



ENGEO

Geotechnical Investigation

14 Waiu Street

Wainuiomata

Lower Hutt

Submitted to:

Envelope Engineering Limited

Level 1 / 68 Dixon Street

Te Aro

Wellington 6011

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ENGEO Document Control:

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1 Introduction

ENGEO Ltd was requested by Envelope Engineering Limited to undertake a geotechnical investigation of the property at 14 Waiu Street, Wainuiomata, Lower Hutt. This work has been carried out in accordance with our signed agreement dated 1 February 2021. The purpose of the assessment was to assist with your resource consent application for the proposed development of the site. Our main objectives of the investigation was to provide information on the likely composition and strength of the existing fill and to provide comments on geotechnical suitability. We understand that it is proposed to place up to approximately 81,000 m³ of additional cleanfill across the site footprint to provide a suitable building platform.

Our scope of works included the following:

- Review of published geotechnical and geological information relevant to the site.
- Site assessment by an experienced ground engineering professional.
- Coordination of a local buried services location contractor to mark out any underground services that may be present on-site.
- Six test pits to a maximum depth of 5 m to assess the typical soil composition of the existing fill.
- Production of this geotechnical report based on the findings of our enquiries and ground investigation and recommendations for further investigations and analysis.

2 Background

We understand the site at 14 Waiu Street was previously used and consented as a clean fill site.

We understand resource consents have been sort to allow the placement of further clean fill and for the remediation of the site to a level suitable for building platforms. It is noted the Hutt City Council have registered an encumbrance on the property title stating that “...no building is to commence on the land until the land has been certified by a chartered professional engineer suitably experience in the geotechnical field in accordance with the conditions for the clean-fill in the resource consent.”

3 Site Description

The site at 14 Waiu Street is located on a relatively flat site in an industrial area in Wainuiomata, Lower Hutt. The site is approximately 3.51 hectares and is elevated above the surrounding industrial properties to the west and the south. The site is lightly vegetated with gorse and shrubs. The site location is shown in Figure 1.

Figure 1: Site Location Plan

Images retrieved from Google Earth (top) and Bayleys (bottom)

4 Desktop Study

4.1 Geological Setting

The geology of the Wellington area has been mapped by the Institute of Geological and Nuclear Sciences (Begg and Johnston, 2000). The mapping indicates the site is underlain by Rakaia Terrane, Sandstone-Mudstone sequences, poorly bedded Sandstone, and fan deposits.

4.2 Nearby Faults

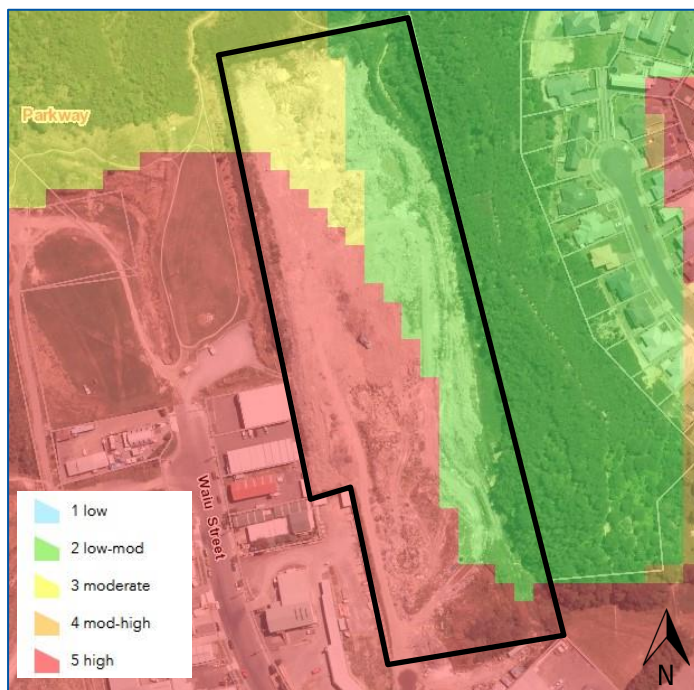
The New Zealand Active Fault Database indicates that the site is located within 20 km of six active faults:

- **Whitemans Valley Fault:** Approximately 2.7 km to the southeast.
- **Wellington Fault:** Approximately 5.2 km to the northwest.
- **Otaki Fault:** Approximately 10.2 km to the northwest.
- **Wairarapa Fault:** Approximately 11.2 km to the southeast.
- **Aotea Fault:** Approximately 11.3 km to the southwest
- **Evans Bay Fault:** Approximately 12.5 km to the southwest
- **Ohariu Fault:** Approximately 13.7 km to the northwest.
- **Akatarawa Fault:** Approximately 13.9 km to the north.

4.3 Regional Seismic Hazard

Greater Wellington Regional Council hazard maps for Wellington indicate that the site area has a combined earthquake hazard rating that varies across the site from low-moderate in the east to high in the southwest as shown in Figure 2. This is based on a low liquefaction hazard, low slope failure hazard and high ground shaking hazard. The site is outside the tsunami inundation zone. It should be noted that the maps are regional in nature and the hazard potential indicated in the maps does not necessarily apply to any specific site.

Figure 2: Combined Earthquake Hazard Map



Data and imagery retrieved from GWRC Web Map Viewer

4.4 Historical Aerial Imagery

We have reviewed historical aerial imagery of the site shown in Figure 3, available through Retrolens, and Google Earth with the earliest available photograph dated 1941. These photos were viewed under the context of identifying changes to morphology and use of the site, outlined below:

- Imagery dated 1941 and 1954 shows the site was mostly grassland with a small meandering stream present. A hedge can be seen passing through the site.
- Imagery dated 1972 shows a recently constructed road and residential properties to the south of the site. Evidence of a stream is no longer visible.
- Imagery from 1995 shows the site was cleared of any vegetation and the surrounding land is undergoing earthworks.
- Google Earth imagery from 2002 shows the re-establishment of light vegetation on the site and the presence of a dirt track across the site.

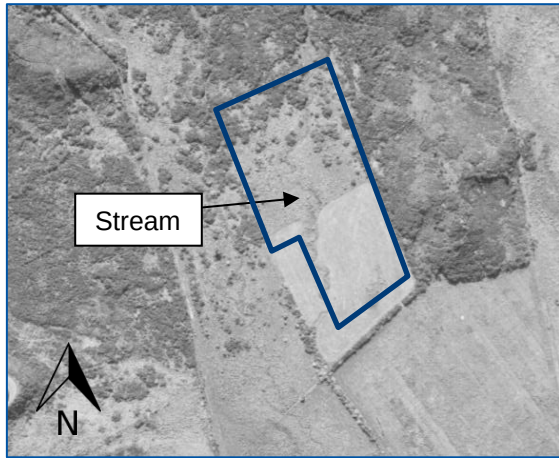
Figure 3: Historical Photos

Photo 1: 1954 Retrolens



Photo 2: 1972 Retrolens



Photo 3: 1995 Retrolens



Photo 4: 2002 Google Earth

4.5 Previous Investigations

We have reviewed previous investigations in the area available through the New Zealand Geotechnical Database (NZGD) and publically available research. The following information is relevant to the site:

- Greater Wellington Waterbore R27/6893: Approximately 120 m to the north of the site. 7 m of gravelly silt, silt and clayey silt. Free flowing water at 6.5 m depth.
- Greater Wellington Waterbore R27/6894: Approximately 120 m to the northwest of the site. 6 m of silty clay and gravelly silt. Free flowing water at depth of 4.3 m to 5.6 m.
- ENGEO BH02: Approximately 400 m to the south east of the site. 20 m of alternating layers of loose sands and very soft to soft silt.
- Greater Wellington Waterbore R27/6932: Approximately 460 m to the northwest of the site. 39 m of alternating layers of silt, clay, sand and gravel.

- NZ Geological Survey WS1 Borehole: Approximately 1.6 km to the south east of the site. The WS1 borehole is the only borehole to extend to basement rock within the Wainuiomata Valley. The borehole has alternating layers of silt, sandy silt and sandy gravel. Basement Greywacke rock is encountered at 61m depth. The softer sediments have an approximate shear wave velocity of 90-150 m/s and are up to 32 m deep. SPT blow counts range from 3 to 30.

4.6 Document Review

We have reviewed a significant number of documents relating to the previous filling works across the site. The following documents discussed below are the most relevant to the geotechnical aspects of the site.

Resource Consent Application WGN180401

The site was notified by Greater Wellington Regional Council (GWRC) as not meeting the consent conditions of a clean fill site. A resource consent application decision by GWRC (reference WGN180401 dated 24 August 2018) notes the following historical non-compliance:

- Material has not be sufficiently compacted and there are areas of isolated loose fill.
- The presence of unsuitable material, notably reinforced concrete on the surface of the site.
- The site was not contoured in a manner that water runoff could be sufficiently controlled.
- Not all of the placed material is likely to have met the definition of clean fill. Two test pit samples taken show that concentrations of some contaminants exceed background levels.

Various Hutt City Council

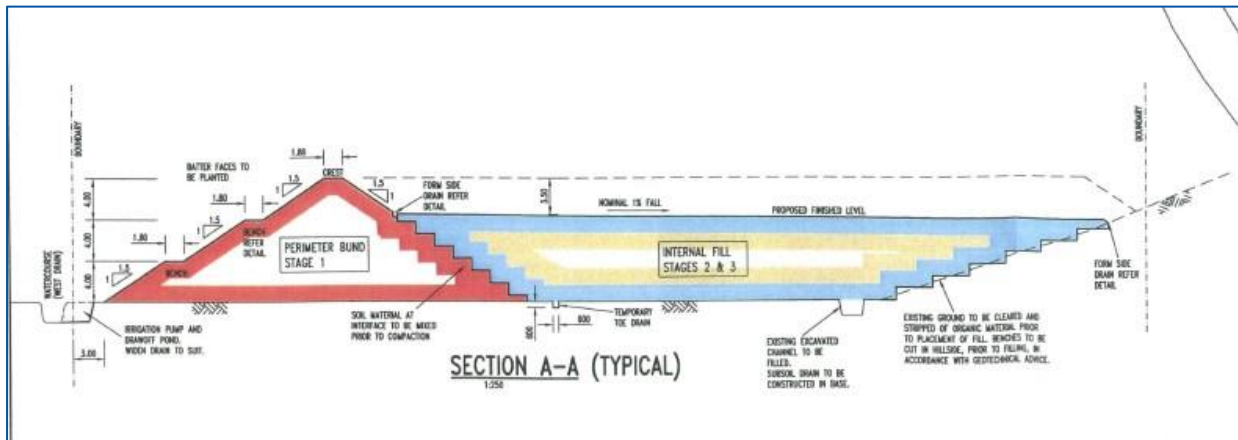
A number of a Hutt City Council infringement notices were issued to the previous land owner and consent holder with some relating to material being placed that did not meet the requirement of clean fill. These included metal, construction debris and car parts.

Resource Consent Application RM060334

A resource consent application dated 22 June 2006 was applied for by Cuttriss Consultants Limited on behalf of the site owner prior to the clean filling operation. The application sought consent to operate a clean fill site of 300,000 m³. The following is detailed in the application:

- Removal of topsoil across the site.
- Clean fill operation is to involve the placement of material sourced from demolition sites and sites where excess earth and other suitable fill material is generated.
- The operation will involve three stages. Stage 1 will involve the creation of earth bund around the western perimeter of the site with an overall height of 12 m. The bund is to have two 1.5 m wide benches and will be sloped at 1V:1.5H. Stages 2 and 3 will involve the placement of clean fill within the inside area of the bund to a depth of approximately 8.4 m with a finish level below the top of the bund of 3.5 m. A design cross section of these stages is shown in Figure 4.

Figure 4: Design Cross Section of Clean Fill Operation



A Geotechnical report by GNS dated 7 September 2005 was provided along with the resource consent application. The following is detailed in the report:

- The valley floor to the west of the ridge (proposed clean fill area) is formed of an unknown thickness of sediments. Sediments are expected to be mainly wet, soft compressible organic muds with sandy layers. The report goes on to say, "*The sediments of the valley floor will consolidate and settle as they are loaded with clean fill. However, as the projected life of the clean fill operation is likely to be considered to be of the order of (10) years, there will be ample time available for the settlement to occur as the filling takes place, and I would expect little or no settlement to occur once filling on the site is completed.*"
- The proposed bunds are to be composed of, well-graded, clean demolition and earth fill materials. When compacted and formed, the 1V:1.5H slopes of the bund will be stable and not prone to any form of slumping or slope instability.
- Demolition and earth materials will require careful monitoring as they are placed to ensure they are well graded and contain fines to fill voids. Large sized material should be broken down and blended before being placed and compacted in 500 mm layers.

This report was later supplemented on 24 April 2008 with the addition of site investigations. The investigations found that below the topsoil is dense silty gravelly material. It was concluded that once topsoil was stripped, the silty gravelly material would provide a good sub-base foundation for the proposed clean fill. Thin layers of organic muds and silts were noted in some test pits which may consolidate as the site is filled. Fill testing was to be completed using Benkelman Beam tests after 1 m of placed fill.

Inspection of Clean Operations

Filling operations were inspected by GNS and reported in a letter dated 18 May 2010. The letter concluded that the recommendations outlined in previous GNS letters had been taken on board and were being enacted on-site. Benkelman beam testing showed tracking achieved "*excellent compaction*". However, it was noted that fill being placed may be too thick to ensure adequate compaction. We note that no testing data is appended to the inspection letter and the values of deflection measured from a Benkelman beam test that qualified as "*excellent compaction*" were not provided.

4.7 Survey

We have been provided a survey completed by Harrison Grierson dated 24 April 2020. Based on the contours of the survey, the bund on the western edge of the site has a maximum height of 4.5 m at a batter of 1V:4H (~15 degrees). The fill placed on the inside of the bund is approximately at the same level as the top of the bund. Based on the survey, it appears the site was not constructed to the maximum proposed design levels.

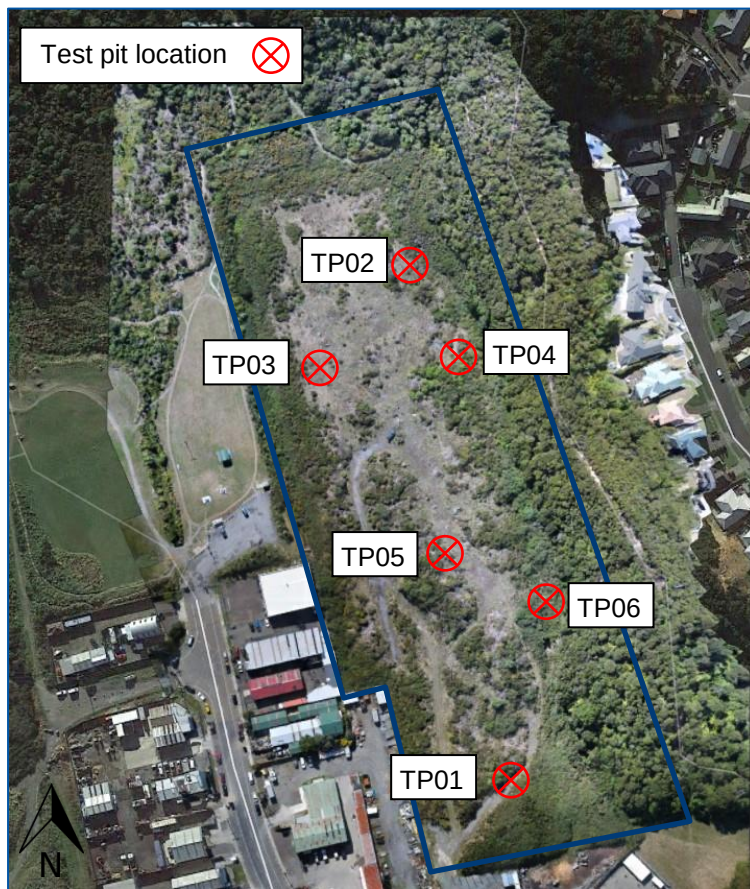
5 Site Investigation

ENGEO visited the site on 17 February 2021 to complete a site assessment and preliminary test pit investigation. Six test pits to a maximum depth of 5.0 m were completed across the site to give a preliminary assessment of the composition of the fill material across the site. A test pit location plan is shown in Figure 5 and full logs are attached as Appendix 1.

Natural ground was encountered in TP02 at a depth of 2.7 m. The remainder of the test pits did not encounter natural ground. Fill encountered across the site was highly variable and contained large amounts of concrete. Variable amounts of domestic waste, treated timber, organic soils, brick, asphalt and metal were present in test pits. Scala probes were completed at each test pit, however due to the presence of concrete and other large materials, most encountered practical refusal at a shallow depth. It was noted that many of the test pits had unstable sidewalls.

Perched water was noted in TP01. The groundwater table was not encountered in any of the test pit holes.

Figure 5: Test Pit Location Plan



6 Geotechnical Recommendations

6.1 Seismic Subsoil Class

As discussed in Section 4.5, alluvium material has been proven to be up to 61 m thick approximately 1.6 km southeast of the site and at least 20 m deep, approximately 400 m southeast of the site. Due to limited information of the depth to rock and the composition and density of the natural material beneath the site, we consider the site to be subsoil Class D. If the strength and thickness of the alluvium can be determined through further investigation, either boreholes or geophysical techniques, it may be possible to prove site subsoil Class C.

6.2 Liquefaction

The scope of this preliminary geotechnical investigation report did not include an assessment of the liquefaction risk associated with the site. We note the regional hazard map for the site indicates a low liquefaction risk. The groundwater table was not encountered during our test pit investigation and we do not consider the materials encountered in our test pits to be potentially liquefiable. Based on the potential for soft silts and a groundwater table depth below the natural ground surface of approximately 4.3 m to 6.5 m, we consider a detailed liquefaction assessment of the natural ground below the fill should be completed.

6.3 Existing Fill Compaction and Settlement

Based on our investigation and review of relevant documents, the existing fill is likely to have not been placed and constructed in accordance with the original consent and geotechnical report. We consider construction monitoring completed during filling does not adequately provide evidence that the fill material has been compacted sufficiently. Furthermore, our investigations and review of documents shows that the composition of the fill does not meet the definition of clean fill as stated in the Wasteminz Technical Guidelines for Disposal to Land 2018.

Providing an estimate of the likely settlement of the existing material is challenging due to the highly variable nature of the material. Organic soft soils were observed in the test pit investigation in the existing fill and we consider it likely that differential settlement will occur if a vertical load is applied.

We have used the Goodger and Leach, 1990 method to estimate potential self-weight settlements. Medium compacted rock fill and well controlled domestic refuse placed in layers is expected to settle 1% to 10% of the fill thickness. Based on the assumption of approximately 8.4 m of fill at the site (our conservative estimate of the material on-site based on the Cuttriss drawing), total settlements in the order of 84 mm to 840 mm can be expected under self-weight. This range is a total settlement and not a differential settlement. The self-weight settlement of general fills is assumed to occur over 10 years, although refuse fills can take over 30 years to stabilise. Therefore, we note that some immediate settlement is likely to have already occurred and that the above estimates do not consider the presence of soft compressible soils below the existing fill.

Under loading of additional fill, we consider settlements of up to 25% of the total thickness of fill (existing plus new) could occur.

It must be noted, that sub-surface conditions vary greatly across the site, and that the above settlement assumptions are based on a low density of investigation and testing.

6.4 Fill Batters

No investigations were completed within the fill bund, however based on the information provided in the GNS report, we understand the bund is composed of well-graded, clean demolition and earth fill materials. The bund is presently at a maximum height of 4.5 m at a 1V:4H slope batter and is moderately vegetated with grasses and shrubs. Due to the low angle of the bund, we consider it is unlikely to present any future instability. However, due to the anticipated material that was used to construct the bund, we recommend a horizontal setback between any buildings and the crest of bund be equal to the vertical height of the bund.

6.5 Foundation Recommendations

Based on our preliminary assessment of the site, we consider three broad types of foundations are applicable for the site, summarised in Table 1.

Table 1: Foundation Recommendations

Type	Objectives	Constraints
Deep piles	Negligible settlement and minimal earthworks required	Piles will need to extend into competent ground within the natural ground below the fill. Augured or driven piles through variable fill with large amounts of reinforced concrete will be difficult. Would require investigations into natural ground.
Gravel raft ground improvement (e.g. Type G1d reinforced crushed gravel raft)	Improving the ground to allow for shallow foundations. This can utilise the proposed additional 81,000 m ³ of fill.	Will require careful monitoring of settlement of the gravel raft on top of the historical fill. Amount and rate of settlements difficult to quantify. We note there is no guarantee when settlements may cease to a rate that is suitable for construction. If a raft is used, we recommended frequent surveying of points to monitor settlement. A geotechnical engineer and structural engineer can confirm an acceptable amount of settlement for the likely proposed buildings. Would require the stripping of topsoil material and testing of the subgrade.
Preloading	Placement of additional fill to accelerate settlement. Allows for shallow foundations.	Will require fill thickness greater than the finished levels, then removal of the excess fill. Will require careful monitoring of settlement of the fill on top of the historical fill. Amount and rate of settlement difficult to quantify. We note there is no guarantee when settlements may cease to a rate that is suitable for construction.
Removable of unsuitable material and replacing with engineered fill	Allows for shallow foundations and minimises the risk of settlements.	Requires large volumes of earthworks and potential disposal of contaminated material.

6.6 Earthworks

For the placement of additional fill on the site we recommended all vegetation and topsoil shall be stripped before the placing of additional fill. A geotechnical engineer shall be engaged to inspect the subgrade is free of any unsuitable material. Unsuitable material is to be removed and replaced with compacted hard fill.

New fill shall be placed in 300 mm lifts and compacted. The standard compaction and method of determination shall be as set out in NZ standards NZS4431 and NZS4402. Fill shall be tested every 600 mm to confirm adequate compaction.

We recommended at the completion of placing fill, the site should be surveyed with multiple points to allow for the ongoing monitoring of settlement. We note there is significant uncertainty in when settlements will reach acceptable rates. This should be confirmed by a geotechnical engineer, a structural and civil engineer should also comment on the effect of these settlements on infrastructure (roads, services etc.) and proposed buildings.

7 Conclusions and Future Work

From a geotechnical perspective, we consider the site is suitable for future business development as long as the recommendations in this report are adopted in any future design. We recommend the following future work be considered as the design stage progresses.

- Detailed foundation recommendations. This may include further investigations depending on the type of foundation recommendation adopted.
- Detailed liquefaction assessment comprising of boreholes through the natural ground stratigraphy.
- Detailed site class investigation (if required). This can be completed concurrent to the liquefaction assessment boreholes.

8 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, Envelope Engineering Limited, 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 (04) 472 0820 if you require any further information.

Report prepared by



Connor Chisnall

Engineering Geologist

Report reviewed by



Karen Jones, CEnvP

Principal Engineering Geologist

APPENDIX 1: Investigation Logs



LOG OF TEST PIT TP01

Geotechnical Investigation

14 Waiu Street
Wainuiomata
18286.000.001

Client : Envelope Engineering Ltd Shear Vane No : N/A
Date : 22/02/2021 Logged By : CM
Max Test Pit Depth : 3.1 m Reviewed By : CC
Digger Type/Size : Bucket Excavator Latitude : -41.251057
Bucket Type/Size : 60 cm Longitude : 174.930127

Depth (m BGL)	Material	Excavatability (Relative Scale)	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane, Su Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
		Easier	Harder								2 4 6 8 10 12
0.5	FILL		ML	SILT with some gravel and some sand; greyish brown. Low plasticity; gravel is fine to coarse, angular to subangular, greywacke; sand is fine to coarse. Contains concrete, red brick and domestic waste. [FILL]					Medium Dense to Dense		
1.0			GM	Silty sandy fine to coarse GRAVEL with minor cobbles and minor boulders; bluish grey. Well graded, angular to subangular, greywacke; sand is fine to coarse; cobbles are angular to subrounded; boulders are subangular, up to 210 mm. Contains wood, concrete and domestic waste. [FILL]					Loosely packed		
1.5								M	Loose to Medium Dense		
2.0									Dense		
2.5									Loosely packed		

GEOTECH TEST PIT LOG - PHOTOS TEST PIT LOGS.GPJ NZ MASTER DATA TEMPLATE.GDT 3/8/21

Bucket excavator met target depth at 3.1 m. at 3.1 m.
Scala Penetrometer met practical refusal at 1.7 m depth.
Standing groundwater was not encountered.

LOG OF TEST PIT TP01

Geotechnical Investigation

14 Waiu Street
Wainuiomata
18286.000.001

Client : Envelope Engineering Ltd **Shear Vane No** : N/A
Date : 22/02/2021 **Logged By** : CM
Max Test Pit Depth : 3.1 m **Reviewed By** : CC
Digger Type/Size : Bucket Excavator **Latitude** : -41.251057
Bucket Type/Size : 60 cm **Longitude** : 174.930127

Depth (m BGL)	Material	Excavatability (Relative Scale)	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane, Su Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
		Easier	Harder								2 4 6 8 10 12
3.0	ALLUVIUM		GM	Sandy SILT with trace gravel; light grey mottled orange. Low plasticity; sand is fine to medium; gravel is fine to medium, subangular, greywacke.				M	-		
			ML								
3.5											
4.0											
4.5											
5.0											

Depth of Excavation: 3.1 m
Termination Condition: Target depth



Bucket excavator met target depth at 3.1 m. at 3.1 m.
 Scala Penetrometer met practical refusal at 1.7 m depth.
 Standing groundwater was not encountered.



LOG OF TEST PIT TP02

Geotechnical Investigation

14 Waiu Street
Wainuiomata
18286.000.001

Client : Envelope Engineering Ltd Shear Vane No : N/A
Date : 22/02/2021 Logged By : CM
Max Test Pit Depth : 5 m Reviewed By : CC
Digger Type/Size : Bucket Excavator Latitude : -41.249159
Bucket Type/Size : 60 cm Longitude : 174.929204

Depth (m BGL)	Material	Excavatability (Relative Scale)	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane, Su Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
		Easier	Harder								2 4 6 8 10 12
	FILL			ML Sandy SILT; brown. Low plasticity; sand is fine. Contains organics and rootlets. [TOPSOIL]				M	-		
0.5				GM Silty fine to coarse GRAVEL with some sand and some gravel; grey mixed brown. Well graded, angular to rounded, greywacke; sand is fine to coarse. Contains brick, asphalt and domestic waste. [FILL]					Dense		
1.0				GM Silty sandy fine to coarse GRAVEL with minor cobbles and minor boulders; bluish grey. Well graded, angular to subangular, greywacke; sand is fine to coarse; cobbles are angular to subrounded; boulders are subangular, up to Contains wood, concrete and domestic waste. [FILL] 1.3 m - Perched water inflow.					Loosely packed		
1.5				1.5 m - Colour changes to dark grey.							
2.0								W	Medium Dense		
2.5									Dense		
									Loosely packed		

GEOTECH TEST PIT LOG - PHOTOS TEST PIT LOGS.GPJ NZ MASTER DATA TEMPLATE.GDT 3/8/21

Bucket excavator met target depth at 5.0 m. at 5 m.
Scala Penetrometer met practical refusal at 2.1 m depth.
Perched groundwater encountered at 1.3 m.

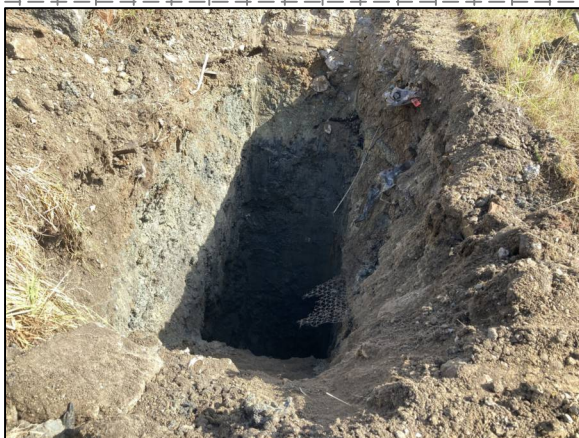
LOG OF TEST PIT TP02

Geotechnical Investigation

14 Waiu Street
Wainuiomata
18286.000.001

Client : Envelope Engineering Ltd **Shear Vane No** : N/A
Date : 22/02/2021 **Logged By** : CM
Max Test Pit Depth : 5 m **Reviewed By** : CC
Digger Type/Size : Bucket Excavator **Latitude** : -41.249159
Bucket Type/Size : 60 cm **Longitude** : 174.929204

Depth (m BGL)	Material	Excavatability (Relative Scale)	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane, Su Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
		Easier	Harder								2 4 6 8 10 12
3.0											
3.5											
4.0	FILL							W	Loosely packed		
4.5				4.2 m - Contains lenses of PEAT; fibrous, dark brown.							
5.0				Depth of Excavation: 5 m Termination Condition: Target depth							



Bucket excavator met target depth at 5.0 m. at 5 m.
Scala Penetrometer met practical refusal at 2.1 m depth.
Perched groundwater encountered at 1.3 m.



LOG OF TEST PIT TP03

Geotechnical Investigation

14 Waiu Street
Wainuiomata
18286.000.001

Client : Envelope Engineering Ltd Shear Vane No : N/A
Date : 22/02/2021 Logged By : CM
Max Test Pit Depth : 3.3 m Reviewed By : CC
Digger Type/Size : Bucket Excavator Latitude : -41.248728
Bucket Type/Size : 60 cm Longitude : 174.929364

Depth (m BGL)	Material	Excavatability (Relative Scale)	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane, Su Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
		Easier	Harder								2 4 6 8 10 12
0.5	FILL		ML	Sandy SILT; brown. Low plasticity; sand is fine. Contains organics and rootlets. [TOPSOIL]					Firm to Stiff		
			GW	Sandy fine to coarse GRAVEL with some silt; brown. Well graded, angular to subangular, greywacke; sand is fine to coarse. Contains brick, concrete and wood. [FILL]					Medium Dense to Dense		
1.0			ML	Gravelly SILT with minor sand; grey. Low plasticity; gravel is fine to coarse, angular to subangular, greywacke; sand is fine to coarse. Contains brick, wood, concrete and metal. [FILL]				M			
1.5									Loosely packed		
2.0			ML	Gravelly SILT; light brown. Low plasticity; gravel is fine to moderate, subrounded to rounded. [FILL]							
2.5			ML	Gravelly SILT with minor sand; grey. Low plasticity; gravel is fine to coarse, angular to subangular, greywacke; sand is fine to coarse. Contains brick, wood, concrete and metal. [FILL]							

GEOTECH TEST PIT LOG - PHOTOS TEST PIT LOGS.GPJ NZ MASTER DATA TEMPLATE.GDT 3/8/21

Bucket excavator met practical refusal at 3.3 m. at 3.3 m depth .
Scala Penetrometer met practical refusal at 0.4 m depth.
Standing groundwater was not encountered.

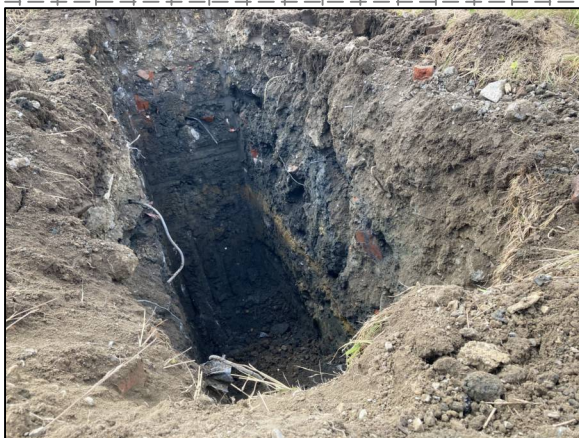
LOG OF TEST PIT TP03

Geotechnical Investigation

14 Waiu Street
Wainuiomata
18286.000.001

Client : Envelope Engineering Ltd **Shear Vane No** : N/A
Date : 22/02/2021 **Logged By** : CM
Max Test Pit Depth : 3.3 m **Reviewed By** : CC
Digger Type/Size : Bucket Excavator **Latitude** : -41.248728
Bucket Type/Size : 60 cm **Longitude** : 174.929364

Depth (m BGL)	Material	Excavatability (Relative Scale)	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane, Su Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
		Easier	Harder								2 4 6 8 10 12
3.0	FILL		ML	Gravelly SILT with minor sand; grey. Low plasticity; gravel is fine to coarse, angular to subangular, greywacke; sand is fine to coarse. Contains brick, wood, concrete and metal. [FILL]				M	Loosely packed		
3.5				Depth of Excavation: 3.3 m Termination Condition: Practical refusal							
4.0											
4.5											
5.0											



Bucket excavator met practical refusal at 3.3 m. at 3.3 m depth .
 Scala Penetrometer met practical refusal at 0.4 m depth.
 Standing groundwater was not encountered.

LOG OF TEST PIT TP04

Geotechnical Investigation

14 Waiu Street
Wainuiomata
18286.000.001

Client : Envelope Engineering Ltd **Shear Vane No** : N/A
Date : 22/02/2021 **Logged By** : CM
Max Test Pit Depth : 3.8 m **Reviewed By** : CC
Digger Type/Size : Bucket Excavator **Latitude** : -41.249375
Bucket Type/Size : 60 cm **Longitude** : 174.929875

Depth (m BGL)	Material	Excavatability (Relative Scale)	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane, Su Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
		Easier	Harder								2 4 6 8 10 12
3.0	FILL		GW	Fine to coarse GRAVEL with some silt, minor sand, minor cobbles and minor boulders; grey. Well graded, angular to subangular, grewacke; sand is fine to coarse; cobbles and boulders are rounded to subrounded, up to 210 mm. Contains concrete. [FILL]			W	Loosely packed			
3.5											
4.0				Depth of Excavation: 3.8 m Termination Condition: Practical refusal							
4.5											
5.0											



Bucket excavator met practical refusal at 3.8 m. at 3.8 m depth .
 Scala Penetrometer met practical refusal at 0.4 m depth.
 Standing groundwater was not encountered.



LOG OF TEST PIT TP05

Geotechnical Investigation

14 Waiu Street
Wainuiomata
18286.000.001

Client : Envelope Engineering Ltd Shear Vane No : N/A
Date : 22/02/2021 Logged By : CM
Max Test Pit Depth : 2.9 m Reviewed By : CC
Digger Type/Size : Bucket Excavator Latitude : -41.250066
Bucket Type/Size : 60 cm Longitude : 174.929783

Depth (m BGL)	Material	Excavatability (Relative Scale)	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane, Su Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
		Easier	Harder								2 4 6 8 10 12
0.5	FILL		ML	Sandy SILT; brown. Low plasticity; sand is fine. Contains organics and rootlets. [TOPSOIL]					-		
			GW	Sandy fine to coarse GRAVEL with minor sand; brown mixed grey. Well graded, angular to subangular; sand is fine to coarse. Contains brick, ceramics, concrete, metal and wood. [FILL]				M	Hard Dense		
1.0									Loosely packed		
1.5			ML	Clayey SILT; light brown. Moderate plasticity. [FILL]					Very Loose to Loose		
2.0			ML	SILT with some gravel, minor cobbles and boulders and trace sand; blueish grey. Low plasticity; gravel is fine to medium, subrounded to rounded, greywacke; cobbles and boulders are subrounded to rounded, up to 200 mm. [FILL]				W	Soft		
2.5			GW	Fine to coarse GRAVEL with some silt, minor sand and minor cobbles; grey. Well graded, angular to subangular, greywacke; sand is fine to coarse; cobbles are subrounded to rounded, up to 140 mm. [FILL]				M	Stiff to Very Stiff		
									Dense		

GEOTECH TEST PIT LOG - PHOTOS TEST PIT LOGS.GPJ NZ MASTER DATA TEMPLATE.GDT 3/8/21

Bucket excavator met practical refusal 2.9 m. at 2.9 m depth .
Scala Penetrometer met practical refusal at 2.3 m depth.
Standing groundwater was not encountered.

LOG OF TEST PIT TP05

Geotechnical Investigation

14 Waiu Street
Wainuiomata
18286.000.001

Client : Envelope Engineering Ltd **Shear Vane No** : N/A
Date : 22/02/2021 **Logged By** : CM
Max Test Pit Depth : 2.9 m **Reviewed By** : CC
Digger Type/Size : Bucket Excavator **Latitude** : -41.250066
Bucket Type/Size : 60 cm **Longitude** : 174.929783

Depth (m BGL)	Material	Excavatability (Relative Scale)	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane, Su Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
	FILL	Easier Harder	GW					M			2 4 6 8 10 12
3.0				Depth of Excavation: 2.9 m Termination Condition: Practical refusal							
3.5											
4.0											
4.5											
5.0											



Bucket excavator met practical refusal 2.9 m. at 2.9 m depth .
 Scala Penetrometer met practical refusal at 2.3 m depth.
 Standing groundwater was not encountered.



LOG OF TEST PIT TP06

Geotechnical Investigation

14 Waiu Street
Wainuiomata
18286.000.001

Client : Envelope Engineering Ltd Shear Vane No : N/A
Date : 22/02/2021 Logged By : CM
Max Test Pit Depth : 5 m Reviewed By : CC
Digger Type/Size : Bucket Excavator Latitude : -41.250222
Bucket Type/Size : 60 cm Longitude : 174.930289

Depth (m BGL)	Material	Excavatability (Relative Scale)	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane, Su Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
		Easier	Harder								2 4 6 8 10 12
0.5	FILL		ML	Sandy SILT; brown. Low plasticity; sand is fine. Contains organics and rootlets. [TOPSOIL]					Loosely packed		
			GW	Sandy fine to coarse GRAVEL with minor sand; greyish brown. Well graded, angular to subangular, greywacke; sand is fine to coarse. Contains concrete and brick. [FILL]				M	Loose to Medium Dense		
1.0									Dense		
1.5			ML	Gravelly SILT with some sand; bluish grey. Low plasticity; gravel is fine to coarse, angular to subangular, greywacke; sand is fine to coarse. Contains concrete, wood, brick, metal and rubber. [FILL]				W	Hard		
2.0											
2.5											

GEOTECH TEST PIT LOG - PHOTOS TEST PIT LOGS.GPJ NZ MASTER DATA TEMPLATE.GDT 3/8/21

Bucket excavator met target depth at 5.0 m. at 5 m.
Scala Penetrometer met practical refusal at 1.5 m depth.
Standing groundwater was not encountered.

LOG OF TEST PIT TP06

Geotechnical Investigation

14 Waiu Street
Wainuiomata
18286.000.001

Client : Envelope Engineering Ltd **Shear Vane No** : N/A
Date : 22/02/2021 **Logged By** : CM
Max Test Pit Depth : 5 m **Reviewed By** : CC
Digger Type/Size : Bucket Excavator **Latitude** : -41.250222
Bucket Type/Size : 60 cm **Longitude** : 174.930289

Depth (m BGL)	Material	Excavatability (Relative Scale)	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane, Su Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
		Easier	Harder								2 4 6 8 10 12
3.0	FILL			Gravelly SILT with some sand; bluish grey. Low plasticity; gravel is fine to coarse, angular to subangular, greywacke; sand is fine to coarse. Contains concrete, wood, brick, metal and rubber. [FILL]							
3.5											
4.0			ML								
4.5											
5.0				Depth of Excavation: 5 m Termination Condition: Target depth							



Bucket excavator met target depth at 5.0 m. at 5 m.
 Scala Penetrometer met practical refusal at 1.5 m depth.
 Standing groundwater was not encountered.