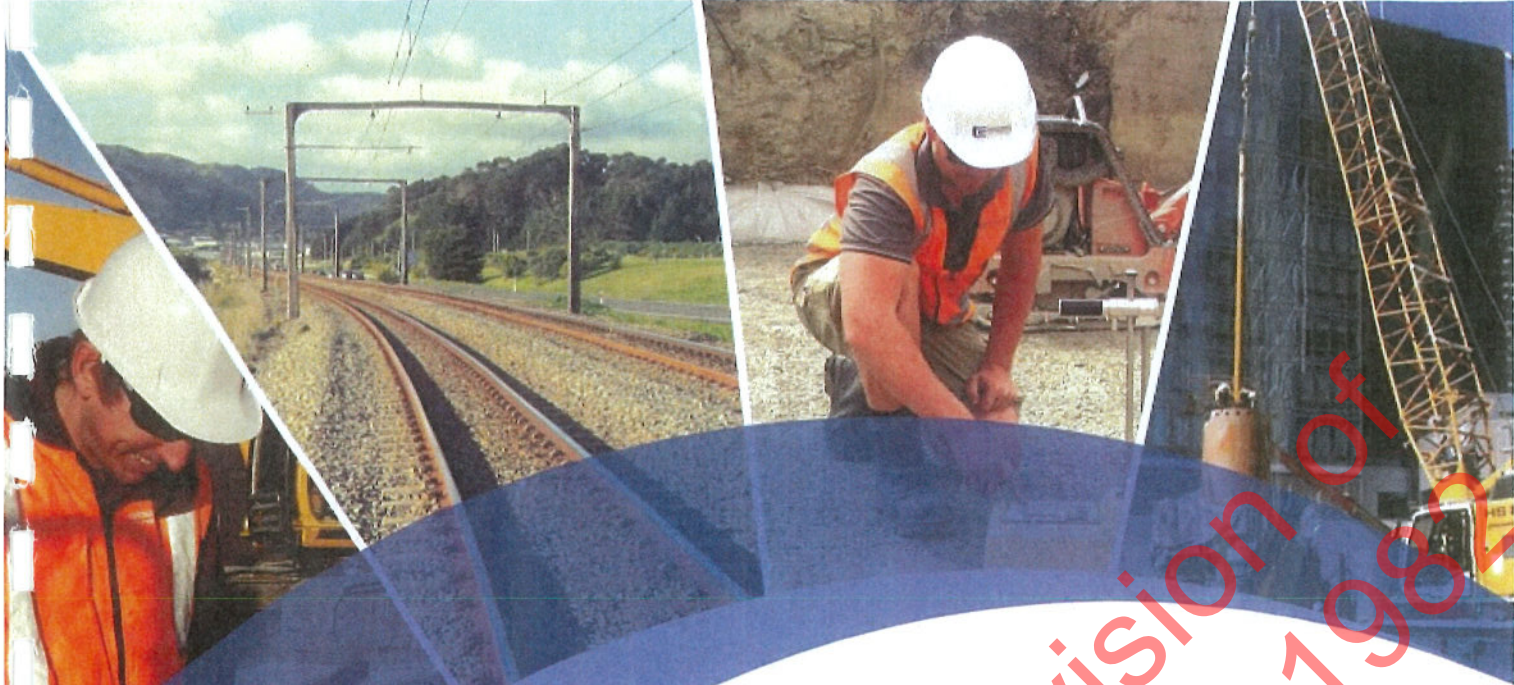




ENGEO

Expect Excellence

Due Diligence Geotechnical Investigation

224 Great South Road
Remuera
Auckland

Submitted to:
Laura Fergusson Trust
224 Great South Road
Remuera
Auckland 1546

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Appendix 2:	Hand Auger Logs
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Appendix 4:	Scala Penetrometer and CBR Results
Appendix 5:	Laboratory Test Results

ENGEO Document Control:

Report Title	Due Diligence Geotechnical Investigation - 224 Great South Road, Remuera			
Project No.	15627.000.000	Doc ID	02	
Client	Laura Fergusson Trust	Client Contact	Chris O'Brien	
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Date	Revision Details/Status	WP	Author	Reviewer
11.01.2019	Issued to Client	JT	LEG	PF

1 Introduction

ENGEO Ltd was requested by Laura Fergusson Trust to undertake a preliminary geotechnical investigation of the sites at 224, 228 and 230 Great South Road, and 49-51, 53 and 53A Omaha Road, Remuera, Auckland. The purpose of this assessment was to undertake a due diligence level investigation to broadly characterise the subsurface conditions and identify geotechnical constraints that may affect future developments on the land parcels comprising this site. Details of any future development proposed for this site had not been determined at the time of writing this report. Accordingly, our conclusions and recommendations should be considered preliminary in nature and additional geotechnical studies, including further exploration may be required to support any application for Resource Consent.

The scope of this study consists of:

- Review of published geotechnical and geological information.
- Geotechnical observation of the site to evaluate the current landform.
- Field investigations including the following:
 - Ten Hand Auger Boreholes with in situ strength testing to a maximum depth of 5 m.
 - Two Machine Boreholes with Standard Penetration Testing (SPT) to a maximum depth of 21.5 m.
 - Six Scala Penetrometer tests (DCP) to 1 m depth.
- Laboratory testing including Shrink Swell analysis of one soil sample.
- Assessment of the likelihood of existing natural hazards against the requirements of Section 106 of the Resource Management Act (1991).
- Preparation of this report outlining the findings of our enquiries and ground investigations, including preliminary recommendations related to suitable foundations for typically lightweight buildings.

2 Site Description

The project site is located in Remuera-Greenlane, Auckland and includes the following land parcels as shown in Figure 1 and on the attached Investigation Location Plan (Appendix 1):

- | | |
|------------------------|--------------------|
| • 224 Great South Road | • 53A Omaha Road |
| • 228 Great South Road | • 49-51 Omaha Road |
| • 230 Great South Road | • 53 Omaha Road |

The site is currently developed with one main commercial single level brick clad building in the western corner of the site, several smaller single and double storey residential buildings as well as a paved carpark in the southern corner of the site. The ground surface across the balance of the site is paved, grassed and landscaped.

The site is bound by residential properties to the west, Great South Road to the south, Omaha Road to the east and the North Island Main Trunk Railway and Auckland-Hamilton (Southern) Motorway to the north. Based on our review of the Auckland Council GeoMaps, two isolated overland flow paths are mapped to be present within the site. These flow paths are shown on Figure 1.

Figure 1: Site Location



Images sourced from Auckland Council GeoMaps and Google Maps. Not to scale.

3 Area Wide Geotechnical Data

3.1 Regional Geology

Regional geological mapping by Geological and Nuclear Sciences (GNS) indicates that the site is located on Auckland Volcanic Group (Qvat) deposits, as shown in Figure 2. We anticipate the site is also underlain by East Coast Bays Formation sediments (Mwe) at depth.

The Auckland Volcanic Field comprises basalt rock and tuff soils. Lithic tuff is volcanic airfall ejecta comprising silt, sand and gravel sized clasts of the surrounding soil and rock, basalt fragments, and unconsolidated ash and lapilli. Tuff deposits weather to form reddish brown clays and silts, and often overlie basalt lava flows. Basalt lava of the Auckland Volcanic Field is typically described as grey to dark grey, dense fine grained olivine basalt or basanite. The thickness and lateral extent of lava flows are highly variable, and are a function of the original landform (paleotopography), proximity to the source, and number of successive lava flows.

The East Coast Bays Formation was formed in a deep marine setting by turbidity (density) currents, resulting in alternating sequences of sandstone and siltstone (termed flysch deposits). *In situ* weathering of the usually dark grey bedrock material has created, in most locations, an overburden comprising mixtures of silts, clays and sands, being predominantly orange, brown and grey in colour.

Figure 2: Published Geological Mapping

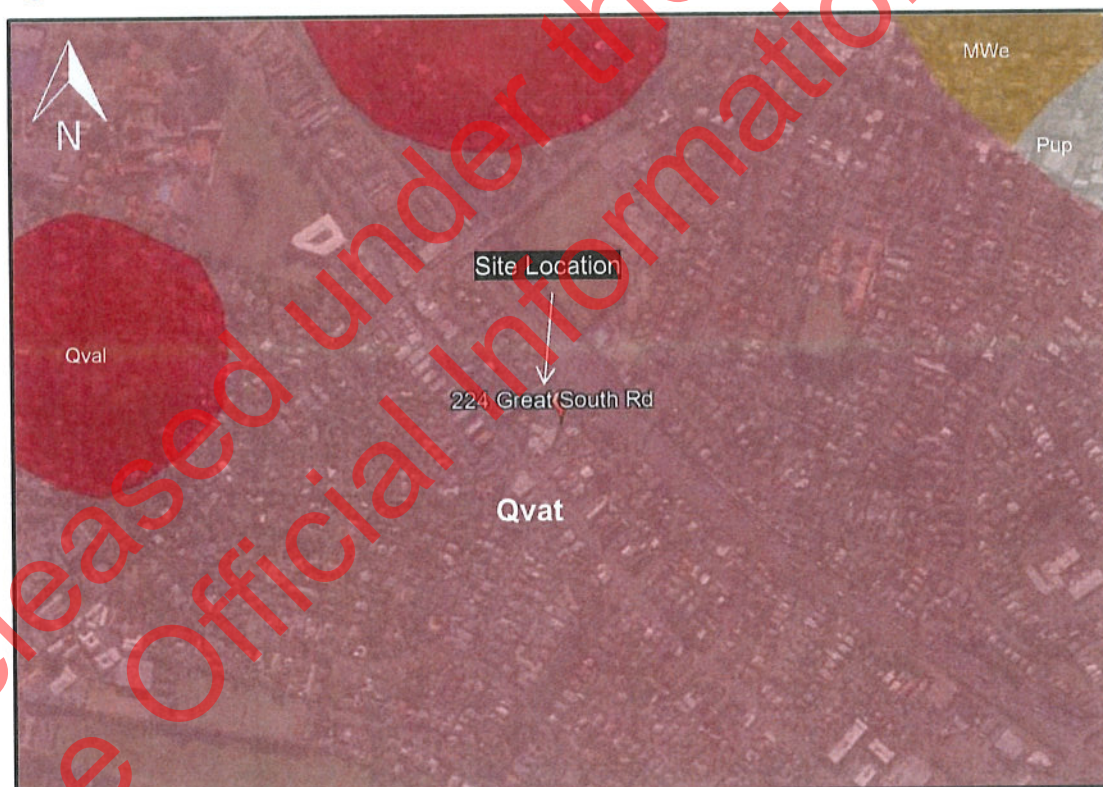


Image sourced from GNS Geological Mapping, and Google Earth. Not to scale.

3.2 Seismicity

The Auckland area is one of the lowest earthquake activity regions in New Zealand. Over the last 150 years, only two earthquakes with magnitudes greater than M5 have been recorded in the region.

We have reviewed the GNS New Zealand Active Faults Database, which indicates there are no known active faults on-site. The nearest active fault is the Wairoa North Fault located approximately 22 km southeast of the site.

The Wairoa North Fault dips at approximately 60 to 70 degrees to the west with a vertical slip rate of approximately 0.1 mm / year. GNS have not established a recurrence interval and date for the last known event at the Wairoa North Fault.

Nearby inactive faults include the Kaipatiki Fault, Birkenhead Fault and the Waiaohia Stream Fault which are located within approximately 15 km of the site.

3.3 Volcanic Activity

Volcanic activity present a significant risk in Auckland. However, the location and timing of eruptions are difficult to predict due to the monogenetic nature of the volcanic field.

The eruption history of the Auckland Volcanic Field (AVF) is known to date back over the last 150,000 years. Nineteen eruptions are known to have occurred within the last 20,000 with 18 of the most recent eruptions occurring between 20,000 and 10,000 years ago. Rangitoto was the last known eruption event which was estimated to be 550 years before present.

Hazards proximately to an eruption include pyroclastic surge, block fall and lava flows. Ash fall at a greater distance can cause large disturbance with remobilisation of ash deposits possible, particularly during rainfall events.

Although the AVF is thought to have a high risk of eruption, it is generally considered to have a low occurrence. Based on the number and frequency of past eruptions it is estimated there is approximately a 1 in 1000 (0.1%) chance an eruption could occur in any one year.

3.4 Historical Aerial Photography

We have reviewed available aerial photographs of the site and surrounding area dating back to 1940. These photographs were viewed with the context of identifying changes to landform.

Aside from the development of the Laura Fergusson Trust buildings between 1959 and 1996, no obvious signs of geomorphic, geological or geotechnical changes are visible in the available aerial photographs.

4 Site Investigation

4.1 Current Landform

ENGEO visited the site on 23 November 2018 and made the following observations:

- The ground surface across the site is relatively flat, with the exception of the northern site boundary.
- A gentle to moderate slope, approximately 2 m high, was observed along the northern property boundary. The slope is grassed and undeveloped.

- A retaining wall between approximately 1 m and 1.6 m in height was observed on the north-western property boundary. The construction of the retaining wall includes both a concrete crib wall and a timber retaining wall.
- The ground surface immediately beyond the northern property boundary steeply slopes down to a railway line. A timber pole retaining wall was also observed at this location.
- No natural surface water flows were identified at the time of the site visit.

4.2 Hand Auger Testing

Ten hand auger boreholes with associated shear vane tests were completed to depths ranging between 0.6 m and 5.0 m below current ground level in the locations shown on the Investigation Location Plan (Appendix 1). All investigations were undertaken from current ground level.

Three hand auger tests (HA07, HA08 and HA10) met practical refusal and terminated on hard material between 0.6 m and 1.2 m depth.

All logs have been prepared in general accordance with the New Zealand Geotechnical Society field classification guidelines (NZGS, 2005) and are presented as an attachment to this report in Appendix 2.

4.3 Machine Borehole Testing

Two machine boreholes MBH01 and MBH02, with associated Standard Penetration Testing (SPT) were advanced to between 21.5 m and 16.5 m depth, respectively. SPTs were conducted at 1.5 m intervals to characterise the soil and rock strength profile.

Standpipe piezometers were installed in each machine borehole location at the time of drilling, but have not been dipped prior to issue of this report. These are referenced as P01 and P02 on the Investigation Location Plan (Appendix 1). The machine borehole logs are presented in Appendix 3.

4.4 Scala Penetrometer Testing

Six Scala penetrometer tests were undertaken across the site, references as SP1 through to SP6 to determine a preliminary subgrade CBR to inform future pavement development.

All tests were completed to 0.9 m depth. The results are presented in Appendix 4 of this report, including their assessed CBR values.

4.5 Generalised Summary of Subsurface Conditions

The results of this site investigation indicate that the site is underlain by a sequence of two differing soil types, broadly typical of the geology described within the published geological map for the area. A general summary of the typical subsoil profile for the project site is given in Table 1.

Fill material comprising reworked clayey silt with angular gravel was observed in the upper 1.2 m of HA07, HA08 and in the upper 0.6 m of HA10. These test locations met practical refusal and terminated within the fill material.

Extremely weak East Coast Bays Formation rock was encountered at 15.5 m depth in MBH01 and at 9.5 m depth in MBH02 however was recovered as a clayey silt and can be considered as a transition zone material.

Very weak rock (siltstone and sandstone) was encountered at 19.5 m depth in MBH01 and at 13.5 m depth in MBH02. We consider this to be the rock level indicator. Based on the machine borehole logs, the depth to rock beneath the site is deeper in the northwest.

Table 1: Summary of Subsurface Conditions

Layer Depth and Range (m)	Material Description	Material Strength
0.0 to 0.2	Topsoil	Not Assessed
0.2 to 2.3	Auckland Volcanic Field¹ Layers of silty clay and clayey silt, with trace gravel (basalt)	Very Stiff to Hard
2.3 to 14.5	East Coast Bays Formation Soil Predominantly silty clay, and layers of clayey silt and silty sand	Very Stiff to Hard
9.5-14.5 to 15.5-19.5	Transition Zone Silty clay	Hard SPT 'N' >50
9.5-15.5 to 21.5	East Coast Bays Formation Rock Layers of siltstone and sandstone	Extremely Weak to Very Weak

¹ Fill material was encountered in HA07, HA08 and HA10.

4.6 Groundwater Conditions

Standing water levels were recorded by dip testing the investigation holes during hand auger testing. Groundwater was encountered in HA02, HA04 and HA05, and not encountered in the remaining hand auger locations.

Standpipe piezometers were installed in each machine borehole location at the time of drilling, but have not been dipped prior to issue of this report.

Table 2 presents the groundwater levels recorded.

Table 2: Measured Groundwater Depths

Hand Auger ID	Depth Below Ground Level (m)
HA02	2.8
HA04	2.8
HA05	3.6

4.7 Laboratory Testing

One soil sample was selected for Shrink-Swell Index testing in accordance with AS1289:Test7.1.1-2003, from the clayey silt material at the site. Full results are presented in Appendix 5, and the data is summarised in Table 3.

Table 3: Shrink-Swell Results Summary

Borehole ID	Sample Depth (m)	Moisture Content (%)	Shrink-Swell Index (%)
HA04	0.2 to 0.7	40.2	4.2

5 Geotechnical Assessment and Recommendations

The site is considered to be geotechnical suitable for future development, subject to the following recommendations.

5.1 Pre-Existing Fill

Fill was observed in three locations (HA07, HA08 and HA10) to a maximum depth of 1.2 m. These tests were undertaken adjacent to underground services, building footprints and landscaped areas. It is our interpretation that the fill material encountered in these investigations is likely to be isolated and placed in association with construction or landscaping at the time of development.

Given the limited coverage of this due diligence investigation, it is possible that further deposits of pre-existing fill are present on-site. In the occurrence of future development, following site clearance, the geotechnical engineer should evaluate the stripped subgrade across the site and determine the extent and nature of any pre-existing filling exposed and determine if the fill material is suitable for use, or advise if undercutting and replacement with engineered fill is required.

5.2 Earthworks

Based on the current landform, observed to be predominantly relatively flat, we anticipate that future earthworks are likely to require minimal cuts and fills. The northern site boundary steeply slopes down to railway lines. The stability of this slope should be considered for cut and fill earthworks proposed in the general vicinity in future.

Native soils that may be involved in cut to fill earthworks at the site (i.e. within the upper 3 m of the ground surface) predominantly comprise very stiff to hard inorganic clays and silts of the Auckland Volcanic Field and East Coast Bays Formation. These soils are generally suitable for handling and compaction using conventional earthworks plant, but may be wet of optimum and allowances for some conditioning may be required prior to placement as structural fill. Future filling should be completed in accordance with NZS 4431 and under the observation of the certifying geotechnical engineer.

5.3 Site Excavations

Stiff to hard (predominantly cohesive) silty and clay soil was encountered in the upper 10 m of the ground surface, as indicated in the subsurface investigations on site. Conventional excavation equipment is likely to be suitable for future earthworks operations at the site.

The groundwater level beneath the site is approximately 2.8 m below existing ground level, based on the results of dip testing in the hand auger boreholes. If future developments at the site incorporate a one-level basement (typically on the order of 3.5 m depth), de-watering is likely to be required during excavations.

5.3.1 General Cuts and Batters

- Temporary unsupported cut slopes should not exceed a batter of 1H:1V (45° from horizontal), and should not be left unsupported at this batter angle for longer than two weeks.
- Cuts should not be exposed to adverse weather conditions and should be covered (with polythene sheeting or similar) to minimise environmental effects.
- Suitable drainage channels must be put in place to divert surface water from unsupported cut faces. Subsurface drains should also be considered for the toe of long-term slopes.
- If any permanent cuts are to be higher than 1.5 m, they should be supported with a specifically designed retaining wall and will need to be approved by a Chartered Professional Engineer practising in Geotechnical Engineering.
- Where vertical and sub-vertical cut faces higher than 0.5 m are required for the construction of retaining walls, in addition to the above recommendations, we recommend that this is done in shortened sections, where possible (<5 m) and the faces are left unsupported for a minimal time period (i.e. one week) or temporarily shored, particularly in close proximity to site boundaries and structures.
- All temporary cuts and batters proximate to boundaries should take into account the potential surcharge and risk of undermining neighbouring property.
- All cuts and batters should be in line with the WorkSafe Good Practice Guidelines for Excavation Safety (July 2016).

5.4 Service line Excavations and Roothing

For excavation of services trenches up to 3 m depth below existing ground, predominantly very stiff to hard clay and silt AVF and ECBF soil are likely to be encountered. The shallowest recorded groundwater level below existing ground was 2.8 m depth. Accordingly, de-watering may be required for excavations of this depth.

Based on the depth to very weak rock being >10 m beneath the site, we do not anticipate specific rock excavation machinery to be required for typical service trench excavations.

At the current ground levels, future pavement development may adopt a CBR of 4% for native soils. An assessment for CBR values should be re-addressed following completion of the earthworks and concept plans for a future development.

5.5 Seismic Hazards

Potential seismic hazards resulting from nearby moderate to major earthquakes can generally be classified as primary and secondary. The primary effect is ground rupture, also called surface faulting. The common secondary seismic hazards include ground shaking, ground lurching, regional subsidence or uplift, soil liquefaction, lateral spreading, landslides, tsunamis, flooding, or seiches. Based on topographic and lithologic data, risk from earthquake-induced regional subsidence / uplift, ground lurching, landslides, flooding, and tsunamis and seiches are considered negligible at the site. The following sections present a discussion of other seismic hazards as they apply to the site.

5.5.1 Ground Rupture

As previously discussed, there are no known active faults located within the general vicinity of the site. Based on regional mapping, and the results of our field exploration, it is our opinion that fault related ground rupture is unlikely at the subject property.

5.5.2 Liquefaction and Lateral Spreading

Soil liquefaction results from loss of strength during cyclic loading, such as imposed by earthquakes. Soils most susceptible to liquefaction are clean, loose, saturated, uniformly graded fine-grained sands. Empirical evidence indicates that loose to medium dense gravels, silty sands, low plasticity silts, and some low-plasticity clays are also potentially liquefiable.

Based on the regional geological setting, predominantly cohesive (plastic) and relatively strong soil strengths down to rock (as depicted in the data collected from our explorations), we anticipate the potential for liquefaction at the site to be low.

5.6 Expansive Soils

Expansive clay and silt soils are common in the Auckland area and they have a tendency to shrink and swell, particularly with seasonal fluctuations of soil water content. This behaviour has implications for shallow foundation design and surface structures, and will need to be addressed during foundation design. We note that silt and clay rich soils were encountered across the majority of the site.

Shrink-swell index testing completed for this site indicates that an appropriate preliminary expansive soils class site classification is H1 in accordance with AS2870. However, this classification may be affected by future earthworks and/or additional testing.

5.7 Flooding

Based on our review of the Auckland Council GeoMaps database, no flood sensitive prone areas, or flood plains, are mapped within the general vicinity of the project site.

5.8 Foundation Design

Shallow foundations (considering the expansive site class) are considered suitable for typically light-weight timber framed buildings of two to three-storeys in height. For mid and high-rise building developments, deep foundations are likely to be required owing to relatively high anticipated building loads and the load distribution.

5.8.1 Shallow Foundations

A preliminary Expansive Site Class of H1 (High) is likely to be suitable for adoption in the occurrence of future (typically lightweight residential and commercial) development at the site. Therefore, future shallow foundation design may be carried out in accordance with AS2870 or alternatively a specific foundation and structural design may be undertaken by a suitably experienced Chartered Professional Engineer. NZS3604 does not apply as the site soils do not fall within the definition of good ground.

The results of our subsurface testing indicates that an unfactored geotechnical Ultimate Bearing Capacity of 300 kPa will likely be available for typically lightweight structures with shallow foundations, within the native clay and silt materials encountered onsite.

5.8.2 Deep Foundations

Where required; deep foundations should extend down to the underlying ECBF rock-mass (i.e. very weak rock) encountered at 19.5 m depth in the north and 15.5 m depth in the south of the site. For increased certainty on the depth to rock across the site a series of additional deep investigations should be undertaken for any future development requiring deep foundations.

Potential deep foundation solutions include screw piles, driven timber/steel/concrete, or bored or Continuous Flight Auger (CFA) concrete piles.

A 600 mm thick layer of medium dense sand was encountered below the water table in MBH01, from 13.7 m to 14.3 m depth. On this basis, an allowance to deal with necking and or hole side wall collapse for bored piles should be taken into consideration if this is the chosen solution for future developments. Installation of concrete piles through CFA methods would eliminate this requirement. Further, for excavation of conventionally bored piles below the water table, dewatering may be required.

Driven piles are a suitable deep foundation solution however often face complexities during consenting owing to the noise and vibration aspects of their installation, particularly within residential areas. Screw piles may be more favourable for building developments requiring deep foundations where deep transition zone (SPT N >50 strength soil) was encountered.

5.9 Seismic Soil Classification

For the purpose of seismic design, our preliminary assessment for the seismic subsoil class is 'Class C – Shallow Soil' in line with NZS 1170.5:2004.

5.10 Assessment against RMA Section 106

Based on our preliminary investigation and assessment, we do not consider existing site contours to be subject to erosion, significant subsidence (including liquefaction), falling debris, slippage or inundation by soil or rock in accordance with the provision of Section 106 of the Resource Management Act 1991.

5.11 Further Work

ENGEO recommends that detailed, development specific geotechnical investigations be carried out (to supplement this due diligence assessment) to support the Resource and Building Consent Applications for future developments at the site. This report will provide development specific geotechnical recommendations.

6 Limitations

- i. We have prepared this report in accordance with the brief as provided. This report has been prepared for the use of our client, Laura Fergusson Trust, their professional advisers and the relevant Territorial Authorities in relation to the specified project brief described in this report. No liability is accepted for the use of any part of the report for any other purpose or by any other person or entity.
- ii. The recommendations in this report are based on the ground conditions indicated from published sources, site assessments and subsurface investigations described in this report based on accepted normal methods of site investigations. Only a limited amount of information has been collected to meet the specific financial and technical requirements of the client's brief and this report does not purport to completely describe all the site characteristics and properties. The nature and continuity of the ground between test locations has been inferred using experience and judgement and it should be appreciated that actual conditions could vary from the assumed model.
- iii. Subsurface conditions relevant to construction works should be assessed by contractors who can make their own interpretation of the factual data provided. They should perform any additional tests as necessary for their own purposes.
- iv. This Limitation should be read in conjunction with the Engineering NZ / ACENZ Standard Terms of Engagement.
- v. This report is not to be reproduced either wholly or in part without our prior written permission.

We trust that this information meets your current requirements. Please do not hesitate to contact the undersigned on (09) 972 2205 if you require any further information.

Report prepared by



Olivia Ellis-Garland
Engineering Geologist

Report reviewed by



Paul Fletcher, CMEngNZ (CPEng)
Associate Geotechnical Engineer

APPENDIX 1:

Investigation Location Plan

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DATE PLOTTED: 17 December 2018 4:35 p.m. BY: DOUG FINLAY

- Notes:**
1. Base drawing sourced from Quickmap Enterprise V8.0.6854.
 2. Aerial image sourced from LINZ Data Service and licensed for re-use under the Creative Commons Attribution 4.0 New Zealand License (Auckland 0.075m Urban Aerial Photos 2017).
 3. Coordinate Origin: MI Eden, Projection: Geodetic 2000.
 4. Levels are in terms of mean sea level.
 5. Contours sourced from Auckland Geomaps.



 — Expect Excellence — Auckland Office 8 Greydene Place, Takapuna 0622, Auckland Tel: 09 972 2205, www.engeo.co.nz	Title: INVESTIGATION LOCATION PLAN	Client: Laura Ferguson Trust		Appendix:	
		Project: 224 Great South Road Remuera Auckland	Designed: LEG	1	
			Drawn: DF		
			Checked: -		
			Date: 17.12.18		Size: A4
Proj No: 15627.000.000		Scale: 1:1000	Revision: -		

APPENDIX 2:
Hand Auger Logs

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LOG OF AUGER HA01

Geotechnical Investigation
224 Great South Road
Epsom, Auckland

Client : Laura Ferguson Trust
Client Ref. : 15627.000.000
Date : 22/11/2018
Hole Depth : 5 m
Hole Diameter : 50 mm

Shear Vane No : 2093
Logged By : GC
Reviewed By : RB
Latitude : -36.883765
Longitude : 174.7878

Depth (m)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Scala Penetrometer					
									Blows per 100mm					
									2	4	6	8	10	12
	TS	ML	Topsoil.											
0.5	AUCKLAND VOLCANIC FIELD	CH	Silty CLAY with trace sand and gravel; light brown with brown, orange and light grey streaks. High plasticity. Minor fine to medium gravel and reddish brown mottles encountered at 0.4m depth.				St-VSt	134/16						
1.0		ML	Silty fine to coarse sand with minor gravel; brown with orange and dark brown streaks encountered between 0.7 m and 0.8 m depth.				VSt	105/16						
1.5		CH	Clayey SILT with minor fine to coarse sand and fine to medium gravel; brown with orange and dark brown streaks, black mottles. Low plasticity. Sand, well graded, sub-angular. Gravel, sub-angular, basalt/scoria.				VSt	95/29						
2.0		CH	Silty CLAY with minor fine to medium gravel; light grey with dark brown and orange streaks, black mottles. High plasticity. Gravel, sub-angular.			M	St-VSt	163/46						
2.5	EAST COAST BAYS FORMATION	ML	Clayey SILT; grey with orange streaks. Low plasticity.				VSt-H	95/49						
3.0		ML	Becomes dark greenish grey at 2.8 m depth.				VSt-H	118/65						
3.5		ML					VSt-H	114/18						
4.0		CH	Silty CLAY; light grey with occasional black mottles. High plasticity.				St	111/49						
4.5		CH					St	118/39						
5.0		CH					St	163/82						
			End of Hole Depth: 5 m Termination Condition: Target depth					200+						
								82/42						
								131/52						
								147/65						
								160/62						
								141/62						

Hand auger met target depth at 5 m.
TS = Topsoil
Standing groundwater was not encountered

LOG OF AUGER HA02

Geotechnical Investigation
224 Great South Road
Epsom, Auckland

Client : Laura Ferguson Trust
Client Ref. : 15627.000.000
Date : 22/11/2018
Hole Depth : 5 m
Hole Diameter : 50 mm

Shear Vane No : 1598
Logged By : BF
Reviewed By : RB
Latitude : -36.884207
Longitude : 174.787945

Depth (m)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Scala Penetrometer					
									Blows per 100mm					
	TS	ML	Topsoil.						2	4	6	8	10	12
0.5	AUCKLAND VOLCANIC FIELD	ML	Clayey SILT with trace sand; brown with light brown and black streaks. Low plasticity.				VSt	117/32						
1.0		ML					VSt	124/35						
1.5		SP	Fine to medium SAND; dark reddish brown. Poorly graded.			M	MD	146/48						
2.0		ML	Clayey SILT with trace sand; brown with orange streaks. Low plasticity.				VSt	171/73						
2.5		ML					VSt	117/48						
3.0	EAST COAST BAYS FORMATION	SP	Fine to medium SAND; dark reddish brown. Poorly graded.				D	UTP						
3.5		ML	Clayey SILT with trace sand; brown with orange streaks. Low plasticity.				H	200+						
4.0		ML	Clayey SILT; grey with brown streaks. Low plasticity.			W	VSt-H	152/16						
4.5		ML	Clayey SILT; dark grey. Low plasticity.			S	St	60/35						
5.0		ML	Becomes wet at 3.2 m depth.				VSt-H	114/35						
5.5		CH	Silty CLAY; light greyish blue with orange streaks. High plasticity.			W	VSt	162/48						
6.0								139/32						
6.5								101/29						
7.0								95/29						
7.5			End of Hole Depth: 5 m Termination Condition: Target depth											

Hand auger met target depth at 5 m.
TS = Topsoil
Dip test showed standing water at 2.8 m

LOG OF AUGER HA03

Geotechnical Investigation
224 Great South Road
Epsom, Auckland

Client : Laura Ferguson Trust
Client Ref. : 15627.000.000
Date : 22/11/2018
Hole Depth : 5 m
Hole Diameter : 50 mm

Shear Vane No : 1413
Logged By : LA
Reviewed By : RB
Latitude : -36.884194
Longitude : 174.788295

Depth (m)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Scala Penetrometer					
									Blows per 100mm					
									2	4	6	8	10	12
	TS	ML	Topsoil.				St							
0.5		ML	SILT with trace gravel; reddish brown. Low plasticity.				H	84/26						
1.0		ML	Clayey SILT; light orange brown. Low plasticity.				H	200+						
1.5		ML	Becomes dark brown with some dark grey mottles at 1.1 m depth.				H	200+						
2.0		ML	Becomes light brown with orange and grey mottles from 1.4 m depth.				H	200+						
2.5		ML	Clayey SILT with trace sand and gravel; dark brown. Low plasticity.				H	200+						
3.0		ML	Clayey SILT with trace sand; greyish brown. Low plasticity.				S-St							
3.5		ML	CLAY; light grey, minor fibrous organics. High plasticity.				VS							
4.0		CH	CLAY; light grey, minor organics. High plasticity.				St							
4.5		ML	CLAY; light grey, minor organics. High plasticity.				VSt							
5.0		CH	Becomes yellowish orange at 3.8 m depth.				VSt							
5.5			End of Hole Depth: 5 m Termination Condition: Target depth											

Hand auger met target depth at 5 m.
TS = Topsoil
Standing groundwater was not encountered

LOG OF AUGER HA04

Geotechnical Investigation
224 Great South Road
Epsom, Auckland

Client : Laura Ferguson Trust
Client Ref. : 15627.000.000
Date : 22/11/2018
Hole Depth : 5 m
Hole Diameter : 50 mm

Shear Vane No : 1598
 Logged By : BF
 Reviewed By : RB
 Latitude : -36.884368
 Longitude : 174.787503

Depth (m)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Scala Penetrometer							
									Blows per 100mm							
									2	4	6	8	10	12		
0.5 1.0 1.5 2.0	AUCKLAND VOLCANIC FIELD	TS	Topsoil.				NA	130/48 117/32 89/35 44/21 57/22 79/32 89/35 79/35								
		ML	Clayey SILT with trace sand; orange brown with dark brown streaks. Low plasticity				VSt									
		ML	Encountered some fine to medium sand at 0.8 m depth Becomes minor fine to medium sand at 1.1 m depth.				M									St
2.5 3.0 3.5 4.0 4.5 5.0	EAST COAST BAYS FORMATION	CH	Silty CLAY; grey with brown streaks. High plasticity. Poor recovery from 2.4 to 2.7 m depth.			S	W	VSt	114/41 127/55 120/35 146/44 114/32 101/29 130/29 98/25							
End of Hole Depth: 5 m Termination Condition: Target depth																

Hand auger met target depth at 5 m.
TS = Topsoil
Dip test showed standing water at 2.8 m
NA = Not Assessed

LOG OF AUGER HA05

Geotechnical Investigation
224 Great South Road
Epsom, Auckland

Client : Laura Ferguson Trust
Client Ref. : 15627.000.000
Date : 22/11/2018
Hole Depth : 5 m
Hole Diameter : 50 mm

Shear Vane No : 1598
Logged By : BF
Reviewed By : RB
Latitude : -36.884489
Longitude : 174.788299

Depth (m)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Scala Penetrometer					
									Blows per 100mm					
									2	4	6	8	10	12
	TS	ML	Topsoil.				VSt							
0.5	AUCKLAND VOLCANIC FIELD	ML	Clayey SILT with trace sand; brown with orange streaks. Low plasticity.			M	VSt	136/36						
		ML					VSt-H	171/44						
1.0		ML	Clayey SILT; light brown. Low plasticity.				VSt	200+						
		ML	Sandy SILT; dark brown. Low plasticity. Sand, fine to medium.				H	162/60						
1.5		ML					VSt	200+						
		ML	Clayey SILT; dark brown with orange streaks. Low plasticity.				St	124/35						
2.0		ML	Sandy SILT; light grey with brown and orange streaks. Low plasticity.				VSt	95/16						
		ML	Clayey SILT; brown. Low plasticity.				VSt	101/29						
2.5	EAST COAST BAYS FORMATION	CH	Sandy SILT; orange brown. Low plasticity. Sand, fine to medium, poorly graded.			W	VSt	114/44						
		CH	Silty CLAY; orange brown with grey streaks. High plasticity.				VSt	155/95						
3.0		CH					VSt	158/76						
		CH	Silty CLAY; light grey with red streaks. High plasticity.				VSt	162/63						
3.5		CH					VSt	152/63						
4.0		CH					VSt	162/62						
		CH					VSt	141/51						
4.5		ML	Clayey SILT; light grey. Low plasticity.				VSt	130/48						
5.0			End of Hole Depth: 5 m Termination Condition: Target depth											

Hand auger met target depth at 5 m.
TS = Topsoil
Dip test showed standing water at 3.6 m

LOG OF AUGER HA06

Geotechnical Investigation
224 Great South Road
Epsom, Auckland

Client : Laura Ferguson Trust
Client Ref. : 15627.000.000
Date : 22/11/2018
Hole Depth : 5 m
Hole Diameter : 50 mm

Shear Vane No : 1413
Logged By : LA
Reviewed By : RB
Latitude : -36.884519
Longitude : 174.788698

Depth (m)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Scala Penetrometer Blows per 100mm
									2 4 6 8 10 12
	TS	ML	Topsoil.				H		
0.5		ML	SILT; dark reddish brown with some reddish orange streaks. Low plasticity.			M	H	200+	
		ML	Clayey SILT; light brown with black mottles. Low plasticity.				VSt	190/54	
1.0		ML	Clayey SILT; greyish brown with reddish orange streaks and black mottles. Low plasticity.				VSt	157/51	
		ML	Silt with trace sand; dark brown. Low plasticity.				St	89/17	
1.5		ML	Clayey SILT with trace fine gravel; brown. Low plasticity.				VSt	124/38	
2.0		CH	Silty CLAY with trace gravel; brown with trace organics. High plasticity. Encountered 5cm thick reddish brown layer with minor gravel at 1.9 m depth. Becomes yellow orange with grey streaks from 2 m depth.				VSt	183/70	
2.5		CH	CLAY with trace organics.; light grey with some yellow orange streaks. High plasticity.				VSt	173/105	
3.0		CH					VSt	178/113	
3.5		CH					VSt	190/119	
4.0		CH	CLAY with trace organics; orange brown with pink and grey streaks. High plasticity.				VSt	200+	
4.5		CH					VSt	113/66	
							VSt	139/87	
							VSt	166/122	
5.0			End of Hole Depth: 5 m Termination Condition: Target depth						

Hand auger met target depth at 5 m.
TS = Topsoil
Standing groundwater was not encountered

LOG OF AUGER HA07

Geotechnical Investigation
224 Great South Road
Epsom, Auckland

Client : Laura Ferguson Trust
Client Ref. : 15627.000.000
Date : 22/11/2018
Hole Depth : 1.2 m
Hole Diameter : 50 mm

Shear Vane No : 1598
Logged By : BF
Reviewed By : RB
Latitude : -36.884693
Longitude : 174.787119

Depth (m)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Scala Penetrometer					
									Blows per 100mm					
									2	4	6	8	10	12
0.0	T	ML	Topsoil.					UTP						
0.5			Clayey SILT with minor gravel; dark brown. Low plasticity. Gravel, fine to medium gravel [FILL].					UTP						
1.0	FILL	ML				M	H							
1.2			End of Hole Depth: 1.2 m Termination Condition: Practical refusal											
1.5														
2.0														
2.5														
3.0														
3.5														
4.0														
4.5														
5.0														

Hand auger met practical refusal at 1.2 m depth on hard material.
T = Topsoil
Standing groundwater was not encountered

LOG OF AUGER HA08

Geotechnical Investigation
224 Great South Road
Epsom, Auckland

Client : Laura Ferguson Trust
Client Ref. : 15627.000.000
Date : 22/11/2018
Hole Depth : 1.2 m
Hole Diameter : 50 mm

Shear Vane No : 1598
Logged By : BF
Reviewed By : RB
Latitude : -36.884685
Longitude : 174.787809

Depth (m)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Scala Penetrometer					
									Blows per 100mm					
	TS	ML	Topsoil.						2	4	6	8	10	12
0.5	FILL	ML	Clayey SILT with trace sand and gravel; intermixed brown, dark brown, grey, and white. Low plasticity [FILL].			M	VSt-H	143/32						
1.0			Becomes fine to medium gravel at 0.9 m depth.				St	95/19						
1.2			End of Hole Depth: 1.2 m Termination Condition: Practical refusal				H	UTP						

Hand auger met practical refusal at 1.2 m depth on hard material.
TS = Topsoil
Standing groundwater was not encountered

LOG OF AUGER HA09

Geotechnical Investigation
224 Great South Road
Epsom, Auckland

Client : Laura Ferguson Trust
Client Ref. : 15627.000.000
Date : 22/11/2018
Hole Depth : 5 m
Hole Diameter : 50 mm

Shear Vane No : 1413
Logged By : LA
Reviewed By : RB
Latitude : -36.88484
Longitude : 174.788648

Depth (m)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Scala Penetrometer					
									Blows per 100mm					
									2	4	6	8	10	12
	TS	ML	Topsoil.				VSt							
0.5	AUCKLAND VOLCANIC FIELD	ML	Clayey SILT; dark orange brown. Low plasticity.				VSt-H	143/38						
		ML						200+						
1.0		ML	Becomes with some fine sand from 1 m depth.				VSt-H	199/49						
		CH	Silty CLAY; reddish brown with grey, orange, and red streaks. High plasticity.				H	174/52						
1.5	AUCKLAND VOLCANIC FIELD	ML	Clayey SILT with trace sand; dark orange brown. Low plasticity.				VSt	200+						
		ML	Clayey SILT with trace sand; brown with grey, orange, and black mottles. Low plasticity.				VSt	143/35						
2.0		ML	Silty CLAY; grey with orange brown streaks. High plasticity.				VSt	181/73						
		CH	Becomes grey at 2.5 m depth.				M	120/78						
2.5	EAST COAST BAYS FORMATION	CH	Becomes with orange streaks at 2.8 m depth.				VSt	108/73						
		CH	Becomes with red streaks at 3 m depth.				VSt	143/70						
3.0		CH	Becomes with pink streaks at 3.3 m depth.				VSt	105/52						
		ML	Clayey SILT; grey with some orange streaks. Low plasticity.				VSt	89/49						
3.5	EAST COAST BAYS FORMATION	ML					VSt	125/70						
4.0		CH	Silty CLAY; grey with pink and orange streaks. High plasticity.				VSt	122/66						
4.5		CH					VSt	143/63						
		CH					VSt	139/64						
5.0			End of Hole Depth: 5 m Termination Condition: Target depth											
Hand auger met target depth at 5 m. TS = Topsoil Standing groundwater was not encountered														

LOG OF AUGER HA10

Geotechnical Investigation
224 Great South Road
Epsom, Auckland

Client : Laura Ferguson Trust
Client Ref. : 15627.000.000
Date : 23/11/2018
Hole Depth : 0.6 m
Hole Diameter : 50 mm

Shear Vane No : 2093
Logged By : GC
Reviewed By : RB
Latitude : -36.884934
Longitude : 174.787387

Depth (m)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Scala Penetrometer					
									Blows per 100mm					
	TS	ML	Topsoil.				NA		2	4	6	8	10	12
0.5	FILL	ML	Clayey SILT with minor sand and gravel; brown with black mottle. Sand, fine to coarse. Gravel, fine, poorly graded, sub-angular [FILL].			M	Vst-H	160/39 UTP						
End of Hole Depth: 0.6 m Termination Condition: Practical refusal														
1.0														
1.5														
2.0														
2.5														
3.0														
3.5														
4.0														
4.5														
5.0														

Hand auger met practical refusal at 0.6 m depth on hard material.
TS = Topsoil
Standing groundwater was not encountered
NA = Not Assessed

APPENDIX 3:
Machine Borehole Logs

Released under the provision of
the Official Information Act 1982

LOG OF BORING MBH-01

Geotechnical Investigation
224 Great South Road
Remuera, Auckland
15627.000.000

Client : Laura Fergusson Trust Core Diameter : 83 mm
Date : 22/11/2018 Hammer Efficiency : 80.8 %
Hole Depth : 21.5 m Logged By/Reviewed By : GC / LEG
Drilling Method : Mud Rotary Latitude : 174.787472
Drilling Contractor : Prodrill Ltd Longitude : -36.884113

Depth (m)	Material	Sample Type	USCS Symbol	DESCRIPTION	Log Symbol	Water Level	Moisture	Consistency/ Density Index	SPT N-Value	Pocket Pen. UCS (kPa)	Torvane Shear (kPa)	Total Core Recovery (%)	Notes
			AP	Asphalt.				NA				25 50 75	
	FILL		GW	Silty fine to coarse GRAVEL with minor fine to coarse sand and fine cobbles; intermixed dark grey with black and dark brown. Gravel and cobbles, subangular, well graded, vesicular basalt [HARDFILL].				MD					
0.5			ML	Clayey SILT with minor fine to coarse sand and trace gravel; light grey with orange and dark brown streaks. Low plasticity.							111/36		
1.0				Interbedded silty CLAY with minor fine to coarse sand, light grey with orange and dark brown streaks, encountered from 0.9 m depth.				St-VSt			92/42		
1.5									1/2/2/2/3/2 N=9		134/65		
2.0			ML	Clayey SILT with trace sand, grey with brown, orange and dark brown mottles. Low plasticity. Trace gravel encountered from 2.1 m depth.									
2.5				Some fine to medium gravel encountered from 2.4 - 2.45 m depth. Gravel, scoria. Trace sand encountered from 2.45 m depth.			M	F					
3.0									1/0/1/10/1/1 N=3		46/7		
3.5			CH	Silty CLAY; brownish grey with occasional black mottles. High plasticity.									
4.0								St					
4.5			ML	Fine to coarse sandy SILT; grey with light brown streaks. Sand, subangular.					1/0/1/1/1/1/1 N=4		62/20		
5.0													

TS = TOPSOIL

NA = Not Assessed

Dip test showed standing water at 3.0 m depth

ECBF = East Coast Bays Formation

TZ = Transition Zone

LOG OF BORING MBH-01

Geotechnical Investigation
224 Great South Road
Remuera, Auckland
15627.000.000

Client : Laura Fergusson Trust Core Diameter : 83 mm
Date : 22/11/2018 Hammer Efficiency : 80.8 %
Hole Depth : 21.5 m Logged By/Reviewed By : GC / LEG
Drilling Method : Mud Rotary Latitude : 174.787472
Drilling Contractor : Prodrill Ltd Longitude : -36.884113

Depth (m)	Material	Sample Type	USCS Symbol	DESCRIPTION	Log Symbol	Water Level	Moisture	Consistency/ Density Index	SPT N-Value	Pocket Pen. UCS (kPa)	Torvane Shear (kPa)	Total Core Recovery (%)	Notes
5.5			ML	Fine to coarse sandy SILT; grey with light brown streaks. Sand, subangular.									
6.0				Becomes light grey with red streaks from 5.5 m depth.				St	1/1/1/1/1/1 N=4		69/16		
6.5				Minor fine to coarse gravel encountered at 6.65 m depth. Encountered minor limonite concretions, becomes orange with brown streaks from 6.7 m depth.				F	1/0/1/1/1/1 N=4		36/3		
7.0													
7.5							M						
8.0				Becomes light grey with red streaks from 8.0 m depth.									
8.5			SW	Silty fine to coarse SAND with minor fine to medium gravel; light grey with occasional orange streaks. Sand and gravel, subangular.				St	1/1/1/1/1/1 N=4		69/29		
9.0													
9.5			ML	Fine to coarse sandy SILT with minor fine to medium gravel; light grey with occasional orange streaks. Low plasticity. Sand and gravel, subangular. Becomes grey with light grey mottles from 9.55 m depth. Encountered 50 - 100 mm interbeds from 9.7 m				St					
10.0													

TS = TOPSOIL

NA = Not Assessed

Dip test showed standing water at 3.0 m depth

ECBF = East Coast Bays Formation

TZ = Transition Zone

LOG OF BORING MBH-01

Geotechnical Investigation
224 Great South Road
Remuera, Auckland
15627.000.000

Client : Laura Fergusson Trust Core Diameter : 83 mm
Date : 22/11/2018 Hammer Efficiency : 80.8 %
Hole Depth : 21.5 m Logged By/Reviewed By : GC / LEG
Drilling Method : Mud Rotary Latitude : 174.787472
Drilling Contractor : Prodrill Ltd Longitude : -36.884113

Depth (m)	Material	Sample Type	USCS Symbol	DESCRIPTION	Log Symbol	Water Level	Moisture	Consistency/ Density Index	SPT N-Value	Pocket Pen. UCS (kPa)	Torsion Shear (kPa)	Total Core Recovery (%)	Notes
10.5			ML	depth of clayey SILT with minor fine to medium gravel; grey with light grey mottles. Low plasticity. Fine to coarse sandy SILT with minor fine to medium gravel; light grey with occasional orange streaks. Low plasticity. Sand and gravel, subangular.					0/1/1/1/2/2/2 N=7		85/33	25 50 75	
11.0								St					
11.5													
12.0			CH	Silty CLAY with some fibrous organics; dark brown with black mottles. High plasticity					1/1/1/1/2/2/2 N=7		72/7		
12.5				Trace organics encountered and becomes light grey with occasional black mottles from 12.2 m depth.				M					
13.0								St					
13.5				200 mm thick layer of clayey SILT encountered from 13.2 m depth.				VSt			124/39		
14.0			SW	Silty fine to medium SAND; grey. Sand, subangular.					1/2/1/3/4/5/6 N=18				
14.5			ML	Clayey SILT with trace sand; grey. Low plasticity.				MD					
15.0			CH	Silty CLAY; grey. High plasticity.				VSt					
15.5								H					

TS = TOPSOIL

NA = Not Assessed

Dip test showed standing water at 3.0 m depth

ECBF = East Coast Bays Formation

TZ = Transition Zone

LOG OF BORING MBH-01

Geotechnical Investigation
224 Great South Road
Remuera, Auckland
15627.000.000

Client : Laura Fergusson Trust Core Diameter : 83 mm
Date : 22/11/2018 Hammer Efficiency : 80.8 %
Hole Depth : 21.5 m Logged By/Reviewed By : GC / LEG
Drilling Method : Mud Rotary Latitude : 174.787472
Drilling Contractor : Prodrill Ltd Longitude : -36.884113

Depth (m)	Material	Sample Type	USCS Symbol	DESCRIPTION	Log Symbol	Water Level	Moisture	Consistency/ Density Index	SPT N-Value	Pocket Pen. UCS (kPa)	Torvane Shear (kPa)	Total Core Recovery (%)	Notes
												25 50 75	
	ECBF TZ		CH	Silty CLAY; grey. High plasticity.					6/8/9/10/12/14 N=45				
15.5			SLT	Completely weathered, grey SILTSTONE; extremely weak. Recovered as clayey SILT, grey. Low plasticity. 70 mm thick layer of completely weathered, grey SANDSTONE encountered from 15.75 m depth.									
16.0													
16.5													
17.0													
17.5								EW	10/12/14/15/21 for 65 mm				
18.0													
18.5									21/29 for 55 mm				
19.0													
19.5			SLT	Highly weathered, grey SILTSTONE, very weak.				VW					
20.0													

TS = TOPSOIL

NA = Not Assessed

Dip test showed standing water at 3.0 m depth

ECBF = East Coast Bays Formation

TZ = Transition Zone

LOG OF BORING MBH-01

Geotechnical Investigation
224 Great South Road
Remuera, Auckland
15627.000.000

Client : Laura Fergusson Trust Core Diameter : 83 mm
Date : 22/11/2018 Hammer Efficiency : 80.8 %
Hole Depth : 21.5 m Logged By/Reviewed By : GC / LEG
Drilling Method : Mud Rotary Latitude : 174.787472
Drilling Contractor : Prodrill Ltd Longitude : -36.884113

Depth (m)	Material	Sample Type	USCS Symbol	DESCRIPTION	Log Symbol	Water Level	Moisture	Consistency/ Density Index	SPT N-Value	Pocket Pen. UCS (kPa)	Torvane Shear (kPa)	Total Core Recovery (%)	Notes
20.5	EAST COAST BAYS FORMATION ROCK		SLT	Highly weathered, grey SILTSTONE, very weak.	x			VW	50 for 50 mm			25 50 75	
21.0					x								
21.5					x								

End of Hole Depth: 21.5 m
Termination: Target depth

TS = TOPSOIL

NA = Not Assessed

Dip test showed standing water at 3.0 m depth

ECBF = East Coast Bays Formation

TZ = Transition Zone

LOG OF BORING MBH-02

Geotechnical Investigation
224 Great South Road
Remuera, Auckland
15627.000.000

Client : Laura Fergusson Trust Core Diameter : 83 mm
Date : 23/11/2018 Hammer Efficiency : 80.8 %
Hole Depth : 16.5 m Logged By/Reviewed By : GC / LEG
Drilling Method : Mud Rotary Latitude : 174.788624
Drilling Contractor : Prodrill Ltd Longitude : -36.884979

Depth (m)	Material	Sample Type	USCS Symbol	DESCRIPTION	Log Symbol	Water Level	Moisture	Consistency/ Density Index	SPT N-Value	Pocket Pen. UCS (kPa)	Torvane Shear (kPa)	Total Core Recovery (%)	Notes
	TS		ML	Topsoil									
0.5			ML	Clayey SILT with minor fine to coarse sand and fine to coarse gravel; brown with light grey and orange streaks. Low plasticity. Sand and gravel, subangular, scoria.				D			200+		
1.0								VSt			131/3		
1.5								H			200+		
2.0			CH	Silty CLAY; light grey with orange streaks. High plasticity.				1/1/0/1/1/0 N=2					
2.5								M					
3.0											118/56		
3.5								St - VSt	1/1/1/1/2/2 N=6				
4.0				Encountered 100 mm layer from 3.85 m depth of clayey SILT; light grey with orange streaks, Low plasticity.									
4.5									1/0/1/1/1/1 N=4		62/23		
5.0				Becomes grey with orange streaks from 4.8 m depth.									

TS = TOPSOIL
NA = Not Assessed

Dip test showed standing water at 3.5 m depth

ECBF = East Coast Bays Formation
TZ = Transition Zone

LOG OF BORING MBH-02

Geotechnical Investigation
224 Great South Road
Remuera, Auckland
15627.000.000

Client : Laura Fergusson Trust Core Diameter : 83 mm
Date : 23/11/2018 Hammer Efficiency : 80.8 %
Hole Depth : 16.5 m Logged By/Reviewed By : GC / LEG
Drilling Method : Mud Rotary Latitude : 174.788624
Drilling Contractor : Prodrill Ltd Longitude : -36.884979

Depth (m)	Material	Sample Type	USCS Symbol	DESCRIPTION	Log Symbol	Water Level	Moisture	Consistency/ Density Index	SPT N-Value	Pocket Pen. UCS (kPa)	Torvane Shear (kPa)	Total Core Recovery (%)	Notes
			CH									25 50 75	
5.5			ML	Clayey SILT; grey. Low plasticity.				St - VSt					
6.0			ML	Fine to coarse sandy SILT; grey. Low plasticity. Sand, subangular.					1/2/1/2/2/2/3 N=9		52/13		
6.5								St					
7.0			ML	Clayey SILT; grey. Low plasticity.									
7.5							M	VSt					
8.0			ML	Fine to coarse sandy SILT; grey. Low plasticity. Sand, subangular.					2/2/1/3/4/3/4 N=14				
8.5													
9.0			ML	Clayey SILT; grey. Low plasticity.				H					
9.5													
10.0			SST	Highly weathered, grey SANDSTONE; very weak.					5/7/1/9/15/20/6 for 10 mm				
			SLT	Completely weathered, grey SILTSTONE; extremely weak. Recovered as clayey SILT; grey. Low plasticity.									
								VW					
								EW					

GEOSCIENCE MACHINE BORING MBH - PRE-REVIEW.GPJ NZ DATA TEMPLATE 2.GDT 10/1/19

TS = TOPSOIL

NA = Not Assessed

Dip test showed standing water at 3.5 m depth

ECBF = East Coast Bays Formation

TZ = Transition Zone

LOG OF BORING MBH-02

Geotechnical Investigation
224 Great South Road
Remuera, Auckland
15627.000.000

Client : Laura Fergusson Trust Core Diameter : 83 mm
Date : 23/11/2018 Hammer Efficiency : 80.8 %
Hole Depth : 16.5 m Logged By/Reviewed By : GC / LEG
Drilling Method : Mud Rotary Latitude : 174.788624
Drilling Contractor : Prodrill Ltd Longitude : -36.884979

Depth (m)	Material	Sample Type	USCS Symbol	DESCRIPTION	Log Symbol	Water Level	Moisture	Consistency/ Density Index	SPT N-Value	Pocket Pen. UCS (kPa)	Torvane Shear (kPa)	Total Core Recovery (%)	Notes
												25 50 75	
			SLT		XXXXXX			EW					
10.5			SST	Highly weathered, grey SANDSTONE; very weak. Sand, fine to coarse.	XXXXXX								
11.0					XXXXXX			VW	50 for 30 mm				
11.5			SLT	Highly weathered, grey SILTSTONE; very weak. Encountered Joint, smooth, planar, very steeply inclined, very narrow at 11.5 m depth.	XXXXXX			VW					
12.0			SST	Highly weathered, grey SANDSTONE; very weak. Sand, fine to coarse.	XXXXXX			VW					
12.5					XXXXXX				38/12 for 10 mm				
13.0			SLT	Completely weathered, grey SILTSTONE; extremely weak. Recovered as clayey SILT; grey. Low plasticity.	XXXXXX			EW					
13.5			SST	Completely weathered, grey SANDSTONE; extremely weak. Sand, fine to medium. Recovered as silty SAND; grey.	XXXXXX			EW					
14.0			SLT	Highly weathered, grey SILTSTONE; very weak.	XXXXXX				50 for 25 mm				
14.5				Encountered 20 - 100 mm interbeds from 14.2 m depth of slightly weathered, grey SANDSTONE, very weak. Sand, fine to medium.	XXXXXX			VW					
15.0					XXXXXX								

TS = TOPSOIL

NA = Not Assessed

Dip test showed standing water at 3.5 m depth

ECBF = East Coast Bays Formation

TZ = Transition Zone

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LOG OF BORING MBH-02

Geotechnical Investigation
224 Great South Road
Remuera, Auckland
15627.000.000

Client : Laura Fergusson Trust Core Diameter : 83 mm
Date : 23/11/2018 Hammer Efficiency : 80.8 %
Hole Depth : 16.5 m Logged By/Reviewed By : GC / LEG
Drilling Method : Mud Rotary Latitude : 174.788624
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Depth (m)	Material	Sample Type	USCS Symbol	DESCRIPTION	Log Symbol	Water Level	Moisture	Consistency/ Density Index	SPT N-Value	Pocket Pen. UCS (kPa)	Torvane Shear (kPa)	Total Core Recovery (%)	Notes	
	EAST COAST BAYS FORMATION ROCK		SLT	Highly weathered, grey SILTSTONE; very weak.	x							25 50 75		
15.5														
16.0				Encountered 250 mm layer of fractured SILTSTONE (inferred crush zone) from 15.85 m depth.	x									
16.5					x									

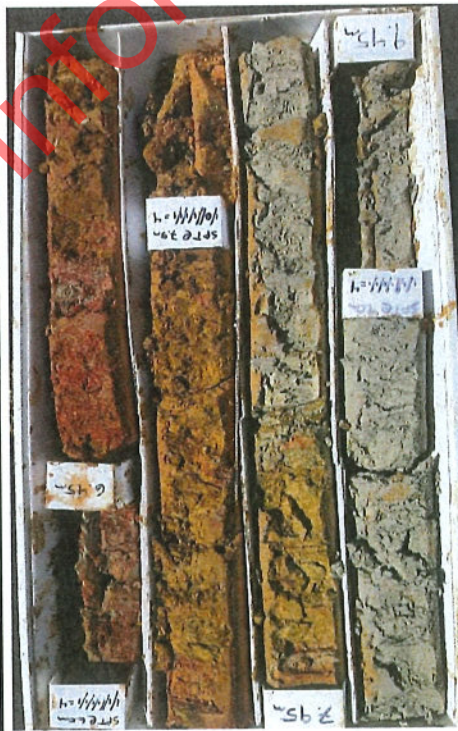
End of Hole Depth: 16.5 m
Termination: Target depth



0.0 - 2.9 m



2.9 - 6.0 m



6.0 - 9.45 m



9.45 - 12.8 m

ENGEO
—Expect Excellence—

Title:

MBH01 Core Box Photos

Client: Laura Ferguson Trust

Project:

224 Great South Road, Epsom,
Auckland

Size: A4

Drawn:

Checked:

Date: 28/11/2018

Scale:

Proj No: 15627.000.000

Revision: 0



12.8 – 19.65 m



15.65 – 19.5 m



19.5 – 21.5 m

ENGEO
—Expect Excellence—

Title:

MBH01 Core Box Photos

Client: Laura Ferguson Trust

Project:
224 Great South Road, Epsom,
Auckland

Designed: LA

Drawn:

Checked:

Date: 28/11/2018

Size: A4

Scale:

Proj No: 15627.000.000

Revision: 0



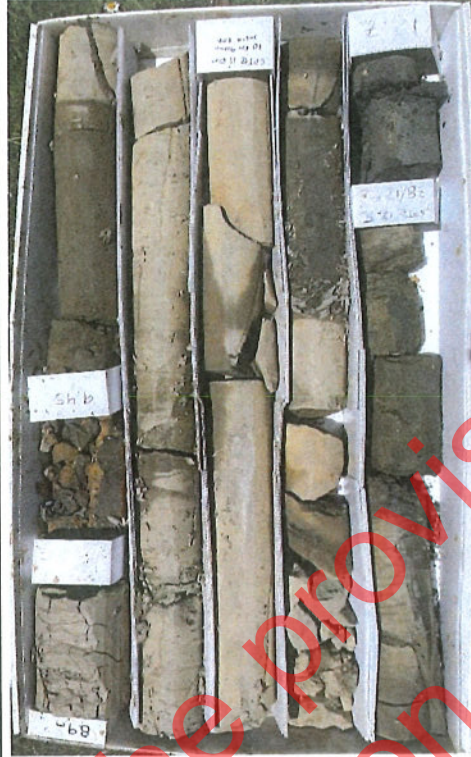
0.0 – 2.6 m



2.6 – 6.0 m



6.0 – 8.9 m



8.9 – 12.7 m

Title:

Client: Laura Ferguson Trust

ENGEO
—Expect Excellence—

MBH02 Core Box Photos

Project:
224 Great South Road, Epsom,
Auckland

Designed: LA

Drawn:

Checked:

Date: 28/11/2018

Size: A4

Scale:

Proj No: 15627.000.000

Revision: 0



12.7 - 16.5 m

Title:

ENGEO
—Expect Excellence—

MBH02 Core Box Photos

Client: Laura Ferguson Trust

Project:

224 Great South Road, Epsom,
Auckland

Designed: LA

Drawn:

Checked:

Date: 28/11/2018

Size: A4

Scale:

Proj No: 15627.000.000

Revision: 0

APPENDIX 4:

Scala Penetrometer and CBR Results

This report may only be reproduced in full.

Dynamic Cone (Scala) Penetrometer Results												
NZS 4402:1988 TEST 6.5.2												
Equivalent CBR Values using AUSTROADS Correlation												
PROJECT		Geotechnical Investigation - 224 Great South Road, Epsom, Auckland										
JOB NO		15627.000.000										
CLIENT		Laura Fergusson Trust										
MATERIAL / LAYER		Surficial Topsoil, Silts and Clays										
DATE TESTED		23-Nov-18										
Test No	1		2		3		4		5		6	
Test Location	S-1		S-2		S-3		S-4		S-5		S-6	
Depth Range mm	No of Blows	<i>Equiv CBR</i>	No of Blows	<i>Equiv CBR</i>	No of Blows	<i>Equiv CBR</i>	No of Blows	<i>Equiv CBR</i>	No of Blows	<i>Equiv CBR</i>	No of Blows	<i>Equiv CBR</i>
0 - 100	1	2	2	4	1	2	1	2	2	4	4	8
100 - 200	4	8	2	4	3	6	1	2	3	6	3	6
200 - 300	6	13	3	6	5	10	2	4	3	6	3	6
300 - 400	4	8	3	6	4	8	2	4	4	8	4	8
400 - 500	6	13	4	8	5	10	3	6	4	8	4	8
500 - 600	7	15	3	6	4	8	3	6	3	6	4	8
600 - 700	5	10	4	8	3	6	3	6	4	8	4	8
700 - 800	3	6	3	6	4	8	3	6	6	13	3	6
800 - 900	3	6	4	8	4	8	4	8	6	13	3	6
900 - 1000												

Test No	7		8		9		10		11		12	
Test Location												
Depth Range mm	No of Blows	<i>Equiv CBR</i>	No of Blows	<i>Equiv CBR</i>	No of Blows	<i>Equiv CBR</i>	No of Blows	<i>Equiv CBR</i>	No of Blows	<i>Equiv CBR</i>	No of Blows	<i>Equiv CBR</i>
0 - 100												
100 - 200												
200 - 300												
300 - 400												
400 - 500												
500 - 600												
600 - 700												
700 - 800												
800 - 900												
900 - 1000												
									Field Staff:	GC		
									Checked by:	LEG		

APPENDIX 5:

Laboratory Test Results

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the Official Information Act 1982

- | | |
|---|-----------------|
| ☐ 124 Montreal Street • Sydenham • Christchurch 8023 | Tel 03 328 9012 |
| ☐ 2-6 Gilmer Terrace • Plimmer Towers • Wellington 6011 | Tel 04 472 0820 |
| ☒ 8 Greydene Place • Takapuna • Auckland 0622 | Tel 09 972 2205 |
| ☐ 124 Maleme Street • Greerton • Tauranga • 3112 | Tel 07 777 0209 |

Project Name and ENGEO Reference	Laura Fergusson Trust Ltd - 15627.000.000		
Testing Conducted by	NB		
Date Samples Received	26.11.2018	Date Test Started	29.11.2018
Tests and Standards Used	Water Content NZS4402:1986:Test 2.1 Sampling <i>in situ</i> Density NZS4402:1986:Test 5.1.3 Shrink-Swell Index AS1289:Test 7.1.1 - 2003		

Shrink-Swell Index Testing Results

Sample ID	HA04 0.2 m to 0.7 m
Soil Description*	Clayey SILT
Initial Water Content (Swell Sample)	40.2%
Initial Water Content (Shrink Sample)	42.1%
Estimated Percentage of inert Inclusions	1%
Extent of Crumbling	Moderate Crumbling
Extent of Shrinkage Cracking	Moderate longitudinal cracking observed
Swelling Strain	0.0
Shrinkage Strain	7.5
Shrink-Swell Index	4.2

* Logged in accordance with NZGS Field Description of Soil and Rock, 2005.

For full log description, refer to relevant report appendix.