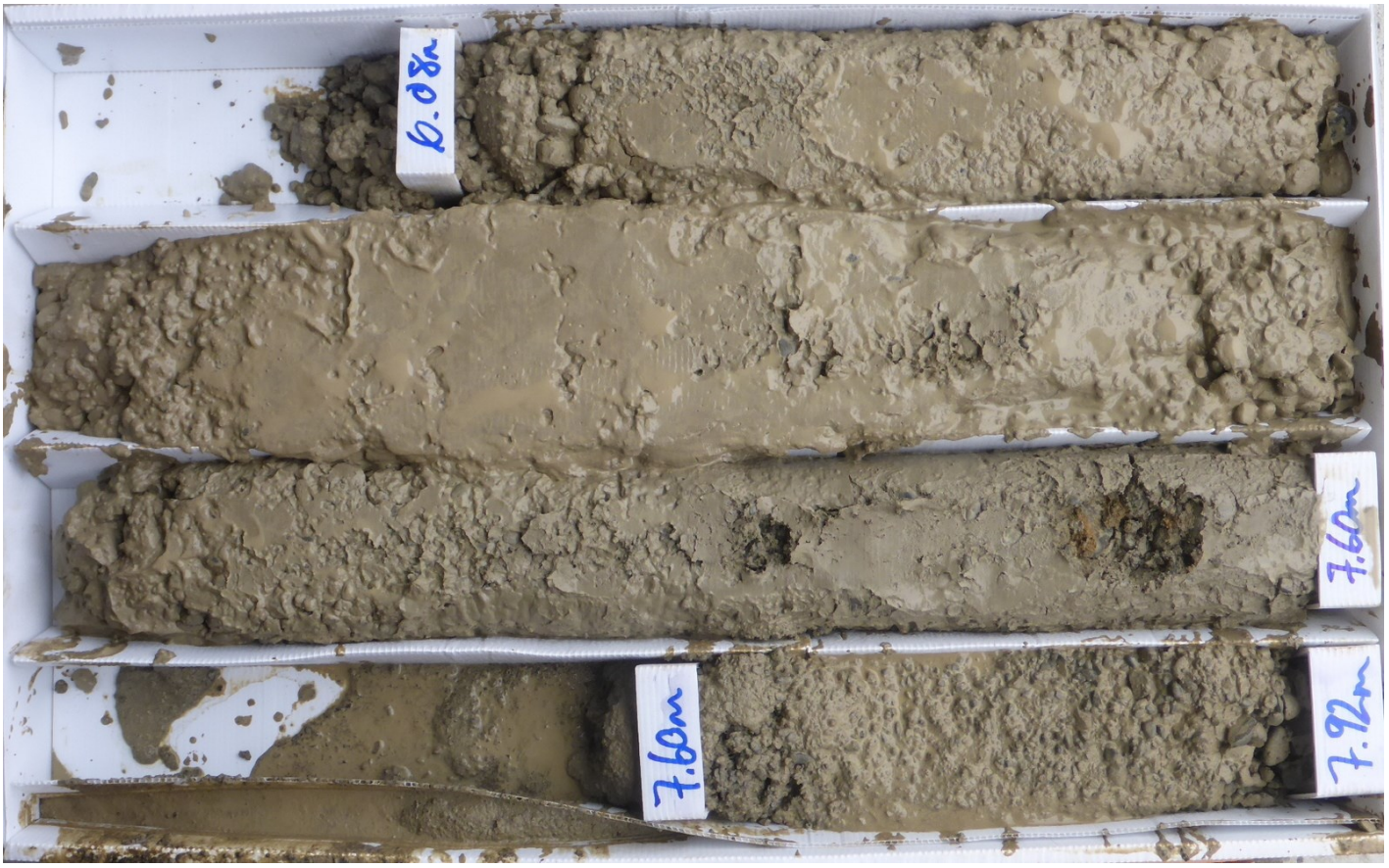




Client / Project:	SUMMERSET GROUP HOLDINGS LTD SUMMERSET RANGIORA DUE DILIGENCE MACHINE BOREHOLE CORE PHOTOS	**Hole ID:**	**BH2**	Summerset RILEY CONSULTANTS
		Date:	17-18 DEC 2018	
Notes:	1. Drill sampling method: McMillan SONIC Geoprobe 8140LC (150Hz) 2. Markers: start/end of run and SPT split-spoon sample in metres; "CL" indicates core loss in metres; brackets indicate run split between boxes; SPT blows/75mm.	**Box No(s).**	1 and 2 of 8	
		Depth from (m):	0.00m	
		Depth To (m):	3.96m	
Project No.	170743	**Interval (m):**	3.96m	

Date printed 10 January 2019





Client / Project:	SUMMERSET GROUP HOLDINGS LTD SUMMERSET RANGIORA DUE DILIGENCE MACHINE BOREHOLE CORE PHOTOS	**Hole ID:**	**BH2**	Summerset RILEY CONSULTANTS
Notes:	1. Drill sampling method: McMillan SONIC Geoprobe 8140LC (150Hz) 2. 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.	**Date:**	17-18 DEC 2018	
		Box No(s).	3 and 4 of 8	
		Depth from (m):	3.96m	
		Depth To (m):	7.92m	
Project No.	170743	**Interval (m):**	3.96m	

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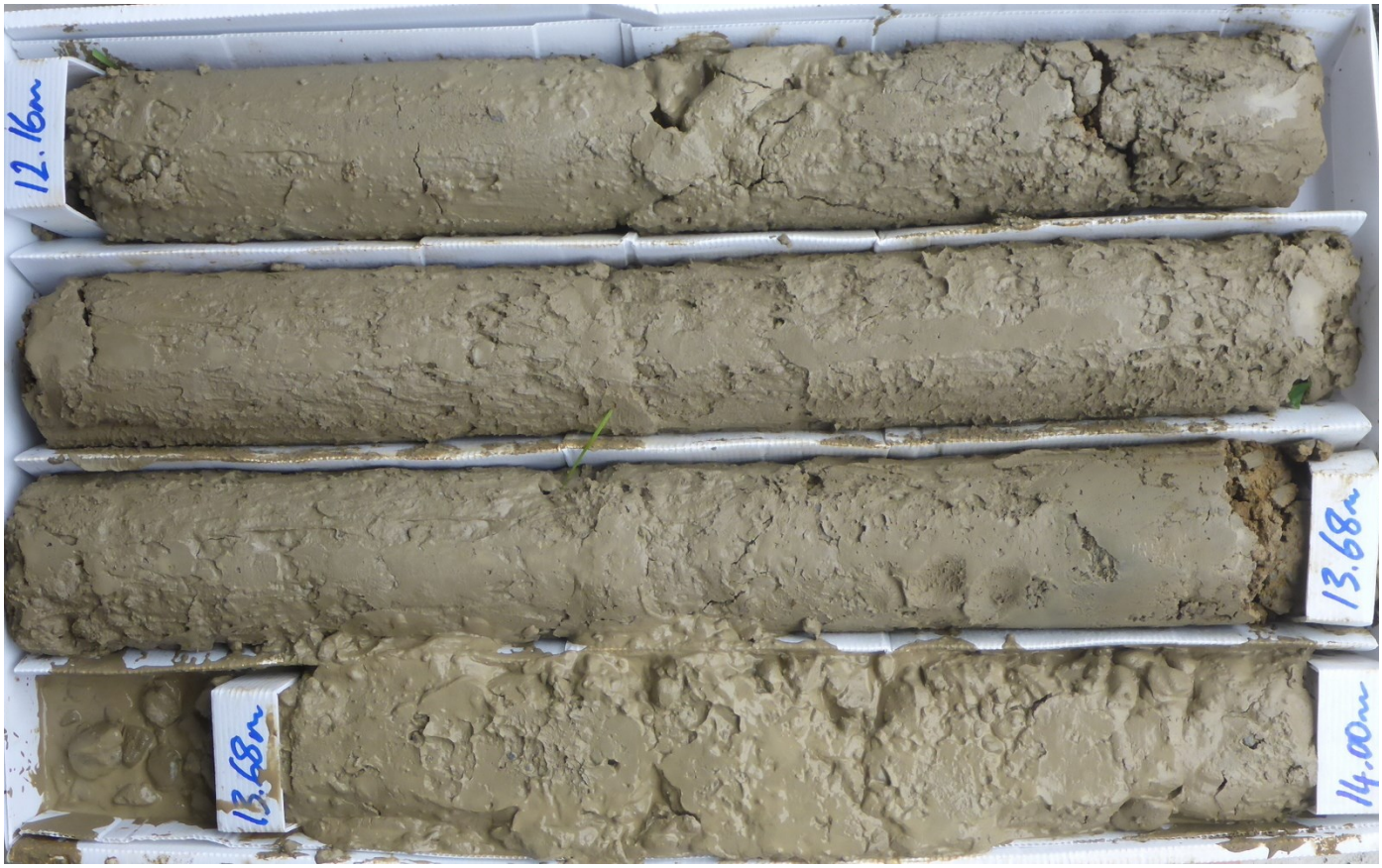
Client / Project:	SUMMERSET GROUP HOLDINGS LTD SUMMERSET RANGIORA DUE DILIGENCE MACHINE BOREHOLE CORE PHOTOS	**Hole ID:**	**BH2**	Summerset RILEY CONSULTANTS
		Date:	17-18 DEC 2018	
Notes:	1. Drill sampling method: McMillan SONIC Geoprobe 8140LC (150Hz) 2. Markers: start/end of run and SPT split-spoon sample in metres; "CL" indicates core loss in metres; brackets indicate run split between boxes; SPT blows/75mm.	**Box No(s).**	5 and 6 of 8	
		Depth from (m):	7.92m	
		Depth To (m):	12.16m	
Project No.	170743	**Interval (m):**	4.24m	

Date printed 10 January 2019



Client / Project:	SUMMERSET GROUP HOLDINGS LTD SUMMERSET RANGIORA DUE DILIGENCE MACHINE BOREHOLE CORE PHOTOS	**Hole ID:**	**BH2**	Summerset RILEY CONSULTANTS
		Date:	17-18 DEC 2018	
Notes:	1. Drill sampling method: McMillan SONIC Geoprobe 8140LC (150Hz) 2. 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).**	7 and 8 of 8	
		Depth from (m):	12.16m	
		Depth To (m):	15.20m	
Project No.	170743	**Interval (m):**	3.04m	

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Client / Project:	SUMMERSET GROUP HOLDINGS LTD SUMMERSET RANGIORA DUE DILIGENCE MACHINE BOREHOLE CORE PHOTOS	**Hole ID:**	**BH3**	Summerset RILEY CONSULTANTS
Notes:	1. Drill sampling method: McMillan SONIC Geoprobe 8140LC (150Hz) 2. 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.	**Date:**	18 DEC 2018	
		Box No(s).	1 and 2 of 3	
		Depth from (m):	0.00m	
		Depth To (m):	3.96m	
Project No.	170743	**Interval (m):**	3.96m	

Date printed 10 January 2019

Client / Project:	SUMMERSET GROUP HOLDINGS LTD SUMMERSET RANGIORA DUE DILIGENCE MACHINE BOREHOLE CORE PHOTOS	**Hole ID:**	**BH3**	Summerset RILEY CONSULTANTS
		Date:	18 DEC 2018	
Notes:	1. Drill sampling method: McMillan SONIC Geoprobe 8140LC (150Hz) 2. 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).**	3 of 3	
		Depth from (m):	3.96m	
		Depth To (m):	6.08m	
Project No.	170743	**Interval (m):**	2.12m	

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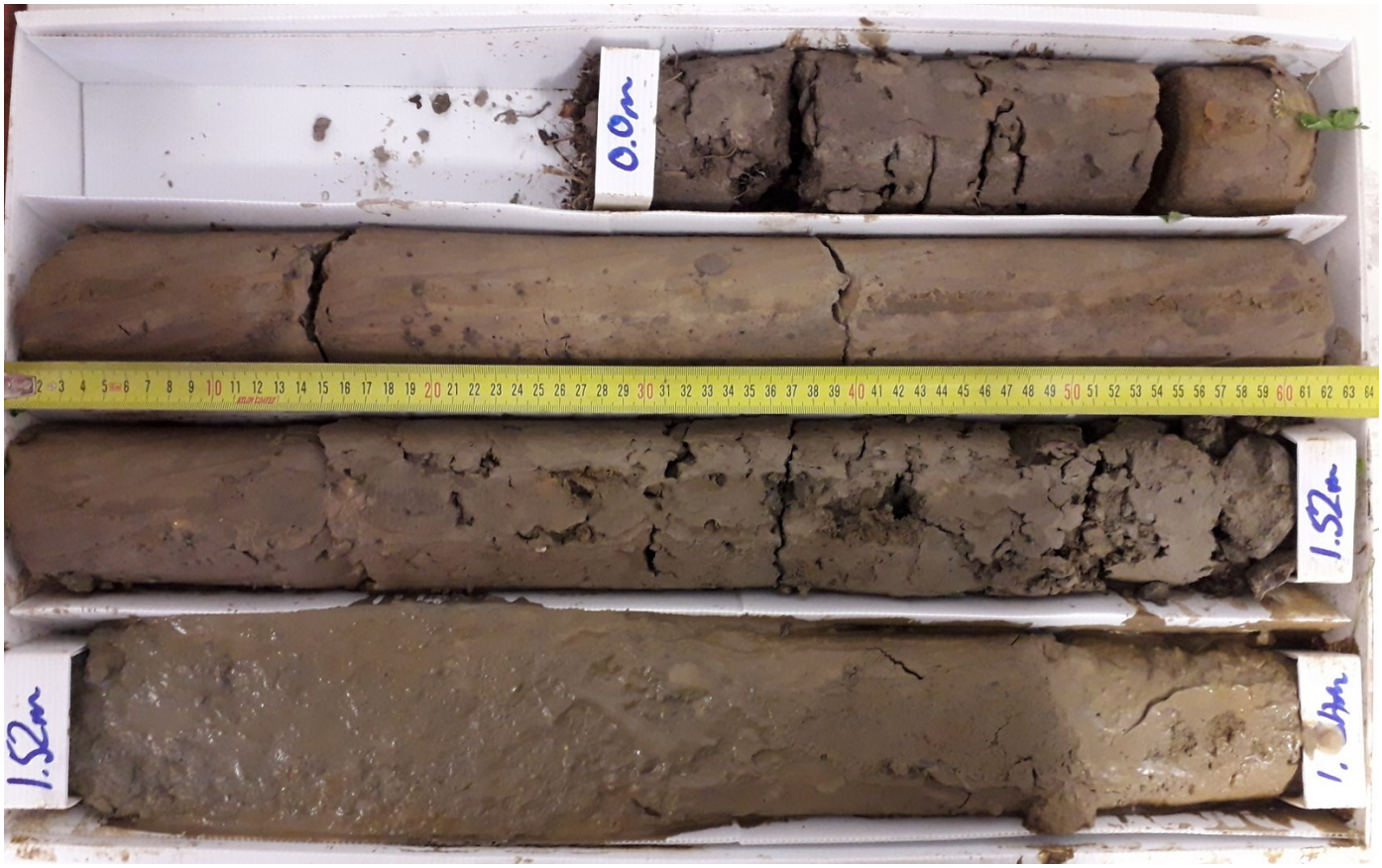

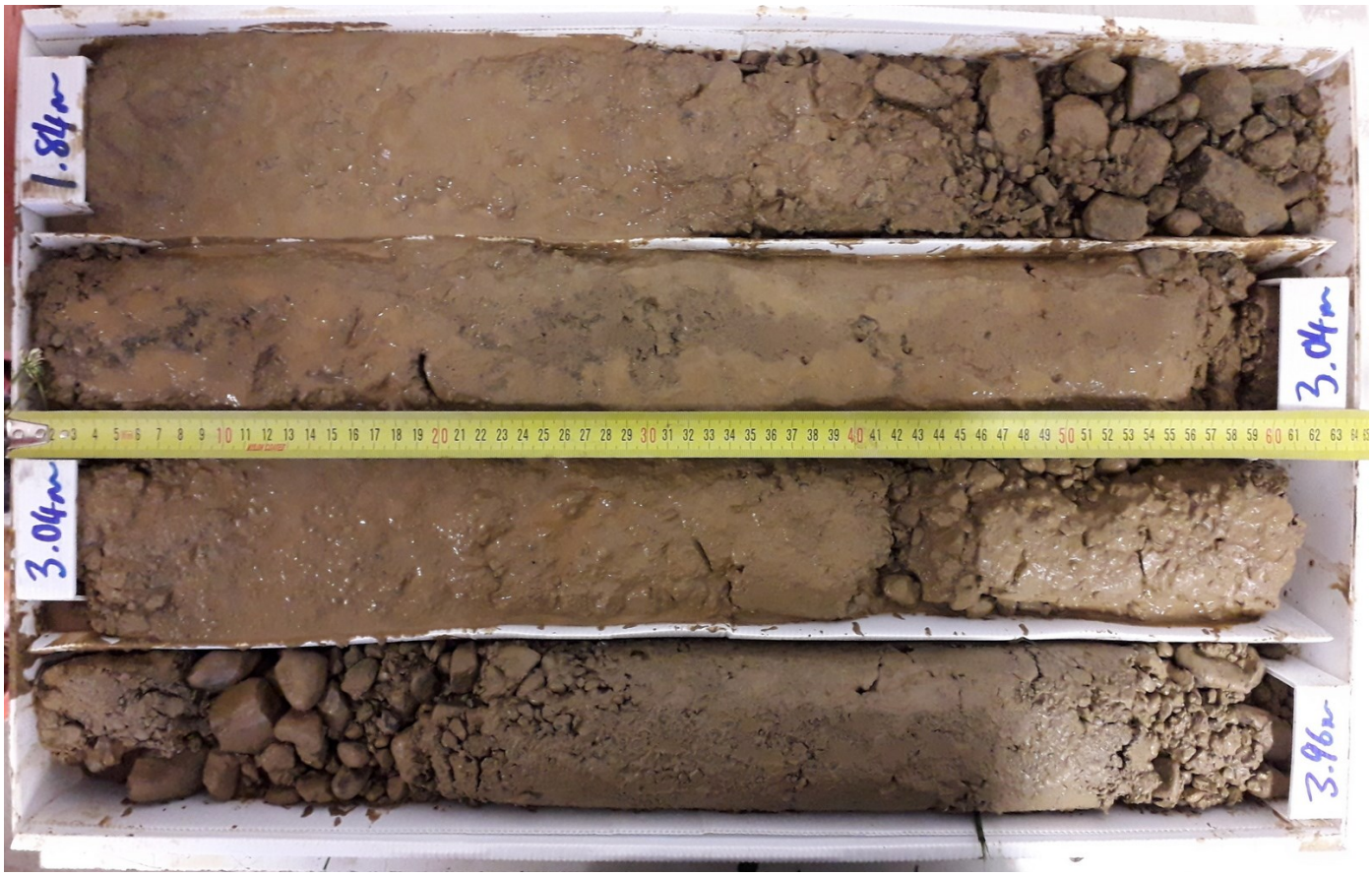

Client / Project:	SUMMERSET GROUP HOLDINGS LTD SUMMERSET RANGIORA DUE DILIGENCE MACHINE BOREHOLE CORE PHOTOS	**Hole ID:**	**BH4**
		Date:	20 DEC 2018
Notes:	1. Drill sampling method: McMillan SONIC Geoprobe 8140LC (150Hz) 2. Markers: start/end of run and SPT split-spoon sample in metres; "CL" indicates core loss in metres; brackets indicate run split between boxes; SPT blows/75mm.	**Box No(s).**	1 and 2 of 3
		Depth from (m):	0.00m
		Depth To (m):	3.96m
Project No.	170743	**Interval (m):**	3.96m

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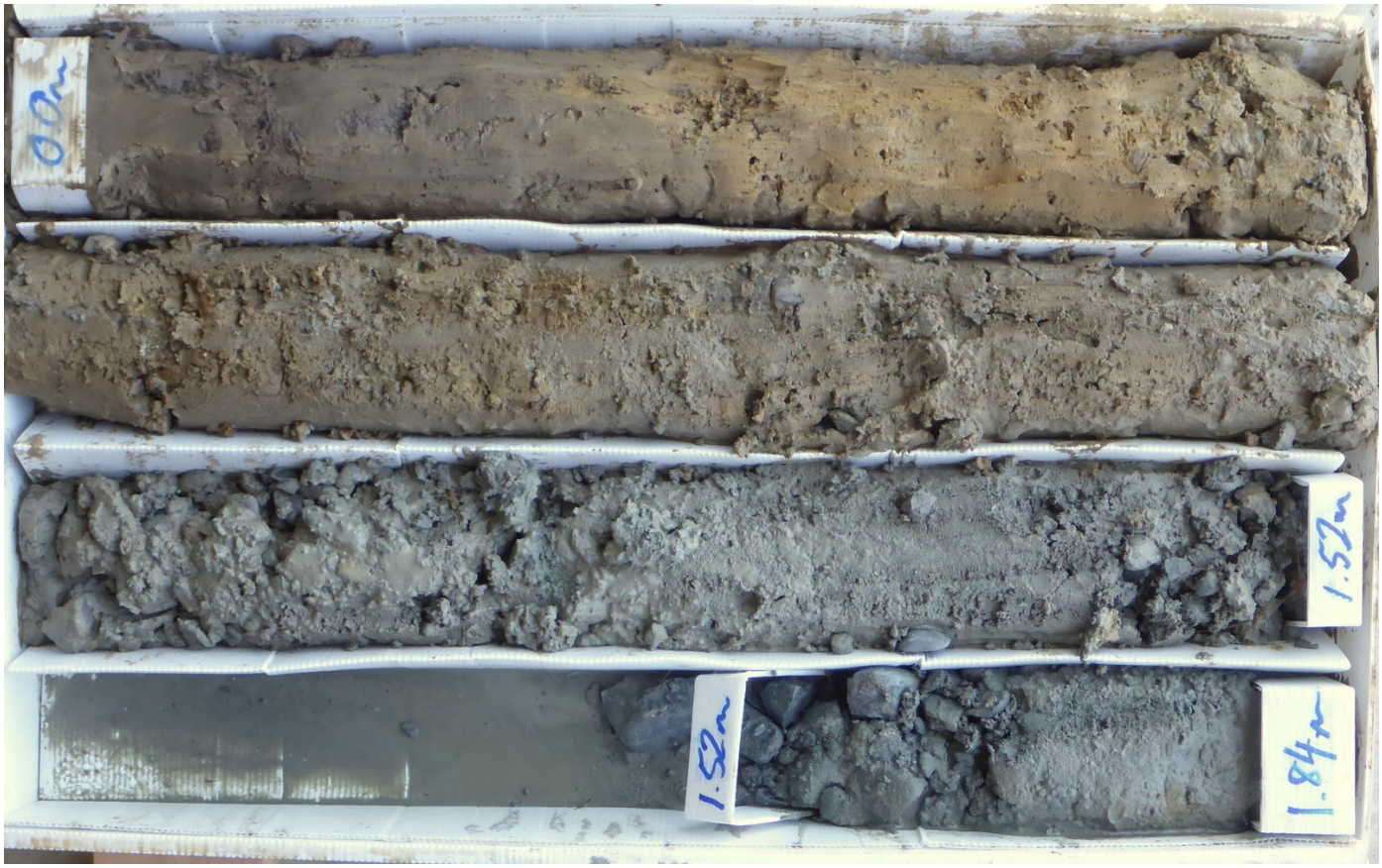
Date printed 10 January 2019

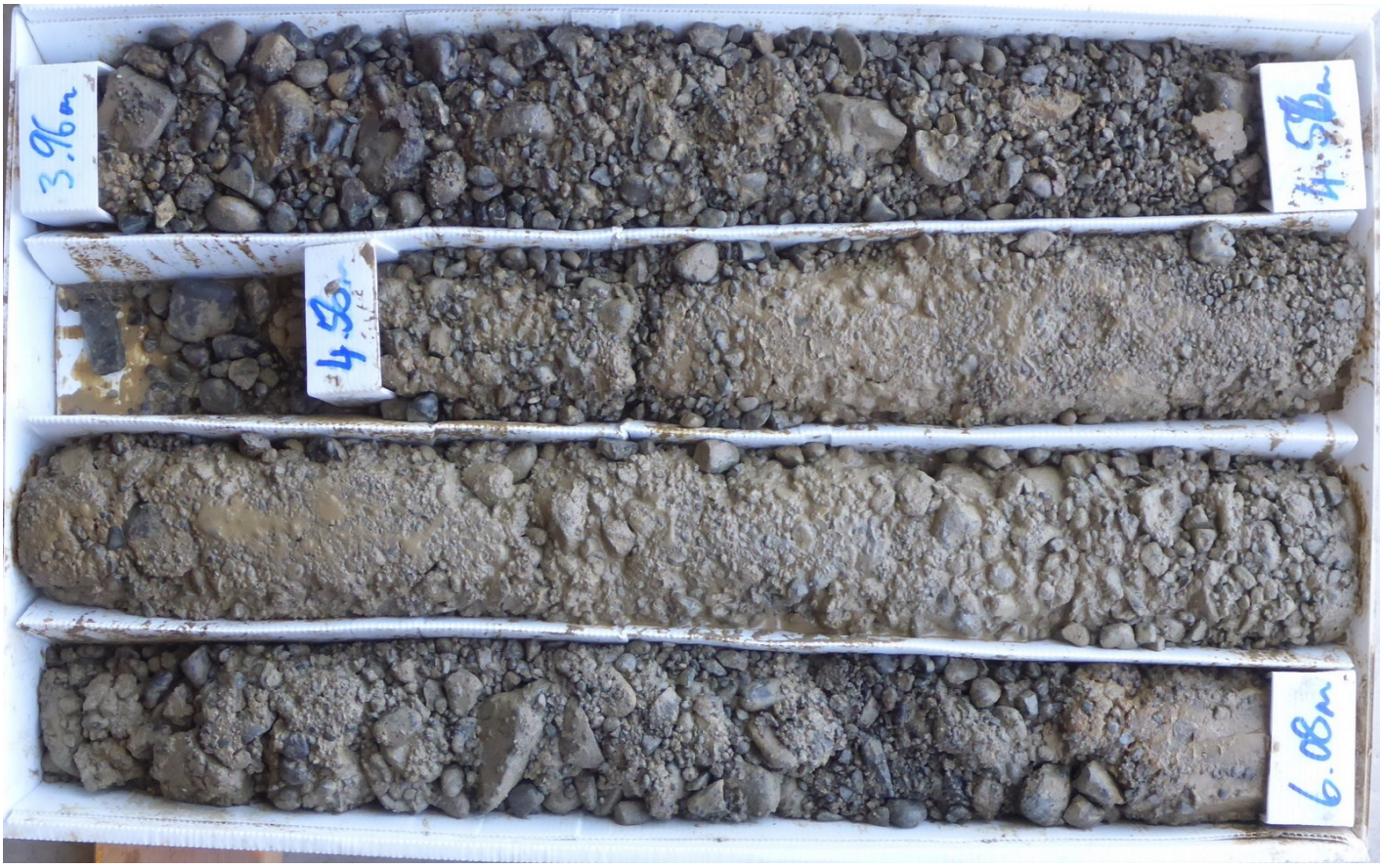
Client / Project:	SUMMERSET GROUP HOLDINGS LTD SUMMERSET RANGIORA DUE DILIGENCE MACHINE BOREHOLE CORE PHOTOS	**Hole ID:**	**BH4**	Summerset RILEY CONSULTANTS
		Date:	20 DEC 2018	
Notes:	1. Drill sampling method: McMillan SONIC Geoprobe 8140LC (150Hz) 2. Markers: start/end of run and SPT split-spoon sample in metres; "CL" indicates core loss in metres; brackets indicate run split between boxes; SPT blows/75mm.	**Box No(s).**	3 of 3	
		Depth from (m):	3.96m	
		Depth To (m):	6.08m	
Project No.	170743	**Interval (m):**	2.12m	

Date printed 10 January 2019



Client / Project:	SUMMERSET GROUP HOLDINGS LTD SUMMERSET RANGIORA DUE DILIGENCE MACHINE BOREHOLE CORE PHOTOS	**Hole ID:**	**BH5**	Summerset RILEY CONSULTANTS
		Date:	19 DEC 2018	
Notes:	1. Drill sampling method: McMillan SONIC Geoprobe 8140LC (150Hz) 2. 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).**	1 and 2 of 3	
		Depth from (m):	0.00m	
		Depth To (m):	3.96m	
Project No.	170743	**Interval (m):**	3.96m	

Date printed 10 January 2019



Client / Project:	SUMMERSET GROUP HOLDINGS LTD SUMMERSET RANGIORA DUE DILIGENCE MACHINE BOREHOLE CORE PHOTOS	**Hole ID:**	**BH5**	Summerset RILEY CONSULTANTS
		Date:	19 DEC 2018	
Notes:	1. Drill sampling method: McMillan SONIC Geoprobe 8140LC (150Hz) 2. 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).**	3 of 3	
		Depth from (m):	3.96m	
		Depth To (m):	6.08m	
Project No.	170743	**Interval (m):**	2.12m	

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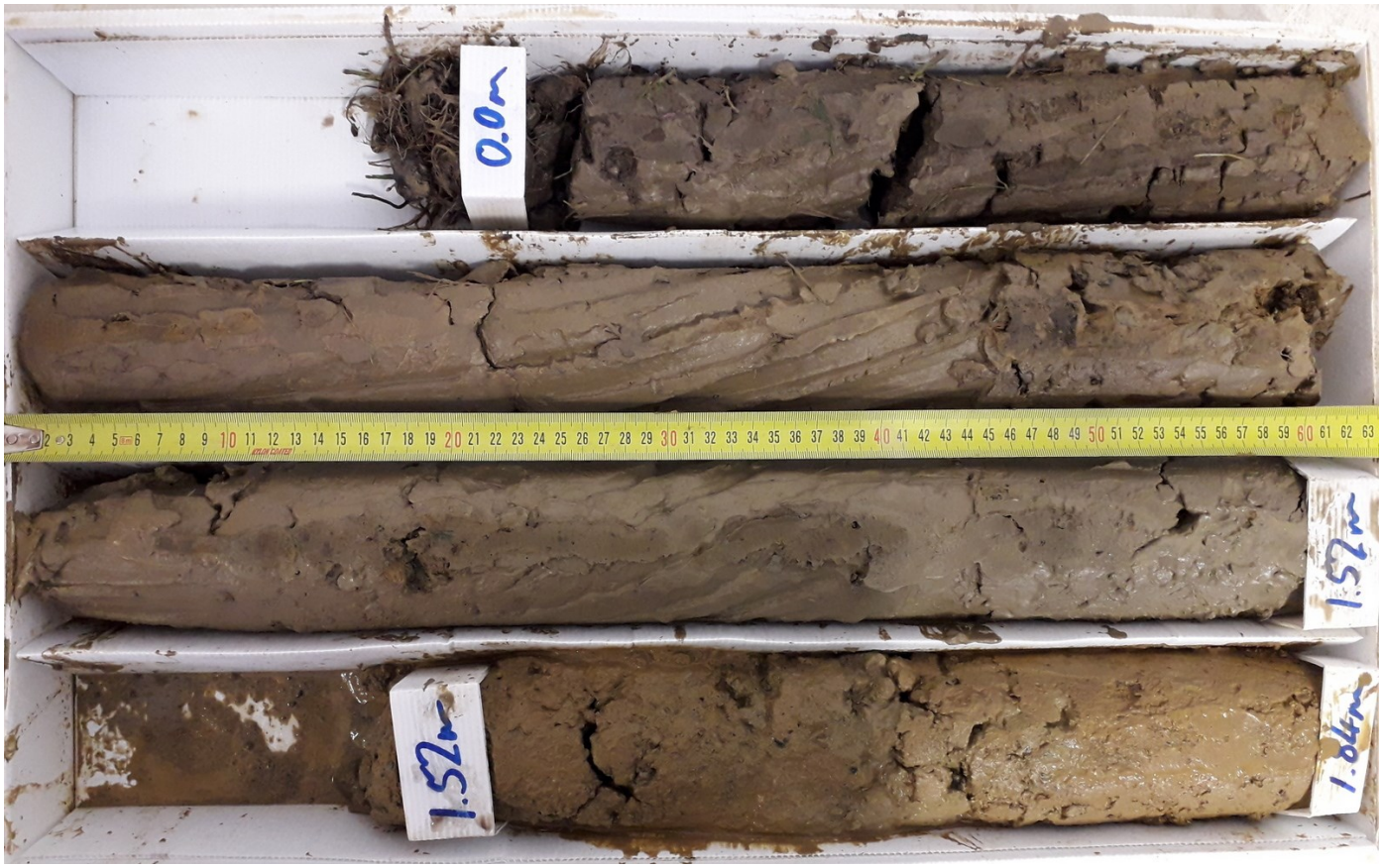
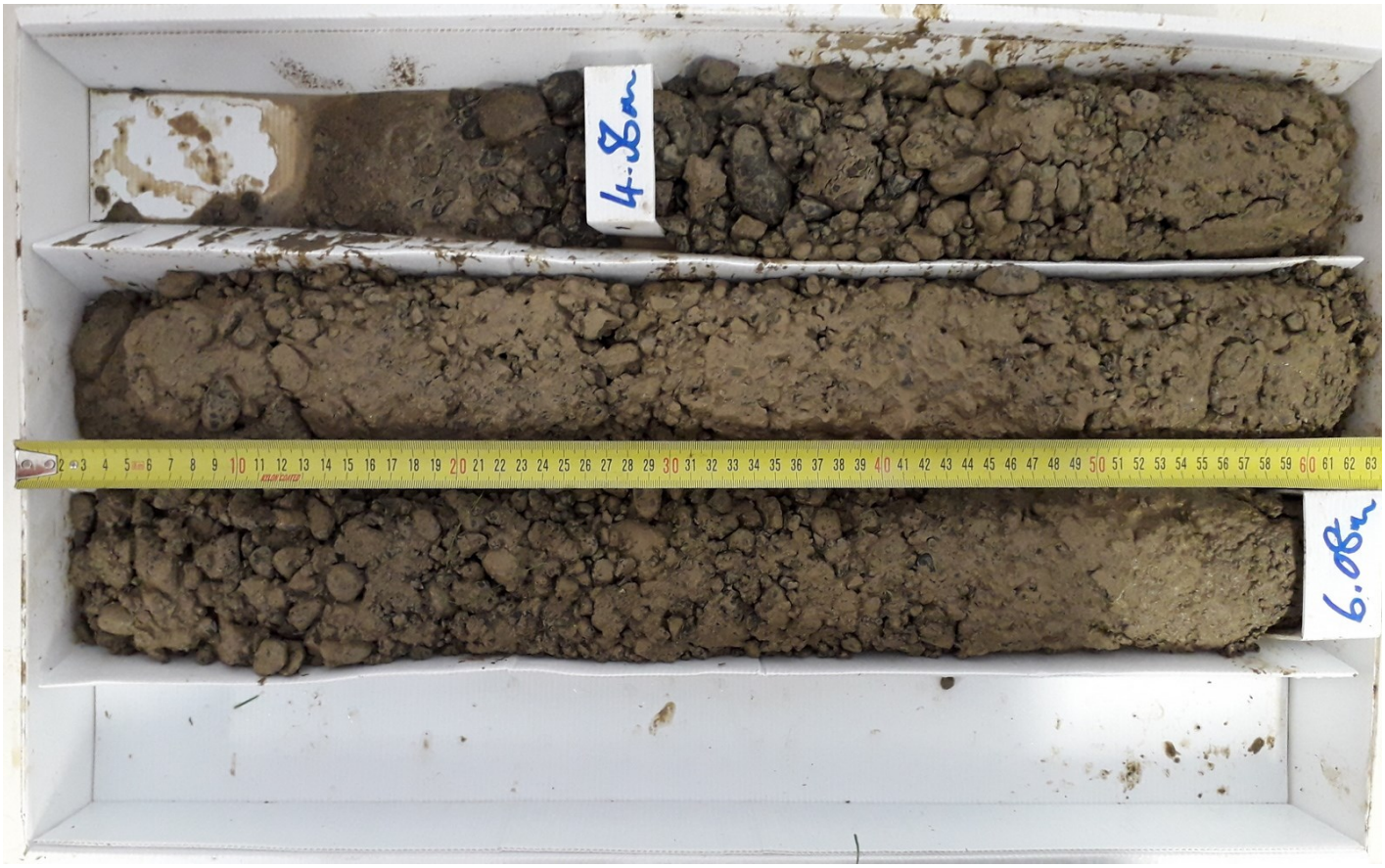


Client / Project:	SUMMERSET GROUP HOLDINGS LTD SUMMERSET RANGIORA DUE DILIGENCE MACHINE BOREHOLE CORE PHOTOS	**Hole ID:**	**BH6**	Summerset
		Date:	20 DEC 2018	
Notes:	1. Drill sampling method: McMillan SONIC Geoprobe 8140LC (150Hz) 2. Markers: start/end of run and SPT split-spoon sample in metres; "CL" indicates core loss in metres; brackets indicate run split between boxes; SPT blows/75mm.	**Box No(s).**	1 and 2 of 3	
		Depth from (m):	0.00m	RILEY CONSULTANTS
		Depth To (m):	4.56m	
Project No.	170743	**Interval (m):**	4.56m	

Date printed 10 January 2019



Client / Project:	SUMMERSET GROUP HOLDINGS LTD SUMMERSET RANGIORA DUE DILIGENCE MACHINE BOREHOLE CORE PHOTOS	**Hole ID:**	**BH6**	Summerset RILEY CONSULTANTS
		Date:	20 DEC 2018	
Notes:	1. Drill sampling method: McMillan SONIC Geoprobe 8140LC (150Hz) 2. 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).**	3 of 3	
		Depth from (m):	4.56m	
		Depth To (m):	6.08m	
Project No.	170743	**Interval (m):**	1.52m	

Date printed 10 January 2019

APPENDIX C

Laboratory Test Results

Central Testing Services
18 Ngapara St, P.O. Box 397, Alexandra 9340, Central Otago, New Zealand
P: 03 4487644, W: www.centraltesting.co.nz, E: info@centraltesting.co.nz

Reference No: 19/022

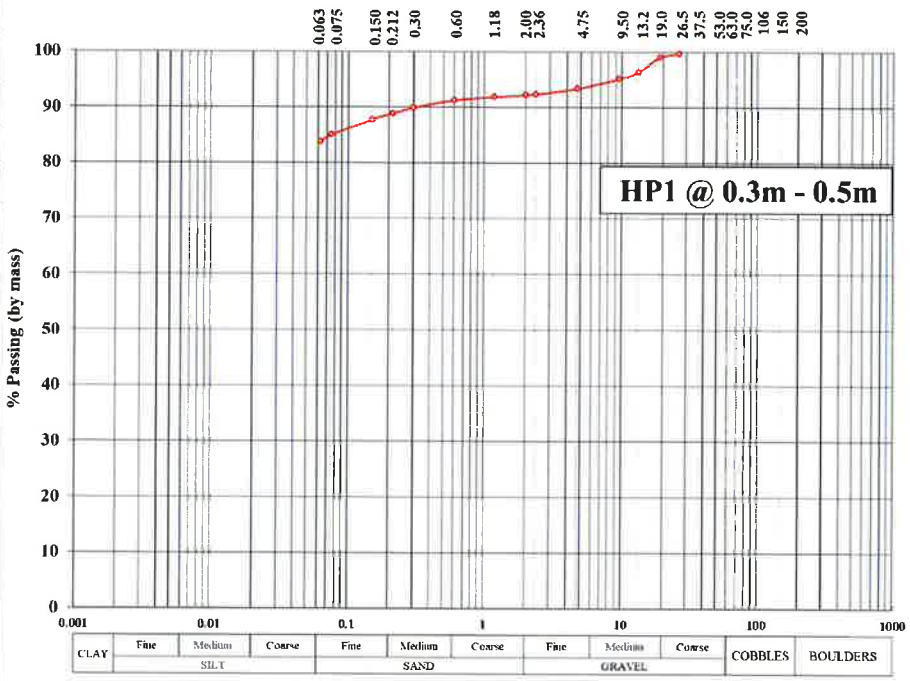
Date: 15 January 2019

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, Rangiora**		
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**

PARTICLE SIZE ANALYSIS (NZS 4402:1986, Test 2.8.1)

Test Sieve (mm)	% Passing (by mass)
63.0	
37.5	
26.5	100
19.0	99
13.2	96
9.50	95
4.75	93
2.36	92
2.00	92
1.18	92
0.60	91
0.30	90
0.212	89
0.150	88
0.075	85
0.063	84



The sample was received in a natural state. The percentage passing the 63µm test sieve was obtained by difference.

WATER CONTENT 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:

- ***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:

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

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Central Testing Services
18 Ngapara St, P.O. Box 397, Alexandra 9340, Central Otago, New Zealand
P: 03 4487644, W: www.centraltesting.co.nz, E: info@centraltesting.co.nz

Reference No: 19/022

Date: 15 January 2019

TEST REPORT – WELHOM DEVELOPMENTS INVESTIGATIONS

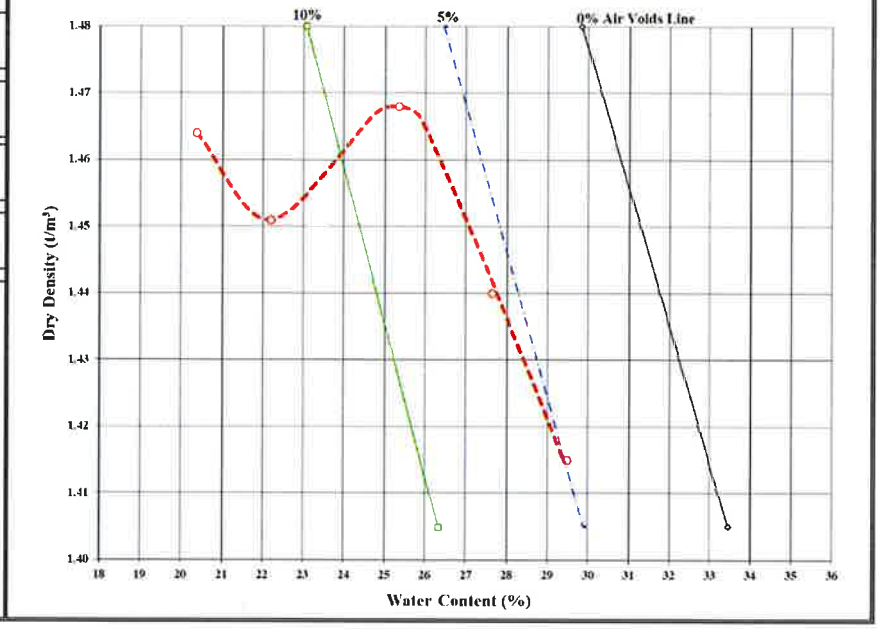
Client Details:	**Riley Consultants Ltd, P.O. Box 4355, Christchurch**	**Attention:**	**A. van Dusschoten**
Job Description:	**Welhom Developments Investigations, cnr Townsend and South Belt Road, Rangiora**		
Sample Description:	**SILT with minor gravel and minor sand**	**Client Order No:**	**170743**
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**

WATER CONTENT & NZ STANDARD COMPACTION - NZS 4402:1986, Test 2.1 & 4.1.1

% Retained (+19.0mm Fraction)	**1.0 %**
Water Content: ("All In" As Received)	**29.6 %**
Maximum Dry Density: (-19.0mm Fraction)	**1.47 t/m³**
Optimum Water Content: (-19.0mm Fraction)	**25.0 %**

Notes:

- *The sample was received in a natural state.*
- *The material tested in the NZ Standard Compaction test was the fraction passing a 19.0mm test sieve.*
- *The air voids lines were calculated from an assumed solid density of 2.65 t/m³.*



Note:

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Tested By: L.T. Smith **Date:** 10 to 15-Jan-19

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Reference No: 19/022

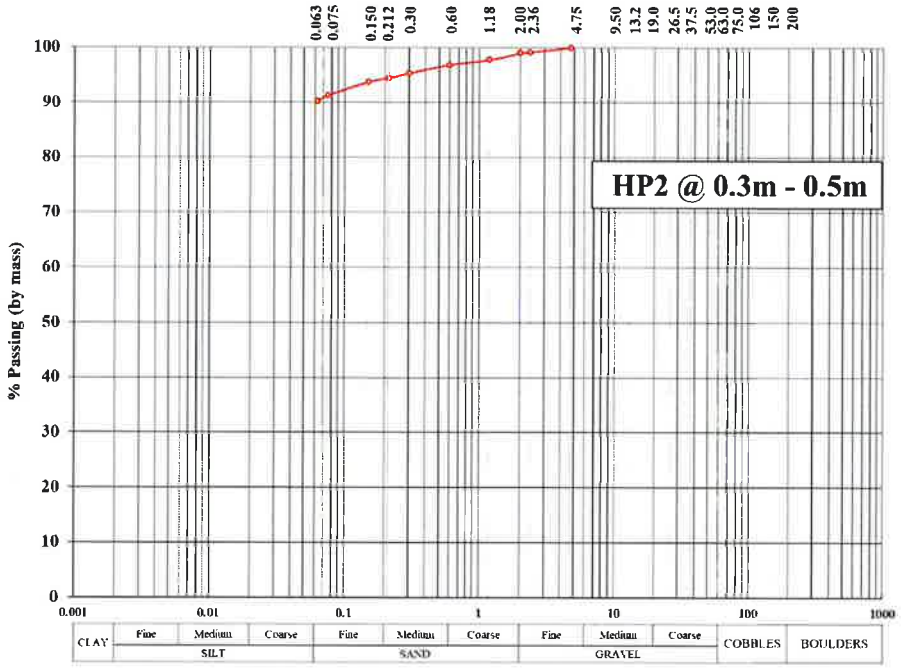
Date: 15 January 2019

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, Rangiora**		
Sample Description:	**SILT with minor sand and trace of gravel**	**Client Order No:**	**170743**
Sample Source:	**HP2 @ 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 SIZE ANALYSIS (NZS 4402:1986, Test 2.8.1)

Test Sieve (mm)	% Passing (by mass)
53.0	
37.5	
26.5	
19.0	
13.2	
9.50	
4.75	100
2.36	99
2.00	99
1.18	98
0.60	97
0.30	95
0.212	94
0.150	94
0.075	91
0.063	90



The sample was received in a natural state. The percentage passing the 63µm test sieve was obtained by difference.

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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Tested By: **L.T. Smith** **Date:** **10 to 15-Jan-19**

Checked By:

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Central Testing Services
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Reference No: 19/022

Date: 15 January 2019

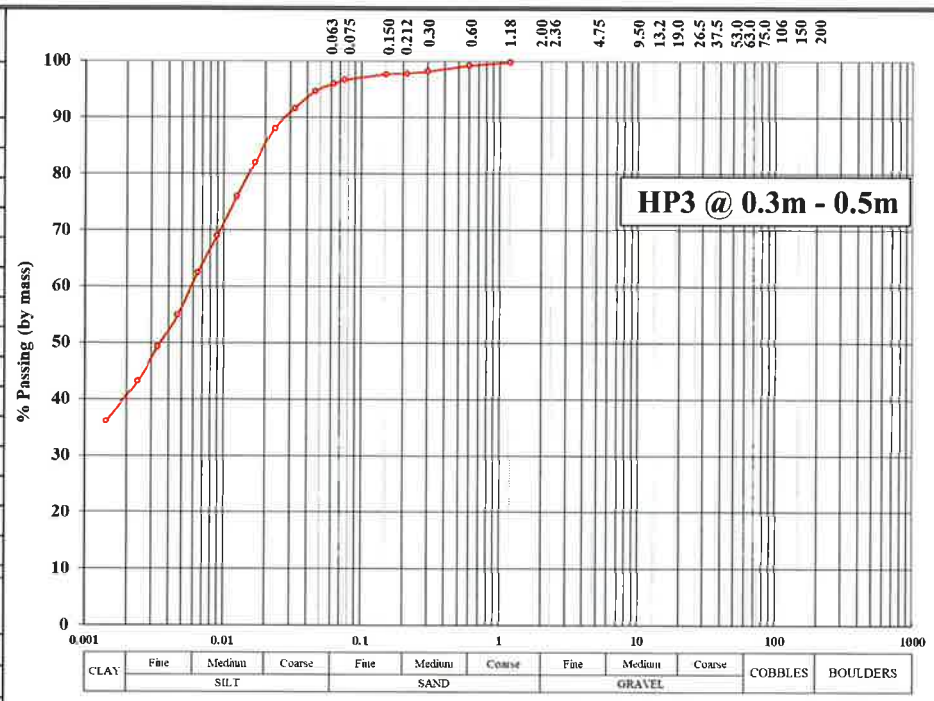
TEST REPORT – WELHOM DEVELOPMENTS INVESTIGATIONS

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, Rangiora		
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 SIZE ANALYSIS (NZS 4402:1986, Test 2.8.1 & 2.8.4)

Test Sieve (mm)	% Passing (by mass)
37.5	
26.5	
19.0	
13.2	
9.50	
4.75	
2.36	
2.00	
1.18	100
0.60	99
0.30	98
0.212	98
0.150	98
0.075	97
0.063	96

Fraction Size	Interpolated % Passing
60 µm	96
20 µm	85
6 µm	60
2 µm	40



The sample was received in a natural state. The percentage passing the 63µm test sieve was obtained by difference. The pH of the hydrometer suspension was 9.5. Sodium hexametaphosphate was used as a dispersant.

PARTICLE SIZE ANALYSIS & HYDROMETER ANALYSIS RESULTS - NZS 4402:1986, Test 2.8.1 & 2.8.4

Description	Fraction Range	% Within Range	Description	Fraction Range	% Within Range
Coarse Gravel	60.0mm to 20.0mm	-	Fine Sand	200 µm to 60 µm	2
Medium Gravel	20.0mm to 6.0mm	-	Coarse Silt	60 µm to 20 µm	11
Fine Gravel	6.0mm to 2.00 mm	-	Medium Silt	20 µm to 6 µm	25
Coarse Sand	2.00mm to 600 µm	1	Fine Silt	6 µm to 2 µm	20
Medium Sand	600 µm to 200 µm	1	Clay	< 2 µm	40

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 index material tested was whole soil.

Note:

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Tested By: L.T. Smith Date: 10 to 15-Jan-19

Checked By:

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Central Testing Services
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Reference No: 19/022

Date: 15 January 2019

TEST REPORT – WELHOM DEVELOPMENTS INVESTIGATIONS

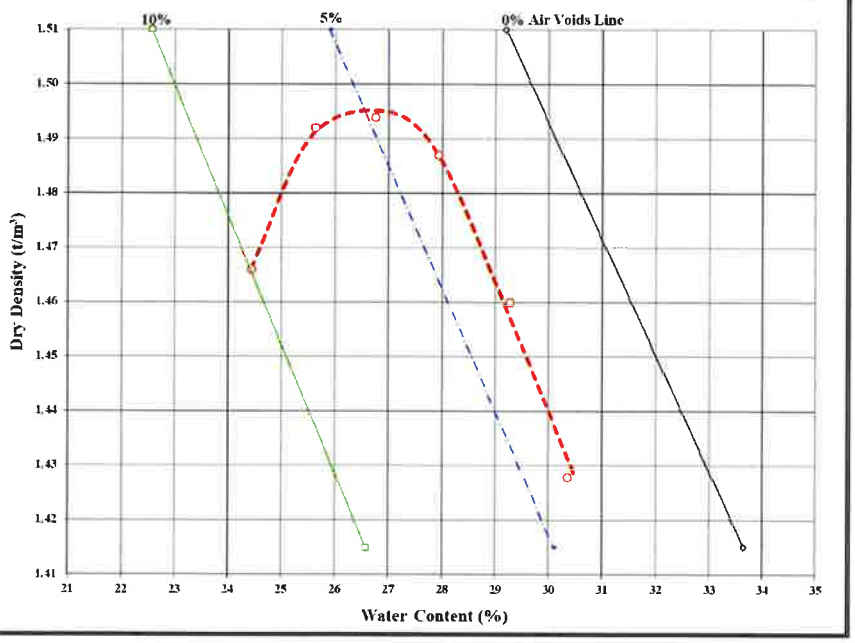
Client Details:	**Riley Consultants Ltd, P.O. Box 4355, Christchurch**	**Attention:**	**A. van Dusschoten**
Job Description:	**Welhom Developments Investigations, cnr Townsend and South Belt Road, Rangiora**		
Sample Description:	**Clayey SILT with trace of sand**	**Client Order No:**	**170743**
Sample 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**

WATER CONTENT & NZ STANDARD COMPACTION - NZS 4402:1986, Test 2.1 & 4.1.1

% Retained (+19.0mm Fraction)	**0.0 %**
Water Content: ("All In" As Received)	**30.1 %**
Maximum Dry Density:	**1.50 t/m³**
Optimum Water Content:	**27.0 %**

Notes:

- *The sample was received in a natural state.*
- *The material tested in the NZ Standard Compaction test was whole soil.*
- *The air voids lines were calculated from an assumed solid density of 2.70 t/m³.*



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Tested By: L.T. Smith **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, 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 material 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:

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

IANZ
ACCREDITED LABORATORY
Accreditation No: 434

Central Testing Services
18 Ngapara St, P.O. Box 397, Alexandra 9340, Central Otago, New Zealand
P: 03 4487644, W: www.centraltesting.co.nz, E: info@centraltesting.co.nz

Reference No: 19/022

Date: 15 January 2019

TEST REPORT – WELHOM DEVELOPMENTS INVESTIGATIONS

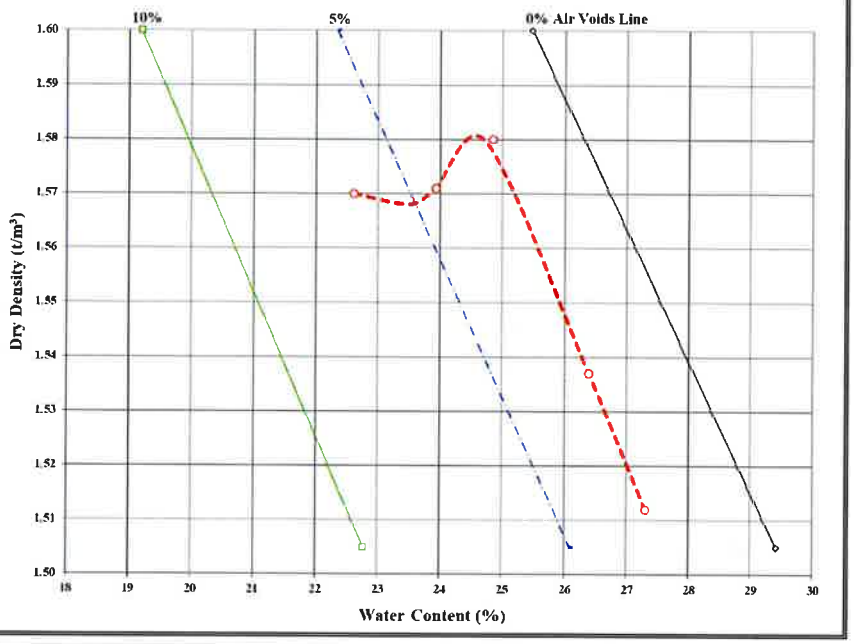
Client Details:	**Riley Consultants Ltd, P.O. Box 4355, Christchurch**	**Attention:**	**A. van Dusschoten**
Job Description:	**Welhom Developments Investigations, cnr Townsend and South Belt Road, Rangiora**		
Sample Description:	**Clayey SILT with minor sand**	**Client Order No:**	**170743**
Sample 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**

WATER CONTENT & NZ STANDARD COMPACTION - NZS 4402:1986, Test 2.1 & 4.1.1

% Retained (+19.0mm Fraction)	**0.0 %**
Water Content: ("All In" As Received)	**24.1 %**
Maximum Dry Density:	**1.58 t/m³**
Optimum Water Content:	**24.5 %**

Notes:

- *The sample was received in a natural state.*
- *The material tested in the NZ Standard Compaction test was whole soil.*
- *The air voids lines were calculated from an assumed solid density of 2.70 t/m³.*



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 material 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:

Approved Signatory

A.P. Julius
Laboratory Manager

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

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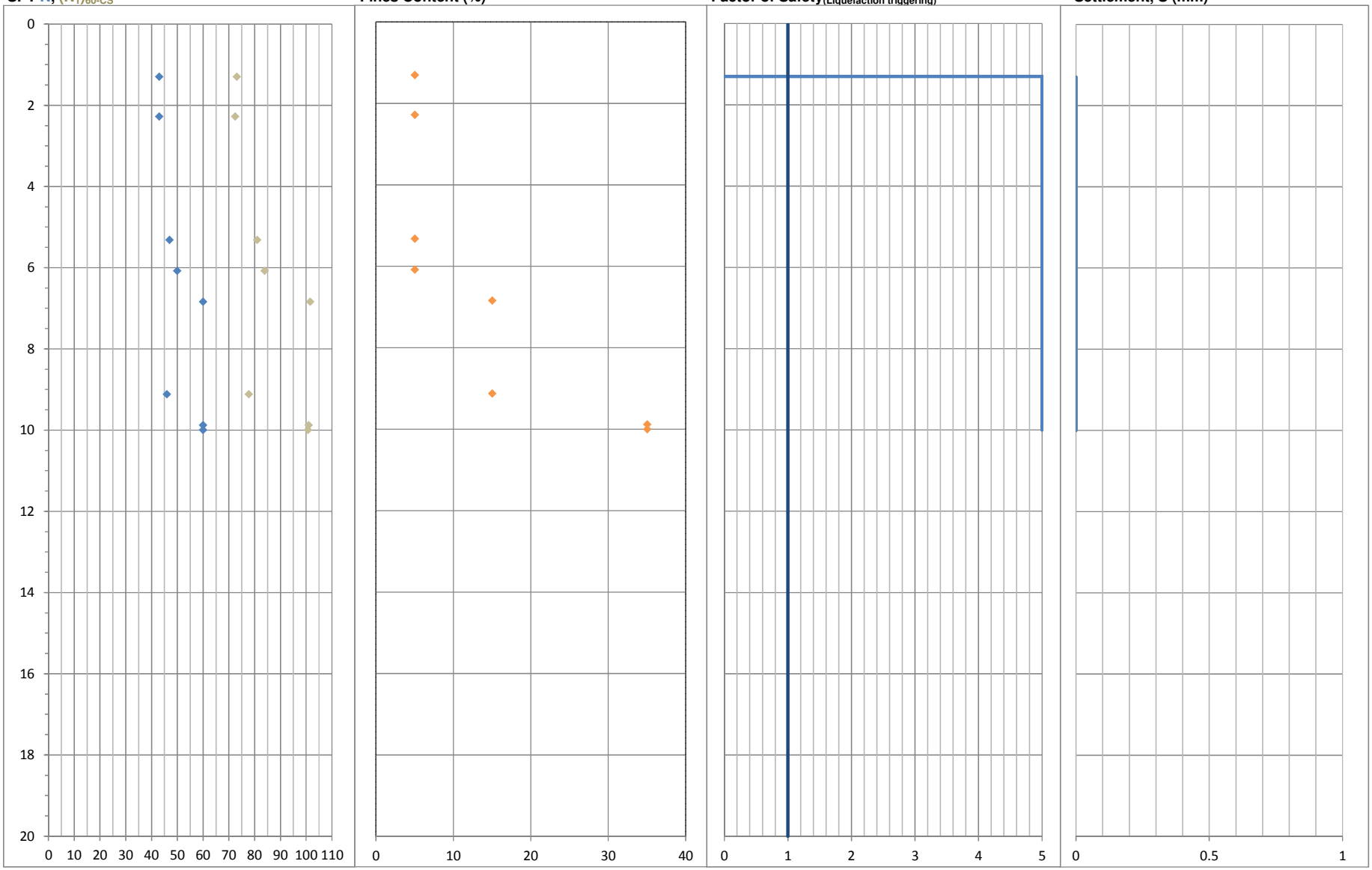
APPENDIX D

Liquefaction Analysis

Test:	***BH1***	File:	170743	***SLS1***	Mw	7.5	PGA	0.13	g	S	0	mm	S_{Index}	0	mm	LSN	0
Project:	Summerset Rangiora			***SLS2***	Mw	6	PGA	0.19	g	S	0	mm	S_{Index}	0	mm	LSN	0
Water table depth:	1.3	m		***ULS***	Mw	7.5	PGA	0.35	g	S	0	mm	S_{Index}	0	mm	LSN	0



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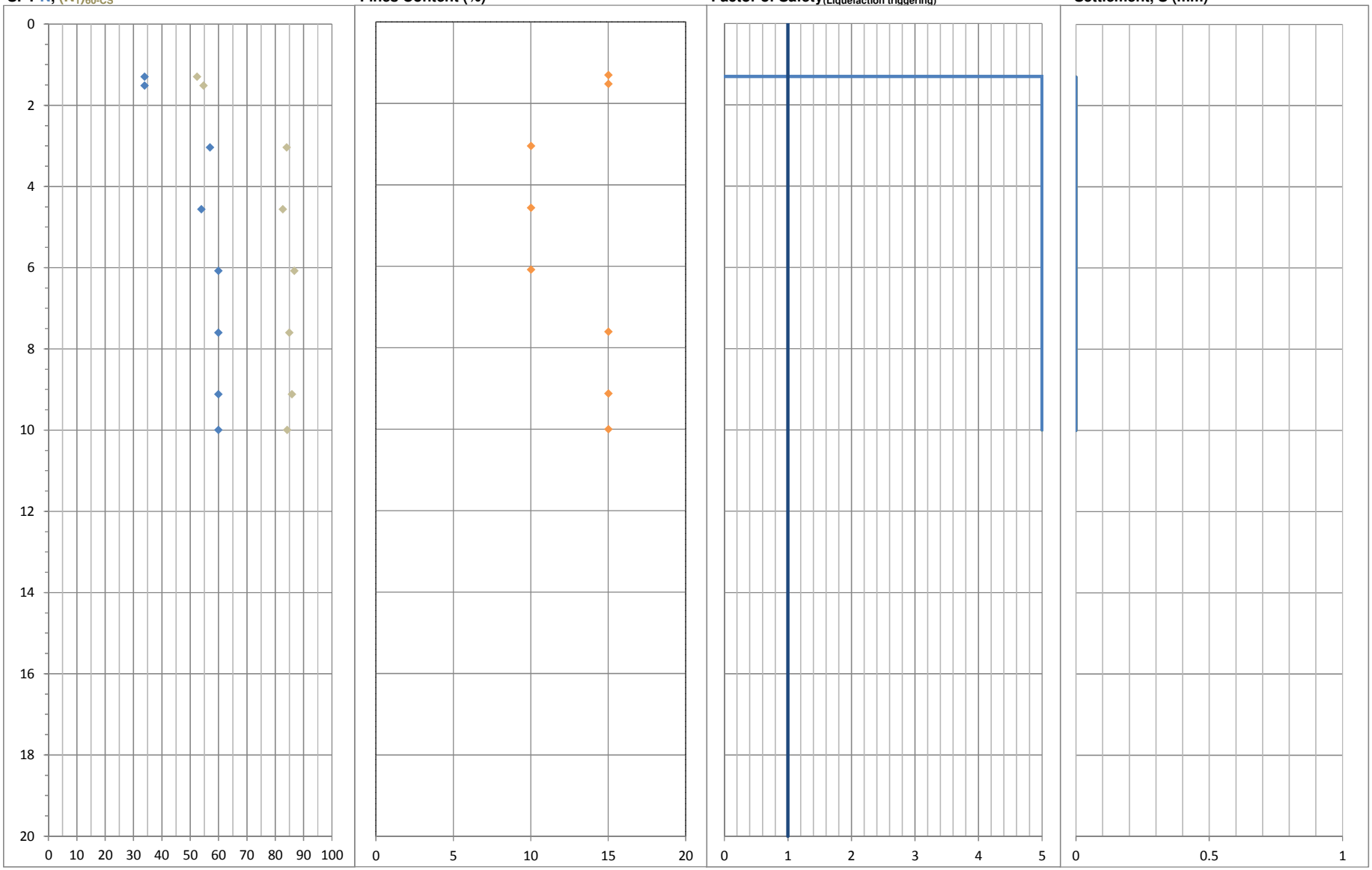
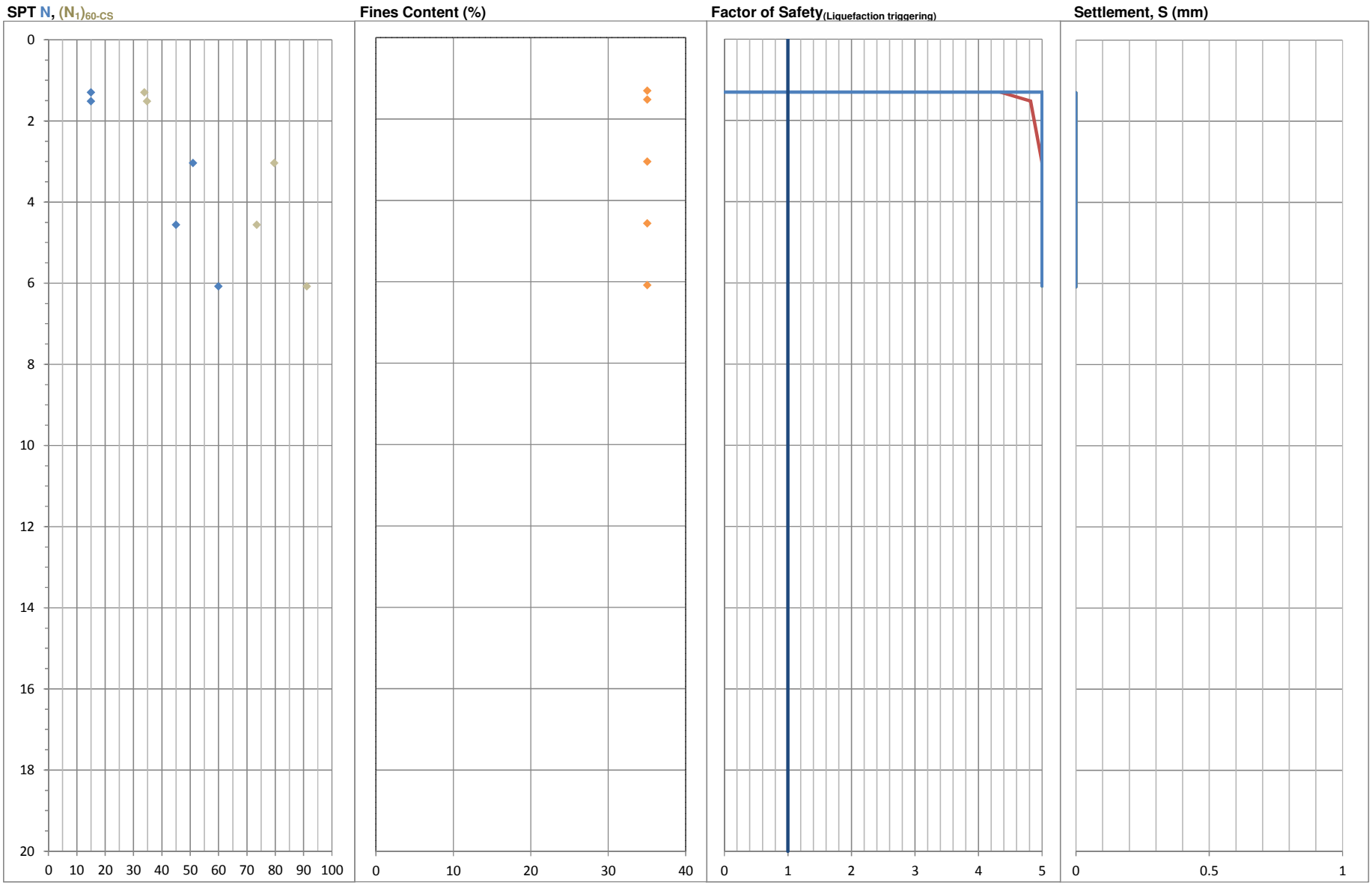
Test:	***170743***	File:	BH2	***SLS1***	Mw	7.5	PGA	0.13	g	S	0	mm	S_{Index}	0	mm	LSN	0
Project:	Summerset Rangiora			***SLS2***	Mw	6	PGA	0.19	g	S	0	mm	S_{Index}	0	mm	LSN	0
Water table depth:	1.3	m		***ULS***	Mw	7.5	PGA	0.35	g	S	0	mm	S_{Index}	0	mm	LSN	0

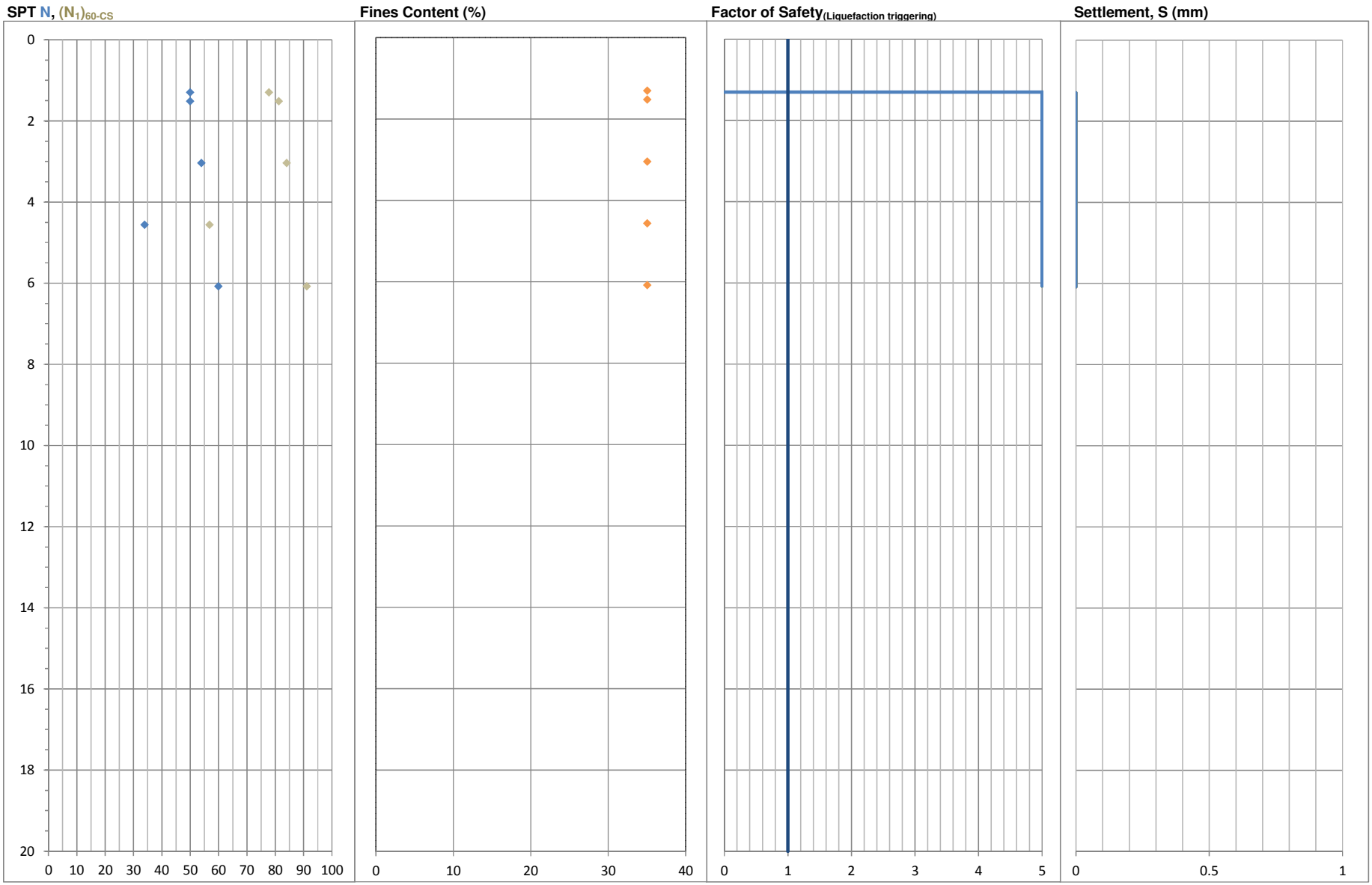


RILEY CONSULTANTS

Test:	***BH3***	File:	170743	***SLS1***	Mw	7.5	PGA	0.13	g	S	0	mm	S_{Index}	0	mm	LSN	0
Project:	Summerset Rangiora			***SLS2***	Mw	6	PGA	0.19	g	S	0	mm	S_{Index}	0	mm	LSN	0
Water table depth:	1.3	m		***ULS***	Mw	7.5	PGA	0.35	g	S	0	mm	S_{Index}	0	mm	LSN	0



Test:	***BH4***	File:	170743	***SLS1***	Mw	7.5	PGA	0.13	g	S	0	mm	S_{Index}	0	mm	LSN	0
Project:	Summerset Rangiora			***SLS2***	Mw	6	PGA	0.19	g	S	0	mm	S_{Index}	0	mm	LSN	0
Water table depth:	1.3	m		***ULS***	Mw	7.5	PGA	0.35	g	S	0	mm	S_{Index}	0	mm	LSN	0



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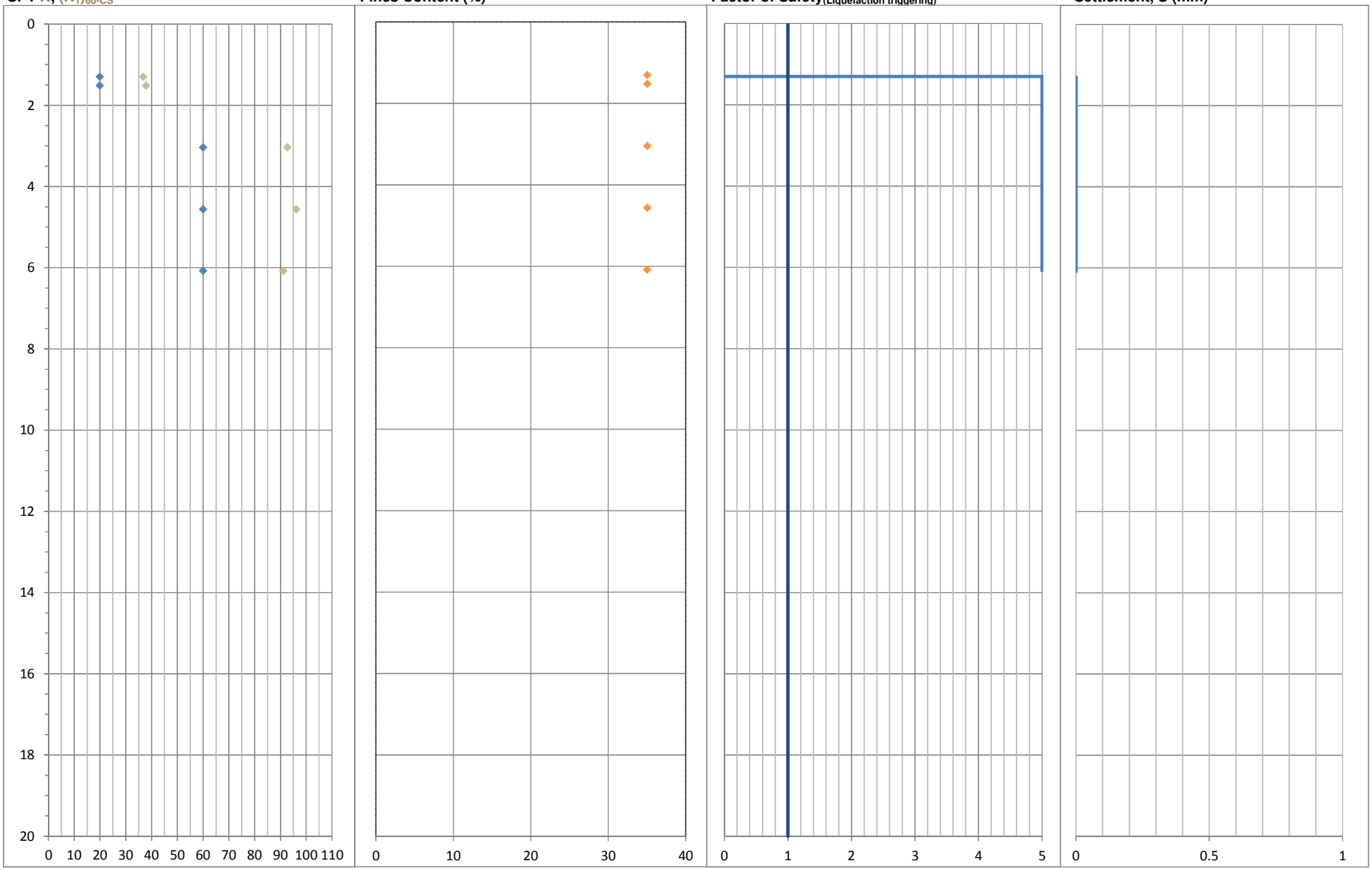
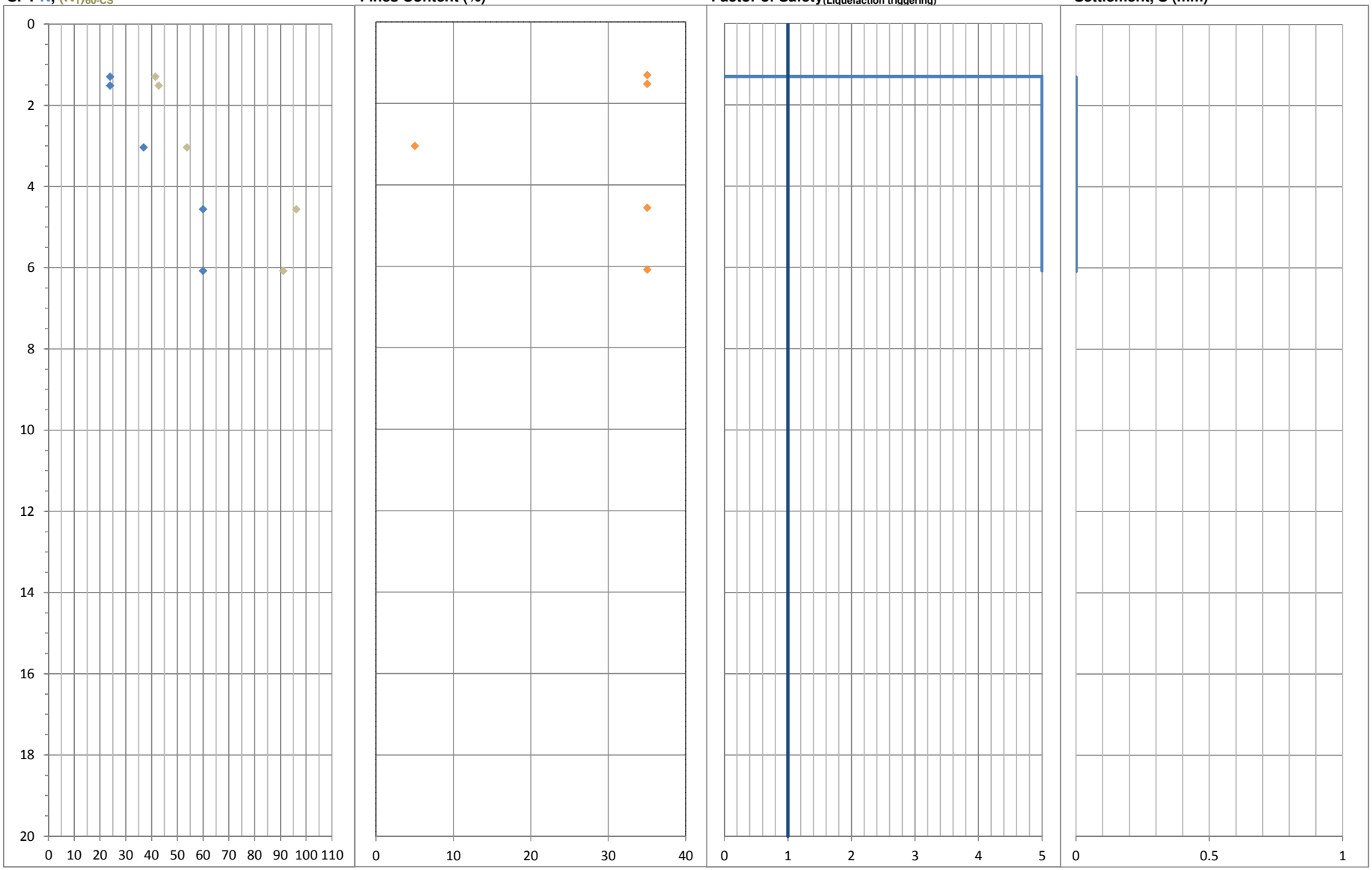
Test:	***BH5***	File:	170743	***SLS1***	Mw	7.5	PGA	0.13	g	S	0	mm	S_{Index}	0	mm	LSN	0
Project:	Summerset Rangiora			***SLS2***	Mw	6	PGA	0.19	g	S	0	mm	S_{Index}	0	mm	LSN	0
Water table depth:	1.3	m		***ULS***	Mw	7.5	PGA	0.35	g	S	0	mm	S_{Index}	0	mm	LSN	0



Test:	***BH6***	File:	170743	***SLS1***	Mw	7.5	PGA	0.13	g	S	0	mm	S_{Index}	0	mm	LSN	0
Project:	Summerset Rangiora			***SLS2***	Mw	6	PGA	0.19	g	S	0	mm	S_{Index}	0	mm	LSN	0
Water table depth:		1.3	m	***ULS***	Mw	7.5	PGA	0.35	g	S	0	mm	S_{Index}	0	mm	LSN	0



APPENDIX E

Drawing

LEGEND

- HA1 — HAND AUGER BOREHOLE LOCATION
- BH1 — MACHINE BOREHOLE LOCATION
- TP1 — TEST PIT LOCATION
- PROPOSED DEVELOPMENT AREA
- LEGAL LOT BOUNDARY

20 0 40 80m

SCALE 1:2000

NOTES:

1. PHOTO SOURCED FROM WAIMAKARIRI URBAN AERIAL PHOTOS (2013–2014), LINZ.
2. PARCELS SOURCED FROM LINZ.
3. HOLE/TEST LOCATIONS APPROXIMATE ONLY AND SUBJECT TO SURVEY CONFIRMATION.

NOT FOR CONSTRUCTION

REV	DATE	ISSUE	BY
2	07.08.19	SITE HATCH	LS
1	31.07.19	REPORT ISSUE	FY

DESIGN	DES CHECK	APPROVED FOR ISSUE
AVD	LAK	T. SMITH
DRAWN	CAD CHECK	
FY	RBT	
DATE DRAWN		ISSUE DATE
20.11.18		7 / 8 / 19

RILEY CONSULTANTS
www.riley.co.nz

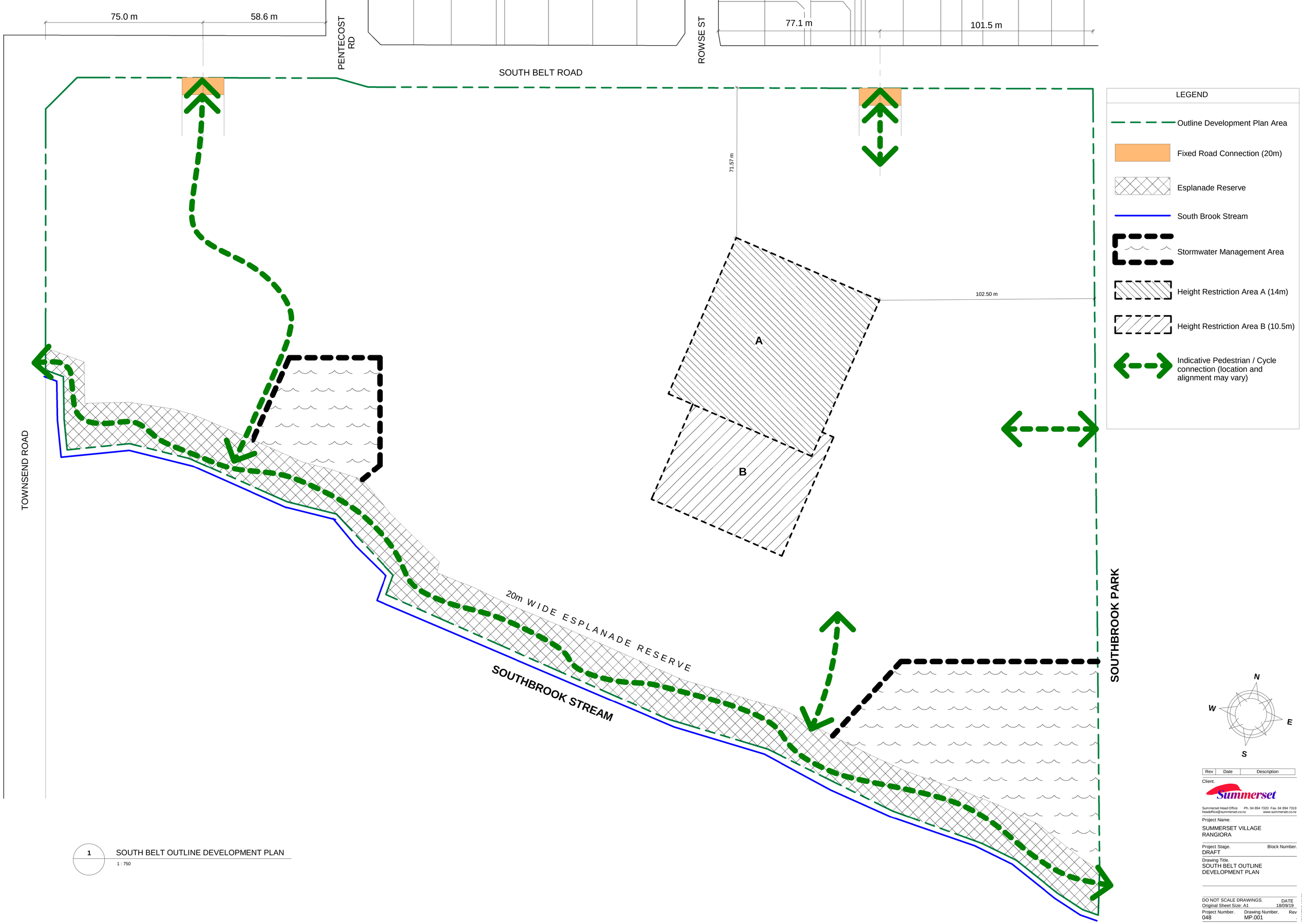
CLIENT	SUMMERSET VILLAGES (RANGIORA) LIMITED
ADDRESS	104 TOWNSEND ROAD & 141 SOUTH BELT, RANGIORA
PROJECT	SUMMERSET RANGIORA
SHEET TITLE	GEOTECHNICAL INVESTIGATION LOCATION PLAN

ACENZ ISO 9001 CERTIFIED GCS

CADFILE	170743-1	
SCALE (A3)	ORIG. SHEET SIZE	
1:2000	A3	
DRAWING No.		REV.
170743-1		2

APPENDIX F

Outline Development Plan



1 SOUTH BELT OUTLINE DEVELOPMENT PLAN

1 : 750

Rev	Date	Description

Client.

Summerset

Summerset Head Office Ph. 04 894 7320 Fax. 04 894 7319
headoffice@summerset.co.nz www.summerset.co.nz

Project Name.

SUMMERSET VILLAGE
RANGIORA

Project Stage. DRAFT

Block Number.

Drawing Title.

SOUTH BELT OUTLINE
DEVELOPMENT PLAN

DO NOT SCALE DRAWINGS.
Original Sheet Size: A1

DATE 18/09/19

Project Number. 048

Drawing Number. MP.001

Rev

12/11/2019 4:24:36 p.m.