

22 April 2022

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Neil Construction Limited PO Box 8751 Auckland 1150

Attention: Trevor Canty

Dear Trevor,

RE: DUE DILIGENCE, GEOTECHNICAL INVESTIGATION REPORT 73 TRIG ROAD, WHENUAPAI

1 INTRODUCTION AND SCOPE

CMW Geosciences (CMW) was engaged by Neil Construction Limited as part of their due diligence process to carry out preliminary geotechnical investigation and reporting of the site at 73 Trig Road, Whenuapai, which is being considered for the construction of light industrial buildings.

The scope of work has been set out to cover the email brief dated 29 March 2022, with associated terms and conditions unchanged as part of our original contract.

The purpose of this report is to describe the investigation completed, the ground conditions encountered and to provide recommendations with respect to geotechnical aspects of the proposed subdivision development as detailed in our proposal letter.

2 SITE DESCRIPTON

The site is located at 73 Trig Road, Whenuapai, legally described as Lot 1 DP 117365, as illustrated in *Figure 1* below. The property has an approximate area of 2.6 hectares and is irregular in shape, being bound by Trig Road to the west, and neighbouring rural properties to the east, north and south

The gradient across the site is generally consistent, falling gradually from the south at approximately RL42.0m down to RL 32.0m along the northern boundary, with an approximate gradient of 1(V):15(H) across the majority of the site.

The site itself currently comprises mostly pasture and overgrown, historic horticultural patches. Tall trees run along most of the paddock fence lines as well as being scattered in the north and north-western areas of the property. An existing dwelling, shed and glasshouse are located within the north-western portion of the site.



Figure 1: Site Location (Auckland Council GeoMaps)

The eastern boundary backs onto the wider Trig and Brigham Creek Road development site which is currently an active earthworks site. (CMW has also been engaged by the client as the Geotechnical Engineer on this adjacent site).

Access to the site is currently from the existing driveway along the north-western boundary, off Trig Road.

3 PROPOSED DEVELOPMENT

At the time of undertaking our investigation and reporting the project was in the early stages of planning and it was anticipated the geotechnical investigation would provide details of preliminary feasibility options for the site.

We have prepared this report on the basis that a future development will broadly comprise minor cuts and fills to form a near level site supporting industrial buildings with shallow strip and pad foundations and widespread floor loads of up to 20kPa.

4 INVESTIGATION SCOPE

4.1 Desktop Study

A desktop study was carried out before commencing fieldwork. This included online research through Auckland Council Geo Maps, Dial Before You Dig, aerial photographs, New Zealand Geotechnical Database (NZGD), and review of existing information.

A review of historic and recent aerial photographs between 1959 and 2017 indicated the following activity:

- Between 1959 and 1996 the subject site was developed from agricultural land for horticultural purposes.
- The existing structures on site were constructed around 1985.

 From 2003 to approximately 2012 the sites horticultural development appears to have been let go and the area returned to pasture.

A review of existing investigation data (a hand auger, CPT, percussion borehole and waterbore) within the site and nearby from NZGD, indicated that:

- The site is underlain by silts and clays of the Puketoka Formation, with potential pockets of historic filling (up to 0.7m) along the south-western boundary.
- Waitemata Group bedrock (sandstone and mudstone) is located at depths of greater than approximately 8m below current ground levels.

4.2 Field Investigation

Following a Dial Before You Dig review, the field investigation was carried out on 4 April 2022 and 20 April 2022. All fieldwork was carried out under the direction of CMW Geosciences in general accordance with the NZGS guidelines¹. The scope of the fieldwork was as follows:

- A walkover survey of the site to assess the general landform, site conditions and adjacent structures / infrastructure. The site walkover generally confirmed the existing contours of the area and there was no evidence of any recent change in the site conditions.
- Five hand auger boreholes, denoted HA01B-22 to HA05B-22, were drilled using a 50mm diameter auger to target depths of up to 5.0m below existing ground levels to observe the near surface soil profile and to facilitate vane shear strength testing. All hand auger boreholes reached the target depth of 5.0m. Engineering logs of the hand augers, together with peak and remoulded vane shear strengths can be found appended to this report.

The approximate locations of the respective investigation sites referred to above are shown on the Site Investigation Plan in *Figure 2* below. Test locations were measured using a handheld GPS. Elevations were inferred from the existing Auckland Council GIS contours.

¹ NZ Geotechnical Society (2005), Field Description of Soil and Rock, Guideline for the field classification and description of soil and rock for engineering purposes.



Figure 2: Site Investigation Plan (Auckland Council GIS)

5 GROUND MODEL

5.1 Published Geology

Published geological maps² for the area depict the regional geology as comprising Late Pliocene to Mid Pleistocene alluvial deposits of the Puketoka Formation as illustrated in *Figure 3* below.

These alluvial clay and silt deposits include pumiceous mud, sand and gravel with muddy peat and lignite, rhyolitic pumice (including non-welded ignimbrite, tephra and alluvial pumice deposits) and massive micaceous sand beds. Below these upper soil layers, the deeper geological formation is reported to comprise interbedded muddy sandstones and siltstones of the East Cast Bays Formation within the Waitemata Group.

Based on the known history of the site and surrounding land levels, we expect that uncompacted fill may be present across some areas of the site due to soft landscaping, past horticultural works, and historic development.

² Edbrooke, S. W. (compiler) 2001: Geology of the Auckland area. Institute of Geological & Nuclear Sciences 1:250 000 geological map 3. 1 sheet +74 p. Lower Hutt, New Zealand. Institute of Geological & Nuclear Sciences.



Figure 3: Regional Geology (GNS Science Geology Map)

5.2 Stratigraphic Units

5.2.1 Topsoil

Topsoil was encountered in all hand auger boreholes to depths of between 200mm and 500mm.

5.2.2 Puketoka Formation Alluvium

Alluvial deposits of the Puketoka Formation were encountered in all hand auger boreholes underlying the topsoil and to the target depth of 5.0m. The soils encountered were generally consistent in all 5 boreholes and also similar to that those encountered in the adjacent sites with a combination of silty clays and clayey silts. The materials ranged from brown grey to brown mottled orange and recorded vane shear strengths ranged from stiff to very stiff with values averaging in excess of 100kPa.

5.2.3 Waitemata Group Soils

Waitemata Group soils were not clearly identified within any of the hand auger boreholes, however based on investigations undertaken on the adjacent site, and the waterbore undertaken historically within this site, we expect Waitemata Group units to underlie the site at depths greater than approximately 8m.

5.3 Groundwater

During the investigation, which was completed in early autumn conditions (April 2022), groundwater was encountered within the boreholes at the depths provided in Table 1 below.

Table 1: Groundwater Data								
Parahala	4 April 2022							
Borenoie	Depth (mbgl)	Elevation (m RL)						
HA01B-22	3.8	29.96						
HA02B-22	4.2	29.82						
HA03B-22	NE	-						
HA04B-22	4.8	33.7						
HA05B-22	4.0	36.0						
Note: mbgl = metres below ground level. NE = Not Encountered.								

It should be noted that although groundwater was encountered at the depths noted above, given the presence of a variable and clayey soil profile, it is possible that perched groundwater may occur at different levels during and following periods of rainfall. It should also be noted that groundwater will fluctuate seasonally.

6 PRINCIPAL GEOHAZARDS AND RECOMMENDATIONS

6.1 General

On the basis of our investigation and review of findings we are satisfied that the site is generally geotechnically suitable for a subdivision containing light industrial structures, subject to the comments and recommendations below.

6.2 Seismic Site Subsoil Category

Based on the conditions observed during the investigation, combined with experience working in the surrounding area, the seismic site subsoil category is provisionally assessed as being Class C (shallow soil site) in accordance with NZS 1170.5.

6.3 Liquefaction

Soil liquefaction is a process where typically saturated, granular soils develop excess pore water pressures during cyclic (earthquake) loading that exceed that effective stress of the soil. In loose soils, some dilation can occur during this process, which can lead to individual soil grains moving into suspension. Following the onset of liquefaction, the shear strength and stiffness of the liquefied soil is effectively lost causing excessive differential settlement of the ground surface, bearing capacity failure and collapse of structures and low-angle lateral spreading of slopes in liquefiable soils. In accordance with the NZGS guidance³ the liquefaction susceptibility of the soils on this site has been considered with respect to geological age and soil fabric.

Across this site, soils below the water table comprise alluvial deposits of the Puketoka Formation. These soils are significantly older than what case history data would suggest as being susceptible to liquefaction. In addition, they typically comprise silty clays and clays that are considered to be too fine grained to be at risk of liquefaction.

³ Earthquake Geotechnical Engineering Practice, Module 3: Identification, assessment and mitigation of liquefaction hazards", (May 2016)

6.4 Load Induced Settlement

Based on the materials observed in our boreholes, settlement is considered to be a low risk for light weight commercial or industrial buildings. However, due to the limited investigation scope, it is possible that areas of soft subsoils may be exposed during future site development. It is recommended that any soft materials uncovered as part of earthworks operations are undercut and replaced with compacted engineered fill.

Soft subsoils may be subject to consolidation settlements due to potential loadings from industrial buildings and floor slabs. Pre-loading of soft soils, general ground improvement during earthworks and possibly piling, or reinforced fill rafts and basal reinforcements may be necessary to mitigate any significant settlement hazards across the industrial zones.

Depending on the proposed earthworks plans, settlement analyses may need to be undertaken as part of any future detailed investigation and design. This will allow for the development of appropriate ground remediation options if necessary.

6.5 Earthworks

All earthwork activities must be carried out in general accordance with the requirements of NZS 4431 and the requirements of the Auckland Council Infrastructure Development Code under the guidance of a Chartered Professional (Geotechnical) Engineer.

6.6 Groundwater Impact Assessment

A preliminary assessment has been made of the impact of any proposed earthworks on groundwater conditions in accordance with the requirements of Section E7 of the Auckland Unitary Plan (AuP).⁴ Following review of the groundwater levels recorded in the investigation boreholes it is considered that future development should comply with the AUP standards E7.6.1.6 and E7.6.1.10 provided cuts and fills are kept to a minimum.

7 FURTHER WORK

This investigation and reporting has been undertaken to support a pre-purchase assessment of the site. If purchase proceeds, further detailed investigation will be required once design/development plans have been confirmed. It should also be noted that no investigation was completed within the vicinity of the existing residential dwelling and therefore further investigation will likely be required to confirm the ground conditions within this area.

8 LIMITATION AND CLOSURE

This report has been prepared for our client Neil Construction Limited. Liability for its use is limited to these parties and to the scope of work for which it was prepared, as it may not contain sufficient information for other parties or for other purposes.

It should be noted that factual data for this report has been obtained from discrete locations using normal geotechnical investigation techniques. As such investigation methods 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 considered in the report.

⁴ Auckland Unitary Plan Operative in Part (Updated 12 June 2020)

If site conditions encountered vary from those outlined above and/or if any unforeseen conditions develop, CMW must be advised immediately such that we can review the recommendations and advise any changes that may be required.

For and on behalf of CMW Geosciences

Prepared by:

Ugan

Tessa Egan Project Engineering Geologist

Reviewed and authorised by:

Andrew Linton Principal Geotechnical Engineer

Distribution: 1 electronic copy to Neil Construction Limited via email Original held at CMW Geosciences

Attachments: Hand Auger Borehole logs





HAND AUGER BOREHOLE LOG - HA02B-22														
Project: Trig & Brigham Creek Road (73 Trig Road)														
P	Project No.: AKL2019-0040										s			
Date: 04/04/2022 Borehole Location: Refer to site plan Logged by: NK Checked by: JW Scale: 1:25									Sheet 1 of 1					
Position: 1744706.6mE; 5926190.8mN Projection: NZTM Elevation: 34.02m Datum: AUCKHT1946 Survey Source: Hand Held GPS														
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			33.8			CH: Silty CLAY: Brown mottled orange. High Plasticity. (Puketoka Formation)	м							
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This report is based on the attached field descrip ion for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.														



HAND AUGER BOREHOLE LOG - HA04B-22												
Client: Neil Group Limited												
	Project: Trig & Brigham Creek Road (73 Trig Road) Site Location: Whenuapai											
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	1.6	Peak = 180kPa Residual = 99kPa					М					
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					<u>k</u> _							
	2.4	Peak = 180kPa Residual = 119kPa			<u>*_</u> *			VSt				
						at 2.60m, becoming pink streaked red.		100				
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	3.2	Residual = 64kPa			<u>*</u> _	at 3.20m, becoming brown mottled red and orange.						
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						at 3.80m, becoming grey mottled black with trace organic inclusions.						
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-	4.8	Peak = 122kPa										
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				5 -	-	Borehole terminated at 5.0 m						
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Remarks: Groundwater encountered at 4.8m.												
		This report	is ba	sed (on the	attached field descrip ion for soil and rock. CMW Geosciences - Field Logging Guide, Revision 3 -	April	2018				
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