





Geotechnical Investigation for Proposed Residential Subdivision at

158 Vinegar Hill Road, Kauri – Resource Consent 2

Rev A

24 May 2021

Job No. NL20029/S2



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GEOTECHNICAL INVESTIGATION FOR PROPOSED RESIDENTIAL SUBDIVISION AT 158 VINEGAR HILL ROAD, KAURI RESOURCE CONSENT 2

Job Number:	NL20029/S2		
Name of Project:	158 Vinegar Hill Road, Kauri – Resource Consent 2		
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Document Version:	Α		
Printed:	24 May 2021		
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Geotechnical

Environmental

Stormwater



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Report Summary

The following summarises the findings of this report however is not to be taken in isolation. It is a requirement that any user of this report review the document in its entirety, including all appendices.

Feature	Commentary		
RMA: Section106	No <i>geotechnical</i> natural hazards were identified (as listed in this Act) that are considered an undue impediment to subdivision/construction (respectively) or that cannot be reasonably addressed by typical engineering design and construction		
Topsoil and Non-Engineered Fill	Topsoil and non-engineered fill were encountered to a maximum depth of 0.4m below present ground level (bpgl), excluding within the hand augerholes PZ01 and PZ02 at the location of the existing pond dam. These soils are unsuitable to support any permanent structures		
Natural Soils	In general, soft to hard alluvial deposits underlain by stiff to hard Northland Allochthon soils		
Unduly Weak, Sensitive, or Compressible Soils	Weak soil not encountered within the test holes carried out on the subject sites however there is a distinct horizon of very weak, saturated soils underlying Lot 2 to the north east of the proposed Lot 19. Mitigation work for the weak soil encountered in Lot 2 is discussed in a separate report.		
	Moderately sensitive soils encountered on site.		
Groundwater	Groundwater was encountered between 2.6m and 2.8m bpgl, excluding the measurements carried out within the hand augerholes PZ01 and PZ02 at the location of the existing ponds dam, where it was encountered to depths between 0.8m and 3.2m bpgl		
Seismic Site Class	Site Class C		
Expansive Soils	Inferred as Moderately Expansive in accordance with B1/AS1		
Slope Stability	Slopes steeper than 1V:5H (11°) are present in places. We consider the site to be suitable for the proposed subdivision from a land stability point of view provided our development recommendations are adopted.		
Preliminary Foundation	Shallow foundations are suitable for the support of typical residential dwellings where slope inclination is flatter than 1V:4H (14°). Outside of the above, foundations must be designed to resist lateral loads - pile foundations are likely to be required		
Retaining	Any future retaining system over 600mm in height or within 1.5m of any permanent structure should be Engineer-designed.		
Pavement	For preliminary design a CBR value of 3% or a modulus of subgrade reaction of 20kPa/mm are considered appropriate for flexible and rigid pavements respectively.		
Construction Constraints	Topsoil and Non-engineered fill are present Sensitive soils are present across the site Northland Allochthon soil are prone to instability when disturbed and exposed to elements. Temporary (unsupported) cuts should not be in excess of 1.2m in height and construction will benefit from being carried out in summertime conditions		
Earthwork Construction Observation	Recommended		

1.0 Introduction

Soil & Rock Consultants (S&RC) were engaged by Evo Land Ltd to carry out a geotechnical investigation at 158 Vinegar Hill Road, Kauri – Resource Consent 2 regarding a proposed residential subdivision.

The subdivision will be carried out in three separate Resource Consent stages. This report is to support 'Resource Consent 2', being creation of twenty one new lots (Lots 3 to 22 inclusive and the balance Lot 800).

Our investigation has been informed by Section 106 of the Resource Management Act which lists 'Natural Hazards' that must be considered by Council when assessing a Resource Consent application. Our assessment has also extended to consideration of the following:

- Provision of a seismic site class in accordance with NZS1170.5:2004.
- Provision of geotechnical comments and/or recommendations related to site stability and site formation work requirements for residential subdivision.

The primary purpose of this reporting is to identify the issues discussed above and provide associated remedial, mitigation, and design recommendations in order that Subdivision Consent can be granted. Information and advice related to good construction practise are also provided. Preliminary foundation design advice is provided as is information.

1.1 Limitations

This report has been prepared by Soil & Rock Consultants for the sole benefit of Evo Land Ltd (the client) with respect to 158 Vinegar Hill Road, Kauri – Resource Consent 2 and the brief given to us. The data and/or opinions contained in this report may not be used in other contexts, for any other purpose or by any other party without our prior review and agreement. This report may only be read or transmitted in its entirety, including the appendices.

The recommendations given in this report are based on data obtained from discrete locations and soil conditions between locations are inferred only. Our geotechnical models are based on those actual and inferred conditions however variations between test locations may occur and Soil & Rock Consultants should be contacted in this event.

Soil & Rock Consultants should also be contacted should the scope or scale of the development proposal vary from that currently indicated.

Preliminary foundation design advice is provided in this report however that information will be confirmed or modified as appropriate at the Building Consent stage.

2.0 Site Description (General Area)

The subject site comprised of several land titles legally described as Lot 1 DP 189623, Lot 2 DP 189623, Lot 2 DP 189623, Lot 2 DP 120527, Lot 2 DP 337386, is irregular in shape and covers an area of approximately 34.6 hectares. The site is bounded by Vinegar Hill and Riversong Road to the west, Patanui Stream to the east and by farmland to the north and south.

The site is rural and is currently used as grazing land. Built development comprises an existing dwelling, sheds, farm paddocks, gravel farm tracks and boundary fences. A 'manmade' pond is present to the west of the property. The site vegetation is mainly grass with shrubs and trees in places particularly along the Patanui Stream and around the pond. The site may be accessed from Vinegar Hill Road and Riversong Road. The location and approximate boundary of the site is shown in Figure 1 below.

The ground surface is generally gentle to moderately sloping (inclinations less than 10°) throughout the site with a dominant slope direction from the west to the east and becomes near-level where approaching the Patanui Stream along the eastern boundary. Localised steep slopes (approximately 18°) exist in places.



Figure 1: Aerial Image (Source: Whangarei District Council GIS Map)

2.1 Proposed Development

Drawings prepared by Cato Bolam show the proposal is to subdivide the overall property into a total of sixty-one rural-residential Lots. Under the 'Resource Consent 2' (RC2) application the site will be subdivided for residential development for Lot 3 to Lot 22 inclusive and the Balance Lot 800. The proposed RC2 residential development is generally situated to the west of the property as shown in Figure 2 below and will be referred to collectively as 'the site' in this report. No development is proposed on the balance Lot 800. Access to the individual lots will be via common driveways from Vinegar Hill Road.

The same set of plans shows a 1% Annual Exceedance Probability (AEP) flood plain is present to the east of the site. These areas will be included in a 'Resource Consent 3' report at a later date.



Figure 2: Proposed Subdivision (Source: Cato Bolam Consultants)

3.0 Geology

Reference to the GNS New Zealand Geological Web Map 1:250,000 Geology map, indicates the site is underlain by two geological units, Recent Alluvial deposits of the Tauranga Group and Melange of Northland Allochthon Group (See Figure 3). These deposits were encountered during our investigation and a description of the encountered soils is given below.

<u>Recent (Holocene) Alluvial Deposits.</u> These materials are variable in terms of consistency and strength and are found typically along stream channels and flood plains of creeks, or along localised gully features. They are typically present as beds of light grey to orange brown muds, sand and gravel, comprising some rock fragments in places. Holocene alluvial deposits may include some beds of black, humus rich clay and fibrous peat. These materials are unconsolidated and very soft and are unsuited to support of residential construction.

<u>Tauranga Group Alluvial Deposits.</u> These deposits are of Pliocene/Pleistocene age, and are therefore older and typically more consolidated that the materials described above. They are typically suited to residential construction however some caution is required as they can vary markedly in composition and engineering characteristics.

Geotechnical risks associated with these deposits are the presence of loose, saturated soils and peats of lesser vane shear strength underlying a stiff crust typically of 2.5m to 3.0m thickness. These soils can be prone to undue consolidation settlement and are subject to seasonal shrinking and swelling as a result of moisture content changes.

<u>Melange of Northland Allochthon.</u> These materials are closely fractured to sheared siliceous and locally calcareous mudstone with micaceous sandstone, siltstone, green and brown shale and some muddy limestone. The complex commonly occurs as a melange of mixed lithologies with a sheared mudstone matrix and many small serpentinite bodies within melange units. The rocks are light to dark coloured.

Due to the high densities of rock mass defects these rocks rapidly weather to weak clay rich materials that form areas of subdued rolling topography. The clays are soft to very soft smectite rich, low shear strength high plasticity clays that are prone to debris sliding and deep-seated creep even on slopes less than 10° (Shakes 1983) which is the underlying reason behind the gentle topography when compared to other soil types. Weathering can extend to 10m depth.

Geotechnical risks associated with these deposits are stability issues even at gentle inclinations. Earthworks (cut and fill) batters should be inclined at no greater than 1V:5H. Depending on cut depth, under-cutting and compacted-clay capping (at least 600mm thick) may be required within the earthwork area.

<u>Other Lithologies</u>. To the east of the stream (along the eastern boundary) are volcanic deposits of the Kerikeri Group. Volcanic ash (tuff) may be present on the site in isolated areas as the lithology boundaries shown on the geologic maps are approximate only.



Figure 3: Geological Map (Source: GNS WebMaps Website)

4.0 Field Investigation

The field investigation carried out on 8 and 9 December 2020 comprised the following components:

- Visual appraisal of the site;
- Drilling of twelve hand augerholes (AH03a, AH03b, AH04, AH05, AH11 to AH15 inclusive, PZ01 and PZ02) to depths between 3.0m and 5.0m below present ground level (bpgl);
- Installation of two piezometers for groundwater monitoring within hand augerholes PZ01 and PZ02;
- Scala penetrometer testing from the base of selected augerholes;

- Drilling of four probe hand augerholes (WW01 to WW04 inclusive) to depths of 1.2m bpgl to assist in wastewater assessment;
- Measurement of three cross sections (A-A', C-C' and D-D') using measuring tape and clinometer.

The test locations are shown on the attached Site Plan, Drawing NL20029/S2/01 in Appendix A. These locations were determined from hand-held GPS and are therefore approximate only.

Measurements of undrained shear strength were undertaken in the hand augerholes (AH03 to AH15 inclusive, PZ01 and PZ02) at intervals of depth using a handheld shear vane in accordance with the New Zealand Geotechnical Society Guidelines for Handheld Shear Vane Tests, dated August 2001. Peak and remoulded vane shear strengths shown on the attached augerhole logs represent dial readings off the shear vane adjusted using the BS 1377 calibration correction factor given on the log.

A visual-tactile field classification of the soils encountered during drilling was carried out in accordance with "Guidelines for the Field Classification and Description of Soil and Rock for Engineering Purposes", issued by the New Zealand Geotechnical Society Inc. (2005).

Dynamic Cone (Scala) Penetrometer testing was carried out from the base of selected augerholes until refusal was reached. Refusal is defined as five consecutive blow counts of 10 or greater per 50mm penetration or a blow count of 20 for 50mm penetration. The results are given on the attached sheet (Appendix B).

4.1 Subsurface Conditions

Subsurface conditions have been interpolated between the test locations and localised variations between and away from the test locations will exist.

In general, the soils encountered comprised topsoil and fill underlain by alluvial deposits and in turn underlain by Northland Allochthon soils. An outline of the soil conditions and investigation results is given below and summarised in Tables 1 and 2 below, and detailed descriptions of the soils are given on the attached logs (Appendix B).

 Topsoil and Fill. Topsoil and/or fill was encountered at each test location generally to a maximum depth of 0.4m below present ground level (bpgl). Deeper fill deposits were encountered in augerholes PZ01 and PZ02 to depths of 3.1m and 1.0m bpgl respectively, being the dam structure. PZ01 and PZ02 were drilled near the dam crest and near the toe. Due to the measured shear strengths and variable composition of the fill material is considered unsuited to residential house construction - unsuitable for the support of permanent structures (i.e. building foundations, floor slabs, pavements etc.).

The depth, lateral extent, and composition of the fill material will vary across the site.

Alluvial Deposits. Alluvial deposits were encountered at most test locations (with the exception
of hand augerholes AH04, AH05, AH09 and PZ01) underlying the topsoil and/or fill to depths
ranging between 1.2m (minimum drilled depth) and 5.0m (maximum drilled depth) bpgl. The
alluvial soils comprised soft to hard silts with lesser amounts of clay and fine sand with occasional
clay-dominant zones. Vane shear strengths recorded within the alluvial material generally ranged
between 58kPa and greater than 200kPa.

Lower vane shear strength readings between 14kPa and 35kPa were recorded in hand augerhole AH03a at depth between 2.5m and 3.0m bpgl. Augerhole AH03a was drilled in Lot 2, beyond the subject site, to the northeast of proposed Lot 19. Mitigation work for the weak soil encountered in Lot 2 is discussed in a separate report (job ref NL20029/S1, date 26 February 2021).

Northland Allochthon Soils. Northland Allochthon soils were encountered underlying the topsoil/fill and alluvial deposits (where encountered) to the termination depths of the hand augerholes (exception is hand augerholes AH03a, WW01 and WW03). The Allochthon soils comprised stiff to hard silts with varying amounts of clays and sands. Vane shear strengths ranged from 51kPa to greater than 200kPa where the soil strength was in excess of the shear vane dial capacity or was 'UTP' – Unable to Penetrate into the soil.

At shallow depth, (ground level to 2.0m) the soils are more sensitive to disturbance. Below 2.0m depth, the re-moulded vane strengths were generally within 50% of the undisturbed test values, indicating low sensitivity of the soil.

 Scala Penetrometer Testing. Scala Penetrometer testing was carried out from the base of selected augerholes. Refusal, inferred to be contact with the transition zone into an underlying dense stratum, was encountered at depths ranging between 3.7m and 7.2m bpgl.

'Sudden' refusal is inferred to indicate contact with a hard or dense surface (such as sandstone/mudstone) and was encountered within hand augerholes AH03a, AH03b, AH13 and AH15 at depths between 3.7m and 6.6mbpgl.

• **Groundwater.** Groundwater measurements were carried out within the hand augerholes on the day of drilling (8 & 9 December 2020) and are summarised in Table 1 and 2 below.

Groundwater measurements taken during drilling are not always an accurate portrayal of the actual long-term groundwater table as groundwater levels can take time to stabilise within the hand augerholes following drilling.

In all cases, shallow groundwater should be expected within low lying areas during the wet months of the year. The areas of shallow groundwater would typically be concurrent with flood plains however may be present at other locations.

Plants of the 'Rush' type usually indicate localised areas of shallow groundwater, including springs.

Groundwater level monitoring was carried out within the piezometers, PZ01 and PZ02, and will be presented/discussed in a separate document ('Dam Report').

Test ID	Termination Depth	Depth to the base of Topsoil/Fill	Vane Shear Strength Range within Natural Ground (kPa)	Scala Penetrometer Termination	Groundwater Depth
	All depths measur	ed in (m) below p	present ground level. (R	Rounded to 1 DP)	
AH03a	5.0	0.2	14 - 200+ UTP	6.6	2.6 (2.2)
AH03b	5.0	0.4	76 - 200+ UTP	5.0	NE (3.5)
AH04	5.0	0.4	62 - 200+ UTP	6.3	2.8 (2.1)
AH05	3.5	0.2	60 - 200+ UTP	NT	NE (1.7)
AH09	3.0	0.4	97 - 200+ UTP	NT	NE (2.5)
AH11	5.0	0.2	92 – 200+ UTP	7.2	NE (3.5)
AH12	5.0	0.2	88 – 200+ UTP	6.4	NE (0.6)
AH13	5.0	0.2	51 – 200+ UTP	5.2	2.7
AH14	4.2 (1)	0.2	95 – 200+ UTP	5.9	NE (0.6)
AH15	3.0 (1)	0.2	133 – 200+ UTP	3.7	NE (2.2)
PZ01	5.0	3.1	86 – 118	NT	3.7
PZ02	3.0	1.0	108 – 200+	NT	0.8

Table 1 – Summa	y of Subsurface	Conditions -	AHs & PZs
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Key:

(1) = Too hard/dense to hand auger

NE = Not Encountered,

NT = Not Tested,

UTP = Unable to penetrate the soil.

Figures in Brackets: Depth to soil logged as 'wet' or 'moist to wet' – where within 0.6m from ground surface moistness or wetness is likely due to surface water

Test ID	Termination Depth	Depth to the base of Topsoil/Fill	Vane Shear Strength Range within Natural Ground (kPa)	Scala Penetrometer Termination	Groundwater Depth
All depths measured in (m) below present ground level. (Rounded to 1 DP)					
WW01	1.2	0.4	NT	NT	NE
WW02	1.2	0.1	NT	NT	NE
WW03	1.2	0.2	NT	NT	NE
WW04	1.2	0.2	NT	NT	NE

Table 2 – Su	mmary of Subsu	rface Conditions –	- WW Augerholes

NE = Not Encountered NT = Not Tested

5.0 Non-Engineered Fill

Non-engineered fill is a man-made soil deposit (not created by natural processes). The term 'nonengineered' implies that the fill was placed without engineering supervision or certification. The potential random composition of this deposit, the uncontrolled manner of placement and resulting unpredictable strength/deformation characteristics render non-engineered fill unsuitable for support of any permanent structures e.g. building foundations, retaining walls, pavements etc.

The composition of the in-situ fill and the tested vane shear strength indicate that the fill was placed without engineering controls therefore it is considered non-engineered.

6.0 Expansive Soils

Visual and tactile assessment indicates that the soils, encountered on site lie in 'Expansive Soil Class **M – Moderately Expansive**' as given in B1/AS1. B1/AS1 states that Class M soils experience surface movements of up to 44mm.

In any case, expansivity testing is recommended for future dwelling development.

7.0 Sensitive Soils

Alluvial deposits and Allochthonous soils can be very sensitive to mechanical disturbance and/or exposure to the elements and our investigation logs indicate the soils in the upper 2.0m are slightly to moderately sensitive. The practical outcome of this characteristic is that soils that test well in-situ can perform poorly when construction is under way. Care is therefore required during construction to ensure the soils are protected to ensure favourable short and long-term subgrade performance.

Practical means of protecting the soils include avoidance of vibration-based compaction equipment, protecting the subgrade following initial site clearance, and minimising the passage of heavy or vibrating construction plant. Reference should be made to Section 12.0 of this report regarding subgrade protection measures.

8.0 Seismic Design Parameters

The site is considered a Class C – 'Shallow Soil Site' as defined by NZS 1170.5:2004.

The Peak Ground Acceleration (PGA) value for a structure of Importance Level 2, adopted for stability analysis of the site is 0.133g (ULS).

9.0 Slope Stability

Qualitative Assessment

Northland Allochthon soils are sensitive to water and disturbance, and are prone to instability even at relatively gentle inclinations (e.g. slopes steeper than 1V: 4H, (14°), sometimes as flat as 1V:5H). It is common for Allochthonous soils to have a natural capping of approximately 1.5m to 4.0m thick clayey silt or silty clay overlying the sensitive layer. The sensitive layer is commonly grey in colour and is very stiff to hard when undisturbed.

The augerholes shows the natural capping is approximately 1.5m thick however could be lesser away from the test locations. It is highly recommended that at least 0.5m of the natural capping remain in place.

The ground surface on site is mainly gentle to moderately sloping with inclinations generally being less than 10° with localised steep slopes (approximately 13°) in places.

At the time of our investigation no visual evidence of major, deep-seated instability was identified.

Our initial assessment is that the site is suitable for the proposed development provided any excavation remains within the natural capping otherwise specific engineering recommendations are required.

Quantitative Assessment

To quantitatively check the overall stability of the slope within the proposed building platforms, stability analyses have been undertaken for the existing topography through cross sections A-A', C-C', and D-D' as indicated on the Site Plan, Drawing NL20029/S2/01.

The computer program SLIDE Version 2018 for slope stability analysis, developed by RocScience Inc. was used for stability calculations. Stability of theoretical translational surfaces was assessed using the Morgenstern-Price method.

Stability analyses have been undertaken for the normal (measured) groundwater, extreme (worst credible) groundwater, and seismic conditions. The measured groundwater condition has been adopted for the seismic condition. Peak Ground Acceleration (PGA) values for the Whangarei Region have been determined as per Section 8.0 of this report.

Lower-bound effective stress shear strength parameters used for our analyses are summarised in Table 3. These have been developed from the soil description, in-situ strength testing, limited back analysis, reference to literature regarding the Allochthon and our experience with these soil types in both the immediate area and the wider region.

Soil Type	Estimated Unit Weight γ (kN/m³)	Effective Cohesion on the Failure Plane c' (kPa)	Effective Angle of Internal Friction ø' (°)
In-situ Fill	18	0	24
Tauranga Group	18	2	26
Weak Transitional Zone	17	3	20
Weathered Northland Allochthon	17	5	24
Less Weathered Northland Allochthon	18	5	30

Table 3 – Effective Stress Strength Parameters

The ratio of resisting forces to disturbing forces is presented as a 'Factor of Safety' (FOS) against slope instability occurring. A FOS of 1 indicates a slope near or at equilibrium.

We have adopted the following for the purposes of our assessment:

- FoS of 1.5 or higher for long-term stability when modelling the existing site conditions (measured groundwater level).
- FoS of 1.3 or higher for medium-term stability to model the worst-credible-case scenario (elevated groundwater level) and
- FoS of 1.2 or higher used for short-term stability to model the effect of extreme conditions (seismic loading).

The values above were adopted from Auckland Council's Code of Practice Factors of Safety for Residential Development.

The results of our analyses are summarised in Table 4 below.

Section	Modellod Conditions	Global Fact	Compliant	
Section	Modelled Conditions	Required	Calculated	Compliant
	Normal Groundwater	1.5	2.2	Yes
A-A'	Extreme (Worst Credible) Groundwater	1.3	1.9	Yes
	Seismic Loading	1.2	1.2	Yes
	Normal Groundwater	1.5	2.5	Yes
C-C'	Extreme (Worst Credible) Groundwater	1.3	2.0	Yes
	Seismic Loading	1.2	1.5	Yes
	Normal Groundwater	1.5	2.2	Yes
D-D'	Extreme (Worst Credible) Groundwater	1.3	1.7	Yes
	Seismic Loading	1.2	1.3	Yes

Stability Conclusions

The minimum factors of safety within the 'practical building platforms' were greater or equal to the required FoS.

We therefore consider the site to be suitable for the proposed development from a global land stability point of view contingent upon the recommendations of this report being adopted in design and construction.

10.0 Geotechnical Discussion

It is our opinion that any geotechnical impediment to the development from 'Natural Hazards' (as listed in Section 106 of the Resource Management Act) can be mitigated through design. This opinion is confined to the geotechnical aspects of RMA Section 106 and assessment of the potential for 'Inundation' from floodwater is excluded from our assessment.

We consider the site to be geotechnically suitable for subdivision and typical residential development within Lots 3 to 20 inclusive provided the recommendations given in this report are observed.

11.0 Site Formation Works

We are not aware of the proposed engineered topography of the site at this stage. We expect earthworks to be carried out in association with the formation of building platforms and access roads to service the proposed subdivision.

The following procedures should be observed during earthworks:

- Prior to commencing earthworks, a sediment control system must be constructed to ensure the Territorial and Regional Authority requirements are met.
- All earthworks should be carried out to the requirements of NZS 4404:2010 'Land Development and Subdivision Infrastructure' and NZS 4431:1989, 'Code of Practice for Earthfilling for Residential Development'.
- It is highly recommended that a minimum of 0.5m of the natural highly plastic clayey or silty soil
 must remain or be placed over any unweathered mudstone or claystone (sensitive layer). This
 could be achieved by undercutting and reworking the top 0.5m of soil within the earthworks area
 to an engineered standard. The use of highly plastic clayey soil is recommended in that top 0.5m
 to act as a capping material.
- Maximum inclination of any natural soil slope (following cut activity) should be 1V:4H (14°) unless special engineered consideration is applied.
- No unsupported cut may be greater than 1.5m in height
- Batters formed by placement of engineered fill may be formed no steeper than 1V:4H (14°) unless special engineered consideration is applied.
- No fill may be deeper than 1.5m unless the subject of specific stability assessment.
- Unsuitable materials (topsoil, non-engineered fill) encountered during building platform preparation should be excavated, removed and replaced with good quality granular fill compacted in layers no greater than 150mm, loose.
- Any springs or seepage of water observed at ground level or intercepted by stripping operations should be captured in a suitable sealed pipe and taken via the shortest route to a safe discharge point as per the Geotechnical Engineer's advice.
- The surficial soils (present on site) can be sensitive to disturbance and must be protected at all the time from exposure to the elements, and from excessive construction plant vibration in order to prevent loss of strength.
- Service trenches should be backfilled with engineered granular fill where this is deemed necessary e.g. under pavements and other permanent structures.

• A Geotechnical Engineer should inspect the prepared subgrade prior to placement of fill and test the fill during placement.

12.0 Pavements

All topsoil, non-engineered fill, vegetation, organic or otherwise unsuitable material should be removed from under pavement areas prior to construction.

For preliminary design a CBR value of 3% or a modulus of subgrade reaction of 20kPa/mm are considered appropriate for flexible and rigid pavements respectively. These values should be confirmed by specific testing by S&RC following preparation of the subgrade.

Maintaining the natural moisture content of a subgrade prior to construction is important. The subgrade can be protected from desiccation, rain damage, and plant-trafficking by placing a protective layer of granular fill immediately upon excavating or filling to grade following inspection by the Geotechnical Engineer. The granular fill can later be left in-situ as a construction sub-base or basecourse if managed well and protected from damage. In summertime conditions consideration should be given to watering the subgrade approximately 48 hours prior to concrete placement to return the subgrade to its inferred pre-excavation moisture content is recommended, the aim being to prevent sweel pressure from post-construction re-hydration of the soils damaging the structure.

Any pavement should be underlain by a basecourse of clean, free-draining granular fill as specified by the designer and should be subjected to compaction by a device of appropriate weight and energy. Silty or sandy subgrades are generally sensitive to disturbance and 'static' rolling only (no vibration) is recommended.

13.0 Preliminary Foundation Design Recommendations

Shallow foundations and/or piled foundations are suitable for the support of typical residential dwellings provided they are supported by stiff natural ground or engineered-quality fill.

S&RC should inspect all foundation excavations to determine whether the exposed soil and foundation conditions are consistent with those described in this report.

Soil expansivity and bearing capacity values will be confirmed during the Building Consent stage.

Shallow Foundations

Shallow foundations are suitable where slope inclination is flatter than 1V:4H (14°) and the foundations are for the support of typical residential dwellings constructed in accordance with NZS3604:2011 and designed to accommodate movement of soil associated with a Soil Reactivity (Class M – Moderately Reactive).

A Dependable Bearing Capacity of 150kPa (Ultimate Bearing Capacity = 300kPa, $Ø_{bc}$ = 0.5) is available for shallow foundations (excluding rib-rafts/waffle slabs) designed to NZS3604:2011 and designed to accommodate movement of soil associated with Soil Expansivity Class M – Moderately Reactive. Note: as described above, that expansivity class should be confirmed as part of Building Consent preparation as it is possible that Site Class H – Highly Expansive soils are present..

Pile Foundations

Piled foundations may be required as follows:

- Where the structural requirements are greater than that given for shallow foundations.
- Where bridging of services is required.
- To provide resistance to Soil Creep where a foundation is situated within 2.0m horizontally of natural ground with a surface inclination steeper than 1V:4H (14°).
- Where any retaining is within the influence zone of the building platform.

Static design of piles can be carried out using the following parameters:

- A Design End Bearing Capacity of 250kPa (Ultimate End Bearing Capacity = 500kPa, Ø_{pc} = 0.5) is available for piled foundations embedded a minimum of 3.5m into stiff natural ground (Structural design may require deeper embedment).
- Design Skin Friction of 20kPa (Ultimate Skin Friction Capacity = 40kPa, Ø_{pc} = 0.5) where within natural cohesive soil or engineered fill.
- 3. No skin friction should be calculated within the 1.0m of any pile to account for the shrink/swell activity of the soil and shallow soil creep.
- 4. No skin friction should be calculated within any non-engineered fill layer.
- Soil creep of at least 1.0m (could be deeper depending on actual location) should be expected where a foundation is within 2.0m of ground sloping steeper than 1V:4H (14°). For design against soil creep the following may be adopted.

- The pile exposed to lateral soil pressure calculated over a width of 3d, where d is the bored pile diameter, and to a 1.0m depth, and using the parameters below
- Soil bulk density: 18kN/m³,
- Internal Friction Angle: 17° for natural soils* and engineered fill,
- K_o (At-Rest) for pile design.

*Due to the sensitivity of the surficial soils, we recommend a lowered value of friction angle to be used for pile design.

14.0 Retaining Structures

We recommend that any future retaining system within the subdivision that will be over 600mm in height or within 1.5m of any permanent structure be Engineer-designed.

Factors of safety and surcharge loadings appropriate to the conditions should be in accordance with 'Limit State Design of Retaining Walls and Foundations for Geotechnical and Structural Engineers' SESOC Seminar Series 2005.

No cutting or filling may be carried out that is in excess of 600mm depth or serviced by batters steeper than 1V:4H (14°) without specific geotechnical assessment, which depending on the location and scale may range from drawing review to further in-ground investigation.

15.0 Stormwater

Concentrated stormwater flows must not be allowed to run onto or over slopes or saturate the ground as this could adversely affect slope stability or foundation conditions. Flows from all impermeable areas must be collected and carried in sealed pipes to a disposal point approved by Council.

Disposal to ground may only be carried out subject to consultation with S&RC or an engineer experienced with Northland Allochthon soils.

16.0 On-site Wastewater Treatment and Dispersal

No reticulated sanitary sewer services the subdivision therefore an on-site wastewater treatment and disposal system is required to service future dwellings.

The purpose of this section is to confirm to Council that on-site treatment and dispersal of domestic wastewater is feasible, and we have demonstrated this by considering a notional four-bedroom dwelling on each Lot as described below. Actual designs suited to individual lots and development proposals will be carried out as part of preparation for Building Consents.

On Site Wastewater Dispersal Feasibility Assessment

We have assessed the feasibility of onsite effluent disposal in accordance with AS/NZS1547:2012 and referred to the Regional Soil and Water Plan (RWSP) for Northland.

We consider that the subsoils encountered within our handauger holes should be categorised as Soil Category 5 - 6 'Slowly Draining' in accordance with Table 5.1 of AS/NZS1547:2012.

Table M1 of AS/NZS1547:2012 recommends a drip irrigation Design Irrigation Rate (DIR) for Soil Category 5 - 6 of 3.0 mm/day as given in Table 5 below.

On slopes steeper than 1H:4V (14°) a lesser discharge rate (2.5mm/day or 2.0mm/day) may be required to avoid land instability. That can be determined by the design Engineer at the time. The minimum Reserve area specified by NZS1547:2012 is 30% of the Primary area however our view is that 50% would be more appropriate.

Table 5 adopts NZS1547:2012 values and illustrates the required wastewater dispersal field for a typical four-bedroom dwelling discharging treated effluent to a Pressure Compensated Dripper Irrigation (PCDI) system. Table 5 indicates that a Reserve field of 30% of the Primary field is available in order to demonstrate compliance with NZS1547:2012. In reality a larger area is available for Reserve treatment if required.

Our handauger 'probes' did not encounter groundwater within 1.2m of ground surface.

Number of Bedrooms	4			
Design Occupancy	6			
Water supply	Roof tank water supply			у
Typical design flow	180/L/person/day			
Total design discharge rate	1080L/day			
Soil Category	5-6			
Design Irrigation Rate (maximum)	3mm/day			
Primary dispersal field	360m²			
Reserve area (30% & 50%)	(200/)	108m²	(500())	180m²
Total area	(30%)	508m²	(50%)	540m²
Setback from a Water Body	Per Northland Regional Plan 2020:			ו 2020:
	Setbacks range 5m – 20m			Эm

Table 5: Summary of Onsite Effluent Dispersal Field Sizing and Set-Backs

We conclude that:

- Each proposed Lot is capable of supporting an on-site wastewater treatment and dispersal system for a typical four-bedroom house;
- Designs for larger dwellings are likely to be feasible;
- All designs for on-site wastewater systems should be carried out by an Engineer experienced in on-site wastewater disposal.

17.0 Earthwork Construction Constraints

Geotechnical aspects of earthwork construction that are anticipated to require special attention by the Contractor and inspecting Geotechnical Engineer include (but are not necessarily limited to) the following:

- Moderately sensitive soils are present across the site which can exhibit a significant strength reduction when disturbed or exposed to the weather. Care is therefore required to protect the exposed soils during construction. Reference should be made to Section 12.0 of this report in this regard.
- Northland Allochthon soils are prone to instability when disturbed and exposed to elements hence care is required to protect exposed subgrade.
- Unsupported cuts in the Allochthon soils can lead to failure of slopes above the cut. Care and prudence are required of the Contractor.

18.0 Observation of Construction

S&RC should be engaged to inspect excavations conditions exposed during construction so that 'actual' ground conditions can be compared with those assumed in formulating this report.

The aspects of the development that require geotechnical observation, testing, and final certification will be determined by Council and given in the Special Conditions of the Consent. The Contractor should make themselves familiar with those conditions and ensure adequate observations are carried out. In any case, the contractor should notify S&RC should ground conditions encountered during construction vary from those described in this report.

Any ground covered by fill or concrete prior to geotechnical inspection will be specifically excluded from completion certification.

19.0 Earthworks Completion Report

Council will require an Earthworks Completion Report (ECR) be submitted by the Geotechnical Engineer at the close of the subdivision earthworks. That document will contain a 'Statement of Professional Opinion' (SOPO) that Council will rely upon to assist with RMA 'Section 224C' processing.

Preliminary recommendations regarding soil characteristics and stability recommendations provided in this report will be confirmed or modified as appropriate within the ECR and SOPO.

Most of these observations would normally be made during subdivisional earthworks monitoring and testing however at this site, we expect that work to be minimal. The developer may opt to have a number of 'bearing capacity' augerholes carried out in order to provide greater detail in the ECR and less reliance, or need for, subsequent site-specific geotechnical work to support Building Consent applications. Some aspects, such as testing for shrink-swell characteristics and bearing capacities of building platforms established in cut ground can only be carried out at the close of earthworks.

It follows that any preliminary designs (typically residential housing) prepared prior to the issue of the ECR and SOPO is at the risk of the designer.

End of Report Text – Appendices Follow



Appendix A

Drawings: Soil & Rock Consultants Site Plan, Cross Sections and Wastewater Disposal Plan









CROSS SECTION D-D'	L20029/S2/04	DRAWN: MB	DATE: 14 Jan 2	2021
	CALES: 1: 300	CHECKED: REV. A		REV. A
		DESIGNE	D:	
Filename: NL20029 - Cross Sections				



		312m ² 19 2632m ²	18 2610m ²		
AMENDMENTS DATE REV DESCRIPTION	Soll&Rock Consultants Xer report & end-of-utiants Level 1, 131 Lincoln Road, Waitakere PO Box 21-424 Henderson, Waitakere 0650 Ph 09 835 1740 Fax 09 835 1847 www.sollandrock.co.nz	Check all dimensions and levels on site before commencing construction. This drawing and design remains the property of Geotechnical Engineering Ltd. and may not be reproduced without the written permission of Geotechnical Engineering Ltd.	158 Vinegar Hill Road Kauri	Wastewater Field for Stage 1	2021/05 DRAWN: NH DATE: September 8, 2020 SCALES: 1: 2000 CHECKED: REV. AT A3 DESIGNED: Filename:



Appendix B

Investigation Logs (Hand Augerholes, Scala Penetrometer Results)

					CLIENT: Evo Land Lt	d c/- Cato Bolam Co	onsu	ltants		Aug	jer Hole	No: AH	03(a)
		So	I&ROCK Your responsive 8	Consultants & cost-effective engineers	PROJECT: Geotechnica Kauri	al Investigation, 158	Vine	egar H	lill Road	, She	et 1	of 1	
Γ	Drill	Type:	50n	nm Hand Auger	Project No:	NL20029/S2			Logged E	By:	DEG		
	Drille	ed By: e Starte	DE0	G 2/20	Coordinates: Ground Elevation:				Shear Va Surface (ane No - Ca Conditions:	alibration D	evel. GEO2	199 - 2/10/2020
	Date	Finish	ed: 9/12	2/20	Water Level:	2.6m 9/12/2020						,	
	STRATIGRAPHY	DEPTH (m)	GRAPHIC LOG	Soil descript "Guideline	ion in accordance with the N Society Inc 2005 s for Field Description of Soil Engineering Use"	Z Geotechnical and Rock in	WATER LEVEL (m)	DEPTH (m)	SCALA I NZS:44((Blows p 1 SHEAR REMOU 5	PENETRO)2:1986 tes er 100mm 0 2 STRENGT LDED SHE 0 11	METER TE st 6.5.2 Increment) 20 3 TH EAR 00 1	EST) 30 (Blows) ○ v ⊙ r 50 (kPa)	LABORATORY TESTS
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			$\begin{array}{cccc} & & & \\ & & & \\ \times & & \times & \\ & & \times & \times \\ & & \times & \times$	plastic (TOP SILT some f light grey, da plastic (ALL SILT some c	SOIL) ine sand to sandy, minor clay irk orange, very stiff, dry to m JVIAL DEPOSITS) ilav, minor fine sand, vellow,	v, orange brown, noist, non to slightly orange brown.	-	-				· · · · · · · · · · · · · · · · · · ·	
		<u>0.5</u>	× × × × × × × × × × × × × × × × × × ×	orange, very clayey SILT, moist, mode	stiff, dry to moist, slightly pla trace fine sand, red brown, o rately plastic	stic		<u>0.5</u>		0			
		_	×	clayey SILT,	trace fine sand, dark orange	, orange red, stiff,		_					
		<u>1.0</u>		dark orange	, orange, light grey			<u>1.0</u>	32 r		, 		
			× × ×	silty CLAY, t moist, highly	race fine sand, light grey, ora plastic	nge, yellow, stiff,		_					
		15	$\overline{\times}$	light grey wit	h orange mottles			15	43 r				
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	OUP	_	× × × × × × × × × × × × × × × × × × ×	clayey SILT, moderately	trace fine sand, light grey, bl blastic	ue grey, firm, wet,	2/2020						
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'H SCAL		<u>4.5</u>	× _ × , × _ × ,					<u>4.5</u>	36 r ⊙	⊖ ^{58 V}			
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JGER LO		50		saturated, hi orange with	ghly plastic light grey mottles			50					200+ UTP V
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	A	0 - 11	a Darah	0	CLIENT:	Evo Land Li	td c/- Cato Bolam Co	onsu	Itants		Aug	ger Hole	No: AH	03(b)
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	rill Type	e: 	50m	m Hand Auger	Pr	oject No:	NL20029/S2			Logged	By:	DEG	ata: CEO2	100 2/10/2020
	ate Star	y. rted:	9/12	/20	Gi	round Elevation:				Surface	Conditions	: Slight	Bloping, Gra	199 - 2/10/2020 ASS
	ate Fini	isheo	d: 9/12	2/20	W	ater Level:	Not Encountered							
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	Date	Finishe	ed: 9/12	2/20	Wate	r Level:	Not Encountered							
	RATIGRAPHY	JEPTH (m)	SAPHIC LOG	Soil descript "Guideline	ion in accordance Society In s for Field Descrij Engineerin	with the NZ c 2005 otion of Soil g Use"	Z Geotechnical and Rock in	ER LEVEL (m)	JEPTH (m)	SCALA NZS:44 (Blows p 1 SHEAR REMOL	PENETRO 02:1986 tes per 100mm 0 2 STRENGT	METER TE st 6.5.2 Increment) 20 3 TH EAR	ST 0 30 (Blows) 0 v	(BORATORY TESTS
	STI	_	G		-	-		MA	_	F	50 1	00 14	50 (kPa)	ΓЪ
	TS	0.0	$\frac{\sqrt{1_{Z}}}{\sqrt{1_{Z}}} \frac{\sqrt{1_{Z}}}{\sqrt{1_{Z}}} \frac{\sqrt{1_{Z}}}{\sqrt{1_{Z}}}$	SILT some f plastic (TOP	ine sand, light gre SOIL)	ey, white, ve	ry stiff, dry, non		0.0					
		_	^ × ^ > × × × × × ×	SILT some f non plastic (SOILS)	ine sand, light ora	inge grey, lig ANGAKAHI/	ght grey, hard, dry, A COMPLEX		_					
		0.5	× × × × × × × × ×	SILT minor of dry to moist, some clay, s	clay, minor fine to non to slightly pla lightly plastic	medium sar astic	nd, orange, hard,		0.5					200+ UTP V
		_	× × × × × ×	, _					_					
		-	\times \times \times \times \times \times \times	light orange	with white speckle	es			_					
		1.0	× × ×						1.0	6	3 r ⊙		⊖ ¹⁵⁸ V	
		_	$\hat{\mathbf{x}}$						_					
			× ^ × ,						_					
	z	_	$\left(\begin{array}{c} \times & \times \\ \times & \times \end{array} \right)$	some fine S. mottles	AND inclusions to	20mm dian	neter, light grey							
	H I	<u>1.5</u>	\times \times \times \times \times \times						<u>1.5</u>	 	o ^c	9 V		
			\times \times \times \times \times \times	CIII T minor f	a como fina to ma	dium cond	trace along light		_					
	1D AL	_	^ × ^ > × × × >	orange, light	pink, white strea	ks, stiff, moi	st, non plastic		_					
	HLAN	2.0	× × × × × ×	minor clay, v	ery stiff, non to sl	ightly plastic	;		2.0	33 r		0122 \	v	
	RT	_	$\times \times \times$	moist to wet	stiff				_					
	Σ		× ` × ` × ` ×	(_					
			^ × ^ > × . × .	trace fine an	gular gravel, stim					30 r		104 \/		
		2.5	× × × ×						2.5			0		
		_	$\left(\begin{array}{c} \times & \times \\ \times & \times \end{array} \right)$						_					
12/21		_	× × ×	wet					_					
DT 5		<u>3.0</u>	×^×						3.0	18 r	_60 V			
013.G		_	× × × × × ×						_					
4H 2		_	$\times \times $						_					
SPJ S		_	\times \times \times \times \times	SILT, some clay, light or	fine to medium sa ange, light pink, w	nd, trace co hite, verv st	arse sand, trace		_					
5020.0		3.5	<u>× × ×</u>		RE 3 50 METRE	s		-	<u>3.5</u>	51			0179	V
8.12.2				(TARGET DE	PTH)	0.			_					
417		_												
01 - AI		4.0							4.0					
AHC														
0029		_							_					
A NL									_					
SCAL		<u>4.5</u>							4.5					
VITH		-							_					
^ 00 ∕									_					
GERL		_							_					
D AU		<u>5.0</u>							<u>5.0</u>					
HAN														

		Ocuculturate	CLIENT: Evo Land Ltd c/- Cato Bolam C	Consu	ltants		Aug	er Hole	No: AH	09
	Soll&ROCH Your responsive	CONSUITANTS e & cost-effective engineers	PROJECT: Geotechnical Investigation, 15 Kauri	8 Vine	egar H	lill Road,	She	et 1	of 1	
Di Di	ill Type: 50 illed By: N)mm Hand Auger N	Project No: NL20029/S2 Coordinates:			Logged By Shear Van	/: ne No - Ca	NN Ilibration Da	ate: GEO6	04 - 24/11/2020
Da Da	ate Started: 9/ ate Finished: 9/	12/20 12/20	Ground Elevation: Water Level: Not Encountered			Surface Co	onditions:	Slightly	Sloping, G	irass
STRATIGRAPHY	DEPTH (m) GRAPHIC LOG	Soil descript "Guideline	ion in accordance with the NZ Geotechnical Society Inc 2005 s for Field Description of Soil and Rock in Engineering Use"	WATER LEVEL (m)	DEPTH (m)	SCALA PE NZS:4402 (Blows pel 10 SHEAR S REMOULI	ENETROM 2:1986 tes r 100mm 2 TRENGTI DED SHE	METER TE t 6.5.2 Increment) 0 3 H AR	ST ● 0 (Blows) ○ r 50 (KPa)	LABORATORY TESTS
ي ب	$-\frac{0.0}{l_{\chi}} \times \frac{1}{\lambda l_{\chi}} \times \frac{1}{\lambda l_{\chi}}$	SILT, some dry, non pla	fine sand, light brown with white grey, very stiff, stic (TOPSOIL)		0.0		1			_
-										
		SILT, minor with brown s (WEATHER light orange minor fine to	clay, trace topsoil stained, light orange, yellow streaks, very stiff, moist, non to slightly plastic ED MANGAKAHIA COMPLEX SOILS) with light grey streaks			41 r •			159 V	
		>			1.0	64			. 165 V	
		> >			<u>1.0</u>		•••••			
Ν		minor clay, ı yellow spec	ninor fine to medium sand, white grey with kles		_					
OCTH	$1.5 \times 1.5 $	> >				68	8 r •••	127	V	
		>			_	• · · · · · · · · · · · · · · · · · · ·				
ILAN		some fine to	coarse sand, dark orange speckles, occasion		-					
ORTH		>			<u>2.0</u>	67	7 r		164 V	
Z		light grey wi inclusions m	th pink and orange mottles inor fine subrounded gravel		-	• • • • • • • • • • • • • • •				
		>			2.5					200+ UTP V
		wet			_					
51		atiff			_	• · · · · · · · · · · · · · · · · · · ·				
01 5/2	3.0 × ×	Sun			3.0	46 r		97 V		
2013.GI		END OF BO (TARGET DE	RE. 3.00 METRES. EPTH)		_					
244S					_					
20.GPJ	3.5				<u>3.5</u>					
.12.202					_					
117 _ 8					_					
01 - AF	4.0				<u>4.0</u>					
- AH					_					
112002					_					
	4.5				4.5					
NTH S(_					
N DOG N					_	. 				
UGER	5.0				5.0	.				
A UNA-										

		Il Dook	Concultorito	CLIENT:	Evo Land I	Ltd c/- Cato Bolam C	onsu	ltants		Aug	ger Hole	No: AH	11
	50	III&KOCK Your responsive &	GONSUITANTS & cost-effective engineers	PROJECT:	Geotechnie Kauri	cal Investigation, 158	8 Vine	egar ⊦	lill Road	, She	eet 1	of 1	
D	rill Type: rilled By:	50m NN	nm Hand Auger	Pi	roject No: oordinates:	NL20029/S2			Logged I Shear Va	By: ane No - Ca	NN alibration D	ate: GEO6	04 - 24/11/2020
D	ate Starte	d: 8/12	2/20	G	round Elevation:				Surface	Conditions	: Slightl	y Sloping, G	rass
ATIGRAPHY	EPTH (m)	APHIC LOG	Soil descript "Guideline	ion in accordan Society s for Field Desi Enginee	nce with the N Inc 2005 cription of Sc	Not Encountered	ER LEVEL (m)	EPTH (m)	SCALA NZS:440 (Blows p 1 SHEAR	PENETRO 02:1986 tes per 100mm 0 2 STRENGT	DMETER TE st 6.5.2 Increment 20	ST 0) 30 (Blows)	BORATORY TESTS
STF		9 BR		Enginee	ing obc		VAT		REMOU			• r	LA
TS	0.0	$\frac{\underline{x}^{\underline{\lambda}} \underline{h}_{\underline{Z}}}{\underline{h}_{\underline{Z}}} = \frac{\underline{x}^{\underline{\lambda}} \underline{h}_{\underline{Z}}}{\underline{x}^{\underline{\lambda}} \underline{h}_{\underline{Z}}} = \underline{x}^{\underline{\lambda}}$	SILT, trace f (TOPSOIL)	ine sand, light l	brown, firm, o	dry, non plastic		0.0					
	0.5		SILT, some with light gre (PUKETOKA	clay, minor fine y streaks, very A FORMATION	to medium s stiff, moist, s)	sand, light orange slightly plastic		 0.5 	46 r			0 ^{164 V}	
	 <u>1.0</u>		light grey wit	h orange strea	ks				56		0 ¹²⁷	v v	
L L		× × × × × × × × × × × × × × × × × × ×							56	ir ⊙	13	32 V	
RANGA GROL		× × × × × × × × × × × × × × × × × × ×	pinkish red r	nottles, light gro	ey with occas	sion orange streaks				67 r	0 ^{119 \}	/	
TAU	2.5		minor fine to streaks	medium sand,	light grey wi	ith light orange				72 r		· · · · · · · · · · · · · · · · · · ·	
5	-	× × × × × × × ×	minor clay, r	on to slightly p	lastic			-					
13.GD1 5/2/2									6	0 r ⊙⊖	92 V		
GPJ S+K_20	-		light grey ora	ange mottles, d	ark orange s	peckles		-		07	400		
1/ _ 8.12.2020.	<u>3.5</u>		SILT, some mottles, very (WEATHER light grey wit	fine to coarse s / stiff, moist, no ED MANGAKA /h dark orange :	and, minor li n to slightly p HIA COMPL speckles	ight grey with orange plastic EX SOILS)		<u>3.5</u> 		o/ I 	0122	• • • • • • • • • • • • • • • • • • • •	
ALLOCTHON	<u>4.0</u>		clayey SILT, orange strea SILT, minor medium sub light grey bro	some fine to m aks, very stiff, m clay, minor fine rounded gravel own, very stiff, r	edium sand noist, non pla to medium s l, orange with moist, non pl	, light grey with astic sand, minor fine to h black speckles, astic)	4.0 		72 r		37 V	
THLAND ,	4.5		minor to son limonite sub	ne fine to mediu rounded gravel	um sand, trac	ce fine to medium			35 r			143 V	
	-	$\begin{array}{c} \times & \times \\ \times & \times \\ \times & \times \\ \times & \times \\ \times & \times \end{array}$	trace fine to coarse sand	medium subrou , grey, black, or	unded gravel range speckl	l, minor fine to les		_					
	5.0	× × × × × × × ×	fine to coars subrounded very stiff, mo	e sandy SILT, t gravel, light gro vist, non plastic	trace clay, tra ey with orang	ace fine to medium ge, orange streaks,		5.0					200+ UTP V
			END OF BOP (TARGET DE	RE. 5.00 METF PTH)	RES.								

		10 Deels	Osusultanta	CLIENT:	Evo Land Lt	d c/- Cato Bolam C	onsu	Itants		Auge	er Hole	No: AH	12
	50	II& HOCK Your responsive &	CONSUITANTS & cost-effective engineers	PROJECT:	Geotechnica Kauri	al Investigation, 158	8 Vine	egar H	lill Road	, Shee	et 1	of 1	
Dri Dri	ll Type: lled By:	50m JP	nm Hand Auger	Pro	oject No: ordinates:	NL20029/S2			Logged E Shear Va	By: ane No - Ca	JP libration D	ate: GEO2	418 - 2/09/2020
Da	te Starte	d: 8/12	2/20	Gro	ound Elevation:	Not Encountered			Surface (Conditions:	Near L	evel, Grass	
STRATIGRAPHY	DEPTH (m)	GRAPHIC LOG	Soil descript "Guideline	ion in accordand Society I s for Field Desc Engineer	ce with the N2 nc 2005 ription of Soil ing Use"	Z Geotechnical	WATER LEVEL (m)	DEPTH (m)	SCALA I NZS:44((Blows p 1 SHEAR REMOU	PENETROM D2:1986 test ber 100mm I 0 20 STRENGTH LDED SHE	METER TE : 6.5.2 ncrement)) 3 H AR 0 1	ST ● 30 (Blows) ○ v ⊙ r 50 (kPa)	LABORATORY TESTS
IS	0.0	<u>x 1</u> , <u>x 1</u> ,	SILT, trace f	ine sand, brown	, stiff, dry, no	n plastic		0.0					
 	0.5	× × × × × ×	SILT, trace of dry, non plas	lay, minor fine s tic (ALLUVIAL I medium sand,	sand, orange DEPOSITS) trace coarse	brown, very stiff, sand, dry to moist		 					200+ UTP V
		× × × × × × × × × × × × × × × × × × ×	SILT, minor speckles, ve	clay, minor fine ry stiff, dry to mo	to medium sa oist, non to sl	and, brown, orange ightly plastic							
	<u>1.0</u>	× × × × × × × × × × × × × × × × × × ×	SILT, some with white gr	fine to medium s ey speckles, ve	sand, trace co ry stiff, moist,	oarse sand, brown non plastic	_	<u>1.0</u>					200+ UTP V
A GROUP		× × × × × × × × × × × × × × × × × × ×	trace to mind	or clay									209 V
TAURANG		× × × × × × × × × × × × × × × × × × ×	SILT, some moist, non p	fine sand, minor lastic	clay, light br	own, very stiff,		 2.0					200+ UTP V
	-	$\begin{array}{c} & & \times \\ \times & & \times \\ & \times & \times \\ & \times & \times \\ & \times & \times$	SILT, minor grey with reo to slightly pla	to some clay, so I streaks, orang astic	ome fine to m e streaks, ver	edium sand, light ry stiff, moist, non	_						
	<u>2.5</u>	×	some clay, n	ninor fine to me	dium sand, sl	ightly plastic		<u>2.5</u>			134 r		206 V
17		× × × × × × ×	minor clay, s	ome fine to me	dium sand, no	on to slightly plastic							
113.GUT 5/2/	<u>3.0</u>	^ × ^ × × × × × × × × × ×	some clay, r slightly plast	ninor fine to med	dium sand, or	range, light grey,		<u>3.0</u>		110	⁾ r	· · · · · · · · · · · · · · · · · · ·	194 V
2 X+C [49.		× × × × × × × × ×	SILT, some orange, light moderately p COMPLEX S	clay to clayey, tr grey with light p blastic (WEATH SOILS)	ace fine to m bink, very tiff, ERED MANG	edium sand, light moist, slightly to SAKAHIA					6 r	155 V	
	<u> </u>		some clay, n	ninor fine to mee sand	dium sand, sl	ightly plastic		<u></u> 			••••	O	
		$ \begin{array}{cccc} $	trace fine to	medium angula	r gravel					107	<u></u>	⊖ ^{158 V}	
LA NLZUUZ9		× × × × × × × × × × × × × × × × × × ×	light grey wit	h orange interm	iixed			-		· · · · · · · · · · · · · · · · · · ·			
	<u>4.5</u> 	× × × × × × × × × × × × × × × × × × ×	trace fine sa	nd, light grey wi ic	th orange stre	eaks, dark orange,		<u>4.5</u> —		77 r ⊙	0 ¹	40 V	
	5.0	$\begin{array}{c} \times & \times \\ \times & \times \\ \times & \times \\ \times & \times \\ \times & \times \end{array}$	SILT, minor inclusion, lig stiff, moist, r	to some clay, fir ht grey with ora on to slightly pla	ne to medium nge, dark ora astic	, limonite sand nge mottles, very	-		51 į	88	V		
HAND			END OF BOF (TARGET DE	RE. 5.00 METR PTH)	ES.								

					CLIENT:	Evo Land Lt	d c/- Cato Bolam Co	onsu	ltants		Aug	er Hole	No: AH	13
		So	II& ROCK Your responsive &	CONSUITANTS , cost-effective engineers	PROJECT:	Geotechnica Kauri	I Investigation, 158	Vine	egar H	lill Road	, She	et 1	of 1	
	Drill Drille	Type: ed By:	50m NN	nm Hand Auger	Pr	oject No: oordinates:	NL20029/S2			Logged Shear Va	By: ane No - Ca	NN alibration D	ate: GEO6	04 - 24/11/2020
	Date	e Starte	d: 8/12	2/20	Gr	ound Elevation:	2 7m 8/12/2020			Surface	Conditions:	Slightly	Sloping, G	irass
	STRATIGRAPHY	DEPTH (m)	GRAPHIC LOG	Soil descript "Guideline	ion in accordan Society s for Field Desc Engineel	ce with the NZ Inc 2005 rription of Soil ring Use"	Z Geotechnical and Rock in	NATER LEVEL (m)	DEPTH (m)	SCALA NZS:44 (Blows p 1 SHEAR REMOL	PENETRO D2:1986 test per 100mm 0 2 STRENGT ILDED SHE	METER TE st 6.5.2 Increment) 20 3 'H EAR	ST ● 30 (Blows) ○ v ⊙ r	LABORATORY TESTS
	TS	0.0	<u>stra stra</u>	SILT, minor white, very s	fine sand, trace tiff, dry, non pla	roots to 1mm stic (TOPSOI	Ø, light brown with L)		0.0	·····				
	TAURANGA GROUP			SILT, some brown orang plastic (ALL minor clay, r some clay, li trace clay, m plastic trace clay, m	clay, minor fine je with black spo JVIAL DEPOSI non to slightly pl ght orange with ninor fine sand, ninor fine sand, on plastic	sand, trace ro eckles, very si TS) astic dark orange brown with wh	oots up to 1mmØ, iff, moist, slightly streaks hite speckles, non	8/12/2020		50 	5	→ → → →	169 \/ 	2223 V 2223 V 2223 V
2020.GPJ S+R_2013.GDT 5/2/21	NO	 3.0 3.5	× × × × × × × × × × × × × × × × × × ×	saturated fine to coars gravel, light saturated, n COMPLEX S no gravel ind silty fine to c pink with wh	e sandy SILT, to brown, orange w on plastic (WEA SOILS) clusions, firm coarse SAND, tr ite grey speckle	race clay, trac with pink spec THERED MA ace clay, brow s, firm, satura	e fine subrounded kles, stiff, NGAKAHIA /n with orange, ted, non plastic	-		35 r • • • • • • • • • • • • • •	51 V	-108 V		
JGER LOG WITH SCALA NL20029 _ AH01 - AH17 _ 8.12.	NORTHLAND ALLOCTH	4.0 4.5 4.5		fine to medi white speck @ 4.2m to 4	um sandy SILT, es, stiff, saturat .5m less than 2	trace clay, pir ed, non plasti 0%	nk with orange c		4.0 4.0 4.5	22 <u>5</u> 25 <u>5</u>		-0 ¹¹¹ V		200+ UTP V
HAND AU		5.0		END OF BOR (TARGET DE	RE. 5.00 METR EPTH)	ES.			<u>5.0</u>		· · · · · · · · · · · · · · · · · · ·			Ð

ſ			10 Deck	0	CLIENT:	Evo Land Li	td c/- Cato Bolam C	onsu	ltants		Aug	er Hole	No: AH	14
		SC	III& KOCK Your responsive &	CONSUITANTS & cost-effective engineers	PROJECT:	Geotechnic Kauri	al Investigation, 158	3 Vine	egar ⊦	lill Road	, She	et 1	of 1	
ſ	Drill Drille	Type: ed By:	50n JP	nm Hand Auger	P	Project No: Coordinates:	NL20029/S2			Logged I Shear Va	By: ane No - Ca	JP alibration D	ate: GE02	418 - 2/09/2020
	Date	e Starte	d: 8/12	2/20	G	Ground Elevation:				Surface	Conditions:	Nearly	Level Gras	is
		DEPTH (m)		Soil descript "Guideline	ion in accordai Society s for Field Des Enginee	nce with the Ni Ince 2005 cription of Soi ering Use"	Z Geotechnical	ATER LEVEL (m)	DEPTH (m)	SCALA NZS:440 (Blows p 1 SHEAR REMOU	PENETRO 02:1986 tes oer 100mm 0 2 STRENGT LDED SHE	METER TE st 6.5.2 Increment) 20 3 H EAR	ST 0 30 (Blows) ○ v ⊙ r	LABORATORY TESTS
	0	0.0		SILT some	fine sand brov	vn stiff dry no	on plastic	Š	0.0	5	0 1	00 1	50 (kPa)	
	TS	_	1/ <u>1/ 1</u>	(TOPSOIL)	nne sand, brov	vii, suii, ury, no	on plastic		-					
	UP	 0.5	× × × × × × × × × × × ×	SILT, minor dry, non plas	fine sand, whit stic (PUKETOK	e grey, black s (A FORMATIC	speckles, very stiff, N)			42 r ⊕				200 V
	A GRO	_	$\begin{pmatrix} \times & \times \\ \times & \times \\ \times & \times \\ \times & \times \\ \times & \times \end{pmatrix}$	SILT, minor moist, slight	clay, some fine ly plastic	e sand, orange	e, grey, very stiff,		_					
	JRANG	<u> </u>	$\begin{array}{ccc} \times & \times \\ & \times & \times \\ & \times & \times \\ & & \times & \end{array}$	SILT, some very stiff, mo	clay, minor fine bist, slightly pla	e to medium sa stic	and, orange, grey,		<u> </u>	33 r	C	95 V		-
	TAL	_	$\times \times \times \times$	clayey SIL I, moist, mode	trace fine sand rately plastic	d, grey, orange	e streaks, very stiff,							
		<u> </u>	× × ×	some clay to	o clayey, slightl	y to moderatel	y plastic		<u>1.5</u>					200+ UTP V
		_	$ \begin{array}{c} \times \\ \times \\$	SIL I, minor light grey, ve MANGAKAF	clay, minor fine ery stiff, moist, IIA COMPLEX	e to medium sa non plastic (W SOILS)	and, orange with EATHERED							
		 2.0		SILT, some 2mmØ, light moist, non to	clay, some incl grey with oran o slightly plastic	lusions of SIL1 ige mottles, ve c	「, trace clay to ry stiff to hard,		 2.0					200+ UTP V
		_	× × × × × ×	SILT, minor streaks, very	clay, trace fine / stiff to hard, d	sand, grey broken Iry to moist, no	own with orange on plastic	_	-	• • • • • • • • • • •				
	LOCTHON	<u>2.5</u> 		very stiff					<u>2.5</u> —					200+ UTP V
13.GDT 5/2/21	THLAND AI	<u></u> <u>3.0</u>		trace to mine water seepa	or clay, white g ge, light green	rey, hard, dry grey, moist			<u> </u>	• • •				
0.GPJ S+R_20	NOR									• • • • • • • • • • • • • • • • • • •				
<u> 417 _ 8.12.202</u>		-	× × × × × × × × × × × ×	greenish ora	inge streaks				-	• • • •				
129_AH01 - A.		<u>4.0</u>		dry					<u>4.0</u>					
H SCALA NL200		 4.5		END OF BOI (TOO HARD	RE. 4.20 METI TO AUGER)	RES.								
GER LOG WITH		-								• • • • • • • • • • • •				
HAND AU(<u>5.0</u>							<u>5.0</u>					-

ſ	1		10 De els	Osmanik		CLIENT:	Evo Land	Ltd c/- Cato Bolam 0	Consu	ltants		Aug	ger Hole	No: AH	15
		50	Your responsive l	CONSUITA & cost-effective er	ants ngineers	PROJECT:	Geotechni Kauri	cal Investigation, 15	8 Vine	egar I	lill Road	, She	eet 1	of 1	
	Drill Drille	Type: ed By:	50r STI	nm Hand Au -	ıger		Project No: Coordinates:	NL20029/S2			Logged Shear Va	By: ane No - C	STL alibration D	ate: GEO1	050 - 3/12/2020
	Date Date	e Starte e Finish	d: 9/1 ed: 9/1	2/20 2/20			Ground Elevation: Water Level:	Not Encountered			Surface	Conditions	: Moder	ately Slope	Grass
	STRATIGRAPHY	DEPTH (m)	GRAPHIC LOG	Soil "C	descript Guideline	ion in accorda Societ s for Field De Engine	ance with the N y Inc 2005 scription of So sering Use"	NZ Geotechnical bil and Rock in	MATER LEVEL (m)	DEPTH (m)	SCALA NZS:444 (Blows p 1 SHEAR REMOL	PENETRC 02:1986 te: ber 100mm 10 2 STRENGT JLDED SHI	METER TE st 6.5.2 Increment) 20 (TH EAR	ST 30 (Blows) ○ v ⊙ r 50 ((P2))	LABORATORY TESTS
┢	ю	0.0	<u>ZUN</u> <u>ZUN</u>	SIL	T, minor	fine sand, gre	y brown, very	stiff, dry, non plastic	: -	0.0					
-	-	_	$ \begin{array}{c c} & & \\ & \times & \times \\ & & \times & \times \\ & & & \times & \times$	SIL ⁻	T, minor to slight	clay, light gre ly plastic (ALL	y orange, very UVIAL DEPO	v stiff, dry to moist, OSITS)	_	-					
	٩	<u>0.5</u>	× × × × × × × × × × × × × × × × × × ×	clay moi	ey SILT, st, mode	trace fine sar	nd, light grey o	prange, very stiff,		 0.5				0177	V
	SROU	_			,	51				-					
	NGA 0	_	^ <u>~</u> ~^; *_* *;							-					
	URAN	<u>1.0</u>								<u>1.0</u>			018	33 V	-
	TA	_	$\times \frac{\times}{\times} \times \frac{\times}{\times}$							-	- · · · · · · · · · · · · · ·				
		_	- ×							-					
		<u>1.5</u>	× × × × × × × × × × × × × × ×	SIL	T, minor aks, verv	fine sand, mir / stiff, moist, r	nor clay, light v ion to slightly i	white grey, orange plastic		<u>1.5</u>			0	142 V	-
		_	×××	(WE min	EATHER or to son	ED MANGAK	AHIA CŎMPĹ lium sand, trao	EX SOILS) ce clay, non plastic		-					
	NOH	_								-					
	LOCT	<u>2.0</u>	× × × × × ×							<u>2.0</u>			•	148 V	
	ND AL	_	× × × × ×	SIL	T, trace t	o minor clay, vith pinkish re	trace to minor	fine sand, light	_	-					
	THLA	 2.5		plas	stic		a, vory can to								207 ∨
	NOR	_	\times \times \times \times \times \times							-					
/21		_	× × ×	pink	tish red	nk with ninkist	red			-					
DT 5/2		3.0	× × × × × ×	iigii	r gi oʻj pii					<u>3.0</u>					200+ UTP V
2013.G		_		END (TOC	OF BOF D HARD	RE. 3.00 MET TO AUGER)	TRES.			-					
L S+R		_								-					
020.GP		<u>3.5</u>								<u>3.5</u>					-
8.12.2		_								-	- · · · · · · · · · · · ·				
AH17		_								-					
AH01 -		<u>4.0</u>								<u>4.0</u>					
0029		_								-					
LA NL		_								-					
TH SCA		<u>4.5</u>								<u>4.5</u>					
UM DO		_								-					
GERL										-					
ND AU		<u>5.0</u>								<u>5.0</u>					-
₹L															

			-	CLIENT: Evo Land Lt	d c/- Cato Bolam Co	onsul	tants		Aug	er Hole	No: PZC	1
	So	Il&ROCK Your responsive &	Consultants & cost-effective engineers	PROJECT: Geotechnica Kauri	al Investigation, 158	Vine	egar ⊢	lill Road	, She	et 1	of 1	
Dril	I Type:	50n	nm Hand Auger	Project No:	NL20029/S2			Logged I	By:	DEG		
Dril	led By:	DE(G 2/20	Coordinates:				Shear Va	ane No - Ca	alibration Da	ate: GEO21 Dom	99 - 2/10/2020
Dat	e Finish	ed: 8/12	2/20	Water Level:	3.7m 8/12/2020			Gunado	Jonations.	100 01	Dam	
IGRAPHY	TH (m)	HIC LOG	Soil descript	ion in accordance with the N Society Inc 2005	Z Geotechnical	(m) TEVEL (m)	(m) HTc	SCALA NZS:440 (Blows p	PENETRO 02:1986 tes er 100mm 0 2	METER TE st 6.5.2 Increment) 20 3	ST o 0 (Blows)	RATORY ESTS
R	ЦЩ Ц	ZAF	Guideline	Engineering Use"		LER	DEF	SHEAR REMOU	STRENGT	H EAR	Ov ⊙r	ABO T
ST		Ū				NA ⁻		5	0 1	00 11	=0 (kDa)	Ľ
	0.0		fine sandy S	ILT, light grey, hard, dry, non	plastic (FILL)		0.0					
	-		fine sandy S light grey ye plastic	SILT, SILT, some clay, clayey llow, orange, very stiff, moist,	SILT, intermixed, non to moderately		-	20 5	62 \/			
	0.5		silty CLAY. t	race fine sand, some inclusio	n of SILT. some		0.5	23				
			clay, trace fi grey brown, moist to wet	ne to coarse sand, light grey, stiff, moist, moderately plasti	orange, yellow, c							
	_		SILT, some	clay, minor fine to coarse sar	nd, brown, grey		_					
	<u>1.0</u>		silty CLAY. I	ight orange brown, stiff, mois	t. moderately	-	<u>1.0</u>	43 r	0 ⁸	9 V		
	-		plastic		.,		_					
	-		of fine sand angular grav	y SILT, clayey SILT, trace fine /el, yellow, orange, grey brow slightly plastic	n, brown, stiff,		_					
FILL	<u>1.5</u>		SILT, some inclusions of grev. stiff, m	clay to clayey, minor fine to c f SILT some fine sandy, mino oist to wet, slightly to modera	oarse sand, some r clay, grey, brown tely plastic		<u>1.5</u>	29 r 				
			some satura	ated pockets, water seepage	6mmØ							
	<u>2.0</u>		clayey SILT, clay, grey, b moderately	, minor fine sand, intermixed v rown grey, orange brown, ver plastic	with SILT, some y stiff, moist,		 2.0	36 r_		⊖ ^{108 V}		
	-						_					
	_		SILT, some grey with ye to moderate	clay to clayey, some fine to c llow light grey mottles, stiff, m ly plastic	oarse sand, brown loist to wet, slightly		_					
	<u>2.5</u>		grey brown,	orange, yellow			<u>2.5</u>	58	• r	0 ^{118 V}		
			clayey SILT, moist, mode	, trace fine sand, yellow, light rately plastic	orange, very stiff,		_					
1.7/7/9	_		SILT, some SILT, inclusi stiff, moist, s	clay, minor fine to medium sa ions to 6mmØ, grey brown, bi slightly platic	and, minor clayey rown, yellow, very		_			404.14		
	<u>3.0</u>		SILT, some very stiff, mo	clay, minor fine sand, organic bist, slightly plastic	c stained brown,		<u>3.0</u>	52		9 ^{101 V}		
		× <u> </u>	water seepa	ige	modium opqulor	/						
Υ 2 2	-	× <u> </u>	gravel, light	yellow grey, grey, very stiff, w	vet, moderately		_					
J.GPJ	3.5	×	plastic (WE	ATHERED MANGAKAHIA CO	DMPLEX SOILS)	2/202	3.5	43 r_		 98 V		
	_	× * ×)	stiff			8/1						
HOH	_	× × ×	some clay to	o clayey, minor fine sand, trac	e fine gravel, white	$\underline{\nabla}$	_					
	-	$\frac{\times}{\times} \frac{\times}{\times}$	plastic	ome orange mottles, slightly to	o moderately		_					
	4.0	- x - x x - x	saturated				4.0	29 r	_8(v		
HLAND	-	× × × × × × × × ×	SILT, some light yellow (clay, minor fine sand, minor f grey, grey, very stiff, wet, moo	ine angular gravel, lerately plastic		_					
RTF	-	× 、×					_					
NO	4.5	\times \times \times \times \times \times	some fine sa	and, some blue green streaks	;		4.5	58	r	115 V		
НSГ		××	SV reading	overestimated by gravel					•			
	-	\hat{x}	no gravel, v	ery stiff			_					
JGER LO		× × × × × × × × × × × × × × × × × × ×	some fine to	medium angular gravel			-	<u>46 г</u>		118 \/		
	5.0	× >	END OF BOI (TARGET DE	RE. 5.00 METRES. EPTH)			<u>5.0</u>	+01				



		110 D	0	CLIENT: Evo Land Ltd C/- Cato Bolam (Consi	ultants	;	Auge	r Hole N	lo: WW	/01
	S	Your responsive t	CONSUITANTS & cost-effective engineers	PROJECT: Geotechnical Investigation, 15 Kauri	8 Vin	egar H	lill Road,	Sheet	t 1 c	of 1	
Dr	ll Type:	50r	mm Hand Auger	Project No: NL20029/S2			Logged By	/: No. No. Calik	CSH pration Dat	ko:	
Da	te Starte	ed: 9/1	2/20	Ground Elevation:			Surface Co	onditions:	Sloping,	Grass	
Da	te Finish	ned: 9/1	2/20	Water Level: Not Encountered	-	1					
GRAPHY	(m) H ⁻	IIC LOG	Soil descript	tion in accordance with the NZ Geotechnical Society Inc 2005	EVEL (m)	(m) H ⁻	SCALA PI NZS:4402 (Blows pe 10	SCALA PENETROMETER TEST NZS:4402:1986 test 6.5.2 (Blows per 100mm Increment) 10 20 30 (Blows)			ATORY STS
STRATI	U E I <td>TRENGTH DED SHEAI</td> <td>R</td> <td>Ov ⊙r</td> <td>LABOR TE</td>							TRENGTH DED SHEAI	R	Ov ⊙r	LABOR TE
	0.0	$\frac{1}{2\sqrt{12}} = \frac{1}{2\sqrt{12}} = \frac{1}$	SILT, minor 1mmØ, stiff,	fine to medium sand, grey, trace roots up to , dry, non plastic (TOPSOIL / FILL)		0.0	50	100	150	0 (kPa)	
FILL	-		SILT, minor speckles, fir	fine to medium sand, light grey with orange m, dry to moist, non plastic (FILL)		_					
	1 -	× × ×	SILT, some	clay, trace fine to medium sand, orange, slightly	'	_					
	0.5			OVIAL DEL OSITO)		<u>0.5</u>					
	-	× × × × × × × × × × × × × × × × × × ×				_					
GROUP	-					_					
RANGA	_		some clay to	o clayey, light orange with light orange streaks, oderately plastic		_					
TAU	-	× × × × × × × × × × × × × × × × × × ×	minor fine s	and		_					
51	1.0	× × ×				<u>1.0</u>					
2013.GDT 5/2/	_					_					
GPJ S+R		× >	END OF BOI TARGET DE	RE. 1.20 METRES. PTH		_					
9.12.2020		-				_					
OGS											
E-WATER-L	1.5	-				<u>1.5</u>					
9_ WASTE	-	_				_					
LA NL2002	-	-				-					
WITH SCA	-	-				-	.				
100	-					-	-				
UGER	2.0					2.0					
HAND A											

		Ormanitanta	CLIENT: Evo Land Ltd C/- C	Auger Hole No: WW02						
	Your responsive	CONSUITANTS & cost-effective engineers	PROJECT: Geotechnical Inves Kauri	tigation, 158 Vi	negar	Hill Road,	Sheet 1	of 1		
	rill Type: 50 rilled By: JF ate Started: 9/ ate Finished: 9/	0mm Hand Auger 5 12/20 12/20	Project No: NL200: Coordinates: Ground Elevation: Water Level: Not En	29/S2 countered		Logged B Shear Var Surface C	y: JP ne No - Calibratio onditions: Ne	n Date: GEO24 ar Level, Grass	418 - 2/09/2020	
ATIGRAPHY	EPTH (m) APHIC LOG	Soil descript	tion in accordance with the NZ Geoto Society Inc 2005 es for Field Description of Soil and R	echnical	EPTH (m)	SCALA P NZS:4402 (Blows pe 10 SHEAR S	ENETROMETER 2:1986 test 6.5.2 er 100mm Increm 20 STRENGTH	SNETROMETER TEST 1986 test 6.5.2 100mm Increment) 20 30 (Blows)		
STR	D R		Engineering Use		REMOUL	DED SHEAR	⊙ r 150 (kPa)	LAE		
TS	$\frac{1}{\frac{1}{2}} \frac{1}{\frac{1}{2}} $	SILT, some	fine sand, brown, very stiff, dry (TOF	PSOIL)	0.0					
		SILT, some non plastic (SOILS)	fine sand, orange brown, very stiff, f WEATHERED MANGAKAHIA COM	nard, dry, IPLEX						
ALLOCTHON		SILT, minor fine angular	to some clay, minor fine to medium gravel, very stiff, moist, non to sligh	sand, trace tly plastic	<u>0.</u>	5				
		SILT, minor speckles, ve	clay, minor fine to medium sand, ora	ange, white	<u>1.</u>					
AUGER LOG WITH SCALA NL20029_WASTE-WATER-LOGS_9.12.2020.GPJ S+R_2		END OF BOI TARGET DE	RE. 1.20 METRES. PTH		1.	5				

	Soil&Bock Consultants				CLIENT:	Aug	Auger Hole No: WW03							
Drill Type: 50mm Hand Auger				SUNSUNAINS cost-effective engineers	PROJECT:	She	et 1	of 1						
Drill Type: 50mm Hand Auger Drilled By: JP					Project No: NL20029/S2 Logged By							JP		
	Date Sta	by. arted	. 9/12	/20	G	round Elevation:			Shear Vane No - Calibration Date: GEO2418 - 2/09/20 Surface Conditions: Slightly Sloping, Grass					
1	Date Fir	nishe	d: 9/12	/20	W	ater Level:	Not Encountered							
TIGRAPHY		(ш) ні л	PHIC LOG	Soil descript "Guideline	ion in accordan Society s for Field Dese	on in accordance with the NZ Geotechnical Society Inc 2005					PENETRO 02:1986 tes er 100mm 0 2	JRATORY 'ESTS		
TRA		5	BRA		Enginee	TEF	DE	REMOU	LDED SHE	AR	⊙r	ABG		
, vi) (0.0	0			Ŵ	0.0	5	0 10	00 1	50 (kPa)			
TOPSOIL				SILT, some (TOPSOIL)	fine sand, grey	brown, very s	tiff, dry, non plastic		_					
		>		SILT, some dry, non plas	fine sand, trace stic (ALLUVIAL	clay, orange DEPOSITS)	with grey, very stiff,							
		^>							_					
		>	$\begin{array}{c c} \times & \times \\ & \times \end{array}$	SILT, minor dry to moist,	to some clay, n non plastic	ninor fine sand	d, orange, very stiff,	-	_					
	(0.5	×××	minor clay, r	noist, non to sli	ghtly plastic			0.5					
4		>	λ											
		->	$\begin{pmatrix} \times & \\ \times & \end{pmatrix}$											
d	5	>	× × +	minor to son	ne clay, minor f	ine to medium	n sand, slightly							
U N		' 	× Ŷ	plastic										
IR/		>	×××						_					
TA	:	>		some clay										
			$\langle \times \rangle$		turne firme and	. l'alat anav an		_	_					
		>	<u>× ~</u> }	moist, mode	rately plastic	i, light grey of	ange, very sun,							
5		<u>1.0</u>	× × ,						1.0					
5/2/2		>	~~~,											
GDT			` <u>~</u> `}											
2013.		>	× × ×											
<u>ч</u>		>	< <u> </u>	END OF BO	RE. 1.20 METE	RES.		-						
GPJ				TARGET DE	PTH									
2020		-							_					
9.12														
JGS									_					
ER-L(1.5							<u>1.5</u>					
-WAT														
ASTE		_							_					
Š														
2002		-							_					
A N														
SCAL		-						_						
MTH														
log		-							_					
GER														
D AU		2.0							<u>2.0</u>					
NAH														

Soil&Rock Consultants						d C/- Cato Bolam (Consultants Auger Hole No: W						V04	
		Sol y	W KOCK	CONSUITANTS & cost-effective engineers	PROJECT:	Geotechnica Kauri	al Investigation, 15	8 Vine	egar ⊦	lill Road	l, She	et 1	of 1	
	Drill Drille	Type: ed By:	50n JP	nm Hand Auger	Pr	roject No: oordinates:	NL20029/S2			Logged Shear V	By: ane No - Ca	JP alibration D	ate: GEO24	418 - 2/09/2020
	Date Date	e Started e Finishe	l: 9/12 ed: 9/12	2/20 2/20	Gi W	round Elevation: /ater Level:	Not Encountered			Surface	Conditions:	Slightly	y Sloping, G	rass
A B A B B B C <th colspan="5">n accordance with the NZ Geotechnical Society Inc 2005</th> <th>PENETRO 02:1986 tes per 100mm 10 2</th> <th>METER TE ti 6.5.2 Increment)</th> <th>ORATORY TESTS</th>						n accordance with the NZ Geotechnical Society Inc 2005					PENETRO 02:1986 tes per 100mm 10 2	METER TE ti 6.5.2 Increment)	ORATORY TESTS	
	A B <td>ATEI</td> <td>DE</td> <td>REMOL</td> <td>JLDED SHE</td> <td>AR</td> <td>⊙r</td> <td>LAB(</td>							ATEI	DE	REMOL	JLDED SHE	AR	⊙r	LAB(
-	0,	0.0	<u>x11</u> x. <u>x11</u> x.	SILT, some	fine sand, brow	n, very stiff, d	ry, non plastic	3	0.0	<u></u>	50 10	00 1	50 (kPa)	
	TOPSOIL		<u>17 18 18 18</u> <u>18 17 18 18</u> <u>18 18 18 18</u>	(TOPSOIL)					_					
		;	× × × × × × × × × × × × × × × × × × ×	SILT, minor gravel, oran plastic (WEA	clay, some fine ge with light gre ATHERED MAN	to medium sa ey, very stiff, d NGAKAHIA CO	and, trace fine ry, non to slightly DMPLEX SOILS)		_					
		; ;	× × × × × × × × × × × × × × × × × × ×	for 80mm; s	ome clay, slight		_							
	_	<u>0.5</u>	× × ×	moist					<u>0.5</u>					
	THON	;	^ × ^ > × × × >											
	TOC	:	× × × × ×											
	ND AL	_;	× × × × × ×											
	RTHLA	-;	\times	dark orange	streaks				_					
	Z	: ;	× × × × ×	—			_							
			×	dark orange	STREAKS									
2/21		<u>1.0</u>	× × × × × × × × × × × × × × × × × × ×						<u>1.0</u>					
2013.GDT 5/		;	^ × ^ > × × × > × × × >						_					
S+R S			<u>^ x ^ x</u>	END OF BOF	RE. 1.20 METF	RES.		_	_					
2.2020.GPJ		_		TARGET DE	PTH				_					
0GS_9.1		_							_					
ATER-L		<u>1.5</u>							<u>1.5</u>					
STE-W														
4W														
NL2002		_					_							
TH SCALA		_					_							
LIM DC						_								
GER L(
		2.0							<u>2.0</u>					
ÌΪ											I			





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 info@soilandrock.co.nz www.soilandrock.co.nz

SCALA PENETROMETER SHEET - TABLE OF BLOWS PER INCREMENT

JOB NO: NL20029/S2

TESTED BY: CsH/STL/NN/JP/DEG

JOB NAME: 158 Vinegar Hill Road-Kauri

DATE: 8/12/2020

Depth of Penetration [mm]	AH03a	AH03b	AH04	AH11	Cont	AH12	AH13	AH14	AH15		
DEPTH STARTIM	5.00	5.00	5.00	5.00	7 00	5.00	5.00	4 20	3.00		
50 mm	4	20+	2	11	10	0.5	4	3	2		
100	2	20	2	18	10	0.5	6	3	3		
150	4		2	7	10	1	20+	4	8		
200	3		3	4	10	1		4	8		
250	1		3	4		1		4	7		
300	2		4	4		2		4	13		
350	1		4	4		2		4	10		
400	3		5	4		2		4	8		
450	3		6	5		2		5	9		
500	4		5	6		2		5	8		
550	4		6	5		3		5	8		
600	4		6	5		2		5	9		
650	3		7	4		3		6	14		
700	3		7	6		4		6	20+		
750	3		6	6		4		8			
800	3		5	5		4		8			
850	3		5	5		4		8			
900	3		6	6		9		8			
950	3		8	5		7		8			
1000	5		9	5		8		8			
1050	5		10	5		9		7			
1100	5		10	8		9		8			
1150	5		11	7		10		8			
1200	6		11	7		10		8			
1250	6		11	7		10		9			
1300	7			7		11		8			
1350	9			7		12		8			
1400	9			9				9			
1450	9			5				8			
1500	10			7				10			
1550	12			7				11			
1600	20+			8				12			
1650				7				12			
1700				7				12			
1750				10							
1800				7							
1850				8							
1900				8							
1950				7							
2000				10							
DEPTH END [m] 🛛 🗭	6.60	5.05	6.25	7.00	7.20	6.35	5.15	5.90	3.70		

Testing Method: NZS 4402:1988 Test 6.5.2 Dynamic Cone Penetrometer



Appendix C

Slope Stability Results

















