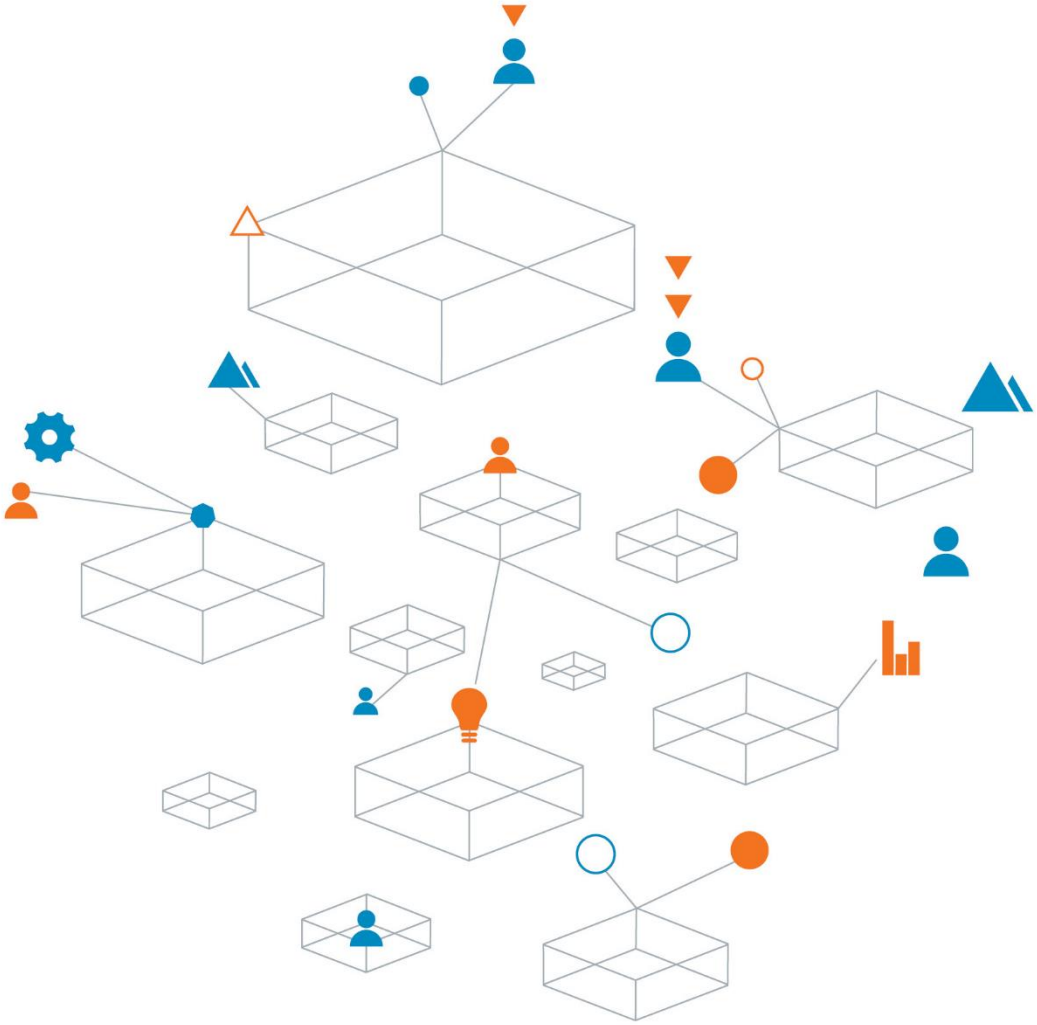
Waikato Building and Construction Limited
106 Elmwood Road, Aongatete

773-TRGGE232725-AA

Geotechnical Assessment Report

5 September 2019



Trust is the cornerstone of all our projects

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Quality information

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Appendices

1. INTRODUCTION

Further to your request, Coffey Services (NZ) Limited (Coffey) has completed a geotechnical assessment into the subsurface conditions for the building platforms at 106 Elmwood Road, Aongatete. The assessment has been completed in accordance with the short-form agreement signed on 31 July 2019.

This report has been prepared to summarise the existing site conditions, present the results of a site investigation and discusses the investigation findings with respect to the new building platforms supporting a proposed dwelling and detached shed. This document has been prepared to support a building consent application to the Western Bay Of Plenty District Council (WBOPDC).

2. SITE DESCRIPTION

The proposed site is a triangularly shaped block of land west of Elmwood Road. It is legally defined as Lot 1 DPS 969 and has a total area of approximately 3.1 hectares.

The site layout and contours are shown on Figure 1 and Figure 2 in Appendix A. The topography comprises gently sloping ground across much of the property, with a small narrow watercourse traversing the southern portion of the property and further watercourses bordering the property boundary in places. In the vicinity of the proposed dwelling and garage, the building platforms are positioned within a slightly elevated ridgeline orientated in a northeast-southwest direction.

The existing property comprises avocado and other fruit trees through much of the site with various structures in the western extent of the property. The property is bounded by Esdaile Road (paper road) to the east, with farms and orchards encompassing the remainder of the property.

3. PROPOSED DEVELOPMENT

From discussions with Claudia Dreschler (site owner) and Heartland Homes (Waikato Building and Construction Limited), it is understood that a 115m^2 timber-clad dwelling founded on timber piles is proposed with the detached garage found on a concrete slab / slab on grade. At the time of writing, concept plans have been provided to Coffey confirming the above.

The proposed designated dwelling and shed building platform locations, for which our investigation and analyses have focused on, was marked out onsite by the client and has been reproduced on Figures 1 and 2.

We understand that the proposed residential development will, subject to council approval, dispose of stormwater along one of the watercourses within or bordering the property. Discharge of wastewater is being designed by others.

4. DESKTOP STUDY

We have reviewed available published and on-line information for the subject site. The sources used for this desktop study have included the following sources:

- Published geological maps;
- The Institute of Geological and Nuclear Sciences (IGNS) online geological map & active faults database;
- The Western Bay of Plenty online geographic information system (GIS) - MAPI;
- The Western Bay of Plenty Lifelines Engineering Study regional earthquake and liquefaction risk assessment[1]; and
- Historical Google Earth images.

5. GROUND INVESTIGATIONS

The subsurface investigations carried out on site are as follows:

- Three hand-auger boreholes (HA01-HA03) to a maximum depth of 5.0m with the boreholes located within or near the extents of the proposed dwelling building footprint;
- Two hand-auger boreholes (HA07 & HA08) to a maximum depth of 3.2m with the boreholes located near the extents of the proposed garage building footprint;
- Three hand-auger boreholes (HA04-HA06) to a maximum depth of 2.4m with the boreholes located beyond the proposed dwelling and garage footprints; and
- A site walkover by an Engineering Geologist to assess geomorphology and identify any other points of interest.

In-situ undrained shear strength measurements were taken within the boreholes using a 'Pilcon' shear vane. The locations of the investigations are shown on Figure 2. Borehole logs are provided in Appendix B.

6. GEOLOGICAL MODEL

6.1. Published Geology

The geological map[2] of the area indicates that the property is underlain by the Tauranga Group alluvium comprising of "pumice, crystal and ash-rich sediments reworked from middle Quaternary ignimbrites" and "alluvial and colluvial gravel and sand dominated by pumice clasts, silt and clay with local peat beds".

[1] Opus International Consultants Ltd, '*Western Bay of Plenty Lifelines Engineering - Microzoning for Earthquake Hazards for the Western Bay of Plenty'*, 2003.

[2] Leonard, G.S., Begg, J.G., Wilson, C.J.N (compilers) 2010. Geology of the Rotorua area. Institute of Geological & Nuclear Sciences 1:250 000 geological map 5. Lower Hutt, New Zealand. GNS Science.

6.2. Investigation Findings

The soils and geological units encountered in our site investigations are generally consistent with the published geology discussed, consisting dominantly of cohesive soils (excluding local peat beds). The main soils observed within the extents of the dwelling and garage building footprints consisted of the following:

Topsoil and Fill – A 50-200mm thick layer of topsoil was encountered in all Coffey hand auger boreholes within the extents of the dwelling and garage building footprints. This topsoil was underlain by shallow non-engineered fill of approximately 200-550mm thickness in hand auger boreholes HA02, HA03, HA07 & HA08. Peak undrained shear strength measurements were undertaken in the fill, recording values between 68kPa to 141kPa.

Alluvial Deposits / Matua Subgroup – Encountered in hand auger boreholes HA01-HA03 and HA07-HA08, and extending to the base of the boreholes, the above geological units are underlain by alluvial soils consisting dominantly of silty clays and clayey silts with varying strengths observed in the hand auger boreholes. Peak undrained shear strengths ranged from 31kPa to greater than 178kPa.

6.3. Groundwater

With exception to hand auger borehole HA08, standing groundwater was recorded in hand auger boreholes within the extents of the dwelling and garage building footprints at depths ranging between 1.4mbgl to 2.2mbgl.

7. GEOTECHNICAL EVALUATION

7.1. Slope Stability

Following a qualitative assessment of the gently sloping ground in the vicinity of the proposed development, the slope gradients have been approximated at no greater than 1V:10H.

Based on our experience of similar slopes and soils, we consider the soils and gently sloping ground in the vicinity of the proposed building platform to be sufficiently stable in the long term.

7.2. Seismic Liquefaction

Cyclic liquefaction is a phenomenon in which loose, saturated, cohesionless soils are subject to temporary loss of shear strength due to porewater pressure build-up during earthquake shaking. Liquefaction may manifest at the ground surface as ‘sand boils’, vertical settlement and horizontal ground deformations (i.e. lateral spreading).

Soils most susceptible to liquefaction are clean, loose, saturated, uniformly graded fine-grained sands. Empirical evidence however shows that loose silt and some clay materials can experience similar phenomena.

The Western Bay of Plenty Lifelines Engineering Study notes that the soils in the area are subject to ‘Widespread Liquefaction’. However, the alluvial deposits that underlie the proposed development are notably absent of significant granular soils in the upper 3-5m profile and instead silty clay and clayey silt soils in the upper 3-5m depth was observed, limiting liquefaction to cyclic softening and reducing the effects of liquefaction observed at the ground surface.

It is anticipated that Ultimate Limit State liquefaction effects on the proposed Importance Level 2 (IL2) dwelling may be managed by relevelling of the piled foundations. Serviceability Limit State Liquefaction is assessed as negligible.

7.3. Lateral Spreading

Lateral spreading is a form of ground movement that can occur on relatively gentle slopes or on virtually flat ground adjacent to bodies of water. Lateral deformations are developed from both cyclic and static shear stresses and the accompanying reduced strength in soils affected by liquefaction. Movements mainly occur during shaking or may continue for some time after shaking has stopped until excess pore pressures generated during liquefaction dissipate.

There is a narrow and shallow watercourse (open drain) to the east and south-east of the proposed development, approximately 35-40m away from the closest edge of the proposed building footprints.

Due to the horizontal distance and size of free face however, in combination with the specific foundation design (as detailed in Section 7.6), the risk of lateral spreading is assessed to be minimal.

7.4. Static Settlement

Settlements can occur where organic or compressible soils are subjected to static loading, e.g. by filling and/or building loads. To assess the potential settlement of the alluvial soils and Matua Subgroup that underlie the site, a qualitative assessment of load-induced settlements as a result of possible building loads has been undertaken.

While some static settlement can be expected, the recommendations given in Section 7.6 will address the risk of load induced settlement on the proposed dwelling and garage.

It should be noted that the structures are both recommended to be entirely within cut ground and no fill placement (aside from what is discussed in Section 7.6) is permitted within the zone of influence of the proposed dwelling and garage.

7.5. Other Natural Hazards

The Western Bay of Plenty District Plan show that the proposed building platforms are not located within areas of possible flooding. The site is however near the zone of possible future coastal inundation which includes areas susceptible to storm surge or sea level rise.

The Institute of Geological and Nuclear Sciences active faults database shows no known faults in the proximity to the site. The closest known fault is the Kerepehi Fault (#2060), approximately 20km southwest of the site.

7.6. Foundation Design

Due to the variable undrained shear strengths of the non-engineered fill and natural alluvial soils encountered below the proposed building platforms, the soils do not meet the standards of ‘good ground’ as defined by NZS 3604. As such, design recommendations are provided below:

7.6.1. Proposed Dwelling

Coffey recommend either Option A or Option B is adopted to reduce the effects of static settlement, lateral spreading and account for the bearing capacity of the underlying soils. As previously mentioned, for either option, no fill is allowed to be placed within the zone of influence of the proposed dwelling and garage (aside from root ball backfilling described below).

<u>Option A</u>

Before foundation construction, Coffey recommend excavation of the building platform (extending at least 1m beyond the extent of the dwelling footprint) to a depth of 0.4m below existing ground level at the downslope (eastern) extent of the building platform. The cut is to extend horizontally to the upslope (western) extent of the building platform, resulting in a final subgrade level of approximately

3.6m RL across the entire building platform. The cut batters on all sides of the building platform should be no steeper than 1V:1H.

It is anticipated that the proposed excavation will remove root balls from existing trees within the building platform, however any root balls that are still present should be removed and voids backfilled with properly compacted engineered fill.

A subsoil drain, minimum 0.5m below the new cut level at the upslope (western) extent of the cut is to be constructed, with 2% positive flow to daylight at a disposal point clear of the building platform.

Following excavation, Coffey recommend a foundation system similar to a 'Type 1 surface structure foundations – light-weight relevellable platform' as given in the MBIE TC3 Technical Guidance[3] and designed for a geotechnical ultimate bearing capacity (GUBC) of 170kPa. An example of such a foundation system is given in Appendix C.

Option B

Alternatively, should excavation not be desired, Coffey recommend piles extending to 3m below existing ground level, designed for a GUBC of 300kPa. Due to the depth of groundwater, it is recommended that piles are driven. Furthermore, piles should be sufficiently braced as per a Type 1 surface structure (or similar) described above. The pole spacing and footing size will need to be confirmed by a structural engineer.

7.6.2. Proposed Garage

Although no plans have been submitted for the proposed garage, given the likely lightweight nature of the garage, it is anticipated that the proposed concrete slab / slab on grade foundation will be satisfactory for a GUBC of 170kPa, provided that the garage is found entirely in cut. This may require undercut and backfill of existing fill. The undercut and backfill should not exceed 600mm thickness and this may require lowering the foundation elevation of the garage.

8. STORMWATER & WASTEWATER DISPOSAL

We understand that the proposed residential development will discharge wastewater into a new onsite effluent treatment field (designed by others), and that stormwater is to be collected and directed into an open drain (upon Council approval).

The effluent disposal system is to be designed in accordance with the Bay of Plenty Regional Council's On-Site Effluent Treatment Regional Plan 2006.

All concentrated stormwater flows (e.g. from roofs, sealed areas, patios, etc.) should be collected and piped to an appropriate disposal location, such as a Council approved stormwater inlet/ drain.

9. OBSERVATION & TESTING

It is recommended that Coffey are given the opportunity to complete observations during earthworks and foundation excavations.

[3] Ministry of Business, Innovation & Employment. Repairing and rebuilding houses affected by the Canterbury earthquakes, dated December 2012. Part C TC3 Technical Guidance New Foundations (Dated April 2015, Version 3a). Page 15.49 to 15.51. Section 15.4.3 Type 1 surface structure foundations – light-weight relevellable platform.

10. CONCLUSIONS & CLOSING REMARKS

Subject to the construction recommendations described in this report, we consider that the proposed building platform will be geotechnically adequate for the proposed residential development. A statement of professional opinion (Cert 10c) is included in Appendix D.

If development plans are updated so as to differ significantly to those described in Section 3 and the concept plans provided by Heartland Homes, Coffey shall be notified of the changes so that the geotechnical recommendations of this report may be reviewed as necessary.

11. LIMITATIONS

This report has been prepared solely for the use of our client, Waikato Building and Construction Limited, their professional advisers and the relevant Territorial Authorities in relation to the specific project described herein. No liability is accepted by this firm or any of its directors, servants or agents, in respect of its use by any other person, and any other person who relies upon any information contained herein does so entirely at their own risk.

This document should always be read in its entirety and is not to be split for further distribution.

The opinions, recommendations and comments given in this report result from the application of normal methods of site investigation. As factual evidence has been obtained solely from hand auger boreholes, which by their nature only provide information about a relatively small volume of subsoils, there may be special conditions pertaining to this site which have not been disclosed by the investigation and which have not been taken into account in the report.

For and on behalf of Coffey

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BSc(Tech), TCC Category 2 Engineering Geologist

Reviewed by:

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Principal Geotechnical Engineer
BSc, MBA, CE (Calif.), CMEngNZ,
TCC Category 1 Geotechnical Engineer
CPEng No. 1025183

Important information about your **Coffey** Report

As a client of Coffey you should know that site subsurface conditions cause more construction problems than any other factor. These notes have been prepared by Coffey to help you interpret and understand the limitations of your report.

Your report is based on project specific criteria

Your report has been developed on the basis of your unique project specific requirements as understood by Coffey and applies only to the site investigated. Project criteria typically include the general nature of the project; its size and configuration; the location of any structures on the site; other site improvements; the presence of underground utilities; and the additional risk imposed by scope-of-service limitations imposed by the client. Your report should not be used if there are any changes to the project without first asking Coffey to assess how factors that changed subsequent to the date of the report affect the report's recommendations. Coffey cannot accept responsibility for problems that may occur due to changed factors if they are not consulted.

Subsurface conditions can change

Subsurface conditions are created by natural processes and the activity of man. For example, water levels can vary with time, fill may be placed on a site and pollutants may migrate with time. Because a report is based on conditions which existed at the time of subsurface exploration, decisions should not be based on a report whose adequacy may have been affected by time. Consult Coffey to be advised how time may have impacted on the project.

Interpretation of factual data

Site assessment identifies actual subsurface conditions only at those points where samples are taken and when they are taken. Data derived from literature and external data source review, sampling and subsequent laboratory testing are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact on the proposed development and recommended actions. Actual conditions may differ from those inferred to exist, because no professional, no matter how qualified, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions. For this reason, owners should retain the services of Coffey through the development stage, to identify variances, conduct additional tests if required, and recommend solutions to problems encountered on site.

Your report will only give preliminary recommendations

Your report is based on the assumption that the site conditions as revealed through selective point sampling are indicative of actual conditions throughout an area. This assumption cannot be substantiated until project implementation has commenced and therefore your report recommendations can only be regarded as preliminary. Only Coffey, who prepared the report, is fully familiar with the background information needed to assess whether or not the report's recommendations are valid and whether or not changes should be considered as the project develops. If another party undertakes the implementation of the recommendations of this report there is a risk that the report will be misinterpreted and Coffey cannot be held responsible for such misinterpretation.

Your report is prepared for specific purposes and persons

To avoid misuse of the information contained in your report it is recommended that you confer with Coffey before passing your report on to another party who may not be familiar with the background and the purpose of the report. Your report should not be applied to any project other than that originally specified at the time the report was issued.

Interpretation by other design professionals

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, retain Coffey to work with other project design professionals who are affected by the report. Have Coffey explain the report implications to design professionals affected by them and then review plans and specifications produced to see how they incorporate the report findings.

Data should not be separated from the report

The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way. Logs, figures, drawings, etc. are customarily included in our reports and are developed by scientists, engineers or geologists based on their interpretation of field logs (assembled by field personnel) and laboratory evaluation of field samples. These logs etc. should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

Geoenvironmental concerns are not at issue

Your report is not likely to relate any findings, conclusions, or recommendations about the potential for hazardous materials existing at the site unless specifically required to do so by the client. Specialist equipment, techniques, and personnel are used to perform a geoenvironmental assessment. Contamination can create major health, safety and environmental risks. If you have no information about the potential for your site to be contaminated or create an environmental hazard, you are advised to contact Coffey for information relating to geoenvironmental issues.

Rely on Coffey for additional assistance

Coffey is familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to a project, from design to construction. It is common that not all approaches will be necessarily dealt with in your site assessment report due to concepts proposed at that time. As the project progresses through design towards construction, speak with Coffey to develop alternative approaches to problems that may be of genuine benefit both in time and cost.

Responsibility

Reporting relies on interpretation of factual information based on judgement and opinion and has a level of uncertainty attached to it, which is far less exact than the design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded. To help prevent this problem, a number of clauses have been developed for use in contracts, reports and other documents. Responsibility clauses do not transfer appropriate liabilities from Coffey to other parties but are included to identify where Coffey's responsibilities begin and end. Their use is intended to help all parties involved to recognise their individual responsibilities. Read all documents from Coffey closely and do not hesitate to ask any questions you may have.

Appendix A - Figures

INSERT: SITE LOCATION

N

Area Of Investigation, See Figure 2

NOTES:
1. All contours and levels are based on the Western Bay Of Plenty District Council GIS (MAPI). Coffey takes no responsibility for the accuracy of these levels and designers working on this site must confirm levels to their own satisfaction.
2. Contours shown at 1m intervals to Moturiki Datum.

LEGEND

Property Boundary

revision	rev	description	drawn	approved	date
	A	FINAL FOR ISSUE	DBC	DAS	05-Sep-2019
	0	DRAFT FOR INTERNAL REVIEW	DBC	DAS	22-Aug-2019

0 15.0 30.0 45.0
Horizontal Scale (metres)
0 15.0 30.0 45.0
Vertical Scale (metres)

drawn	DBC
approved	DAS
date	05-Sep-2019
scale	1:750
original size	A3

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client: Waikato Building and Construction Limited
project: 106 Elmwood Road Aongatete
title: Site Plan
project no: 773-TRGGE232725 | figure no: 1 | rev: A

15/08/2019F:\1.GENZ\1. TT PROJECTS\232725 106 ELMWOOD ROAD, AONGATETE\7. DRAWINGS\CGL DRAWINGS\WORKING\#232725 SITE PLAN.DWG

NOTES:
1. All contours and levels are based on the Western Bay Of Plenty District Council GIS (MAPI). Coffey takes no responsibility for the accuracy of these levels and designers working on this site must confirm levels to their own satisfaction.
2. Contours shown at 1m intervals to Moturiki Datum.

revision	rev	description	drawn	approved	date
	A	FINAL FOR ISSUE	DBC	DAS	05-Sep-2019
	0	DRAFT FOR INTERNAL REVIEW	DBC	DAS	22-Aug-2019

0 4.0 8.0 12.0
Horizontal Scale (metres)
0 4.0 8.0 12.0
Vertical Scale (metres)

drawn	DBC
approved	DAS
date	05-Sep-2019
scale	1:200
original size	A3

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client: Waikato Building and Construction Limited
project: 106 Elmwood Road Aongatete
title: Geotechnical Investigation Site Plan
project no: 773-TRGGE232725 | figure no: 2 | rev: A

15/08/2019F:\1.GENZ\1. TT PROJECTS\232725 106 ELMWOOD ROAD, AONGATETE\7. DRAWINGS\CGL DRAWINGS\WORKING\#232725 SITE PLAN.DWG

Appendix B – Investigation Data

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Soil Description Explanation Sheet (1 of 2)

DEFINITION:

In engineering terms soil includes every type of uncemented or partially cemented inorganic or organic material found in the ground. In practice, if the material can be remoulded or disintegrated by hand in its field condition or in water it is described as a soil. Other materials are described using rock description terms.

CLASSIFICATION SYMBOL & SOIL NAME

Soils are broadly described in accordance with the Unified Soil Classification System (UCS) as shown in the table on Sheet 2. However, there are some departures from this and reference should be made to the New Zealand Geotechnical Society 'Field Description of Soil and Rock' 2005 for clarification.

PARTICLE SIZE DESCRIPTIVE TERMS

NAME	SUBDIVISION	SIZE
Boulders		>200 mm
Cobbles		60 mm to 200 mm
Gravel	coarse	20 mm to 60 mm
	medium	6 mm to 20 mm
	fine	2 mm to 6 mm
Sand	coarse	600 μm to 2 mm
	medium	200 μm to 600 μm
	fine	60 μm to 200 μm

MOISTURE CONDITION

Dry	Looks and feels dry. Cohesive and cemented soils are hard, friable or powdery. Uncemented granular soils run freely through hands.
Moist	Soil feels cool and darkened in colour. Cohesive soils can be moulded. Granular soils tend to cohere.
Wet	As for moist but with free water forming on hands when handled.

CONSISTENCY OF COHESIVE SOILS

TERM	UNDRAINED STRENGTH s_u (kPa)	FIELD GUIDE
Very Soft	<12	Easily exudes between fingers when squeezed.
Soft	12 - 25	Easily indented by fingers.
Firm	25 - 50	Indented by strong finger pressure & can be indented by thumb pressure.
Stiff	50 - 100	Cannot be indented by thumb pressure.
Very Stiff	100 - 200	Can be indented by thumb nail.
Hard	200 - 500	Difficult to indent by thumb nail.

DENSITY OF GRANULAR SOILS

TERM	DENSITY INDEX (%)	SPT N-value (Blows / 300mm)
Very loose	Less than 15	Less than 4
Loose	15 - 35	4 - 10
Medium Dense	35 - 65	10 - 30
Dense	65 - 85	30 - 50
Very Dense	Greater than 85	Greater than 50

MINOR COMPONENTS

FRACTION	TERM	% OF SOIL MASS	EXAMPLE
Major	(...) [UPPER CASE]	≥ 50 [major constituent]	GRAVEL
Subordinate	(...)y [lower case]	20 - 50	Sandy
Minor	with some... with minor...	12 - 20 5 - 12	with some sand with minor sand
	with trace of (or slightly) ...	< 5	with trace of sand (slightly sandy)

SOIL STRUCTURE

ZONING		CEMENTING	
Layers	Continuous across exposure or sample.	Weakly cemented	Easily broken up by hand in air or water.
Lenses	Discontinuous layers of lenticular shape.	Moderately cemented	Effort is required to break up the soil by hand in air or water.
Pockets	Irregular inclusions of different material.		

GEOLOGICAL ORIGIN

WEATHERED IN PLACE SOILS	
Extremely weathered material	Structure and fabric of parent rock visible.
Residual soil	Structure and fabric of parent rock not visible.

TRANSPORTED SOILS	
Aeolian soil	Deposited by wind.
Alluvial soil	Deposited by streams and rivers.
Colluvial soil	Deposited on slopes (transported downslope by gravity).
Fill	Man made deposit. Fill may be significantly more variable between tested locations than naturally occurring soils.
Lacustrine soil	Deposited by lakes.
Marine soil	Deposited in ocean basins, bays, beaches and estuaries.

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Soil Description Explanation Sheet (2 of 2)

SOIL CLASSIFICATION INCLUDING IDENTIFICATION AND DESCRIPTION

FIELD IDENTIFICATION PROCEDURES (Excluding particles larger than 60 mm and basing fractions on estimated mass)							USC	PRIMARY NAME
COARSE GRAINED SOILS More than 50% of materials less than 60 mm is larger than 0.06 mm	(A 0.06 mm particle is about the smallest particle visible to the naked eye)	GRAVELS More than half of coarse fraction is larger than 2.0 mm	CLEAN GRAVELS (Little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes.			GW	GRAVEL
				Predominantly one size or a range of sizes with more intermediate sizes missing.			GP	GRAVEL
			GRAVELS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below)			GM	SILTY GRAVEL
				Plastic fines (for identification procedures see CL below)			GC	CLAYEY GRAVEL
		SANDS More than half of coarse fraction is smaller than 2.0 mm	CLEAN SANDS (Little or no fines)	Wide range in grain sizes and substantial amounts of all intermediate sizes			SW	SAND
				Predominantly one size or a range of sizes with some intermediate sizes missing.			SP	SAND
			SANDS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below).			SM	SILTY SAND
				Plastic fines (for identification procedures see CL below).			SC	CLAYEY SAND
FINE GRAINED SOILS More than 50% of material less than 60 mm is smaller than 0.05 mm			IDENTIFICATION PROCEDURES ON FRACTIONS <0.2 mm.					
			DRY STRENGTH	**DILATANCY**	**TOUGHNESS**			
		SILTS & CLAYS Liquid limit less than 50	None to Low	Quick to slow	None		ML	SILT
			Medium to High	None	Medium		CL	CLAY
			Low to medium	Slow to very slow	Low		OL	ORGANIC SILT
		SILTS & CLAYS Liquid limit greater than 50	Low to medium	Slow to very slow	Low to medium		MH	SILT
			High	None	High		CH	CLAY
			Medium to High	None	Low to medium		OH	ORGANIC CLAY
HIGHLY ORGANIC SOILS			Readily identified by colour, odour, spongy feel and frequently by fibrous texture.				Pt	PEAT

• Low plasticity – Liquid Limit W_L less than 35%. • Medium plasticity – W_L between 35% and 50%.

COMMON DEFECTS IN SOIL

TERM	DEFINITION	DIAGRAM
PARTING	A surface or crack across which the soil has little or no tensile strength. Parallel or sub parallel to layering (eg bedding). May be open or closed.	
JOINT	A surface or crack across which the soil has little or no tensile strength but which is not parallel or sub parallel to layering. May be open or closed. The term 'fissure' may be used for irregular joints <0.2 m in length.	
SHEARED ZONE	Zone in clayey soil with roughly parallel near planar, curved or undulating boundaries containing closely spaced, smooth or slickensided, curved intersecting joints which divide the mass into lenticular or wedge shaped blocks.	
SHEARED SURFACE	A near planar curved or undulating, smooth, polished or slickensided surface in clayey soil. The polished or slickensided surface indicates that movement (in many cases very little) has occurred along the defect.	

TERM	DEFINITION	DIAGRAM
SOFTENED ZONE	A zone in clayey soil, usually adjacent to a defect in which the soil has a higher moisture content than elsewhere.	
TUBE	Tubular cavity. May occur singly or as one of a large number of separate or inter-connected tubes. Walls often coated with clay or strengthened by denser packing of grains. May contain organic matter.	
TUBE CAST	Roughly cylindrical elongated body of soil different from the soil mass in which it occurs. In some cases the soil which makes up the tube cast is cemented.	
INFILLED SEAM	Sheet or wall like body of soil substance or mass with roughly planar to irregular near parallel boundaries which cuts through a soil mass. Formed by infilling of open joints.	

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Engineering Log - Hand Auger

Borehole ID.	**HA01**
sheet:	1 of 1
project no.	**773-TRGGE232725**
client:	**Waikato Building and Construction Limited**
date started:	**01 Aug 2019**
principal:	
date completed:	**01 Aug 2019**
project:	**106 Elmwood Rd, Aongatete**
logged by:	**DBC**
location:	**See Site Plan**
checked by:	**DAS**

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90°

drill model: | drilling fluid: | hole diameter : 50 mm | vane id.: 2244

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	vane shear (kPa) remoulded / peak	structure and additional observations
HA, N			VS 120/ 45 kPa		0.0			**ORGANIC SILT**: non plastic to low plasticity, black.	M			**TOPSOIL**
			VS 66/ 16 kPa		0.5			**Silty CLAY**: medium to high plasticity, orange brown, with minor pumiceous fine to coarse grained sand.	M	VSt	50 100 150 200	**MATUA SUBGROUP**
			VS 62/ 26 kPa					**Clayey SILT**: medium plasticity, orange brown.	M	St		
			VS 75/ 31 kPa		1.0			**Silty CLAY**: medium to high plasticity, orange brown.	M	St		
		01/08/19, STGW	VS 71/ 14 kPa		1.5			1.2 m: becoming orange brown streaked cream. 1.4 m: standing groundwater. 1.6 m: becoming highly plastic.	M to W			
			VS 65/ 28 kPa		2.0			1.8 m: becoming pale grey streaked orange brown. 1.9 m: groundwater encountered. 2.1 m: becoming moderately to highly plastic, orange brown streaked pale grey.	M			Sample taken at 1.8m. Partially reduced recovery below the water table due to water suction.
			VS 75/ 8 kPa		2.5			2.6 m: becoming highly plastic.	M to W			Sample taken at 2.5m.
			VS 91/ 14 kPa		3.0			**Clayey SILT**: medium plasticity, cream streaked orange brown, with some sand.	M			Sample taken at 3.1m.
			VS 57/ 14 kPa					**Silty CLAY**: medium to high plasticity, orange brown streaked cream, with minor sand.	W	St		
			VS 114/ 24 kPa		3.5			**Clayey SILT**: medium plasticity, pinkish cream.	M	VSt		
			VS >178 kPa		4.0			3.8 m: becoming cream streaked orange brown with some sand.	W			Sample taken at 3.9m.
			VS 145/ 22 kPa					**Sandy SILT**: non plastic, orange brown. 4.4 m: becoming grey.	W	VSt to H		Sample taken at 4.2m. Sample taken at 4.4m.
			VS 109/ 10 kPa		4.5			**SILT**: low plasticity, pale grey, with some clay and minor sand.	W	VSt		Sample taken at 4.7m.
					5.0			Hand Auger HA01 terminated at 5.0 m Target depth				

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- HA hand auger

* bit shown by suffix e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remoulded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- S saturated
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Hand Auger

Borehole ID.	**HA02**
sheet:	1 of 1
project no.	**773-TRGGE232725**
client:	***Waikato Building and Construction Limited***
date started:	***01 Aug 2019***
principal:	
date completed:	***01 Aug 2019***
project:	***106 Elmwood Rd, Aongatete***
logged by:	***DBC***
location:	***See Site Plan***
checked by:	***DAS***

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90°

drill model: | drilling fluid: | hole diameter : 50 mm | vane id.: 2244

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	vane shear (remoulded ⊕ peak ⊙) (kPa) 50 100 150 200	structure and additional observations
HA, N			VS 93/ 10 kPa		0.0			**ORGANIC SILT**: non plastic to low plasticity, black.	M			**TOPSOIL FILL**
								SILT: non plastic to low plasticity, orange brown, with minor clay and some topsoil inclusions.	M			**FILL**
			VS 71/ 16 kPa		0.5			**SILT**: non plastic to low plasticity, orange brown, with minor clay.	M	St	⊕ ⊙	**MATUA SUBGROUP**
			VS 45/ 8 kPa					**Clayey SILT**: medium plasticity, orange brown, with some sand.	M to W	St	⊕ ⊙	
					1.0			**Silty CLAY**: medium to high plasticity, orange brown.	M to W	F	⊕ ⊙	
			VS 36/ 2 kPa					1.1 m: becoming pale grey streaked orange brown with minor sand.	W		⊕ ⊙	
			VS 36/ 4 kPa		1.5			1.3 m: becoming orange brown streaked cream. Sand absent.			⊕ ⊙	
		▽ 01/08/19, STGW	VS 36/ 4 kPa		2.0			1.9 m: with minor sand. 2.0 m: standing groundwater.			⊕ ⊙	
								Clayey SILT: medium plasticity, cream streaked orange brown, with some sand. Groundwater encountered.	S			Partially reduced recovery below the water table due to water suction.
			VS 47/ 4 kPa		2.5			**Silty CLAY**: medium to high plasticity, cream streaked orange brown.	W	F	⊕ ⊙	
			VS 38/ 4 kPa					2.8 m: with minor sand and weakly cemented siltstone clasts.			⊕ ⊙	
			VS 102/ 28 kPa		3.0			**Clayey SILT**: medium plasticity, cream streaked orange brown, with some sand and some weakly cemented siltstone clasts.	W M to W	VSt	⊕ ⊙	
								Silty CLAY: high plasticity, cream.				
					3.5			Hand Auger HA02 terminated at 3.2 m Target depth				
					4.0							
					4.5							
					5.0							

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- HA hand auger

* bit shown by suffix
e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remoulded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description
based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- S saturated
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Hand Auger

		Borehole ID.	***HA03***
		sheet:	1 of 1
		project no.	***773-TRGGE232725***
client:	***Waikato Building and Construction Limited***	date started:	***01 Aug 2019***
principal:		date completed:	***01 Aug 2019***
project:	***106 Elmwood Rd, Aongatete***	logged by:	***DBC***
location:	***See Site Plan***	checked by:	***DAS***

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90°

drill model: | drilling fluid: | hole diameter : 50 mm | vane id.: 2244

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	vane shear (remoulded ⊕ peak ⊙) (kPa) 50 100 150 200	structure and additional observations
HA			VS 68/ 4 kPa		0.0			**ORGANIC SILT**: non plastic to low plasticity, black.	M	St		**TOPSOIL FILL**
								SILT: low plasticity, orange brown, with minor topsoil inclusions.	M			**FILL**
			VS 65/ 4 kPa		0.5			**Silty CLAY**: medium to high plasticity, orange brown mottled cream, with some pumiceous fine to coarse grained sand.	M to W	St		**MATUA SUBGROUP**
			VS 99/ 4 kPa					0.7 m: becoming cream streaked orange brown. Sand absent.				
			VS 69/ 4 kPa		1.0			1.2 m: becoming orange brown streaked cream.				
			VS 53/ 4 kPa		1.5			1.4 m: becoming cream streaked orange brown.				
								1.6 m: with weakly cemented siltstone clasts.	W			
			VS 56/ 4 kPa		2.0			2.2 m: standing groundwater.				
N		01/08/19, STGW	VS 56/ 4 kPa		2.5			2.4 m: becoming highly plastic. Siltstone clasts absent.	M to W			
			VS 46/ 4 kPa					**Clayey SILT**: medium plasticity, orange brown, with some sand. Groundwater encountered.	S W to S	St F to VSt		Partially reduced recovery below the water table due to water suction.
			VS 113/ 22 kPa		3.0			**Silty CLAY**: high plasticity, cream streaked orange brown.				
			VS 114/ 20 kPa		3.5							
			VS 85/ 26 kPa		4.0							
			VS 91/ 26 kPa		4.5			**Clayey SILT**: medium plasticity, orange brown mottled cream, with some sand and some black manganese nodules.	W	St to VSt		
			VS 147/ 33 kPa		5.0			Hand Auger HA03 terminated at 5.0 m Target depth				

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- HA hand auger

* bit shown by suffix
e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remoulded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description
based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- S saturated
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Hand Auger

Borehole ID.	***HA04***
sheet:	1 of 1
project no.	***773-TRGGE232725***
client:	***Waikato Building and Construction Limited***
date started:	***01 Aug 2019***
principal:	
date completed:	***01 Aug 2019***
project:	***106 Elmwood Rd, Aongatete***
logged by:	***DBC***
location:	***See Site Plan***
checked by:	***DAS***

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90°

drill model: | drilling fluid: | hole diameter : 50 mm | vane id.: 2244

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	vane shear ⊕ remoulded ⊙ peak (kPa) 50 100 150 200	structure and additional observations
HA, N			VS 77/ 12 kPa		0.0			**ORGANIC SILT**: non plastic to low plasticity, black.	M			**TOPSOIL FILL**
			VS 54/ 4 kPa		0.5			**Silty CLAY**: medium to high plasticity, orange brown streaked cream.	M	St	⊕ ⊙	**FILL**
			VS >178 kPa					0.7 m: with minor sand.			⊕ ⊙	
			VS 33/ 2 kPa		1.0			**Clayey SILT**: medium plasticity, orange brown mottled cream, with some weakly cemented siltstone clasts.	M to W	VSt to H	⊙	
		01/08/19, GWE							W	F	⊕ ⊙	
			VS 47/ 4 kPa		1.5			**Silty CLAY**: medium to high plasticity, orange brown streaked cream, with some weakly cemented siltstone clasts. 1.2 m: groundwater encountered. 1.3 m: becoming highly plastic, siltstone clasts absent.	S / M to W			
									M to W	F	⊕ ⊙	**BURIED TOPSOIL**
								ORGANIC SILT: non plastic to low plasticity, black. Hand Auger HA04 terminated at 1.7 m Target stratum				
					2.0							
					2.5							
					3.0							
					3.5							
					4.0							
					4.5							
					5.0							

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- HA hand auger

* bit shown by suffix
e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description
based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- S saturated
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Hand Auger

Borehole ID.	**HA05**
sheet:	1 of 1
project no.	**773-TRGGE232725**
client:	**Waikato Building and Construction Limited**
date started:	**20 Aug 2019**
principal:	
date completed:	**20 Aug 2019**
project:	**106 Elmwood Rd, Aongatete**
logged by:	**DBC**
location:	**See Site Plan**
checked by:	**DAS**

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90°

drill model: | drilling fluid: | hole diameter : 50 mm | vane id.: 2244

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	vane shear ⊕ remoulded ⊙ peak (kPa) 50 100 150 200	structure and additional observations
HA / N		Not Encountered	VS 38/ 4 kPa		0.0			**ORGANIC SILT**: non plastic to low plasticity, dark brown.	M			**TOPSOIL FILL**
								Clayey SILT: medium plasticity, cream streaked orange brown, with minor topsoil inclusions.	M to W	F		**FILL**
			VS 38/ 4 kPa		0.5			**Silty CLAY**: medium to high plasticity, cream streaked orange brown.	M to W	F to VSt		**MATUA SUBGROUP**
			VS 54/ 12 kPa					0.7 m: becoming brown orange streaked cream.				Possible fill to base of hand auger borehole.
			VS 36/ 2 kPa		1.0							
					1.5							
			VS 119/ 18 kPa									
			VS 42/ 6 kPa		2.0				W			
			VS 62/ 18 kPa					Hand Auger HA05 terminated at 2.4 m Target stratum				
					2.5							
					3.0							
					3.5							
					4.0							
					4.5							
					5.0							

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- HA hand auger

* bit shown by suffix e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- S saturated
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Hand Auger

Borehole ID.	***HA06***
sheet:	1 of 1
project no.	***773-TRGGE232725***
client:	***Waikato Building and Construction Limited***
date started:	***20 Aug 2019***
principal:	
date completed:	***20 Aug 2019***
project:	***106 Elmwood Rd, Aongatete***
logged by:	***DBC***
location:	***See Site Plan***
checked by:	***DAS***

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90°

drill model: | drilling fluid: | hole diameter : 50 mm | vane id.: 2244

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	vane shear ⊕ remoulded ⊙ peak (kPa) 50 100 150 200	structure and additional observations
HA — N		Not Encountered	VS 174/ 53 kPa		0.0			**ORGANIC SILT**: non plastic to low plasticity, dark brown.	M		⊕ ⊙	**TOPSOIL FILL**
			VS 115/ 18 kPa		0.5			**Clayey SILT**: medium plasticity, orange brown, alternating Silty CLAY, moderately to highly plastic, orange brown.	M	St to VSt	⊕ ⊙	**FILL**
			VS 59/ 12 kPa		1.0			0.6 m: becoming orange brown mottled grey.	M to W		⊕ ⊙	
			VS 56/ 18 kPa		1.5			1.3 m: becoming orange brown streaked grey brown.			⊕ ⊙	
								ORGANIC SILT: non plastic to low plasticity, black.	M to W			**BURIED TOPSOIL**
					2.0			Hand Auger HA06 terminated at 1.6 m Target stratum				
					2.5							
					3.0							
					3.5							
					4.0							
					4.5							
					5.0							

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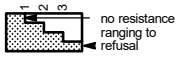
method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- HA hand auger

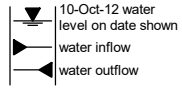
* bit shown by suffix
e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration



water



samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description
based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- S saturated
- Wp plastic limit
- Wl liquid limit

consistency / relative density
- VS very soft
- S soft
- F firm
- St stiff
- VSt very stiff
- H hard
- Fb friable
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense

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Engineering Log - Hand Auger

Borehole ID.	**HA07**
sheet:	1 of 1
project no.	**773-TRGGE232725**
client:	**Waikato Building and Construction Limited**
date started:	**20 Aug 2019**
principal:	
date completed:	**20 Aug 2019**
project:	**106 Elmwood Rd, Aongatete**
logged by:	**DBC**
location:	**See Site Plan**
checked by:	**DAS**

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90°

drill model: | drilling fluid: | hole diameter : 50 mm | vane id.: 2244

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	vane shear (remoulded ⊕ peak ⊙) (kPa) 50 100 150 200	structure and additional observations
HA N					0.0			**ORGANIC SILT**: non plastic to low plasticity, dark brown.	M			**TOPSOIL FILL**
			VS 100/ 28 kPa					**Clayey SILT**: medium plasticity, orange brown, with minor topsoil inclusions.	M	St to VSt	⊕ ⊙	**FILL**
			VS 141/ 28 kPa		0.5			**Silty CLAY**: medium to high plasticity, orange brown.	M		⊕ ⊙	
									M	VSt		
			VS 85/ 28 kPa					**Clayey SILT**: medium plasticity, orange brown, with minor topsoil inclusions.	M	St to VSt	⊕ ⊙	**MATUA SUBGROUP**
			VS 144/ 53 kPa VS >178 kPa		1.0			**Clayey SILT**: medium plasticity, orange brown. 0.9 m: becoming grey brown with minor sand.			⊕ ⊙	
			VS 62/ 22 kPa		1.5			**Silty CLAY**: high plasticity, orange brown streaked cream.	M to W	F to St	⊕ ⊙	
			VS 56/ 16 kPa		2.0			1.9 m: becming pale grey.			⊕ ⊙	
			VS 33/ 4 kPa		2.5			**Clayey SILT**: medium plasticity, orange brown streaked cream, groundwater encountered.	S		⊕ ⊙	
			VS 46/ 8 kPa					**Silty CLAY**: high plasticity, white streaked brown orange.	M to W		⊕ ⊙	
		▽ 20/09/19	VS 50/ 4 kPa		3.0			**Clayey SILT**: medium plasticity, white streaked orange brown, with minor sand.	M to W	F to St	⊕ ⊙	
								Hand Auger HA07 terminated at 3.2 m Target depth				
					3.5							
					4.0							
					4.5							
					5.0							

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- HA hand auger

* bit shown by suffix e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remoulded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- S saturated
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

coffey
A TETRA TECH COMPANY

Engineering Log - Hand Auger

Borehole ID.	**HA08**
sheet:	1 of 1
project no.	**773-TRGGE232725**
client:	**Waikato Building and Construction Limited**
date started:	**20 Aug 2019**
principal:	
date completed:	**20 Aug 2019**
project:	**106 Elmwood Rd, Aongatete**
logged by:	**DBC**
location:	**See Site Plan**
checked by:	**DAS**

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90°

drill model: | drilling fluid: | hole diameter : 50 mm | vane id.: 2244

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	vane shear (remoulded ⊕ peak ⊙) (kPa) 50 100 150 200	structure and additional observations
HA N		Not Encountered	VS 94/ 4 kPa		0.0			**ORGANIC SILT**: non plastic to low plasticity, dark brown.	M			**TOPSOIL FILL**
									M			**FILL**
								Clayey SILT: low to medium plasticity, brown orange streaked cream.	M	St	⊕ ⊙	**MATUA SUBGROUP**
			VS 49/ 2 kPa		0.5			**Clayey SILT**: medium plasticity, cream streaked orange brown. 0.4 m: becoming orange brown streaked cream.	M to W	F to VSt	⊕ ⊙	
			VS 63/ 2 kPa					**Silty CLAY**: medium to high plasticity, cream streaked orange brown.			⊕ ⊙	
			VS 47/ 2 kPa		1.0			1.1 m: with minor sand. 1.2 m: sand absent.			⊕ ⊙	
			VS 31/ 2 kPa		1.5			1.5 m: becoming dark orange brown mottled cream with minor sand. 1.6 m: becoming highly plastic and brown orange. Sand absent. 1.8 m: becoming cream streaked brown orange.	W		⊕ ⊙	
			VS 43/ 2 kPa		2.0						⊕ ⊙	
			VS 109/ 26 kPa		2.5			2.5 m: becoming moderately to highly plastic.			⊕ ⊙	
			VS 31/ 4 kPa					2.7 m: becoming highly plastic and pale grey.			⊕ ⊙	
			VS 45/ 8 kPa		3.0						⊕ ⊙	
								Hand Auger HA08 terminated at 3.2 m Target depth				
					3.5							
					4.0							
					4.5							
					5.0							

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Appendix C - Type 1 Surface Structure

UPDATE:
December 2012

Table 15.5: Surface structure capability summary

	Vertical Land Settlement (SLS)		Lateral Stretch (ULS)	
	<100 mm (Moderate)	>100 mm (Potentially Significant)	<200 mm (Moderate)	<500 mm (Major)
Type 1 – light-weight platform (standard solution) Enhanced NZS 3604 subfloor	Yes	No[1]	Yes	No
Type 2 – underslab platform (standard solution) **Type 2A** – 150 mm underslab on gravel	Yes	No[1]	Yes	Yes
Type 2B – 300 mm underslab on gravel		Up to 200 mm[1]		
Type 3 – concepts for specific design **Type 3A** – Re-levellable platform	Yes	Subject to design	Yes	Yes
Type 3B – Stiff platform				

(1) Unless ground has been improved (refer to section 15.3.4)

15.4.3 Type 1 surface structure foundations – light-weight relevellable platform

This concept utilises normal NZS 3604 piled construction with the exception that the bearers are bolt laminated to ensure continuity along the bearer (Figure 15.15). All the piles are 125 mm square NZS 3604 ordinary timber piles, each fixed to the bearers with four wire dogs and two skew nails. In the event of a lateral spread beneath the floor of up to 200 mm, the outer piles are expected to remain upright, stabilised by the plywood perimeter bracing, and the soil is expected to deform around the pile foundations. The inner piles are expected to rotate about the connection to the bearer and may require replacement or straightening after a significant lateral spreading event. The plywood bracing system is capable of resisting the ULS shaking expected in the Canterbury Earthquake Region.

While the performance under spreading is expected to be better when the spreading is in the direction of the bearers, there is also sufficient bracing in combination with a floor diaphragm to resist spreading in the orthogonal direction.

Depending on the degree of tilt on the inner piles after the earthquake, some piles may need to be replaced. However, the extension of the ground beneath the foundation will cause the piles to tilt in opposing directions, providing a degree of triangulation, which will serve to brace the floor against translation.

Fibre-cement products may be used in lieu of plywood and further information on substitution in this foundation type should be sought from the manufacturers' websites.

DELETION:
December 2012

To provide the best performance in the event of significant liquefaction and/or spreading, several principles are recommended in the layout of the superstructure, where practicable. These include:

- A simple rectangular floor plan is preferred. When the floor length-to-width ratio is greater than two, a central bracing wall should be included.
- If the floor is less than 12 m long and the other (shorter) direction is greater than 6 m then the central plywood bracing wall could be omitted.
- 'L' or 'T'-shaped floors may be constructed (as in Figure 15.15) but the plywood bracing must continue beneath the floor at re-entrant corners for at least 2/3 of the building width along these lines.
- Total floor area limited to approximately 150 m^2.
- Sheet claddings and sheet linings (as opposed to strip linings such as weatherboards, unless underlaid with sheet lining).
- Rooms with an upper size limit (maximum wall spacing of no more than 7 m in the long direction of the room).
- Long wall elements between windows and walls continuous above and beneath windows (ie, a deep beam with holes in it rather than a series of discrete elements).
- Internal cross walls continuous from one side to the other with doorway openings kept to a minimum size.
- A pitched truss roof with the ridge running in the long direction of the house (likely to be the most normal roof construction on a rectangular floor plan).
- Solid connections between the tops of internal walls and the roof framing (helps to mobilise the stiffness of the triangulated roof).
- A 2.7 m stud in lieu of a 2.4 m stud (provides deeper wall panels over doorways and above and below windows).

Figure 15.15: Plan of Type 1 surface structure

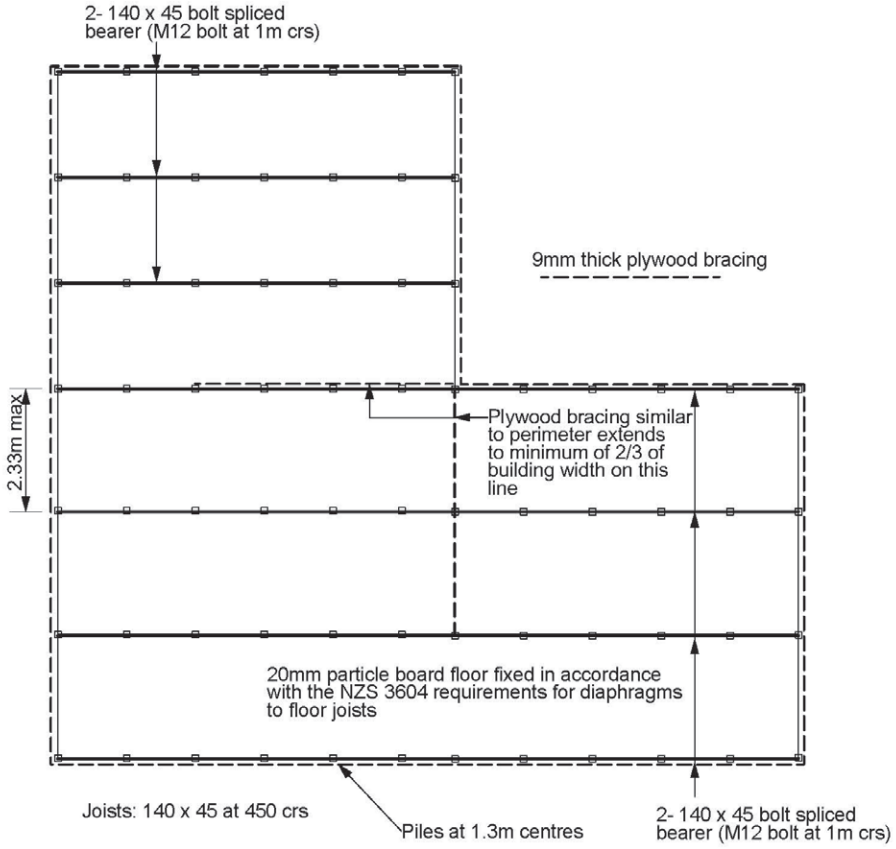
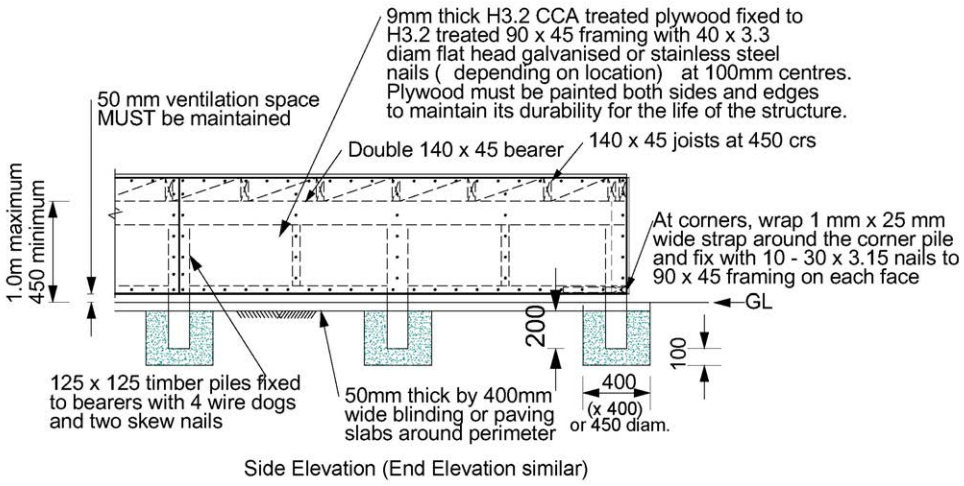


Figure 15.16: Perimeter foundation details for Type 1 surface structure

UPDATE:
December 2012



Appendix D – Suitability Statement

To: Western Bay of Plenty District Council

STATEMENT OF PROFESSIONAL OPINION AS TO THE GEOTECHNICAL SUITABILITY OF LAND FOR BUILDING

Development: —
Owner: CLAUDIA DRESCHLER
Location: 106 ELMWOOD ROAD, AONGATETE
I DAVID CULLEN of COFFEY SERVICES (NZ) LTD
(full name)
96 CAMERON RD, TAURANGA
(name and address of firm)

Hereby confirm that:

1. I am a professional person, appropriately qualified with experience in geotechnical engineering to ascertain the suitability of the land for building development and was retained as the Soils Engineer for the above development.

2. An appropriate level of site investigation and construction supervision has been carried out under my direction and is described in my development evaluation report dated:.....

3. In my professional opinion, not to be construed as a guarantee, I consider that:
   a. The areas shown in my report dated..... of each new allotment or on the development site are suitable for the erection thereon of the building types appropriate to the zoning of the land, provided that:
   THE RECOMMENDATIONS & COMMENTS IN COFFEY REPORT ~~#~~#773-TRGGE232725 ARE FOLLOWED

   b. The completed works give due regard to all land slope and foundation stability considerations.

   c. The earth fills shown on the attached Plan No. N/A have been placed in accordance with the Subdivision and Development Code of Practice of the Western Bay of Plenty District Council.

   d. The filled ground is suitable for the erection thereon of residential buildings not requiring specific design in terms of NZS 3604: 1999 and related documents provided that:
   REFER COFFEY REPORT #773-TRGGE232725-AA

   e. The original ground not affected by filling is suitable for the erection thereon of residential buildings not requiring specific design in terms of NZS 3604: 1999 and related documents provided that:
   REFER COFFEY REPORT #773-TRGGE232725-AA

4. This professional opinion is furnished to the Council and the owner for their purpose alone, on the express condition that it will not be relied upon by any other person and does not remove the necessity for the normal inspection of foundation conditions at the time of erection for any dwelling.

Signed: ..... Date: 05-Sep-2019

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