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Wainono Investments Limited 21 Gatland Road Drury Auckland 2113 21 December 2018

Our Ref: 180432-B

Attention: Mr Nick Pollard

Dear Sir

GEOTECHNICAL INVESTIGATION PROPOSED SUBDIVISION 21 GATLAND ROAD, DRURY

1.0 Introduction

The following report has been prepared by Riley Consultants Ltd (RILEY) at the request of Mr Nick Pollard on behalf of Wainono Investments Limited. It presents the results of a geotechnical investigation for a proposed residential subdivision at the above address.

The purpose of the geotechnical investigation and report is to investigate subsoil conditions, assess overall ground stability, and provide general foundation recommendations for the proposed development in support of a resource consent application to Auckland Council (Council). A separate report has been prepared by RILEY to address land contamination aspects of the development.

2.0 Site Description and Proposed Development

The site is located on the southern side of Gatland Road. It is approximately 1.21ha and is currently used for pastoral farming purposes. An existing dwelling and multiple sheds are located in the central and western portions of the site.

The site is bounded by residential properties to the west and undeveloped farmland to the east and south. Site access is via Gatland Road to the north. From the architectural drawings in the Council property file, the existing dwelling is a concrete slab-on-grade and shallow strip type foundation.

From a review of Council GIS contour data, slopes on site range from flat to gently sloping (maximum 5 degrees). A shallow 'gully' feature is present and spans the site from the north to the south. A swampy area is noted adjacent to the southern boundary of the proposed subdivision where existing surface runoff flows into.

It is proposed to subdivide the site into 20 residential lots with a road accessway. The existing dwelling on Lot 20 will remain. The proposed access for the lots are via a spine road through the centre of the subdivision, and a current unformed road adjoining from proposed Lots 12, 14, and, 16. The cut and fill earthwork plans are not available at the time of report preparation.



3.0 Geology

With reference to the 1:250,000 Geological Map 3 of Auckland, together with our experience of the surrounding area, we infer the site is underlain by alluvial sediments of the Puketoka Formation of the Tauranga Group. A preliminary review of nearby machine hole drillings available on the New Zealand Geotechnical Database (NZGD) indicates alluvial soils overlie Waitemata Group deposits at approximately 20m to 22m depth.

The Puketoka deposits generally consist of pumiceous mud, sand, and gravel with muddy peat and lignite. It also consists of rhyolite pumice including non-welded ignimbrite, tephra and alluvial pumice deposits and massive micaceous sand. These soils are often highly variable in strength and character. The presence of these materials, typically beneath a capping of volcanic material, was confirmed on-site by the subsurface investigation. This material is also found beneath recent alluvial soil, which consists of very stiff organic silt within the swamp area.

4.0 Geotechnical Site Investigation

A site walkover appraisal was carried out by a RILEY geotechnical engineer on 5 November 2018. Results from on-site observations indicated no obvious evidence of past instability, erosion, slope slippage, or soil creep affecting the proposed development and their immediate surroundings.

Fourteen hand auger boreholes (HA1 to HA14) were drilled to a maximum depth of 5m between 11 and 16 October 2018 to assess the subsurface conditions in the vicinity of the proposed lots. The approximate borehole locations are shown on the attached site plan (RILEY Dwg: 180432-1). Pilcon shear vane testing was undertaken at 0.5m intervals in the cohesive soils. These results are also shown on RILEY cross sections (RILEY Dwgs: 180432-2 to -4). Scala penetrometer testing was also conducted at the base of selected boreholes to investigate for competent material.

Representative bulk samples were recovered from TP1 and TP2 for laboratory testing. Standard compaction, and CBR testing was undertaken on the samples by WSP Opus Laboratories in Auckland. Two standard compaction tests were undertaken in accordance with NZS 4402 test 4.1.1, on material immediately below the topsoil to establish appropriate compaction control criteria for the engineered fill. Two sets of California bearing ratio (CBR) tests were undertaken in accordance with NZS 4402:1986 test 6.1.1 and test 2.1 with 2% and 4% lime added. The results are outlined in Section 6.0 below.

5.0 Subsurface Investigation

Subsoil conditions encountered at the borehole locations are summarised below, and a detailed description of the soils encountered during drilling is shown on the attached borehole logs:

- Topsoil was encountered within all boreholes (except HA14) to the depths ranging from 0.1m to 0.45m depth.
- Fill was not encountered in any of the boreholes during drilling.
- Volcanic deposits of the South Auckland Volcanic Field (SAVF) were encountered beneath the topsoil to depths between 0.5m and 2m within most of the boreholes except HA7, HA11, and HA14.

The volcanic deposits typically comprised silt, with varying amounts of clay and sand. The materials encountered were generally light brownish orange with a black mottled, non to slightly plastic. Shear strengths encountered during the investigation were generally of very stiff (117kPa to 199+kPa) consistency.

 Alluvial sediments of the Puketoka Formation were identified beneath the topsoil and/or volcanic deposits within all boreholes. These sediments generally consisted of light grey with red and pink mottled silts and clays. The plasticity ranges from non to high. Measured shear strengths typically ranged from stiff to hard (60kPa to 223+kPa) consistency.

Organic material was encountered within the lower lying southern and eastern portions of the site. These deposits were encountered at 2.5m depth extending to the base of the holes (5m). The organic clay/silt had a firm to stiff consistency with measured strengths of between 34kPa to 92kPa. The locations and the approximate depths of where organic material was encountered are shown on RILEY Dwg: 180432-1.

An approximate 600mm in thickness layer of weaker silt (40kPa to 58kPa consistency) was identified at a depth of 4m within HA8 and HA10 (eastern boundary).

- Groundwater was generally encountered at depths between 2.8m to 4m across the site during drilling except HA1 (dry at the time of drilling) and HA12 to HA14, where groundwater was measured between 0.4m and 1.0m below ground level. The soils above the water table were noted to be moist to wet.
- Standard piezometers were installed in HA1 (P1) and HA11 (P2). We visited the site on three further occasions to monitor the groundwater levels. The groundwater monitoring results are shown in Table 1.

Borehole	Piezometer Screen		Groundwater Dep Dates Monito	• •	
Borenole	Depths (m)	Drilling (16/10/2018)	5/11/2018	12/11/2018	22/11/2018
P1(HA1)	1.0 to 5.0	Not Encountered	3.7	3.7	3.8
P2(HA11)	1.0 to 5.0	2.8	1.5	1.5	1.4

Table 1: Summary of Monitoring Results

6.0 Laboratory Test Results

The standard compaction test results from samples recovered from TP1 and TP2 indicate maximum dry densities of 1.14t/m3 and 1.27t/m3 at optimum moisture contents of 42% and 36%, respectively. The full results are attached in Appendix C.

Selected CBR values of 9% and 3% were achieved, respectively. The additional 2% lime resulted in a minor improvement in soaked CBR in TP1 soils while a significant improvement was achieved in the TP2 soils. For both samples, with 2% lime added, the laboratory soaked CBR was 11%.

7.0 Geotechnical Considerations

On the basis of the geotechnical investigation, RILEY considers the proposed development to be generally suitable for the ground conditions encountered at the borehole locations, subject to the recommendations presented in the following sections.

The majority of the proposed lots are considered suitable for future buildings, subject to further input from a suitably experienced geotechnical engineer familiar with the content of this report. Based on the existing available information, the land within the swamp area (discussed in Section 7.3) will require further investigations prior to development.

7.1 Ground Stability

The risk of slope/ground instability affecting the proposed development is considered low, given the relatively high soil strengths encountered, together with the gentle land gradients within and around the proposed development.

7.2 Settlement

Organic material was identified during the investigation. The depths where these organic materials were encountered are shown on RILEY Dwg: 180432-1. It is considered that filling will likely be required in the lower (southern and eastern) portions of the site. The swampy and organic material are considered to be susceptible to settlement under fill and dwelling foundation loads.

Once earthworks design are available, calculations should be carried out to assess the settlement magnitude induced by earthfill and the likely timeframe for settlement to attenuate. Pre-loading may be required to accelerate settlement and reduce the magnitude of post-development long-term settlement. An assessment of required pre-loading heights and placement timeframe will need to be carried out. Settlement monitoring would also be required prior to development of the lots.

Alternatively, to mitigate this risk, the soft swampy and organic materials presents the lower portion of the site could be removed and replaced with engineered fill. However, this is considered unlikely to be economic as the organic material extends close to or beyond 5m.

7.3 Swamp and Groundwater Considerations

An overland flowpath was located in the central portion of the site and discharges into the swamp area. A relatively high groundwater level between 0.4m to 1m was identified within this area at the time of investigation.

The measured groundwater tables generally range from 2.8m to 4.9m (except the swamp area). The proposed cut is unknown at this stage. The groundwater level shown on RILEY Dwg: 180432-1, represents the groundwater level at the time of drilling and following monitoring. Possible effects on the groundwater table should be included as part of a geotechnical review when the earthworks plans are available.

7.4 Foundation Requirements

The underlying, relatively stiff, natural soils (typically the upper 2.5m depth) should be suitable to enable the future light timber framed residential structures to be supported on conventional shallow-type foundations (i.e. footings, pads, or short piles) designed in accordance with NZS: 3604:2011. The soils have been assessed as Class M to H, moderately to highly expansive, with respect to AS: 2870:1996. Class M and H is defined as moderately to highly reactive clays and silts, which can experience ground movement from moisture changes. This would need to be defined with further geotechnical inputs.

To minimise the risk of shrink/swell movement affecting the future structures, conventional shallow foundations designed in accordance with NZS: 3604:2011, should extend a minimum 800mm into stiff natural ground. Alternatively, a specific foundation design may be undertaken in accordance with AS: 2870:1996 (i.e. waffle type slabs). Foundations may be designed assuming the following preliminary parameters:

- 300kPa Ultimate Bearing Capacity (Geotechnical Ultimate).
- 150kPa Dependable Bearing Capacity (Ultimate Limit State).
- 100kPa Allowable Bearing Capacity (Serviceability Limit State).

As mentioned previously, low-strength organic soils were encountered beyond 2.5m depth in places. This organic material is not considered suitable to support any permanent structures. Whilst earthworks are envisaged to be minimal, care should be taken during site development to avoid 'over excavation' reducing the crust of stiff material. Where those materials are present, dwellings should be subject to specific design.

All foundations, within the 45-degree zone of influence of stormwater and sanitary sewer lines, will need to be specifically designed to ensure that foundation loads are transferred to the soils below this zone.

8.0 Site Development

8.1 Earthworks

No earthworks proposals are available at this time. However, due to the gentle contour of the site, we expect only minimal earthworks will be undertaken. We anticipate that earthworks will principally involve excavations for the road pavement, service lines, and cutting down of the high elevated areas, plus fill placement over the lower lying parts of the site.

Earthworks fill compaction testing should be undertaken at, or in excess of, the frequency recommended in NZS: 4431. We envisage that earthworks control will be undertaken principally using allowable air voids and shear strength criteria.

All fill should be placed in a controlled manner in accordance with NZS: 4431. Based on laboratory compaction testing, earth fill should achieve an average shear strength of 150kPa with no single result less than 120kPa. Additionally, fill should achieve an average air voids percentage less than 8% with no single result greater than 10%.

Surficial topsoil layers should be stripped prior to fill placement and stockpiled well clear of the earthwork areas and/or used for pre-loading. This material may be reused following engineered fill placement spread over the lots to a maximum depth of 300mm.

The site earthworks proposals should be reviewed by a geotechnical engineer familiar with the contents of this report. Any exposed areas of soft or organic soils within the proposed building platform should be inspected and undercut at the discretion of an experienced geotechnical practitioner.

8.2 Retaining Walls

All cuts and fills exceeding 500mm in height should be supported by specifically designed retaining walls and reviewed by an experienced geotechnical engineer.

Retaining walls should include a drainage layer behind the wall consisting of drainage metal (e.g. TNZ F/2) with a drainage coil at the base. All collected groundwater should be diverted to an appropriated designed reticulation system of outfall.

8.3 Road Subgrade California Bearing Ratios

The laboratory test results showed varying CBR results (3% and 9%) from natural soil recovered on-site without any improvement from lime. Lime stabilisation should improve the available CBR. The test results indicate that the CBR can be increased to 11% with the addition of 2% lime in both samples. Based on the laboratory test results, we recommend that a CBR value of 7% should be used for preliminary road pavement design with the adding of 2% lime (to 300mm depth). We recommend that a program of Scala testing be undertaken during site earthworks to confirm the available CBR at road subgrade level following improvement.

8.4 Services

Stormwater runoff from roofs and paved areas should be collected and piped to a public reticulation system, or outfall, away from the development.

We anticipate that most stormwater and sanitary sewer lines will be found either within stiff natural soils or engineered fill (e.g. stiff alluvial and volcanic fill). Consideration should be given to the presence of the softer organic soils present across the site and their effect on service line performance and construction. For pipelines interbedded in the organic soils, specific bedding modifications are best recommended when the trenches are excavated and the weaker materials at the invert level are examined in detail. This could also steepen the pipe gradients or increase pipe diameter.

It is recommended that installation of stormwater and sanitary sewer lines be undertaken utilising trench shields and/or battering in soils of low plasticity, provided the shoring methodology complies with the relevant New Zealand standards and legislation. The use of sumps and pumps, will likely, be required to control groundwater inflows during service line installation.

Further geotechnical comment will be required in this regard once detailed development drawings are available.

9.0 Conclusions

RILEY considers that the proposed development is suitable subject to the following recommendations:

- The risk of slope instability affecting the proposed development is considered low, given the relatively high soil strengths encountered in the soil profile, together with the gentle land gradients surrounding the proposal.
- No earthworks proposals are available at this time. However, due to the gentle contour of the site, we expect only minimal earthworks will be undertaken. The site earthworks proposals should be reviewed by a geotechnical engineer familiar with the contents of this report prior to subdivisional development.

- Settlement of the organic soils, and as a result of surcharge filling and building loads, could be mitigated through pre-loading.
- To minimise the risk of shrink/swell movement affecting the future structures, conventional shallow foundations designed in accordance with NZS: 3604:2011, should extend a minimum 800mm into stiff natural ground. Alternatively, a specific foundation design may be undertaken in accordance with AS: 2870:1996 (i.e. waffle type slabs) using the parameters provided in this report.
- All cuts and fills exceeding 500mm in height should be supported by specifically designed retaining walls and reviewed by an experienced geotechnical engineer.
- Based on lab testing results, we recommend that a CBR value of 7% should be used for preliminary road pavement design with 2% lime stabilisation.
- Stormwater runoff from roofs and paved areas should be carefully collected and piped to a public reticulation system or outfall away from the development.

10.0 Limitation

This report has been prepared solely for the benefit of Wainono Investments Limited as our client with respect to the brief. The reliance by other parties on the information or opinions contained in the report shall, without our prior review and agreement in writing, be at such parties' sole risk.

Recommendations and opinions in this email 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 email 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.

Riley Consultants Ltd would be pleased to provide this service to Wainono Investments Limited and believes the project would benefit from such continuity. In any event, it is essential Riley Consultants Ltd is contacted if there is any variation in subsoil conditions from those described in the email as it may affect the design parameters recommended in the email.

If you have any queries, please do not hesitate to contact the undersigned.

Yours faithfully RILEY CONSULTANTS LTD

Prepared by:

Reviewed by:

Minna Ji Geotechnical Engineer

Borehole Logs (HA1 to HA14)

RILEY Dwgs: 180432-1 to -4

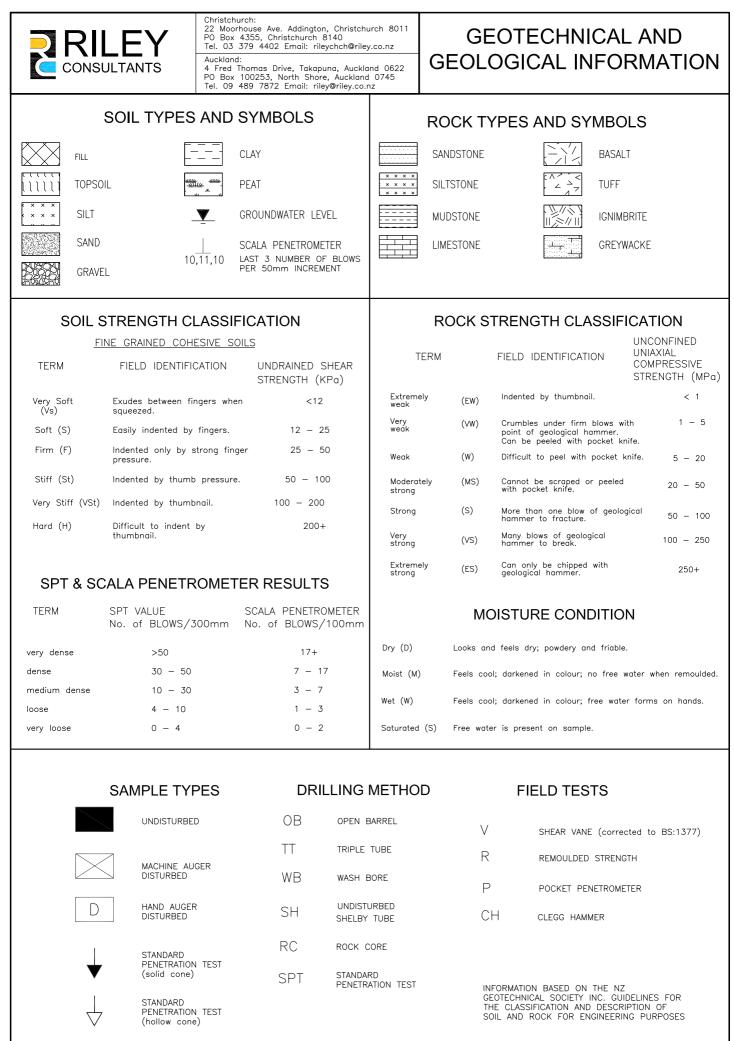
WSP Opus Laboratories Test Results

James Beaumont Senior Geotechnical Engineer

Approved for issue by:

Brett Black Director, CPEng

Enc:



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2.50	C T	layey SILT; líght orange and li roderately plastic [PUKETOK	ght grey mixed FORMATION	d, Very stiff, v].	× × ×							R= 5:
-3	V	LAY, some silt; bluish grey wi ery stiff, moderately plastic.	h Irace red mo	ottles. Stiff to						11/10/2018	vs s	∨ R= 5 ∨ V= 1: R= 1
3,40	n ge	ilty CLAY; light grey to white w oderately plastic.		. Very stiff,			*					∨ V= 19
-4 4.10	c	70 m - 3,80 m 100mm of brig LAY, some silt; light yellowish ottles. Very stiff, moderately p	brown with rea	d and orange			∠ × ⊥			~	w	∨ V= 12 R= 44
		LAY, minor silt, trace sand, tra oderately plastic; Sand, fine; g					۵ ×					∨ V= 1; R= 3i
		DH @ 5.05 m			1.1		$\begin{array}{c} 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 $				w	V=10 No. 1 1.0, 1, 0, 0, 1, 0, 0, 0, 1, 0, 1, 0, 0, 1, 1, 1, 1, 2, 1, 1, 1, 1, 2, 1, 1, 1, 2, 1, 1, 1, 2, 3, 3, 3, 4
eathered, mode ompletely weath elative soil Stre	hering erately ered, r ngth - v se, stiff bed Sa		Perm Schrr Vinsitu V=Pe to per to per	a Penetrome eability Test iidt Hammer Vane Shea ak, R≅Resion eatrate r Strike (1st, ; r Rise (1st, ;	Strength tual, UTP: 2nd)	(kPa) ≋Unable	GROUNDWATE None Slow Seep Rapid Inflov HOLE TERMIN/ Target Depth	(depth 3.0 m) v(depth)	ż.om	3.00	m: Wate	Remarks nr strike - Very slow see

ttand .: 180 nono (E) 40 0.25 0.60	432	2 Start Date: 16- Finish Date: 16- restment Ltd Geological Desc (refer to separate Geolechnic Information sheet for furth	ription	Hole 5.0		m):	Hole position Refer to s Co-Ordina	ite plan.					No.:
180 nono (E) 180 0.00	opsoil Geological Unit	2 Finish Date: 16- restment Ltd Geological Desc (refer to separate Geolechnic Information sheet for furth	ription	Hole 5.0	e Dej	m):	Co-Ordina	tes ():				1	
nono (L) Debth (L) 0.25	opsoil Geological Unit	Geological Desc (refer to separate Geolechnic Information sheet for furth	cription	5.0				0					HA5
0.25	obsoil	(refer to separate Geotechnic Information sheet for furth	al and Geological			oth:						She	eet: 1 of 1
					Legend	Unified Symbol	il Shear Streng (kPa)	(blows	enetrometer s / 50 mm) 9 12 1	Groundwater		Samples	Tests
0.60	≝	TOPSOIL			11						M		
	SA	SILT, minor clay, orangish brown. V SOUTH AUCKLAND VOLCANIC I	Very stiff, slightly plasti FIELD].	ic x	× ×	1	۵ ×						∨ V= 11 R= 58
1	•	Silty CLAY; brownish light grey with Stiff to very stiff	n trace orange mottles,	x x x	× × ×						ΜŴ		∨ V= 10 R= 62 ∨ V= 12
1.60		SILT, minor clay; white		××	× × ×	1							V- 14
2 2.05	lon	Silty CLAY; light grey with orange m moderately plastic.	nottles, Very stiff,	x ki x i	× × × ×	111							∨ V= 14 R= 77 ∨ V= 12: R= 92
3	Puketoka Forma	organics, Organics, amorphous,		<u>x x x x </u>	× × × ×		۵ ×						∨ V= 12 R= 80
				<u>x</u> <u>x</u>	× × × ×					11/10/2018			∨ V= 16 R= 12
4.15		Organic CLAY; dark brown, Stiff, me		N 141	1 × 1 × 1 + 5					Ţ	s		∨ V= 15 R= 52
		Clayey SILT, minor organics, trace :	sand; light brownish , fine; organics,	- ix	××××		×						∨ V= 62 R= 31
		EOH @ 5.00 m							6.4m				No. 1 R= 22 0, 0, 0, 0, 0, 1, 1, 1, 1, 1, 2, 1, 1, 1, 1, 1, 2, 2, 2, 2, 9, 11, 8, 9, 10, 11, 12, 15
ss Wea	theri		Fermeability Test	it	blows/5	50mm	GROUNDWATI	ER		SA	VF*-		Remarks Auckland Volcanic Fi
soil Stre ium der ill Distu	ength ise, s bed	h - very soft/very loose, soft/loose, stiff/dense, very stiff/very dense Sample	 Insitu Vane Shea V=Peak, R=Resi to penetrate Water Strike (1st 	ar Strer idual, L t, 2nd :	JTP=L		HOLE TERMIN	w (depth)					
	4.15 4.45 5.00 ttion s Wea m den Distu Undis	2.05 Logramue 4.15 4.45 5.00 Logramue 4.15 5.00 Logramue Substrated Disturbed Disturbed Undisturb	2.05 SILT, minor clay, white 2.05 Silty CLAY; light grey with orange n moderately plastic. 2.80 m - 3.25 m Orange and light g organics. Organics. Organics, amorphous, a 3.20 m Grades to minor organics, a 3.20 m Grades to trace organic, an Organic CLAY; dark brown, Stiff, m plastic. 4.15 4.10 m Grades to trace organic, an Organic CLAY; dark brown, Stiff, m plastic. 5.00 EOH @ 5.00 m titions: EOH @ 5.00 m titions: Weathering - unweathered, slightly, moderately weathered, nighly weathered, oil Strength - very soft/very lose, soft/lose, and mense, stiff/dense, very stiff/very dense Disturbed Sample Disturbed Sample Indisturbed Sample Indisturbed Sample	SILT, minor clay, white SILT, minor organica, amorphous, SILT, minor organics, amorphous SILT, minor organics, trace amorphous Crganic CLAY; dark brown, Stiff, moderately to highly plastic. Clayey SILT, minor organics, trace sand; light brownish grey. SILT, minor organics, trace sand; light trace, trace sand; light brownish grey. SILT, minor organics, trace sand; light brownish grey. SILT, minor organics, trace sand; light trace, trace sand; light brownish grey. SILT, minor organics, trace sand; light trace, trace, stiff, moderately plastic; sand, fine; organics, somethous, SOUND STANDED Sample Disturbed Sample Statueted Sample Statueted Stample Statueted Stample Statueted Stample Statueted Stample Statueted Stample Statuetees St	2.05 SILT, minor clay, white X 2.05 Silty CLAY; light grey with orange mottles, Very stiff, moderately plastic. X 2.80 m - 3.25 m Orange and light grey mixed with trace organics. Organics, amorphous. X 3.20 m Grades to minor organics, amorphous X 4.15 4.10 m Grades to trace organic, amorphous X Organic CLAY; dark brown, Stiff, moderately to highly plastic. X Clayey SiLT, minor organics, trace sand; light brownish grey. Stiff, moderately plastic; sand, fine; organics, amorphous. X EOH @ 5.00 m EOH @ 5.00 m Scala Penetrometer - the permeability Test Schmidt Hammer institu Vane Shear Strey V=Peak, R-Residual, the penetrate wathered, slighty moderately weathered, slighty moderately classe, stiff/dense, very stiff/very dense Y Disturbed Sample Disturbed Sample Y Yater Strike (1st, 2nd Yater Rise (Tst, 2nd Yater Ri	1.60 SILT, minor day, white 2.05 Silty CLAY; light grey with orange mottles. Very stiff, moderately plastic. 2.06 Silty CLAY; light grey with orange mottles. Very stiff, moderately plastic. 2.80 m - 3.25 m Orange and light grey mixed with trace organics. Organics. amorphous. Image: Silty CLAY; light grey with orange mottles. Very stiff, moderately plastic. 4.15 4.10 m Grades to minor organics, amorphous Image: Silty CLAY; dark brown. Stiff, moderately to highly plastic. 5.00 Organic CLAY; dark brown. Stiff, moderately to highly plastic. Image: Silty CLAY; dark brown. Stiff, moderately to highly plastic. 5.00 Clayey SILT, minor organics, trace sand; light brownish gramorphous. Image: Silty CLAY; dark brown. Stiff, moderately plastic, sand, fine; organics, amorphous. EOH @ 5.00 m EOH @ 5.00 m Scala Penetrometer - blows// Permeability Test Schmidt Hammer Itions: Image: Silt/Very lose, solf/lose, moderately weathered, slightly meathered, slightly meathered, slightly weathered,	180 SiLT, minor day, white X 2.05 SiLT, minor day, white X 2.05 Sily CLAY, light grey with orange motiles, Very stiff, moderately plastic. X 2.06 Sily CLAY, light grey with orange motiles, Very stiff, moderately plastic. X 2.07 99 2.80 m - 3.25 m Orange and light grey mixed with trace organics. Organics, amorphous, X 3.20 m Grades to trace organic, amorphous X X 4.15 Criganic CLAY, dark brown, Stiff, moderately to highly plastic. X Clayey SILT, minor organics, trace sand; light brownish amorphous. X X Clayey SILT, minor organics, trace sand; light brownish amorphous. X X EOH @ 5.00 m EOH @ 5.00 m Permeability Test Schmidt Hammer Weathering - unweathered, slightly moderately brows, software distrength - very soft/very loose, software, moderately weathered, residualy wathered or schware wathered residualy wathered is Strength - very soft/very loose, software, moderately wathered, misitu Vane Shear Strength (kPa) V=Permeability Test or permetability Test or permetability Test or the company is the compa	1.60 SILT, minor clay, white x x x x x x x x x x x x x x x x x x x	1.60 Site CLAY: light grey with orange motiles, Very stift, moderately plastic. Image: Site CLAY: light grey with orange motiles, Very stift, moderately plastic. 2.05 Site CLAY: light grey with orange motiles, Very stift, moderately plastic. Image: Site CLAY: light grey mixed with trace great in trac	150 SILT, minor clay, white X 205 Silty CLAY, light gray with orange motiles, Very stift, X X 90 280 m - 3.25 m Orange and light gray mixed with trace organics. Organics, amorphous X 110 Grades to trace organics, amorphous X 115 4.10 m Grades to trace organics, amorphous X 115 Chay, dark brown, Sift, moderately to highly plassc. X 116 Chay, dark brown, Sift, moderately to highly plassc. X 116 Chay, dark brown, Sift, moderately to highly plassc. X 116 Chay, dark brown, Sift, moderately to highly matching, amorphous X 116 Chay, dark brown, Sift, moderately to highly matching, amorphous X 116 Chay, dark brown, Sift, moderately to highly matching, amorphous X 117 Chay, dark brown, Sift, moderately to highly matching, amorphous, a	150 SIL T, minor day, white X Sill, CLAY, ight grow with orange and light grey mixed with trace X Organics, Organics, amorphous X Crays Sill, moderately to highty X/L plastic. Crays Sill, moderately to highty Crays Sill, moderately plastic, samd, fine, organics, X Store Tore organics, trace samd, light Solid Penetrometer - blows/50mm Weatherding - staffwared, Hight Weatherd, sight X Minore String (16, CPa), white white staff, staffwared staff, staffwared staff, staffwared staffwared, staffwared staffwared, staffwared, staffwared, staff, 2nd) Weatherding -	160 SILT, minor day, while X 205 Silv, CLAY, fairt grey with orange molites, Very slift, moderately plastic. X 310 Silv, CLAY, fairt grey with orange molites, Very slift, moderately plastic. X 320 Gradies to trace organics, amorphous. X 320 Gradies to trace organic, amorphous. X Carganice, CAY, dark brown. Slift, moderately to highly plastic, sand, fing, organics, is and fing, organics, amorphous. X Carganice, CAY, dark brown. Slift, moderately to highly plastic, sand, fing, organics, is and	150 Sity CLAY, light grey with orange motiles. Very sitf, moderately plastic. Sity CLAY, light grey with orange motiles. Very sitf, state and state of the state organics, amorphous Sity CLAY, light grey with orange motiles. Very sitf, state and state of the state organics, amorphous Sity CLAY, light grey with orange motiles. Very sitf, state and state of the state organics, amorphous Sity CLAY, light grey with orange motiles. Very sitf, state and state of the state organics, amorphous 150 4.10 m Grades to trace organic, amorphous Sity CLAY, dark brown, Sitf, moderately to highly plastic, and, fine; organics, amorphous Sity CLAY, dark brown, Sitf, moderately to highly plastic, and, fine; organics, amorphous. Sity CLAY, dark brown, Sitf, moderately to highly plastic, and, fine; organics, amorphous. Sity CLAY, dark brown, Sitf, moderately blastic, and, fine; organics, amorphous. EOH @ 5.00 m State Penetrometor - blowsform, moderately wathered, highly wath

2				Riley Consultants 4 Fred Thomas Drive Takapuna 0622 Tol: +649 489 7872 Fax:	Limited							HAND	Al	JC	GER	RLOG
Proje 21 G	ect: Satland	Ro	ad		Locati Papal					Hole positio Refer to sit						No.:
Job I)43	2	Start Date: 16- Finish Date: 16-	10-18 10-18	Groun	d Level	l (m):		Co-Ordinate	es ():					HA6
Clier W		Inv	restmen	t Ltd		-	Hole D 5.00 n		2						She	eet: 1 of 1
Elevation (m)	Depth (m)	Geological Unit	(re	Geological Desc fer to separate Geotechnic Information sheet for furth	al and Geo	ological tion)	Legend	Unified Symbol	1990.	hear Strengt (kPa)		a Penetrometer ows / 50 mm)	Groundwater	Soil Moisture	Samples	Tests
	0,30	Topsoil	TOPSOI	L			111			100 150 200	1		I I	M		
	0.75	SAVF -	SILT, tra [SOUTH	ce clay; brownish orange. AUCKLAND VOLCANIC F	Very stiff, n FIELD].	ion plastic	× × × × × ×		A	×	and the state					∨ V= 160 R= 25
	1	1		SILT; trace gravel; grey with ; slightly plastic	n trace orar	nge mottles,	× × × × ×							MM		∨ V= 166 R= 105
	1.50			nor clay, minor gravel; light lastic; gravel, fine; purniced		own, Stiff,	**		۵	×						∨ V= 111 R= 34
	<u>1.95</u> -2			Y; light grey with minor ora ely plastic.	ange mottle	es, Very stiff	××		< ام							∨ V= 74 R= 43
		Puketoka Formation	2.80 m - mottles,	2.95 m Grades to greyish	white with c	orange	 		<u>م</u>	×	T T					∨ V= 123 R≈ 55
	-3 3.50	Puketol					× × × ×				Ť		810205/11	w		\sim V= 105 R= 52
	4.00		Clayey S moderate	ILT; greyish white with oran aly plastic.	nge mottles	s, Stiff, — — — — —			۵	×	k		Y	s		V= 95 R= 34
			SILT, mir Very stiff,	ior to some clay, white with slightly to moderately plas	i trace orar itic; sand, fi	nge mottles, ine.	× × * × × × × ×		ا د	×						∨ V= 154 R= 28
	<u>5.00</u>		EOH @ 5	5.00 m			××××		۵. 		W. J. W. W. W. W. W. W.					V= 123 R= 18 0, 0, 1, 0, 0, 0, 1, 0, 0, 1, 0, 1, 1, 0, 1, 1, 1, 1, 1, 1, 3, 2, 1, 1, 2, 1, 2, 2, 2, 2, 3, 6, 7, 3, 5, 3, 4, 3, 3, 3
	-7] 7.0m				*
Rock I weath compl Relativ firm/m • S I L U	ered, mod etely weal ve soil Str edium de mall Distu arge Distu 100 Undi	ather lerate here ength nse, s inbed urbed sturb	ely weather d, residual n - very sof stiff/dense, Sample	rad, nigniy weathered, ly weathered t/very loose, sof/loose, very stiff/very dense	 ✓ Perms ✓ Schmi ✓ Insitu V=Pei to pen Water ✓ Water 	Penetrome eability Test idt Hammer Vane Shea ak, R=Resid netrate r Strike (1st, 2 Fine (minute	r Strength dual, UTP: , 2nd) 2nd) an	(kPa) =Unab		COUNDWATE None Slow Seep (Rapid Inflow LE TERMINA Farget Depth	(depth 3.7 (depth) TED DUE					Auckland Volcanic Field

roject:			faor;	Location:				ŀ	lole po	sition		 			No.:
1 Gatland	Ro	ad	Start Date: 11-1	Papakura	nd Lev	ol (m			Refer 1 Co-Ord	to site	plan.				
	0432	2	Finish Date: 11-1						Co-Ora	inates	; ():	 			HA7
Vainon	Inv	estment	Ltd		Hole 5.00		h:							She	eet: 1 of 1
(m) Depth (m)	Geological Unit	(refe In	Geological Descr r to separate Geotechnic formation sheet for furthe	al and Geological	- Trans	Unified Symbol	Soi		ear Str (kPa)		Scala Penetror (blows / 50 m	Groundwater	Soil Moisture	Samples	Tests
-0.35 -1 1.30 -2 ^{2.00} -3 -3	Puketoka Formation	0.35 m - 0 SILT, minc mottles, Vi FORMATIO Silty CLAY Very stiff, s 1.90 m Gra and trace p Silty CLAY Very stiff, s 2.10 m Gra plastic.	light grey with trace to m lightly to moderately plas ades to clayey SiLT; oran ink mottles. : grey with minor orange a oderatyely plastic. ides to brownish grey with	with trace orange miceous (PUKETO) inor orange mottles ic, pumiceous. and trace pink mottle n minor pink and trac by to moderately ith trace orange				۵ ۵	x	×			MW WS		$\bigvee V= 21$ $\bigvee V= 14$ $R= 31$ $\bigvee V= 13$ $R= 62$ $\bigvee V= 12$ $R= 62$ $\bigvee V= 12$ $R= 92$ $\bigvee V= 12$ $R= 62$
- 4 		Organic SII stiff to very EOH @ 5.0	.T, minor clay; dark brown stiff, slightly plastic; orgar 	ι with dark specks, rics, amorphous.		× *		×	×		·····				V = 80 R = 31 V = 52 R = 15 No. 21 0, 1, 2, 3, 2, 3, 3, 3, 3, 6, 7, 8, 9, 6, 6, 5, 6, 8, 10, 12, 12
eathered, mo impletely wea elative soil St	athen lerate there ength nse, i urbed urbed	ly weathered d, residually i - very soft/v stiff/dense, vi Sample Sample	a, nigniy weathered, weathered ery loose, soft/loose, ery stiff/very dense	Scala Penetrom Permeability Tei Schnidt Hamm Insitu Vane She V=Peak, R=Res to penetrate Water Strike (1st Water Rise (1st, Rise Time (minu	st ar Streng idual, UT t, 2nd) 2nd)	jth (kP 'P=Una	a) able	X HOL	Rapid Ir	eep (de nflow (/IINATE	epth 3.1 m) depth) ED DUE TO:			R	Remarks

2			ANTS Te	iley Consultants Fred Thomas Drive kapuna 0622 ki + 649 469 7672 x:	Limited								HAN	D A	L	JG	GEF	RLOG
Proje 21 G	ct: iatland	Ro	ad		Locati Papak							sition: o site						No.:
Job N	No.:)432		Start Date: 11- Finish Date: 11-	10-18		d Level	(m)	:	-		inates	•					HA8
Clien Wa		Inv	estment L				Hole D 5.00 n		:								She	et: 1 of 1
Elevation (m)	Depth (m)	Geological Unit	(refer t	Geological Desc to separate Geotechnic ormation sheet for furth	al and Geo		Legend	Unified Symbol		(k	ar Stro (Pa)		Scala Penetrome (blows / 50 mm	eter I)	Groundwater	Soil Moisture	Samples	Tests
	0.10	SAVF -	TOPSOIL.)111 * _×			0 10	0 150	200		2 15		DM M		
	0.50	13	SILT; reddis non plastic [h brown with trace blac SOUTH AUCKLAND V	k mottles, v OLCANIC	Very stiff, FIELD]₊	× ×					×				м		∽ V= 2234
	⊢1		moderately p	e silt; grey with orange r plastic [PUKETOKA FO des to trace white speck	RMATION],		-			د ۵	<						∨ V= 183 R= 133
											Δ×							∨ V= 173 R= 133
	-2		moderately t	les to minor silt, light gr to highly plastic. les to pink, orange and		-				4	× ×							∨ V= 163 R= 110
	2.90	Puketoka Formation								۵	×							∨ V= 127 R= 83
-	-3	Puket	Silty CLAY; p moderately p	pinkish grey with red mo plastic.	ottles, stiff,	slightly to				۵ ;	×							∨ V= 117 R= 67
	3.80		3.50 m Grad	les lo light orange,					▲ 	×					11/10/2018			\sim R= 33
-	-4		SILT, trace d pumiceous.	lay; whitish grey. Firm, i	non to sligt	ntly plastic;	× × × × × ×		۵×		1				Z			∨ V= 40 R= 17
	5 5.00		SILT, trace g pumiceous.	ravel; grey. Very stiff to	hard; non	plastic;	* × * × * ×					×						∽ V= 223+
	-6		EOH @ 5.00	'n								×						∽ V= 223+
Rock W weathe comple Relative firm/me Sn	rred, mod stely weat e soil Stro edium der mall Distu arge Distu	atheri erate hered angth nse, s rbed rbed	d, residually w - very soft/ver stiff/dense, ver Sample	highly weathered, eathered ry loose, soft/loose, y stiff/very dense	 Perme Schmi Insitu V=Pea to pen Water Water 	Penetrome eability Test dt Hammer Vane Shea ak, R=Resi etrate Strike (1st Rise (1st, Time (minut	t r Strength dual, UTP= , 2nd) 2nd) and	(kPa) =Unat	he [r X s r	apid In	ep (de flow (d	epth 4.0 m) depth) ED DUE TO:	5	J. SAV	F* -		emarks Juckland Volcanic Field
All din	nensio Scale		n metres										Shear Van 4494	e No.		Lo	ogged AL	by: Checked b

Proje 21 G	atland	Ro	ad	Location: Papakura			Hole position Refer to site					No.:
Job N	lo.:	0432	Start Date: 11	-10-18 Ground	d Level (m	1):	Co-Ordinate	•			H	IA9
Clien		Inv	vestment Ltd		Hole Dept 5.05 m	h:				:	Sheet:	of 1
		_		,i					Ę	e	-	
Elevation (m)	Depth (m)	Geological Unit	Geological Desc (refer to separate Geotechni Information sheet for furth	cal and Geological	Legend	Soil S	hear Strength (kPa)	Scala Penetrometer (blows / 50 mm)	Groundwater		Samples	Tests
	0.30)	Topsoil	TOPSOIL; brown,		$\frac{111}{111}$					DM		
	0.70	SAVEN	SILT, trace sand; light brownish or plastic, sand, fine [SOUTH AUCKI FIELD].	ange. Very stiff, non AND VOLCANIC		۵. ۱	× -			м		∨ V= 1 R= 3
	-1 1.30		SILT, trace clay, light brown. Stiff, FORMATION].	non plastic (PUKETOKA		Δ. :	،					∨ V= 7 R=2
			SILT; brownish white, Stiff, non pla	istic, pumiceous,	× × × × × × ×	▲ ×						∨ V= 8 R= 2
	1,90 - 2		Silly CLAY, light bluish grey. Very	stiff, moderately plastic,	×		▲ ×					∨ V= 1 R= 8
	2.50	Formation	CLAY, minor sitt; grey with orange moderately to highly plastic.	mottle, Very stiff,	1 *	-			1			∨ V= 2
	-3	Puketoka For					۵x					∨ ^{V= 1} R=
	-						▲ × ↓					∨ V= 1 R= 8
	<u>3.90</u> - 4		3.80 m Grades to some silt, grey. SILT, trace clay, trace sand; grey v Very stiff, non plastic; sand, fine.	vith orange mottles,	× × × ×		×					∨ ^{V= 1} R=6
-	4.40		Pumiceous; white, Stiff, non plastic		× × × × × ×	A	×		11/10/2018			∨ V= 1 R= 5
-	- 5 5 05		4.80 m Grades to minor day, white mottles; slightly plastic.	with trace orange	× × ×	a x			ti i			$\sim \frac{V=6}{R=4}$
	-6		EOH @ 5.05 m					4			1, 1	1 , 1, , 2, , 2, , 2, , 2, , 2, , 4, , 8, , 9, , 8,
Rock N weathe comple Relativ firm/me Sr La	ered, mor etely wea e soil Str adium de mall Distr irge Distr	atheri Jerate therei ength nse, s urbed urbed		 ▼ Scala Penetromet Permeability Test ▼ Schrnidt Hammer ✓ Insitu Vane Shear ∨=Peak, R=Resid to penetrate Water Strike (1st, 1) ₩ Water Rise (1st, 2) ₩ Rise Time (minute 	Strength (kP lual, UTP=Un 2nd) 2nd) and	a) X able HC	COUNDWATER None Slow Seep (c Rapid Inflow DLE TERMINAT Target Depth	lepth 4.7 m) (depth)	SA	/F* - Sc	Remai auth Auckla	ks nd Volcanic f

2				Riley Consultants Fred Thomas Drive akapuna 0622 el: +649 489 7872 ax:	Limited							HAND	Al	JC	GEF	R LOG
Proje 21 G Job N	atland	Roa 432		Start Date: 11-	Locatio Papak 10-18	kura	id Level	l (m):		Hole position Refer to s Co-Ordination	ite pla					No.: HA10
Clien Wa	t:		estment l	Finish Date: 11-	10-18		Hole D 5.00 r	•	:						She	et: 1 of 1
Elevation (m)	Depth (m)	Geological Unit		Geological Desc to separate Geotechnic formation sheet for furth	al and Geo		Legend	Unified Symbol		Shear Streng (kPa)	ıth ٤	Scala Penetromete (blows / 50 mm)	Groundwater	Soil Moisture	Samples	Tests
	0.20 0.60 -1 -1 -2 -2 -3 <u>3.50</u> <u>3.80</u> -4 <u>4.20</u>	Puketoka Formation	(AUCKLAN SILT, mino plastic (PU CLAY, som moderately 1,60 m Gre Silty CLAY moderately SILT, mino pumiceous	a day; brownish orange, ND VOLCANIC FIELD]. or clay; light orange. Ven (KETOKA FORMATION] he silt; orange and light of thighly plastic. ades to minor silt; light gr ades to minor silt; light gr (light orange and orange plastic.	stiff, non to rrey mixed. rey with oran a mixed, Ve e. Stiff, slig	o slightly Very stiff, nge mottle ery stiff, htly plastic							15 94/20141	s ws		\vee V= 215+ \vee V= 138 R= 25 \vee V= 169 R= 109 \vee V= 185 R= 126 \vee V= 185 \vee R= 92 \vee V= 163 R= 92 \vee V= 163 R= 92 \vee V= 80 R= 52 \vee V= 58 R= 15 \vee V= 148 R= 68 \vee V= 215+
Expla Rock N weather comple Relativ firm/me Sr La	- 6 - 7 Annation Mass Weat red, mode tely weat extely weat extely weat extely weat extely defined attely weat extely defined attely defined a	atheri erate hered angth nse, s rbed rbed	ly weathered d, residually - very soft/v tiff/dense, v Sample Sample	hered, slightly d, highly weathered, weathered rery loose, soft/loose, ery stiff/very dense	Perma Schmi Schmi V=Pea to pen Water Water Water	Strike (1sl Rise (1st,	t r ar Strength dual, UTP t, 2nd) 2nd) ar	n (kPa) '=Unab		ROUNDWATE None Slow Seep Rapid Inflov	(depti v (dep	oth)		VF*		No. 1
		ns i	ed Sample	T	¥ Rise T	lime (minul	(eS)					Shear Vane 608	No.	L	.ogged AL	by: Checked by

Project:	AIN I S Tal: +649 489 7872	Location:		Hole position	1:		_	No.:
21 Gatland Ro		Papakura	11	Refer to site	e plan,			
Job No.: 18043	2 Start Date: 11- Finish Date: 11-	10-18	l Level (m)		s ():			HA11/P2
Client: Wainono Inv	estment Ltd	H	Hole Depth 4.65 m				S	Sheet: 1 of 1
Elevation (m) Depth (m) Geological Unit	Geological Descr (refer to separate Geotechnic: Information sheet for furthe	al and Geological	Legend Unified Symbol	Soil Shear Strength (kPa)	Scala Penetrometer (blows / 50 mm)	Groundwater	Soil Moisture	ອ ອ ແມ່ນ ກາຍ ກາຍ Tests
0.20	TOPSOIL.			50 100 150 200	3 6 9 12 1	-	м	
0.80	SILT, minor clay, trace sand; light b stiff, non plastic (PUKETOKA FORM	rownish yellow. Very MATION].	× × × × × ×	a X				∨ V= 1 R= 4
- 1 1.10	SILT, minor clay, brownish light grey slightly plastic.	/. Very sliff to stiff,	× × × × ×	Δ ×		\$11/2018	MW	∨ V= 5 R= 2
1.50	SILT, some clay, light grey, Stiff, slig	htly plastic.	×	م ×		112		√ V= 6 R= 4
	Silty CLAY, trace sand; light grey. S sand, fine.	liff, moderately plastic;	u x x x					V= 8
Nuketoka Formation	2,00 m Grades to light yellowish gre	y.	k x x	a' ×		ø		~ R=4
	2.50 m Grades to very stiff.			Δ ×		11/10/2018	s	∨ V= 1 R= 6
3.00	CLAY, some silt, trace to minor same with orange mottles. Very stiff, mode fine.			× ∆				∨ ^{V= 9} R= 3
-	11ne.			a ×				∨ ^{V= 1} R= 8
- 4 4.05	Silty CLAY, some organics; light bro	wnish grev Veru stiff						∨ V= 1 R= 4
- 4.65	slightly to moderately plastic; organic	cs, amorphous.	× × ×	×				∨ V= 1
-5	EOH @ 4.65 m				5.ôm			No. 11 4, 3, 4, 7, 7, 8, 8, 8, 7, 6, 6, 6, 5, 4, 5, 11, 11, 13
weathered, moderat completely weather Relative soil Strengt firm/medium dense;	dy weathered, migniy weathered, d, residually weathered h - very soft/very loose, soft/loose, stiff/dense, very stiff/very dense	Scala Penetromet Permeability Test Schmidt Hammer Insitu Vane Shear V=Peak, R=Resid to penetrate Water Strike (1st.	Strength (kPa) ual, UTP=Unat	le None X Slow Seep (o Rapid Inflow	depth 2.8, 1.5 m) (depth)			Remarks ar was encountered at th im, dated 12/11/2018
	stiff/dense, very stiff/very dense Sample		2nd) nd) and					

٤	CONS		ANTS	4 Fred Thomas Drive Takapuna 0522 Tel: +649 489 7872 Fax:		1 0522. 9 469 7872 HAND AUC								۲ LOG
Proje	ect: Satland	Ro	he		Locati Papal				Hole position Refer to site					No.:
lob N	No.:			Start Date: 11	-10-18		nd Level	(m):	Co-Ordinates					HA12
Clier		0432	2	Finish Date: 11	-10-18	<u> </u>	Hole De	anth				_	She	
) Inv	estment	Ltd			4.25 n						0116	1 of 1
(m)	Depth (m)	Geological Unit		Geological Desc er to separate Geotechni nformation sheet for furth	cal and Ge		Legend	Unified Symbol	Soil Shear Strength (kPa)	Scala Penetrometer (blows / 50 mm)	Groundwater	Soil Moisture	Samples	Tests
		opsoil	TOPSOIL	2			111					w		
	0.45		Clayey Sil [PUKETO	LT, yellowish grey, Very KA FORMATION],	stiff, moder	ately plastic	$\frac{1}{2}$		ے ۲		11/10/2018	ws		V= R=
	0.90 1		mottles and white specks. Very stiff, moderately plastic;				۱		an 1	s		V= R=		
									× م					∨ V= R=
	-2	Formation —							A X					∨ V= R=.
	2.50	- Puketoka	Organic C highly plas	LAY, some silt, dark grej stic.	y and black	mixed, Stif	<u></u>		م ×					V= 8 R= 4
	-3								▲×					∨ V= 5 R= 2
			3.80 m Gra	ades to 100mm of fine s	and laver.				a x					∨ ^{V= 5} R= 2
	-4			ades to trace purniceous		•	Ξ							∨ UTP
	<u>4.25</u> 5		EOH @ 4.			•	<u></u>			5.0m				No. 1 3, 3, 5, 7, 9, 10, 9, 12, 9, 7, 6, 7, 6, 70, 10, 10
	-6													
-	-7													
tock / veath ompli telativ	ered, mo etely wea /e soil St	atheri derate there rength	ely weathere d, residually h - very soft/	thered, slightly ed, highly weathered, / weathered /very loose, soft/loose, very stiff/very dense	Perm Schm Vinsitu V=Pe	a Penetromi neability Tes hidt Hamme Vane Shea tak, R=Resi netrate	it ir ar Strength	(kPa)	None X Slow Seep (d				R	emarks
I u	mall Dist arge Dist 100 Und	urbed	Sample		Wate	r Strike (1s r Rise (1st,	2nd) an	đ	HOLE TERMINAT					

2			ANTS	Riley Consultants I 4 Fred Thomas Drive Takapuna 0622 Tel: +649 489 7872 Fax:	_imited					HAND	Al	JC	GEF	R LOG		
Proje 21 G	ect: Gatland	Ro	ad		Location: Papakura				Hole position					No.:		
Job 1)43:	2	Start Date: 11-1 Finish Date: 11-1		d Leve	l (m)	:	Co-Ordinates ():					HA13		
Clier W		Inv	estment	Ltd		Hole D 5.05 i		1					She	Sheet: 1 of 1		
Elevation (m)	Depth (m)	- 0					Unified Symbol		Shear Streng (kPa)	th Scala Penetrometer (blows / 50 mm)	Groundwater	Soil Moisture	Samples	Tests		
	0.35	Topsoil		dark brown,	nne mottles. Verv stif		l		0 100 150 200		BIOCOLAL	w s		∨ V= 105 R= 6		
	5 5 5 1 5		Silty CLAY: light grey with minor orange mottles, Very stiff, moderately plastic [PUKETOKA FORMATION].								1111			R= 6 ∨ V= 141 R= 74		
-	1.50		CLAY, so stiff, mode	me silt; light grey with mino rately to highly plastic.	or orange mottles, ver							s		∨ V= 154 R= 77		
	-2	u						4	×		1			∨ V= 141 R= 22		
	2.45	Puketoka Formation	highly pla:	LAY, minor silt; dark. Stiff stic; organics, amorphous. ades to dark grey.	to firm, moderately to			A X						∨ ^{V= 49} R= 15		
	-3	Puk						ΔX			1			∨ V= 34 R= 15		
	<u>3.80</u> 4		SILT, trace	e clay, trace sand; light gre	ay. Very stiff, non	× ×		•	×					∑ R= 9		
	4.50			nd, fine; dilatent behaviou .20 m Wood pieces.	r.	× × × × × × ×			×		1			V= 77		
	5 5,05	T	Organic S organics, a	ILT, minor clay; dark brow amorphous and fibrous mi	n. Stiff, slightly plastic xed.				×		1111			 ✓ R= 15 ✓ V= 92 R= 18 		
	-6		EOH @ 5.	05 m							化学学学生 医子宫骨骨周周周			No. 1 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 2, 2, 2, 2, 2, 3, 3, 3, 3, 3, 3, 4, 5, 5, 6, 7, 8, 7, 8, 7, 10, 9		
Rock M weathe comple Relativ firm/me Si L La	ared, moo ately weat ye soil Stri edium dea mall Distu arge Distu	atheri lerate here ength nse, s rbed irbed	ely weathere d, residually 1 - very soft/ stiff/dense, v Sample	a, nigniy weathered, weathered very loose, soft/loose, very stiff/very dense	Scala Penetrome Permeability Tesi Schmidt Hamme Insitu Vane Shea V=Peak, R=Resi to penetrate Water Strike (1st Water Rise (1st, Rise Time (minut	t r strengtl dual, UTF , 2nd) 2nd) ar	h (kPa P=Unai		ROUNDWATE None X Slow Seep Rapid Inflow IOLE TERMINA Target Depth	(depth 0.4 m) v (depth)			R	emarks		
All dir	nensio Scale		n metres 1							Shear Vane I 608	No.	L	ogged GB			

Project:		iralogists	ax:	Location:			-	Hole positio	l on:			T		No.:	
21 Gatlan	d Ro	ad	Chart Datas 44	Papakura				Middle of Lot 9				_	HA14		
Job No. 1	8043	2	Start Date: 11 Finish Date: 11		nd Leve	i (m)	:	Co-Ordinat	tes ()						
Client: Wainor	no In	vestment	Ltd		Hole D 5.00 r		6						Sheet	:: 1_of 1	
Elevation (m) Depth (m)	E E E E E Geological Description Geological Description (refer to separate Geotechnical and Geological Information sheet for further information) Information Information				Legend	Unified Symbol	Soil S	hear Streng (kPa)		Scala Penetrometer (blows / 50 mm)	Groundwater	Soil Moisture	Samples	Tests	
0.7	Alluvium	SILT, mind mottles. si	or clay; dark brown with iff to very stiff, slightly pl	trace dark orange lastic (ALLUVIUM),	* × × × × ×		· · ·	×			11/10/2018	w		∨ V= 1! R=6	
-1-1-1-1			ILT, minor clay, dark gre ery stiff, non to slightly p		ge × × × <u>· v</u>							S		∨ V= 11 R= 9	
	Silty CLAY, trace sand; orange and light grey mixed. Very stiff, moderately plastic; sand, fine; purticeous (PUKETOKA FORMATION).					-		x						∨ V= 1: R=6	
2						-		×						∨ V= 1 R= 4	
1 () () ()	tion					-		× 1						∨ ^{V= 9} R= 5	
- 3	5 Puketoka Formation						Δ	×						∨ ^{V= 1} R=6	
3.5		Organic C sand, fine.	LAY, trace sand, dark b	rown. Stiff, highly plast	1 m		۵×					s		∨ V= 4 R= 1	
- 4		4.00 m Gr	ades to firm.				×							∨ ^{V= 3} R= 2	
							ام	× 1 1						∨ V= 7 R= 4	
4.9 5 ^{5.0}	10 10 Y	brown lam	e sand, trace organics; l ination. Very stiff, non pl amorphous.	light grey with trace da lastic; sand, fine;	rk X	-		×						No. 1 1, 2, 3, 3, 3, 2, 1 2 2	
- - - - - - - - - -		ЕОН @ 5.	00 m											$\begin{array}{c}1,2,2,\\2,3,2,\\3,6,6,\\12,11,\\10,5,\\5,8,\\10,8,\\5,3,3,\\4,4,4,\\4,4,4,\\4,4,4,\\5,4,5,\\6\end{array}$	
- - - 7										7.0m				1	
Explanati Rock Mass V		ning - unwea	thered, slightly	Scala Penetrom Permeability Te		/s/50n	nm G		ER				Re	marks	
weathered, n completely w Relative soil	nodera reather Streng	tely weathere ed, residually th - very soft/	ed, highly weathered,	 Permeability Te Schmidt Hamme Insitu Vane She V=Peak, R=Res to penetrate 	er ar Strengt			None Slow Seep		· · ·					
• Small D	isturbe isturbe	d Sampie d Sample bed Sample		Water Rise (1st	, 2nd) a	nd	Н	OLE TERMIN	ATED						
All dimens	sions ale 1		6			_				Shear Vane N 608	0.	Lo	gged GB	by: Checke	

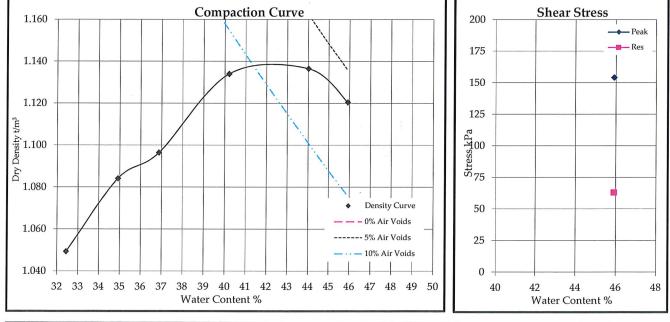
DRY DENSITY / WATER CONTENT RELATIONSHIP STANDARD COMPACTION

\\SD **OPUS**

Project :	21 Gatland Road								
Location :	21 Gatland Road								
Client :	Riley Consultants Ltd.								
Contractor :	Riley Consultants Ltd.								
Sampled by :	-								
Date sampled :	15/10/18								
Sampling method :	Not Stated								
Sample description :	Silty CLAY; Brown; Moist, Pl	astic							
Sample condition :	As Received	Project No :	1-LA014.00						
Solid density :	2.65 t/m^3 (Assumed)	Lab Ref No :	AL3257/1						
Source:	21 Gatland Road	Client Ref No :	180432						

			Test Results		
Maximum dry density	1.14	t/m³	Natural water content	44.0 %	, D
Optimum water content	42	%	Fraction tested	Whole	

Sample ID		A	В	C	D	Nat	E	
Bulk density	t/m³	1.390	1.463	1.501	1.590	1.637	1.635	
Water content	%	32.4	34.9	36.9	40.2	44.0	45.9	
Dry density	t/m³	1.049	1.084	1.096	1.134	1.136	1.120	
Sample condition		Dry	Dry	Moist	Moist	Moist	Moist	
Peak stress	kPa	UTP	UTP	UTP	UTP	140+	154	
Remoulded stress	kPa	UTP	UTP	UTP	UTP	-	63	



Test Methods Notes Compaction NZS 4402 : 1986 Test 4.1.1 (Standard) Shear Strength using a Hand Held Shear Vane, NZ Geotechnical Soc Inc 8/2001

Date tested : Date reported : 19/11/18

08-13/11/18

Sampling is not covered by IANZ Accreditation. Results apply only to sample tested. This report may only be reproduced in full

IANZ Approved Signatory

Designation : Date :

Ben Richardson Assistant Laboratory Manager 20/11/18



All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

PF-LAB-025 (19/03/2018)

WSP Opus Auckland Laboratory Quality Management Systems Certified to ISO 9001

7A Ride Way, Albany Private Bag 101982, NS Mail Centre, North Shore City 0745, New Zealand

Page 1 of 1

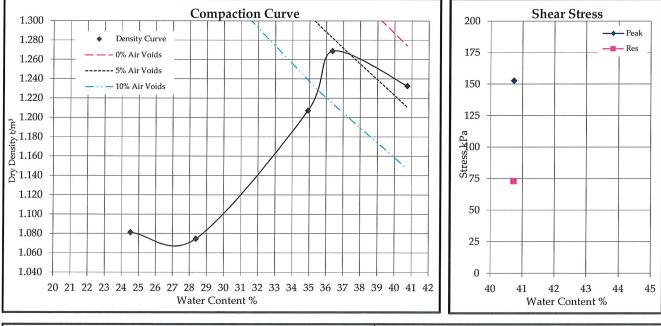
Telephone +64 9 415 4660 Website www.wsp-opus.co.nz

CALIFORNIA Project: Location: Client: Contractor: Sampled by:	TEST R 21 Gatlar 21 Gatlar Riley Cor	REPORT nd Road nd Road nsultants nsultants	Ltd.		Date sampled:15/10/18Sampling method:Not StatedSample condition:As ReceivedSample description:Silty CLAY, Brown, Moist, Plastic*Date sample/s received:16/10/18						Project No: 1-LA014.00 Lab Ref No: AL3257/2-4 Client Ref No: -			
	Sample		Soaking				Test Results			Water conten	t Water content	Water content		
	condition at test	Curing time (Days)	time (Days)	Passing 19mm (%)	Surcharge mass (kg)	Lime additive (%)	Cement additive (%)	Swell (%)	Penetration (mm)	as received (%)	as compacted (%)		Dry density (t/m ³)	CBR value (%)
Lab Ref No.	Location	21 Gatland	Road					Sample d	escription	Silty CLAY	, Brown, M	oist. Plastic		
AL3257/2	Soaked	0	4	100	4	0	0	0.2	2.5	44.3	44.3	46.2	1.12	9
Lab Ref No.	Location	21 Gatland	Road					Samplad	accomintion	Silter CLAX	l, Brown, M	aist Dlastia		
AL3257/3	Soaked	3	4	100	4	2	0	0.2	escription 2.5	44.3	43.1	46.2	1.10	11
Lab Ref No. AL3257/4	Location Soaked	21 Gatland 3	Road	100	4	4	0	Sample d	escription 2.5	Silty CLAY 44.3	7, Brown, M 41.7	oist, Plastic 45.2	1.10	14
Test Methods CBR Water Content Compaction	NZS : 4402 : NZS : 4402 : NZS : 4402 :			Notes Material Used Rate of penet:	ration :	Passing 19mm 1mm/min	n sieve Z Accreditation			/ IANZ Accre		its apply only t	to sample tested	d.
Date tested: Date reported: PF-LAB-021 (19/03/2018)	12-15/11/1 20/11/18			pproved Si	gnatory Ben Richar		Fell.	I		Ó		Tests indicated not accredited outside the sco of the laborator accreditation	are pe	Page 1 of 1
WSP Opus Auckland Labor Quality Manage		Certified to 1	ISO 9001		Private E	Way, Albany Bag 101982, N ty 0745, New	S Mail Centre, Zealand	North			none +64 9 41 te www.wsp-o			1 age 1 01

DRY DENSITY / WATER CONTENT RELATIONSHIP STANDARD COMPACTION

Project : **21** Gatland Road Location : TP2 Client : **Riley Consultants Ltd** Contractor: **Riley Consultants Ltd** Sampled by : Not Stated Date sampled : Not Stated Sampling method : Not Stated Sample description : Silty CLAY; Brown; Moist, Plastic Sample condition : 1-LA014.00 As Received **Project No:** Solid density : 2.65 t/m³ (Assumed) Lab Ref No : AL3328/1 Source: **21 Gatland Road Client Ref No:** 180432

				Fest Results				
Maximum dry den	sity	1.27	t/m³		Natural wate	r content	40.7	%
Optimum water co	ontent	36	%		Fraction test	Whole Sample		
Sample ID		A	В	C	D	Nat		
Bulk density	t/m³	1.346	1.379	1.629	1.730	1.735		
Water content	%	24.5	28.4	34.9	36.3	40.7		
Dry density	t/m³	1.081	1.075	1.207	1.269	1.233		
Sample condition		Dry	Moist-	Moist	Moist	Moist		
			Dry					
Peak stress	kPa	UTP	UTP	UTP	UTP	153		
Remoulded stress	kPa	UTP	UTP	UTP	UTP	73		



Test Methods		Notes
Compaction	NZS 4402 : 1986 Test 4.1.1 (Standard)	%Air voids lines are not covered by IANZ accreditation due to
Shear Strength usir	g a Hand Held Shear Vane, NZ Geotechnical Soc Inc 8/2001	the solid density being assumed.

Date tested : Date reported :

28/11/18 - 07/12/18 10/12/18

Sampling is not covered by IANZ Accreditation. Results apply only to sample tested. This report may only be reproduced in full

IANZ Approved Signatory

Ben Richardson Designation : Assistant Laboratory Manager 10/12/18 Date :

Tests indicated as not accredited are outside the scope of the laboratory's accreditation

PF-LAB-025 (19/03/2018)

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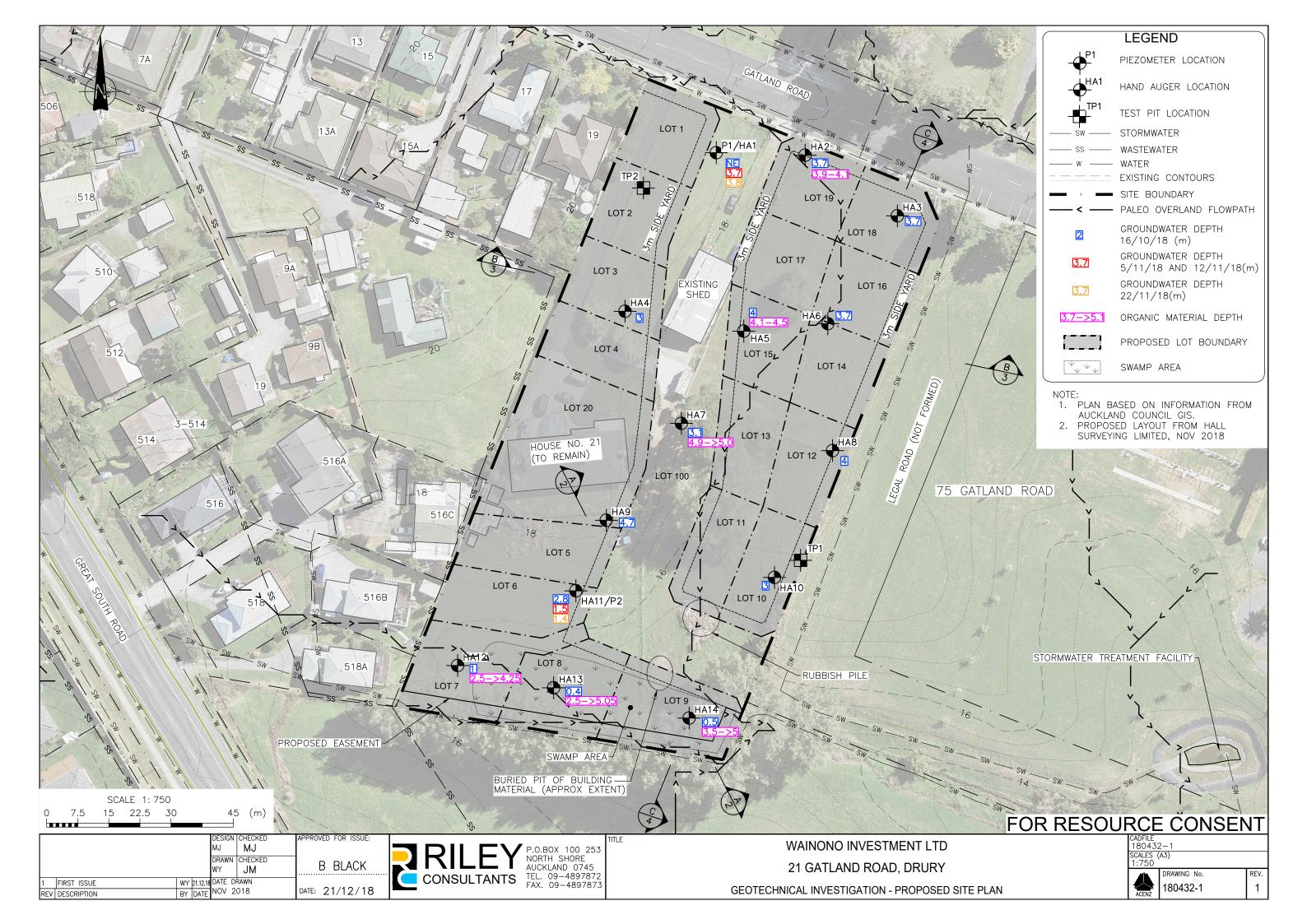
Page 1 of 1

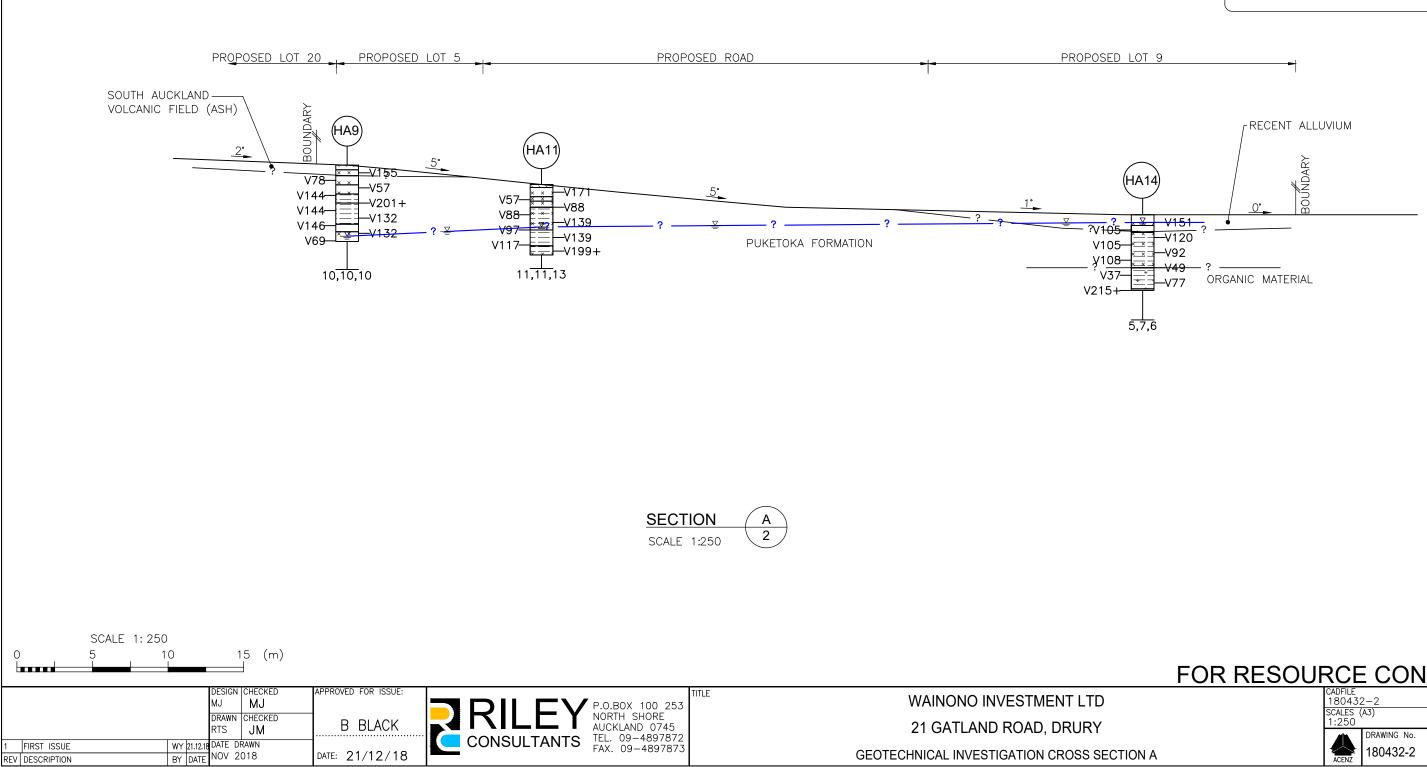
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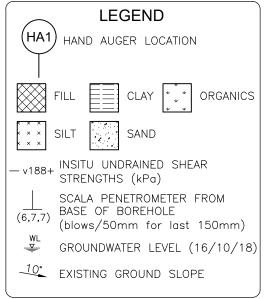
Telephone +64 9 415 4660 Website www.wsp-opus.co.nz

ACCREDITED LABORATORY

CALIFORNL	- New York and the second second second	G RATIO REPORT	a provide the state of the state of the	ULDED)								wsp	ο	PUS
Project: Location: Client: Contractor: Sampled by:	-	nsultants] nsultants]			Date sampled:Not StaSampling method:Not StaSample condition:As RecSample description:Silty CDate sample/s received:			d ved Y; Brow	n; Moist,] [1/18	Plastic	Project No: 1-LA0014.00 Lab Ref No: AL3328/2-4 Client Ref No: 180432			
						Te	st Results							
	Sample condition at test	Curing time (Days)	Soaking time (Days)	Passing 19mm (%)	Surcharge mass (kg)	Lime additive (%)	Cement additive (%)	Swell (%)	Penetration (mm)		Water content as compacted (%)		Dry density (t/m ³)	CBR value (%)
Lab Ref No.	Location	TP2						Sample d	lescription	Silty CLAY	; Brown; M	oist Plastic		
AL3328/2	Soaked	0	5	100	4	0	0	0	5	41.3	41.3	41.5	1.22	3
		TD2												
Lab Ref No. AL3328/3	Location Soaked	TP2 3	4	100	4	2	0	Sample d	lescription 2.5		; Brown; M		1.00	
111352015	Soaked	5	T	100	4	2	0	0	2.3	41.3	40.4	40.6	1.22	11
Lab Ref No.	Location TP2							Sample d	lescription	Silty CLAY	; Brown; M	oist, Plastic		
AL3328/4	Soaked	3	4	100	4	4	0	0	2.5	41.3	39.0	37.2	1.22	40
Test Methods CBR Water Content Compaction	NZS : 4402 : NZS : 4402 : NZS : 4402 : NZS : 4402 :			Notes Material Used Rate of penet		Passing 19mr 1mm/min	n sieve			/ IANZ Accred		ts apply only t	to sample tested	d.
Date tested: Date reported: PF-LAB-021 (19/03/2018)	02-05/12/18 10/12/18	8	IANZ Appr Designation Date :		Ben Richar	dson aboratory M	lanager			ACCREDITED	NZ LABORATORY	Tests indicated not accredited a outside the sco of the laborator accreditation	are pe	Page 1 of 1
WSP Opus Auckland Labo Quality Manage		Certified to I	SO 9001		Private B	Way, Albany 8ag 101982, N ty 0745, New	S Mail Centre Zealand	e, North		: .	ione +64 9 41: te www.wsp-c			



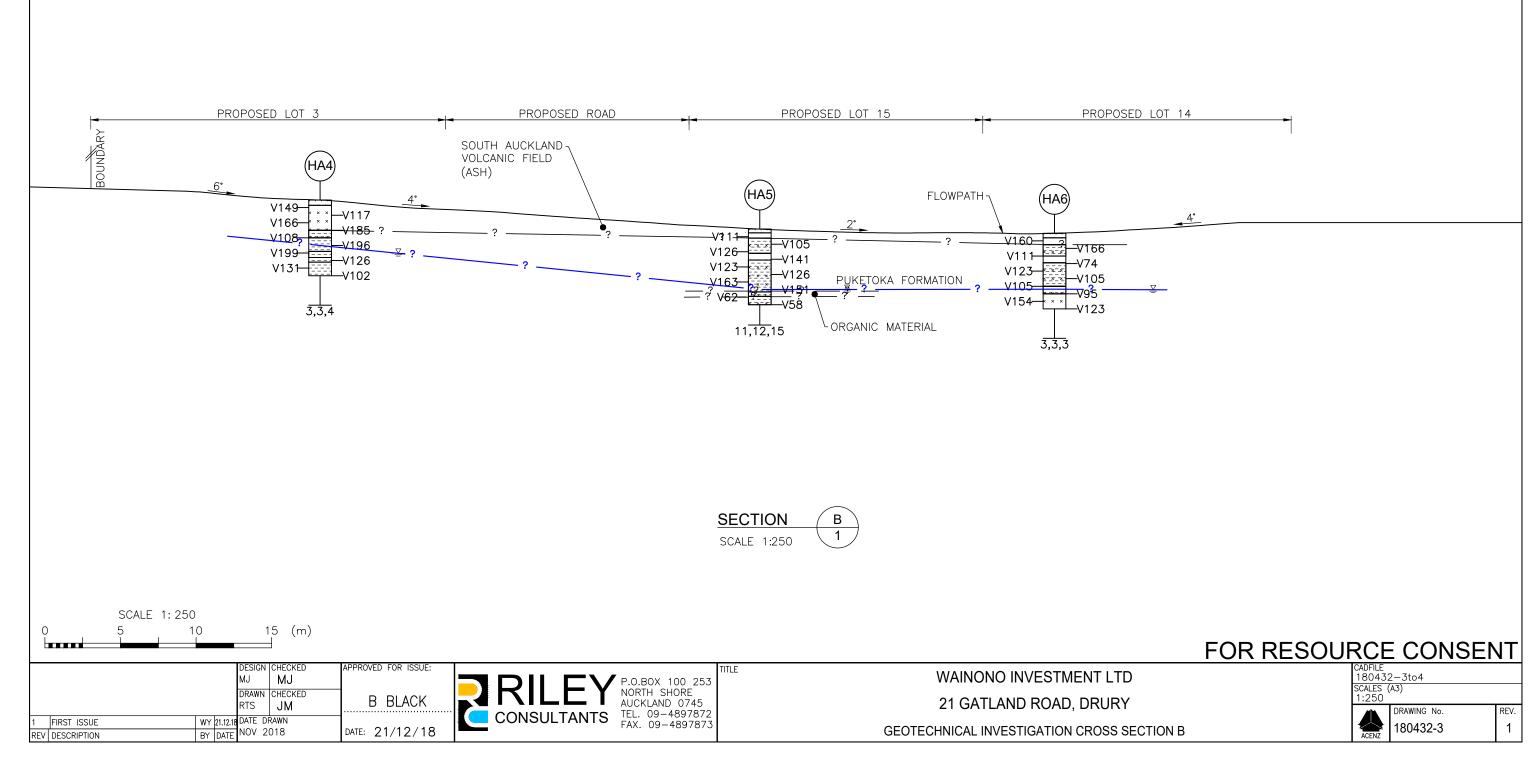


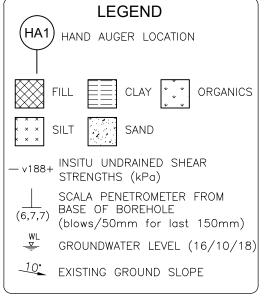


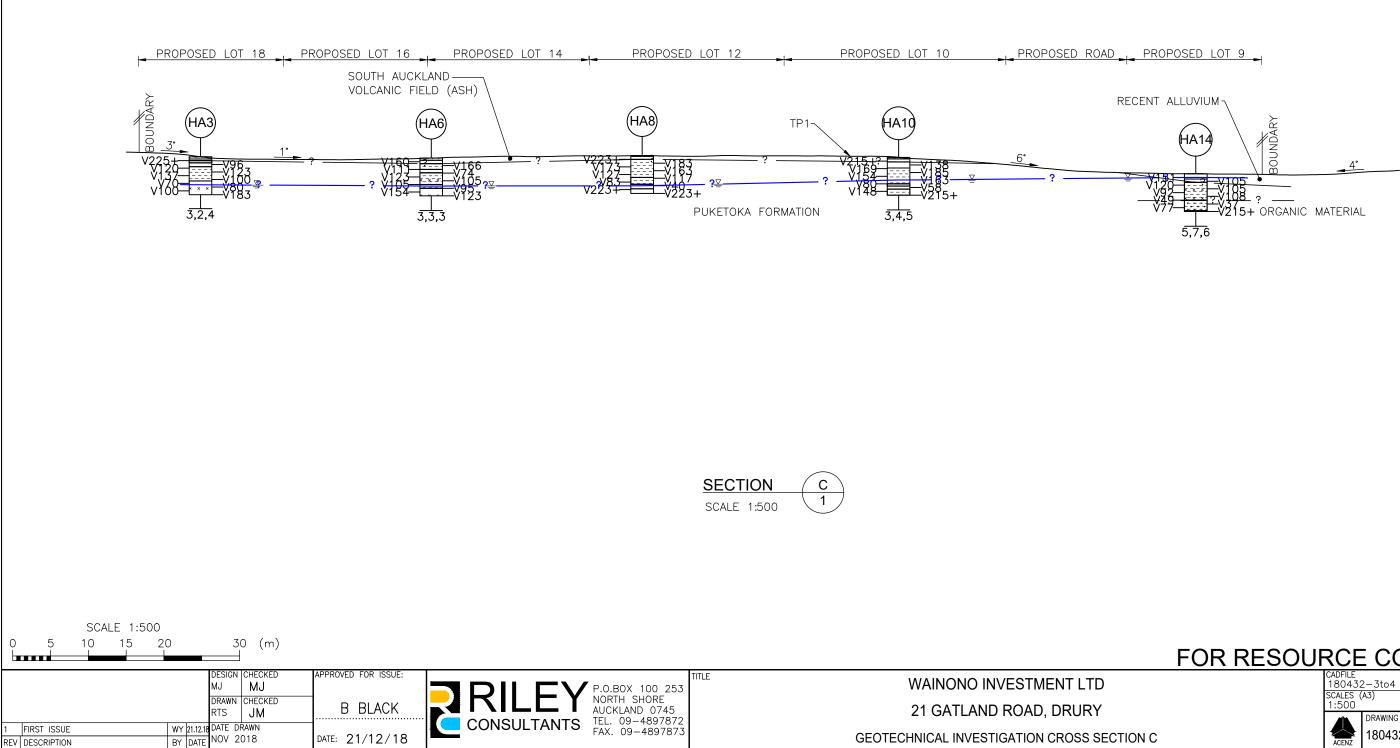
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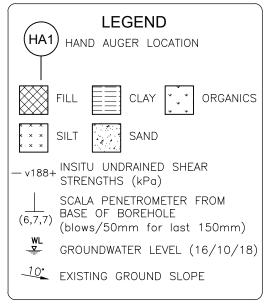
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SCALES (A3)				
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