



**APPROVED BUILDING CONSENT**  
**BC24-011274**  
**Date: 28/11/2024**  
**Page: 1 of 21**  
**Rotorua Lakes Council**

**Fran Muraahi**  
**21 Island View Road, Rotorua**  
**Proposed Dwelling**  
**Geotechnical Assessment Report (V2)**

**14 April 2021**

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## 1. Introduction

Stratum Consultants Ltd (Stratum) has been engaged by Fran Muraahi to carry out a geotechnical assessment for the proposed subdivision at 21 Island View Road, Rotorua (the site).

The purpose of this report is to assess the geotechnical suitability of the proposed house site and provide geotechnical recommendations for the proposed subdivision and future residential development. It supersedes the version dated 26 February 2021.

This report is part of the documentation to be submitted to the Rotorua Lakes Council to support the resource consent application. It may also be used to support the building consent application for development of the house site, subject to review of the final building plans.

## 2. Site Description

The subject property is known as 21 Island View Road, Rotorua and is legally described as Lot 179 DPS 1083.

The site is within residential area of Rotorua, located on the corner of Ross Road and Island View Road, approximately 2.2km south-west of Lake Rotorua. The site is approximately 995m<sup>2</sup> and contains an existing dwelling and two detached single garages. The topography of the site gently slopes to the south-east, ranging between approximately RL 302m to 304m above the Moturiki Datum

The topography of the site and surrounding area (one metre contours) is shown below on Figure 1.



Figure 1: Site Setting

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### 3. Proposed Development

The development involves subdividing the site into two lots (Lot 1 and Lot 2), with areas of 623m<sup>2</sup> and 370m<sup>2</sup> respectively. The existing dwelling shall be located within Lot 1, with a relocatable dwelling proposed to be placed within Lot 2.

Lot 1 shall be serviced off Island View Road, whereas Lot 2 is proposed to be serviced off Ross road.

A scheme plan of the subdivision is included in Appendix B.

The relocatable dwelling is assumed to be a single storey, timber framed dwelling designed in general accordance with NZS3604:2011.

### 4. Site Investigations

A subsurface investigation consisting of a site walkover, four hand augered boreholes, four Scala penetrometers and shear vane tests were conducted by Stratum on 14 January 2021.

The hand augered boreholes were advanced to 3.0m to 4.4m below ground level (bgl).

The hand augered boreholes, Scala penetrometer and shear vane tests were conducted at the locations shown on the test location plan presented in Appendix C. Borehole logs and test results are also included in Appendix C.

### 5. Site Conditions

#### 5.1. Published Geology

The regional geological map<sup>1</sup> indicates that the site is underlain by Late Pleistocene lake deposits which generally consist of lacustrine pumice-bearing sandy or clayey silt.

The Rotorua District Plan indicates the site is not within areas having soft ground potential, not located near any known fault or potential active fault zone, is outside of any geothermal zones, and is not located within a landslide potential zone.

#### 5.2. Subsoil Conditions

The ground conditions encountered in the hand auger boreholes generally comprised topsoil ranging between 0.2m to 0.3m bgl, underlain by very loose to medium dense sands down to a maximum depth of 1.3m bgl. Beneath this, two 0.2 to 0.6m thick layers of very stiff to hard silt were encountered within medium dense to dense sand and pumice gravel. The pumiceous gravel extended to the base of the boreholes (up to 4.4m depth).

Groundwater was not encountered in the hand auger boreholes.

The seismic subsoil category at this site has been assessed as Class D (deep or soft soil site) in terms of NZS 1170.5 section 3.1.3.

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<sup>1</sup> GNS Science QMap Rotorua, scale 1:250,000, 2010.

## **6. Geotechnical Assessment**

### **6.1. General**

As discussed in Chapter 3 of the Rotorua Civil Engineering Industry Standard (RCEIS) dated 2012, several potential hazards affect the Rotorua District.

With reference to Table 1 of Chapter 3 of the RCEIS, the site is not considered to be affected by erosion, internal erosion, collapsible soils, geothermal gas or eruptions, corrosive soils, contamination, fill material, landslip, slope instability, inundation, groundwater flooding, ground rupture, old geothermal bores or land adjacent to watercourses, lakes or streams. These hazards do not apply since the site is elevated, away from steep slopes, active faults, geothermal areas, overland flowpaths or bodies of water.

Some of the hazards presented in Table 1 are regional hazards, such as volcanic eruption, ground shaking, subsidence due to depressurisation of a geothermal aquifer, tectonic subsidence, and even historic lake or stream beds and lake terraces. The risk of such hazards to the subject site is no more or less than the remainder of the district and within acceptable levels, so these hazards will not be discussed further herein.

The remaining hazards are ground settlement due to compressible soils, liquefaction hazards and post-earthquake subsidence. These hazards will be discussed below.

### **6.2. Foundation Bearing Capacity**

The site investigation results indicate that the near surface sands, encountered down to 1.3m bgl are of insufficient strength to provide a geotechnical ultimate bearing capacity of 300kPa (100kPa allowable bearing capacity) and therefore do not comply with the definition of 'good ground' as per NZS 3604:2011 "Timber Framed Buildings".

The silt and pumice gravel and sand below 1.1 to 1.3m depth can typically provide a geotechnical ultimate bearing capacity of 300kPa.

As such, we consider deepened piles, shallow ground improvement or specific engineered design will be required, as discussed in Section 7.1 below.

### **6.3. Settlement**

The natural soils beneath the proposed house site are normally consolidated, and no organic material was encountered. Although very loose to loose sands were encountered within our investigations, this will be mitigated by the foundation remediation options. As such, based on the soils identified and soil strength testing carried out, the anticipated loads from a relocated dwelling are unlikely to exceed the allowable settlement limit of 25mm given in NZS3604:2011, provided the recommendations within this report are followed.

### **6.4. Liquefaction**

Liquefaction is a term used to describe the strength loss experienced by a saturated cohesionless soil when subjected to cyclic loading (i.e. earthquakes). Soil that is susceptible to liquefaction tends to contract when subject to cyclic stresses, which induces excess pore water pressure that leads to a reduction in shear strength. Recently deposited and loose saturated natural soils and poorly compacted fills can be highly susceptible to liquefaction.

Groundwater was not encountered in the subsurface investigation (up to 4.4m bgl). Since the founding soils are not saturated, they are not susceptible to liquefaction. While some strength loss may occur at depth during a seismic event, this is not

expected to be result in significant settlements at the surface due to the 'crust' of non-liquefiable material.

As such, we consider the risk of liquefaction induced damage affecting the proposed development to be low.

## 7. Recommendations

### 7.1. Foundations

#### 7.1.1. General

As discussed in Section 6.2 above, the near surface sands, encountered to between 1.1 and 1.3m bgl do not comply with the definition of good ground as per NZS 3604:2011.

As such, standard foundations are not suitable. We consider that deepened piles, shallow ground improvement or specific engineered design are suitable options for the proposed dwelling to mitigate these unsuitable soils.

Any foundation works should be carried out by, or under the supervision of a Licensed Building Practitioner.

#### 7.1.2. Deepened Piled Foundation

This option is recommended where the dwelling has a suspended floor, and involves boring or driving timber or concrete piles. Specific design will be required.

The foundations shall extend through the very loose to loose sands, encountered down to 1.3m, and found on the underlying very stiff to hard silt and medium dense to dense pumice gravel and sand.

The upper soils are not considered to provide full lateral constraint, so deepened piles are to be designed by a structural engineer using a reduced friction angle of 25° for the upper soils.

Bored piles should be founded at least 0.4m below the very loose to loose sands, approximately 1.5 to 1.7m bgl across the site. This depth should be confirmed during construction by a geotechnical engineer.

If driving piles, the piles should be driven in accordance with the design. We anticipate that the driven piles completed within the area of very loose to loose sand would achieve the required set approximately 1.5m to 2.5m below current ground level, within the medium dense soils and very stiff to hard silt.

Once the competent soils have been reached, the piles can be assumed to have a geotechnical ultimate bearing capacity of 300kPa (100kPa allowable bearing capacity).

#### 7.1.3. Shallow Ground Improvement

This involves over-excavating and removing any very loose or loose sand up to 1.0m, compacting the base, and replacing it with compacted backfill to the design level.

All earthworks shall be completed in accordance with the recommendations given in Section 8.3. Specific design will be required.

Upon completion and certification of the earthworks, the foundations can be designed for a geotechnical ultimate bearing capacity of 300kPa (allowable bearing capacity of

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100kPa). A standard NZS 3604:2011 foundation can therefore be used provided the bearing capacity of the building platform is tested and certified during construction.

#### **7.1.4. Specific Engineered Design**

Alternatively, a reduced bearing capacity could be used in the foundation design, which would reduce the amount of ground improvement required.

The house foundations can be designed with a reduced geotechnical ultimate bearing capacity of 210 kPa (70 kPa allowable bearing capacity), subject to compacting the foundation subgrade in-situ following preparation of the building platform.

After the subgrade is compacted in-situ, additional testing would be required to confirm the strength of the subgrade and establish if further undercutting is required, as per the shallow ground improvement.

The foundations would need to be specifically designed by a Chartered Engineer for the reduced bearing capacity as noted above, or to the bearing capacity assessed during construction. A proprietary foundation system that has been approved for low bearing capacity soils (e.g. Firth RibRaft) may also be used. Provided the bearing capacity of the soil is not exceeded, expected settlements over the lifetime of the building are expected to be less than 25mm for shallow foundations.

#### **7.2. Earthworks**

All earthworks, including excavation, preparation of subgrade, and backfill should be performed in accordance with the geotechnical recommendations presented in this report and applicable portions of the New Zealand Standard 4431:1989 entitled, "Code of Practice for Earth Fill for Residential Development" prepared by Standards New Zealand and the Rotorua Civil Engineering Industry Standard (RCEIS).

Any cuts or fills greater than 0.5m in height shall be shaped to a gradient of no greater than 1:2 (vertical to horizontal), unless retained by an engineer designed structure.

Earthworks associated with the shallow ground improvement option should be carried out in accordance with the following recommendations:

- Earthworks should be performed under periodical observation and testing by a geotechnical engineer to confirm ground conditions and compliance with the recommendations presented in this report.
- Any topsoil or very loose to loose sands shall be removed from below the building platform area, encountered down to 1.0m bgl. The undercut shall extend at least 1.5 metres from the foundations where possible.
- The subgrade shall be compacted in-situ and inspected and tested by a geotechnical engineer to confirm to strength of the subgrade.
- An approved fill material shall be placed and compacted in layers of 200 mm to bring the site up to design level.
- Granular fill shall be compacted to achieve an average of at least 12 blows per 300 mm penetration with the Scala penetrometer, with no single value to be less than 10 blows.
- Cohesive fill shall be compacted to achieve a minimum average undrained shear strength of 150 kPa, with no single value to be less than 130 kPa and

maximum aid voids of 10%.

- Filling will require testing and certification from a geotechnical engineer if greater than 0.45m in depth or 50m<sup>3</sup> in volume.
- The contractor shall ensure works are carried out to maintain stability of temporary slopes, in particular those in excess of 0.5m in height and 1:2 (V:H) in steepness.
- Appropriate overland flow and sediment control measures will be required during earthworks and construction.

### **7.3. Stormwater**

All stormwater falling on hard surfaces including roofs, decks, driveways and patios shall be collected and piped to the stormwater disposal system.

We consider that disposal via on site soakage is an acceptable option. A separate stormwater design report is being prepared.

### **7.4. Effluent Disposal**

Effluent disposal is to be via the council reticulated system.

## **8. Conclusion**

Provided the recommendations of this report are complied with, it is our professional opinion that the proposed subdivision is suitable for development in accordance with the requirements of the New Zealand Building Code.

Deepened pile foundations, specific foundation design and/or shallow ground improvement will be required due to the very loose to loose sands encountered.

A statement of professional opinion as to the geotechnical suitability of land for development (Rotorua District Council form 1A) is included in Appendix A.

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## 9. Limitations

The assessment given in this report is based on limited site data from discrete test locations. Variations in ground conditions could exist across the site. The nature and continuity of subsoil conditions away from the test sites are inferred and it must be appreciated that actual conditions could vary from the assumed model.

This report has been prepared for the sole benefit of Fran Muraahi, their professional advisers and the relevant territorial authorities for the proposed subdivision at 21 Island View Road, Rotorua. It is not to be relied upon or used out of context by any other person without reference to Stratum Consultants Ltd. The reliance by other parties on the information or opinions contained in this report shall, without prior review and agreement in writing, be at such party's sole risk.

### STRATUM CONSULTANTS LTD

Report Prepared By:



Jared Fox  
Engineering Geologist

Reviewed and Approved By:



Elles Pearce-Danker  
Senior Geotechnical Engineer

Date: 14 April 2021

V2 updated by Elles Pearce-Danker

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## **Appendix A**

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### *Statement of Professional Opinion*

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To:  
**Group Manager Infrastructure**  
 Rotorua District Council  
 Private Bag  
**ROTORUA**

# 1A - STATEMENT OF PROFESSIONAL OPINION AS TO SUITABILITY OF LAND FOR SUBDIVISION

Subdivision: Subdivision of Lot 179 DPS 1083

Owner/Developer: Fran Muraahi

Location: 21 Island View Road, Rotorua

I, Elles Pearse-Danker of Stratum Consultants Ltd  
 (Full Name) (Name & Address of Firm)

hereby confirm that:

I am a ~~Chartered Professional Engineer~~ Geoprofessional experienced in the field of geotechnical engineering and was retained by the owner/developer as the Geotechnical Expert on the above subdivision.

Site investigations have been carried out under my direction and are described in my report dated 14/04/2020.

I am aware of the details of the proposed scheme of subdivision and of the general nature of proposed engineering works as shown on the following drawings:

SurveyOne, Scheme Plan, ref. 2036-1, dated 24 December 2020.

(Insert reference to all drawings including dates of latest amendments)

I confirm that I have given consideration to the level of complexity as identified in the Rotorua Civil Engineering Industry Standard Chapter 3.

In my professional opinion, not to be constructed as a guarantee, I certify that the proposed works give due regard to land slope and foundation stability considerations and that the land is suitable for the proposed subdivision, providing that:

- a) The recommendations given in my report are followed, applicable to Lot 2.
- b) Deepened piles, ground improvements or specific foundation design are undertaken for building.
- c) A geotechnical plan review is undertaken at building consent stage.

This professional opinion is furnished to the Council and the owner/developer for their purposes alone, on the express conditions that it will not be relied upon by any other person and does not remove the necessity for further inspection during the course of the works.

Signed: Elles PD

Date: 23/02/2020

☒ Council's property file/LIM has been viewed for relevant information.

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## **Appendix B**

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### *Drawings*

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## **Appendix C**

*Site investigation data and location plans*

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**Project Title:** Geotechnical Assessment  
  
**Site Address:** 21 Island View Road  
**City:** Rotorua  
**File Number:** 233840-R-E-S001

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### Test Location Sketch



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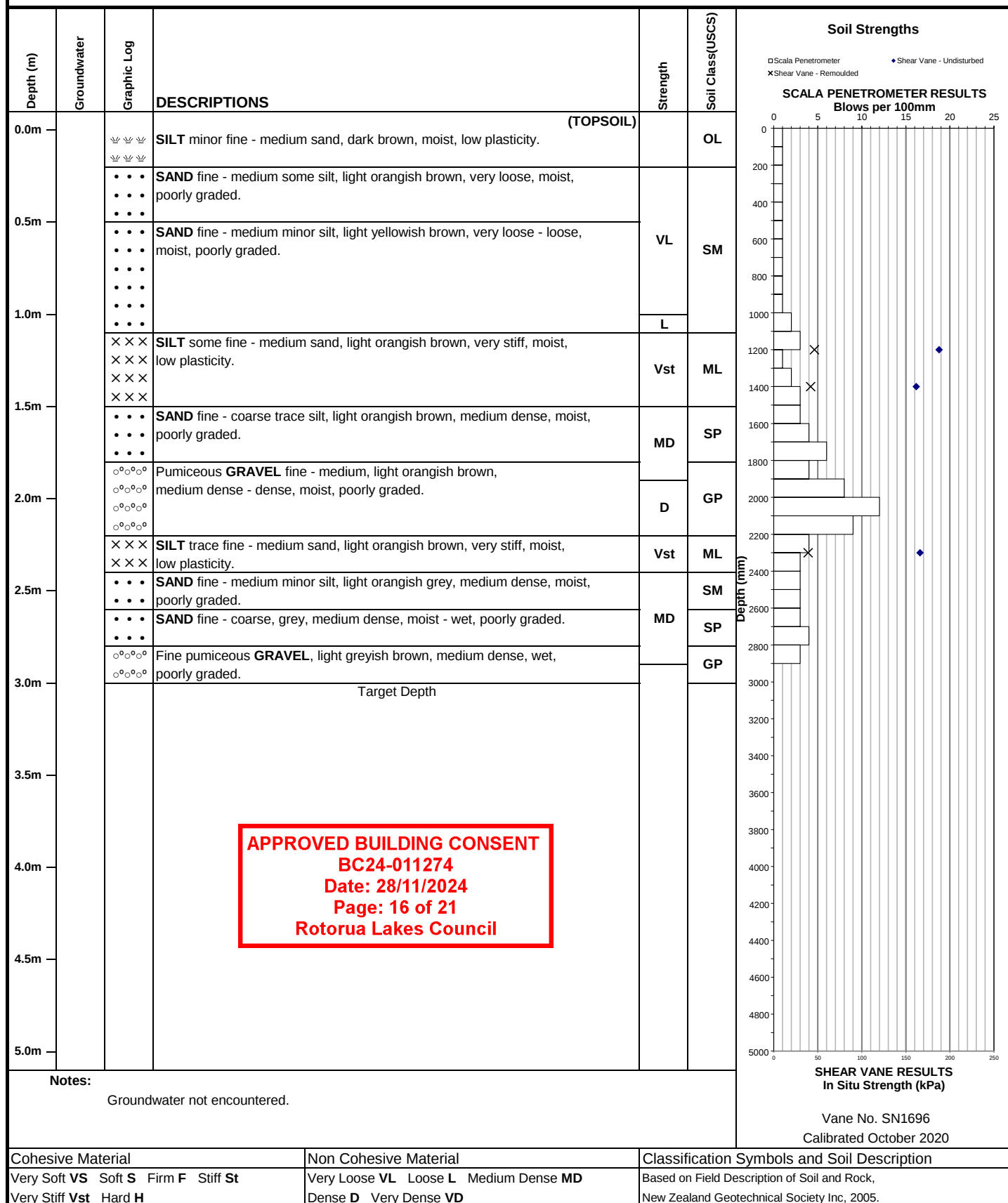
**Date:** 14/01/2021  
**Logged By:** SG  
**Checked:** JNF



**Hand Augered Borehole**

**Borehole No :** HA01

**Associated Penetrometer No :** SP01



**Notes:**

Groundwater not encountered.

Cohesive Material

Very Soft VS Soft S Firm F Stiff St

Very Stiff Vst Hard H

Non Cohesive Material

Very Loose VL Loose L Medium Dense MD

Dense D Very Dense VD

Classification Symbols and Soil Description

Based on Field Description of Soil and Rock,  
 New Zealand Geotechnical Society Inc, 2005.

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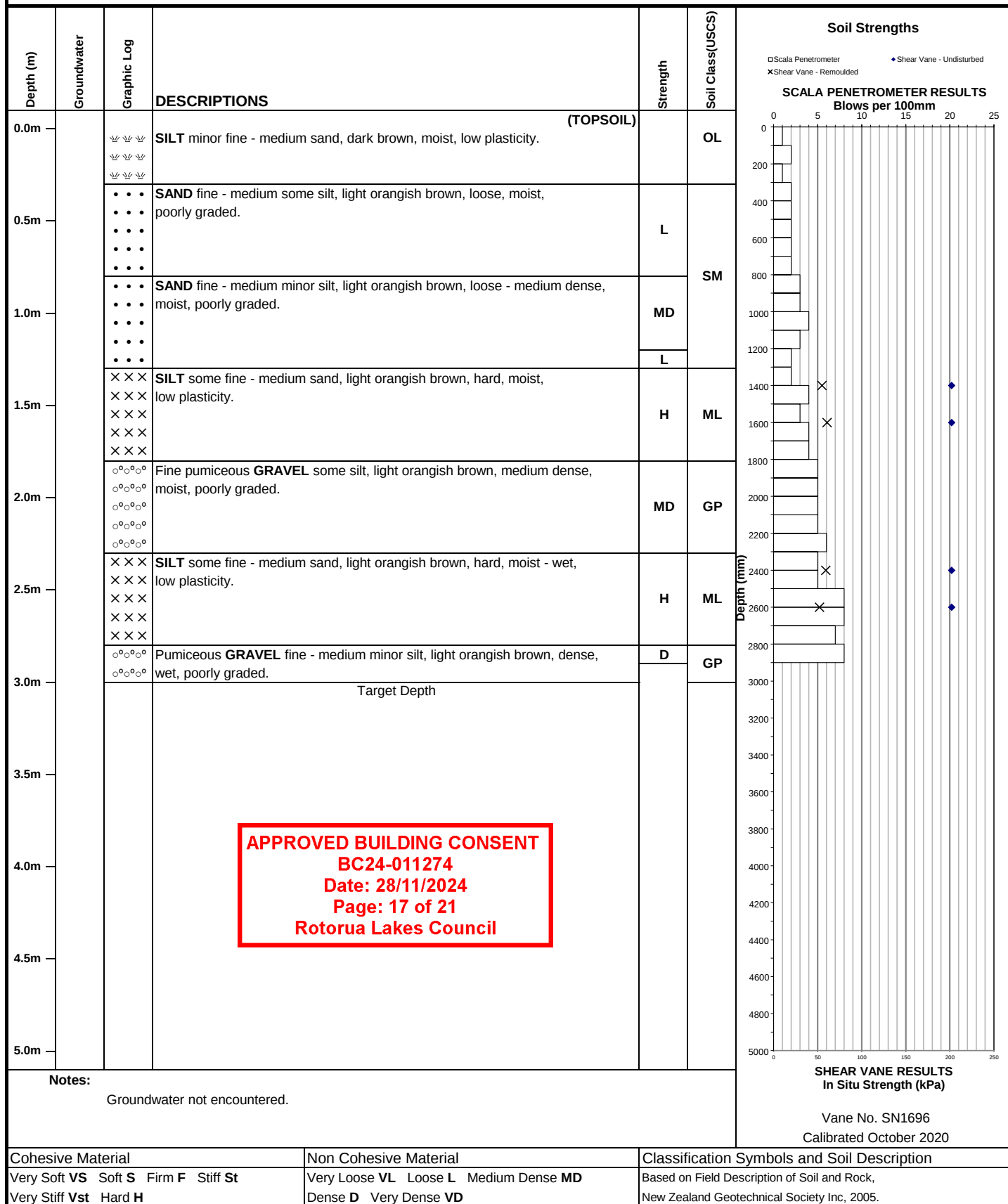
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**Checked:** JNF



**Hand Augered Borehole**

**Borehole No :** HA02

**Associated Penetrometer No :** SP02



**Notes:**

Groundwater not encountered.

|                                           |                                           |                                              |
|-------------------------------------------|-------------------------------------------|----------------------------------------------|
| Cohesive Material                         | Non Cohesive Material                     | Classification Symbols and Soil Description  |
| Very Soft VS   Soft S   Firm F   Stiff St | Very Loose VL   Loose L   Medium Dense MD | Based on Field Description of Soil and Rock, |
| Very Stiff Vst   Hard H                   | Dense D   Very Dense VD                   | New Zealand Geotechnical Society Inc, 2005.  |

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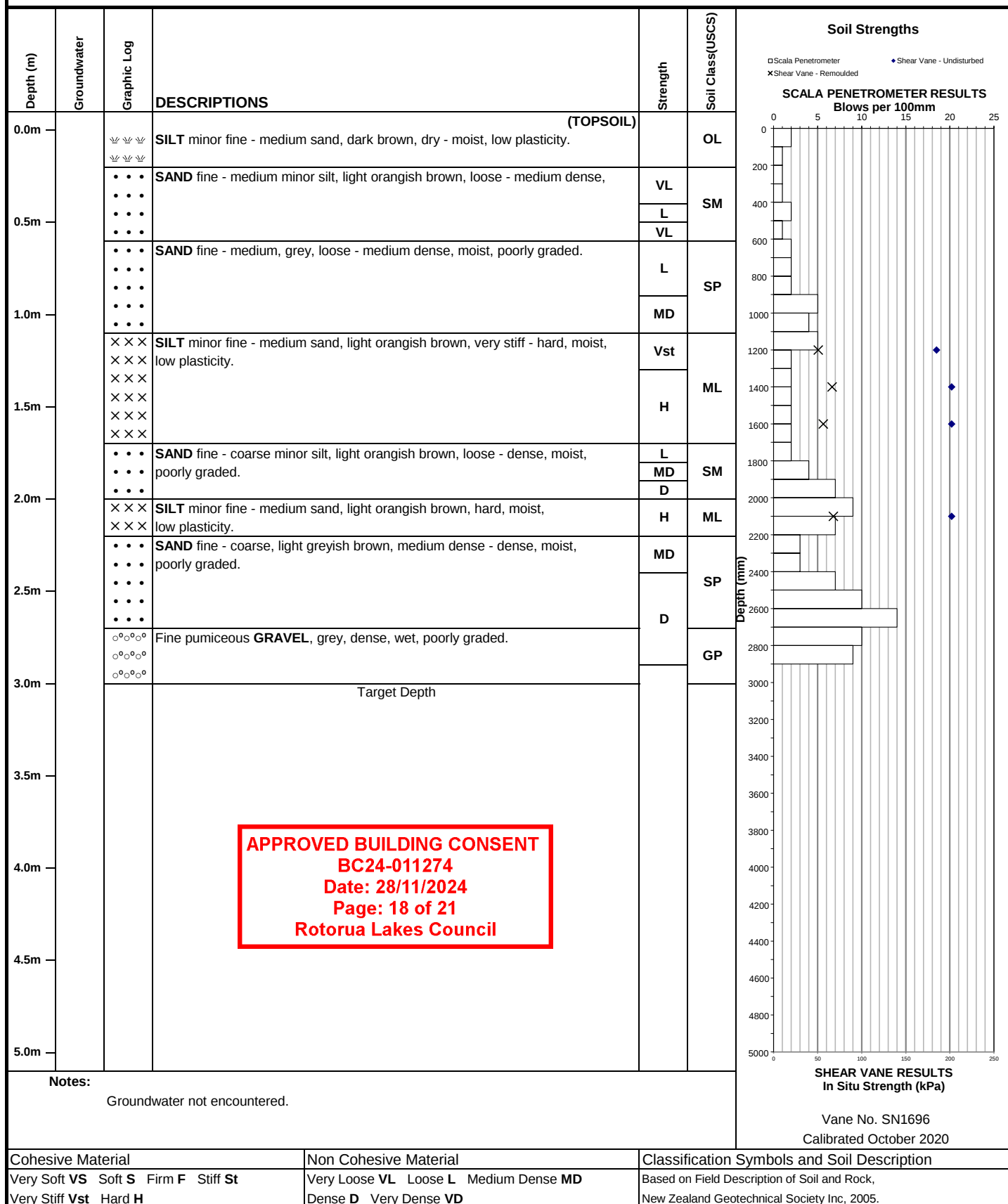
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**Hand Augered Borehole**

**Borehole No :** HA03

**Associated Penetrometer No :** SP03



|                                           |                                           |                                              |
|-------------------------------------------|-------------------------------------------|----------------------------------------------|
| Cohesive Material                         | Non Cohesive Material                     | Classification Symbols and Soil Description  |
| Very Soft VS   Soft S   Firm F   Stiff St | Very Loose VL   Loose L   Medium Dense MD | Based on Field Description of Soil and Rock, |
| Very Stiff Vst   Hard H                   | Dense D   Very Dense VD                   | New Zealand Geotechnical Society Inc, 2005.  |

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**City:** Rotorua  
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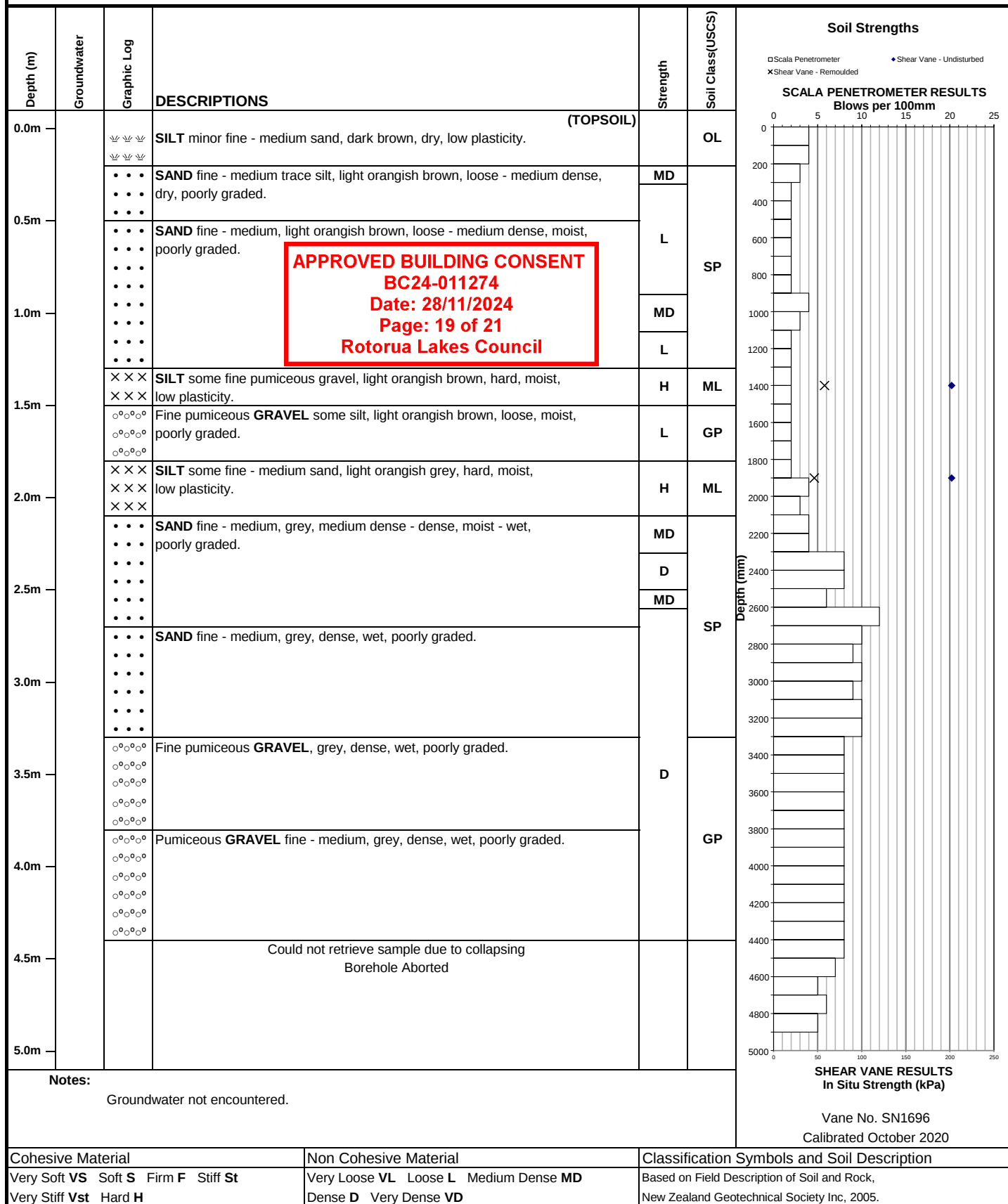
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### Hand Augered Borehole

**Borehole No :** HA04

**Associated Penetrometer No :** SP04



|                                           |                                           |                                              |
|-------------------------------------------|-------------------------------------------|----------------------------------------------|
| Cohesive Material                         | Non Cohesive Material                     | Classification Symbols and Soil Description  |
| Very Soft VS   Soft S   Firm F   Stiff St | Very Loose VL   Loose L   Medium Dense MD | Based on Field Description of Soil and Rock, |
| Very Stiff Vst   Hard H                   | Dense D   Very Dense VD                   | New Zealand Geotechnical Society Inc, 2005.  |

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### Shear Vane Test Results

**Notes:** UTP: Unable to penetrate.

Shear Vane readings are used to designate soil strength for cohesive soils only unless otherwise specified.

**Shear Vane SN1696**

**Calibrated Oct-20**

**Constant 1.443**

| HA01          |             |     |          | S/V No.   |     | SN1696      |
|---------------|-------------|-----|----------|-----------|-----|-------------|
| Depth<br>(mm) | Undisturbed |     |          | Remoulded |     | Sensitivity |
|               | Reading     | kPa | Strength | Reading   | kPa |             |
| 1200          | 130         | 188 | Vst      | 32        | 46  | 4.1         |
| 1400          | 112         | 162 | Vst      | 29        | 42  | 3.9         |
| 2300          | 115         | 166 | Vst      | 27        | 39  | 4.3         |

| HA02          |             |     |          | S/V No.   |     | SN1696      |
|---------------|-------------|-----|----------|-----------|-----|-------------|
| Depth<br>(mm) | Undisturbed |     |          | Remoulded |     | Sensitivity |
|               | Reading     | kPa | Strength | Reading   | kPa |             |
| 1400          | 140         | 202 | H        | 38        | 55  | 3.7         |
| 1600          | 140         | 202 | H        | 42        | 61  | 3.3         |
| 2400          | 140         | 202 | H        | 41        | 59  | 3.4         |
| 2600          | 140         | 202 | H        | 36        | 52  | 3.9         |

| HA03          |             |     |          | S/V No.   |     | SN1696      |
|---------------|-------------|-----|----------|-----------|-----|-------------|
| Depth<br>(mm) | Undisturbed |     |          | Remoulded |     | Sensitivity |
|               | Reading     | kPa | Strength | Reading   | kPa |             |
| 1200          | 128         | 185 | Vst      | 35        | 51  | 3.7         |
| 1400          | 140         | 202 | H        | 46        | 66  | 3.0         |
| 1600          | 140         | 202 | H        | 39        | 56  | 3.6         |
| 2100          | 140         | 202 | H        | 47        | 68  | 3.0         |

| HA04          |             |     |          | S/V No.   |     | SN1696      |
|---------------|-------------|-----|----------|-----------|-----|-------------|
| Depth<br>(mm) | Undisturbed |     |          | Remoulded |     | Sensitivity |
|               | Reading     | kPa | Strength | Reading   | kPa |             |
| 1400          | 140         | 202 | H        | 40        | 58  | 3.5         |
| 1900          | 140         | 202 | H        | 32        | 46  | 4.4         |

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### **Scala Penetrometer Results**

**Probe description:** 9kg hammer falling 500mm striking a steel anvil driving a 16mm diameter rod fitted with a 20mm diameter cone

Depth of penetration begins at the existing ground level. Scala Penetrometer readings are used to designate soil strength for non-cohesive soils only unless otherwise specified.

| Depth of Penetration | SP01            | SP02            | SP03            | SP04            |  |  |  |  |
|----------------------|-----------------|-----------------|-----------------|-----------------|--|--|--|--|
| GL Start (mm)        | Blows Per 100mm | Blows Per 100mm | Blows Per 100mm | Blows Per 100mm |  |  |  |  |
| 0                    |                 |                 |                 |                 |  |  |  |  |
| 100                  | 1               | 1               | 2               | 4               |  |  |  |  |
| 200                  | 1               | 2               | 1               | 4               |  |  |  |  |
| 300                  | 1               | 1               | 1               | 3               |  |  |  |  |
| 400                  | 1               | 2               | 1               | 2               |  |  |  |  |
| 500                  | 1               | 2               | 2               | 2               |  |  |  |  |
| 600                  | 1               | 2               | 1               | 2               |  |  |  |  |
| 700                  | 1               | 2               | 2               | 2               |  |  |  |  |
| 800                  | 1               | 2               | 2               | 2               |  |  |  |  |
| 900                  | 1               | 3               | 2               | 2               |  |  |  |  |
| 1000                 | 1               | 3               | 5               | 4               |  |  |  |  |
| 1100                 | 2               | 4               | 4               | 3               |  |  |  |  |
| 1200                 | 3               | 3               | 5               | 2               |  |  |  |  |
| 1300                 | 1               | 2               | 2               | 2               |  |  |  |  |
| 1400                 | 2               | 2               | 2               | 2               |  |  |  |  |
| 1500                 | 3               | 4               | 2               | 2               |  |  |  |  |
| 1600                 | 3               | 3               | 2               | 2               |  |  |  |  |
| 1700                 | 4               | 4               | 2               | 2               |  |  |  |  |
| 1800                 | 6               | 4               | 2               | 2               |  |  |  |  |
| 1900                 | 4               | 5               | 4               | 2               |  |  |  |  |
| 2000                 | 8               | 5               | 7               | 4               |  |  |  |  |
| 2100                 | 12              | 5               | 9               | 3               |  |  |  |  |
| 2200                 | 9               | 5               | 7               | 4               |  |  |  |  |
| 2300                 | 4               | 6               | 3               | 4               |  |  |  |  |
| 2400                 | 3               | 5               | 3               | 8               |  |  |  |  |
| 2500                 | 3               | 5               | 7               | 8               |  |  |  |  |
| 2600                 | 3               | 8               | 10              | 6               |  |  |  |  |
| 2700                 | 3               | 8               | 14              | 12              |  |  |  |  |
| 2800                 | 4               | 7               | 10              | 10              |  |  |  |  |
| 2900                 | 3               | 8               | 9               | 9               |  |  |  |  |
| 3000                 |                 |                 |                 | 10              |  |  |  |  |
| 3100                 |                 |                 |                 | 9               |  |  |  |  |
| 3200                 |                 |                 |                 | 10              |  |  |  |  |
| 3300                 |                 |                 |                 | 10              |  |  |  |  |
| 3400                 |                 |                 |                 | 8               |  |  |  |  |
| 3500                 |                 |                 |                 | 8               |  |  |  |  |
| 3600                 |                 |                 |                 | 8               |  |  |  |  |
| 3700                 |                 |                 |                 | 8               |  |  |  |  |
| 3800                 |                 |                 |                 | 8               |  |  |  |  |
| 3900                 |                 |                 |                 | 8               |  |  |  |  |
| 4000                 |                 |                 |                 | 8               |  |  |  |  |
| 4100                 |                 |                 |                 | 8               |  |  |  |  |
| 4200                 |                 |                 |                 | 8               |  |  |  |  |
| 4300                 |                 |                 |                 | 8               |  |  |  |  |
| 4400                 |                 |                 |                 | 8               |  |  |  |  |
| 4500                 |                 |                 |                 | 8               |  |  |  |  |
| 4600                 |                 |                 |                 | 7               |  |  |  |  |
| 4700                 |                 |                 |                 | 5               |  |  |  |  |
| 4800                 |                 |                 |                 | 6               |  |  |  |  |
| 4900                 |                 |                 |                 | 5               |  |  |  |  |
| 5000                 |                 |                 |                 |                 |  |  |  |  |

**Notes:**

**APPROVED BUILDING CONSENT**  
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**Rotorua Lakes Council**