APPENDIX C: Geotechnical Assessment

Please use this report as a general guide only. This is not site specific. For a detailed site specific Geotech report please arrange your own testing.

WILLOWRIDGE
DEVELOPMENTS LIMITED

195 LAKE VIEW TERRACE,
HAWEA

GEOTECHNICAL ASSESSMENT FOR PROPOSED RESIDENTIAL SUBDIVISION: LAKE VIEW TERRACE

REF: R5160-1A
DATE: 23 OCTOBER 2019

GCL
Ground Consulting Ltd

REPORT QUALITY CONTROL

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DOCUMENT CONTROL				
REPORT TITLE		GEOTECHNICAL ASSESSMENT FOR PROPOSED RESIDENTIAL SUBDIVISION: LAKE VIEW TERRACE		
REPORT REFERENCE		R5160-1A	PROJECT NUMBER	5160
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REV	DATE	REVISION STATUS	AUTHOR	REVIEWER
A	23 OCTOBER 2019	ISSUED TO CLIENT	SHANNON FITZGERALD	PETER FORREST
APPROVAL				
AUTHOR SIGNATURE			REVIEWER SIGNATURE	
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EXECUTIVE SUMMARY

Scope of Work		GCL has been engaged to conduct a geotechnical investigation of the ground conditions for the proposed subdivision at 195 Lake View Terrace Hawea. The report is for the purpose of subdivision resource consent application to Queenstown Lakes District Council. The report was commissioned by Willowridge Developments Limited.
Current Site Status		The site proposed for development currently presents as open grass land. The subdivision proposed is located approximately 1km from Hawea township and 2.3km from State highway 6 (Lake Hawea – Albert Town Road). The project area is surrounded by original Hawea holiday batches and new residential developments at various stages of construction.
Development Proposals		The development proposed comprises 89 lots ranging is size from 600 – 900m2 across an area of 8.53ha. The subdivision will provide an in-ground stormwater facility servicing all residential developments and surface run off associated with roading and paving.
Site Details	Location	Lot 2. DP 536086
	History	Formally pastoral, currently grassed undevelopment land.
Ground Conditions	Published Geology	Late Pleistocene Glacial and Outwash Deposits (comprising unsorted bouldery clay-rich gravel (till) with minor banded silt and sand lenses, and unweathered to slightly weathered, well sorted, sandy gravel) respectively.
	Previous Investigations	Nil.
	Hydrogeology	Depressed groundwater. No surface water features observed at the site.
	Environmental Condition	No environmental hazards are expected.
Natural Hazards	Liquefaction	Elevated topography, dense SAND, sandy GRAVEL / gravelly SAND with depressed groundwater – site at nil to low risk of liquefaction.
	Alluvial landforms	Nothing to influence the site.
	Seismic characteristics	Seismic Soil Class D considered appropriate. The site proposed for development is centred between two active faults. Design should be cognisant of NZS1170.5.
Geotechnical Considerations	Slope Stability	No stability issues.
	Building Platform	Some earthworks required to form building platforms.
	Foundations	NZS3604 "good ground' present which will provide an ultimate bearing capacity of 300kPa for traditional shallow foundations below the topsoil horizon.
	Earthworks	Standard conditions apply to align with QLDC Code of practice. Site won material is not suitable for reuse.
Stormwater Disposal	Onsite stormwater management facility required – currently under design.	
Wastewater Disposal	QLDC wastewater network.	

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1 INTRODUCTION

1.1 PROJECT BRIEF

A geotechnical assessment has been completed under commission by Willowridge Developments Limited for the purpose of subdivision resource consent for the development of 195 Lakeview Terrace at the request of Paterson Pitts Group. The proposed development comprises 89 lots located at Lake Hawea. The site location is presented in Drawing 001.

This geotechnical assessment has been prepared as part of the documentation required in obtaining resource consent with Queenstown Lakes District Council (QLDC).

This report includes a summary of the investigations undertaken and provides an assessment of:

- Ground conditions.
- Groundwater conditions.
- Natural hazards.
- Building platform stability.
- Foundation conditions.
- Earthworks.
- General on-site stormwater management.
- Other pertinent constraints and issues identified with the site.

1.2 PROPOSED SITE DEVELOPMENT

The proposed development comprises 89 lots ranging in size from 600 – 900m^2 serviced by Lake View Terrace. An internal ring road and two north – south streets provide access to the bulk of residential lots. Three right of ways (ROW's) towards the north of the development provide vehicle access to Lots 27 – 38. A scheme plan for the subdivision layout is presented in Appendix A.

Currently under design, is a stormwater management facility likely to comprise a below ground disposal system located in the southeast corner of development. Effluent is reticulated into the council system.

Final subdivision levels have not been determined to date, however, we understand that some levelling of the steeper central portion of the subdivision will be undertaken to provide suitable gradients for residential development.

2 DESK TOP STUDY

2.1 PREVIOUS INVESTIGATIONS

GCL has reviewed the QLDC eDocs facility which provided limited site investigation documentation for the immediate area. GCL has undertaken recent site investigations within the local district and are therefore familiar with the ground conditions of the area.

2.2 NEW ZEALAND GEOTECHNICAL DATABASE

The New Zealand Geotechnical Database (NZGD) has been viewed and two geotechnical investigations have been identified in the vicinity of the proposed subdivision.

1. 9 Isthmus Place, Lake Hawea – Building Platform Assessment comprising the completion of hand augers and Scala penetrometer tests to determine local ground conditions.
2. 3 Brewster Crescent, Lake Hawea - Building Platform Assessment comprising the completion of hand augers and Scala penetrometer tests to determine local ground conditions.

No further geotechnical investigations were identified in the immediate project area.

2.3 HISTORICAL AERIAL PHOTOGRAPHS

Aerial photographs available from the Google Earth Images and Retrolens.nz dating from 1945 to 2019 were studied to observe the site over time and assess the geomorphological setting. The review of historic aerial photography indicates that the project area has remained absent from ground modification and development during this time.

2.4 PUBLISHED GEOLOGY

The Geological Map of New Zealand, Sheet 18 (Wakatipu), at a scale of 1:250,000 maps the site as being divided in by Late Pleistocene Glacial Deposits towards the north and Late Pleistocene Outwash Deposits towards the south. The Glacial Deposits comprise unsorted bouldery clay-rich gravel (till) with minor banded silt and sand lenses, whereas the River Deposits are best described as unweathered to slightly weathered, well sorted, sandy gravel which define the terraces in Clutha area.

2.5 SITE SERVICES

With reference to the Queenstown Lakes District Council GIS viewer the purposed subdivision is serviced by the following infrastructure:

Main vehicle access off Lake View Terrace, Hawea (North west corner)

- Sewer Pipe: 100mm diameter U-Polyvinyl Chloride.
- Water Pipe: 150mm diameter Polyethylene (High Density) main pipe.
- Stormwater Pipe: 375mm diameter U-Polyvinyl Chloride.

Foot access easement off Charles Court, Hawea (South east corner)

- Sewer Pipe: 150mm diameter U-Polyvinyl Chloride.
- Stormwater Pipe: 450mm diameter U-Polyvinyl Chloride.

It should be noted that at the time of our site investigation that there was no evidence of any buried services inside the purposed development area.

3 SITE CONDITIONS

3.1 SITE DETAILS

The proposed development occupying a rectangular area of 8.53Ha is centred amongst a mixture of original Lake Hawea batches and new residential developments which neighbour the west, south and east boundaries. On completion, the subdivision will offer 89 lots ranging in size from 600 – 900m2. Lake View Terrace just off the north boundary provides the main access to the development. Access to individual lots is provided by an internal ring road, two north – south streets and three right of ways.

The subdivision is located approximately 1km from Lake Hawea township and slightly further towards the west is State Highway 6 (Lake Hawea – Albert Town Road) which is the main arterial between Wanaka and the West Coast.

3.2 SITE TOPOGRAPHY

The site is located on the southside of the Lake Hawea terminal moraine. The moraine is elevated by 25 meters above Lake Hawea defining a moderately steep northside, a mostly flat but undulated crest, and a gently sloping southside which levels out across the Hawea Flats. Landform features outside of this general description includes an elongate portion of negative topographic relief in the northwest corner and an isolated topographic knoll occupied by residence at Lot 1 – DP536086 central to the north boundary.

The topographic differential for this site ranges from 368mRL to 353mRL based on the highest point being the main access on north boundary through to the lowest point in the south east corner respectively. Slope angles across the moraine face are typically gentle to moderately steep ranging from 8° – 18° with the steeper portion of the subdivision located within the central portion of the site.

The site is presently grassed with sporadic plantings of native shrubs and exotic trees.

3.3 SITE SURFACE WATER FEATURES

The site largely contains no surface water features and surface water appears to exit the subdivision via sheet flow over the south and east boundaries.

The subdivision contains a topographic low within the north east portion of the site which appears to contain an ephemeral flow path (dry at the time of investigation). The feature, as shown on Drawing 002, exits the subdivision at the north east corner.

3.4 SLOPE INSTABILITY FEATURES

The site contains no observed slope instability features including the steeper slopes located within the central portion of the subdivision.

3.5 NATURAL HAZARDS

The following information is taken from the public domain and GIS systems of Queenstown Lakes District Council (QLDC) and Otago Regional Council (ORC). A full hazard risk assessment for natural hazards is then provided in Section 6.

3.6 ORC LIQUEFACTION HAZARD ZONING

The ORC hazard mapping relies on the Opus report provided to the Council titled Seismic Risk in the Otago Region (2005). This study identifies the area as 'possibly susceptible', subject to actual determination of the ground conditions and geology at a particular location.

3.7 GIS HAZARD MAPPING

With reference to the ORC and QLDC GIS and hazard mapping, the site area has the following characteristics:

Table 1. Natural Hazards identified by ORC & QLDC

IDENTIFIED HAZARD TYPE	COUNCIL	STATUS / DISCUSSION
ACTIVE ALLUVIAL FAN	QLDC	The site is not mapped for any active alluvial fan process, but is recognised as an alluvial landform associated with bedrock outcrops and glacial moraine.
FLOOD ZONE	QLDC	The site is not in a flood hazard zone.
ACTIVE FAULTING	ORC	The site is centred between two active fault zone systems: The Cardrona- Hawea Fault 1km to the west and The Grandview Fault 1.5km to the east.
ACTIVE LANDSLIDES	QLDC	The site is not in an area of known active landslides.
LIQUEFACTION	ORC	The site area is mapped as being possibly susceptible to liquefaction due to the likely presence of loose fine-grained sediments.
SEISMIC EVENT RECURRENCE INTERVAL	ORC	A 1:2500-year seismic event will cause significant shaking and damage to inappropriately designed structures (intensity MMVII).
SOIL CLASS	ORC	The seismic soil classification for the area is Class D.

3.7.1 ACTIVE FAULTING

The proposed development is centred between two active faults comprising The Cardrona-Hawea Fault, 1km to the west and The Grandview Fault, 1.5km to the east. These two faults are inferred to run parallel to Hawea Flat / Upper Clutha basin before intersecting over Lake Hawea forming a single fault. It should be noted that placement of such fault boundaries is associated with a generous margin of error and no fault traces are visible in the immediate Lake Hawea area.

In addition, the Cardrona-Hawea Fault was previously referred to as the NW Cardrona Fault which has since been amended following reinterpretation of the fault system by GNS and ORC due to modern mapping technique's and remapping of surface expressions.

The Cardrona-Hawea Fault and Grandview Fault recurrence interval is estimated at 30,000 & 22,000 years respectively.

4 SUB SURFACE CONDITIONS

4.1 FIELD INVESTIGATIONS

Sub-surface investigations have been undertaken across the entire subdivision area comprising mechanical test pitting and Scala penetrometer testing. The assessments have been broadly spaced to provide maximum coverage in order to develop a sound geological model, with some strategic sitings to interrogate ground conditions proximal to inferred ephemeral overland flow paths and unusual geomorphologic landforms.

The investigations were undertaken by a suitably qualified engineering geologist from GCL, with locations determined with a hand-held GPS device and the use of QLDC GIS viewer, Google Maps and civil construction plans provided by the client.

A total of 23 mechanically excavated test pits were completed to a depth between 2.2m & 3.2m below ground level. Test pits typically encountered off-white silty SAND / SAND at depth within the central and north portion of site as opposed to sandy GRAVEL and lesser amounts of cobbles towards the south of the proposed development.

Scala penetrometer testing twined each of the 23 test pits. Refusal was typically met on intercept of the predominate underlying formation being glacial and outwash deposits.

The location of each test pit and SPT completed for this investigation is shown in Drawing 002.

4.2 INVESTIGATION LOGGING

Soils recovered from the test pits have been logged and are presented in Appendix B. Logging of the soil encountered has been undertaken in accordance with NZ Geotechnical Society Guidelines for the Field Classification and Description of Soil and Rock for Engineering Purposes.

The Scala penetrometer results have been plotted on logs as presented in Appendix B. Determination of the soil density as tested by the Scalas has been undertaken in accordance with NZ Geotechnical Society Guidelines for the Field Classification and Description of Soil and Rock for Engineering Purposes, Table 2.8.

4.3 GROUND CONDITIONS

A summary of the sub-surface conditions identified in the investigations undertaken is presented below in order of depth from the ground surface. The sub-surface conditions have been extrapolated between the investigations undertaken. Whilst care has been taken to provide sufficient sub-surface information following best practice for the purposes of resource consent, no guarantee can be given on the validity of the inference made. As such, it should be appreciated that ground conditions may vary between the investigations undertaken.

4.3.1 Topsoil

Topsoil mantles the site to a typical depth of between 0.2 & 0.3m. This material is moderately organic with lessor amounts of gravel. Roots and rootlets are common as is a gradational basal contact with the underling alluvium horizon.

4.3.2 Alluvium Deposits

Underlying the topsoil horizon, alluvium uniformly mantles the site to a typical depth of 0.6m. This material presents as light brown to light yellowish brown in colour, containing varying quantities of clay and sandy GRAVEL, or gravelly SAND, and in almost each assessment a portion of cobbles and boulders was observed.

Gravel is fine to coarse and sub rounded to subangular. Sand is fine to medium grained. Cobbles range in size from 100 to 200mm diameter, sub rounded to subangular in shape. Boulders up to 0.4m diameter were occasionally encountered. The clay content in almost all assessment sites decreased with depth and integration into the underlying glacial till. Roots and rootlets are common extending to the full depth of the soil horizon.

4.3.3 Late Pleistocene Glacial Deposits (Till)

Glacial deposits form the predominate underlying geological formation across the north and central portion of site associated with the terminal moraine landform as identified by TP101 – 109, 116 - 119 to a maximum depth of 2.9m below ground level.

This granular material is described as light grey through to off-white SAND in colour containing variable amounts of gravel, cobbles and boulders. The sand is typically fine to medium grained. The large size fraction comprising gravel, cobble, sand boulders is mostly subrounded to subangular in shape, gravel size ranged from fine to coarse, cobbles and boulders up to 0.4m diameter in size.

The large size fraction is sporadically distributed throughout the soil profile. Material rarely formed concentrates, beds or lenses with the exception of an inferred integration zone between glacial and outwash deposit at the toe of the terminal moraine.

Based on results from the SPT's undertaken, a relative density of "dense" can be applied to this formation whereby a blow count between 7 – 17 blows per 100mm Scala rod advancement is achieved. Furthermore, the material excavated from depth presented partially as clasts which is indicative of high soil strength.

4.3.4 Late Pleistocene Outwash Deposits

Outwash deposits form the predominate underlying geological formation across the south of site associated with the wider area known as Hawea Flats and was identified by TP110 – 115, 120 – 123 to a maximum depth of 3.2m below ground level.

Variations of light to dark grey material comprising sandy GRAVEL / gravelly SAND, moderately thick beds of laminated silty SAND, and occasional pockets of cobbles / boulders best describe this soil profile.

Sand is typically medium to coarse grained whereas gravel ranged from fine to coarse in size and sub rounded to sub angular in shape. Cobbles and boulders as identified in TP112 present as semi spherical, sub-rounded to subangular in shape up to 200mm diameter in size. This

material often formed discrete imbricated sub horizontal bedding structures and discontinuous lenticular structures.

Laminated silty SANDS identified in TP112 – 114 present as light brown to off-white coloured moderately thick beds, often associated with gravelly SAND interlayering encountered at depths between 1.15 – 3.0m below ground level.

Similar to the Glacial Deposits, a relative density of "dense" can be applied to this formation. Scala's typically refused on contact with formation somewhat attributed by the coarse material make up. Although unassessed, a reduced density of "medium dense" is applied to silty SANDS based on knowledge of this material.

4.4 GROUNDWATER CONDITIONS

Ground water was not encountered in any of the excavated test pits.

Given the sloping nature of the topography and elevation above recognised water bodies, it is unlikely that a coherent groundwater table would rise significantly to the extent that it would interfere with shallow foundations.

This observation is concordant with the topographical setting of the subdivision, being approximately 18 to 20m above the Hawea River. As such we expect the coherent groundwater table to be considerably deeper than the proposed soak-pits.

5 GROUND MODEL

5.1 GENERAL

We have developed a ground model for the site based on the investigations undertaken to date including a desktop study, site mapping and sub-surface tests. A summary of the ground model is provided as follows:

- The site is presently undeveloped and does not appear to have been significantly modified.
- The site currently presents as grassed dotted with a mixture of native and exotic shrub and tree species.
- The site is located on gently to moderately sloping topography which does not display any slope instability features. In addition, the site is remote from steeper slopes and/or slopes prone to the development of slope instability features.
- The site is consistently underlain by competent ground conditions comprising either glacial till (SAND and minor amounts of gravel and cobbles), or outwash deposits (sandy GRAVEL / gravelly SAND). Topsoil and alluvium mantle this formation to a typical depth of 0.6m.
- The site does not contain any permanent surface water features. Surface water from the site is likely to dissipate as sheet flow in a general southerly direction with the exception of a topographic low / ephemeral flow path in the north east corner of site which will likely concentrate run-off in this respective direction.

- No groundwater inflows were encountered in the subsurface investigations. Given the nature of sloping topography, elevation above known water bodies and free draining gravels identified along the south boundary, it is likely that project area contains depressed groundwater levels and likely >15m depth given the level of the Hawea River.
- The site is located in the vicinity of an active fault zone with a Seismic Soil Class D.
- The site is not prone to liquefaction due to the nature of the relatively coarse deposits, their density, and the depressed groundwater level.

The ground model developed above has been utilised to consider the various geotechnical aspects of the proposed development which is presented in Section 6 of this report.

5.2 GEOTECHNICAL RISK

The ground model presented in this report is based on the investigations undertaken to date and it should be appreciated that there is inherent risk with the formulation of a ground model. In particular we note the following:

- Ground conditions can vary between investigations undertaken and there is always some natural variability in ground conditions.
- Discrete sub-surface investigations may not identify small-scale ground irregularities, particularly associated with human disturbance such as offal pits, drainage line back-fills and landscaping works.
- Ground strength varies with changes in water content, soil type and ground loading. As such, it should be appreciated that weaker ground conditions may develop over that measured due to periods of wet weather and/or during the winter months.
- The potential geotechnical effects of climate change are not well understood to date. Effects may include changes in groundwater levels, soil saturation and surface water characteristics which may have an effect on site development.

Given the potential risk profile provided above, we have adopted a conservative approach when considering the geotechnical aspects of the proposed development provided in Section 7 of this report.

6 NATURAL HAZARD RISK ASSESSMENT

6.1 GENERAL

In accordance with Section 106 of the Resource Management Act, we have undertaken a qualitative natural hazards risk assessment for the proposed subdivision. The natural hazard consequence and likelihood of occurrence has been assessed by means of the overall risk matrix as shown in Table 2, with the risk classifications defined in Table 3.

Table 2: Risk Matrix

POTENTIAL CONSEQUENCES	LIKELIHOOD				
	VERY UNLIKELY (0 – 5%)	UNLIKELY (5 – 45%)	POSSIBLE (45 – 55%)	LIKELY (55 – 95%)	ALMOST CERTAIN (95 – 100%)
SEVERE	LOW	LOW	MODERATE	HIGH	VERY HIGH
MODERATE	NEGLIGIBLE	LOW	MODERATE	MODERATE	HIGH
MINOR	NEGLIGIBLE	LOW	LOW	MODERATE	MODERATE
NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE	LOW	LOW

Table 3: Summary of Risk Classification

RATING SCALE	SECTION 106 COMPLIANCE	DISCUSSION
VERY HIGH	NON-COMPLIANT	THERE IS A HIGH PROBABILITY THAT SEVERE DAMAGE TO THE PROPOSED HOUSE SITE COULD ARISE FROM AN IDENTIFIED SOURCE WITHOUT APPROPRIATE REMEDIAL ACTION
HIGH	NON-COMPLIANT	THE PROPOSED HOUSE SITE IS LIKELY TO EXPERIENCE SIGNIFICANT DAMAGE FROM AN IDENTIFIED SOURCE WITHOUT REMEDIAL ACTION
MODERATE	NON-COMPLIANT	IT IS POSSIBLE THAT DAMAGE COULD ARISE TO THE PROPOSED HOUSE SITE, BUT IT IS UNLIKELY THAT SUCH DAMAGE WOULD BE SIGNIFICANT
LOW	COMPLIANT	IT IS POSSIBLE THAT DAMAGE COULD ARISE TO THE PROPOSED HOUSE SITE FROM AN IDENTIFIED SOURCE THOUGH THIS IS LIKELY TO BE MILD OR UNLIKELY
NEGLIGIBLE	COMPLIANT	THE PRESENCE OF THE IDENTIFIED SOURCE DOES NOT GIVE RISE TO THE POTENTIAL TO CAUSE SIGNIFICANT DAMAGE TO THE PROPOSED HOUSE SITE

6.2 SUBDIVISION ASSESSMENT

Table 4 shows a risk register for the proposed subdivision and appropriate mitigation measures if applicable based on Tables 2 & 3.

Table 4: Risk Register

RISK	POTENTIAL CONSEQUENCES	LIKELIHOOD	RISK CLASSIFICATION	COMMENT	MITIGATION MEASURES
SLOPE INSTABILITY	MODERATE	UNLIKELY	LOW	REMOTE FROM ANY ACTIVE LANDSLIDE. NO GEOMORPHOLOGICAL EXPRESSION OF RECENT ACTIVITY.	N/A
GROUND SUBSIDENCE	MODERATE	VERY UNLIKELY	NEGLIGIBLE	COMPETENT GROUND CONDITIONS	N/A
SOIL SHRINK/SWELL	MODERATE	VERY UNLIKELY	NEGLIGIBLE	GRANULAR SOILS	NO SPECIFIC ENGINEERING DESIGN REQUIRED FOR SHRINK SWELL
EARTHQUAKE	SEVERE	POSSIBLE	MODERATE	THE PROPOSED DEVELOPMENT IS LOCATED IN A SEISMICALLY ACTIVE AREA BOUND BY THE CARDRONA – HAWEA FAULT AND GRANDVIEW FAULT	APPROPRIATELY DESIGNED STRUCTURE IN ACCORDANCE WITH NZS1170.
LIQUEFACTION	MODERATE	UNLIKELY	NEGLIGIBLE	DEPRESSED GROUNDWATER AND DENSE FREE DRAINING SOILS	N/A
DEBRIS FLOW	MODERATE	UNLIKELY	NEGLIGIBLE	NO CATCHMENT SOURCE OR ALLUVIAL FAN	N/A
FLOODING	MODERATE	UNLIKELY	NEGLIGIBLE	NO SURFACE WATER COURSE AND FREE DRAINING SOILS	N/A
TSUNAMI	MINOR	VERY UNLIKELY	NEGLIGIBLE	ELEVATED SITE REMOTE FROM LAKE	N/A
VOLCANIC ERUPTION/ASH FALL	MODERATE	VERY UNLIKELY	NEGLIGIBLE	REMOTE FROM ACTIVE VOLCANIC CENTRE	N/A

Table 4 indicates the risk classification for the identified natural hazards is negligible for all risks apart from "Earthquakes" where appropriate mitigation measures can be reasonably provided. As such, we consider the proposed subdivision fulfills Section 106 of the Resource Management Act.

7 GEOTECHNICAL CONSIDERATIONS

7.1 GENERAL

The geotechnical aspects of the proposed development have been considered principally with the aim of demonstrating that safe and stable conditions for the proposed homesites are presently available or are achievable with appropriate remedial works/constraints. This in particular has been considered with respect to the following information, standards, guidelines and codes:

- The ground model developed in Section 5 of this report.
- NZS 3604:2011: "Timber-framed buildings".
- AS 2870:2011: "Residential slabs and footings".
- NZS 1170:2004: "Structural design actions".
- New Zealand Building Code: Clauses B1, E1, G12 & G13.
- District and Regional Plan provisions on residential development.
- Council development codes, standards and guides on residential development.

Of note, is NZS 3604:2011 and the New Zealand Building Code which provide a set of criteria for determining whether safe and stable conditions or "good ground" are achieved, whereby "good ground" allows for the design of standard foundations in accordance with the provisions of the standards. In summary, "good ground" defines conditions where the risk of foundation failure is considered to be low to nil. Foundation failure is possible via the following mechanisms which are addressed in this report as follows:

- Slope instability - this includes foundation failure associated with slope derived instability and is addressed in Section 7.2 of this report.
- Weak ground - this includes foundation failure associated with poor bearing capacity and is addressed in Section 7.4 of this report.
- Ground settlement/consolidation - this includes ground consolidation associated with building loads, earthworks loads, and dewatering and is addressed in Section 7.5 of this report.
- Soil expansiveness - this includes soil shrink/swell associated with drying and wetting of the soil profile and is addressed in Section 7.6 of this report.
- Seismicity - this includes the effects of ground shaking associated with a seismic event and is addressed in Section 7.7 of this report.

7.2 SLOPE STABILITY

The proposed subdivision is located predominately on gentle sloping topography which is dictated / shaped by the Lake Hawea terminal moraine. The elevated north portion makes way to the lower Hawea flats at slope angles between 8 – 18 degrees to the horizontal.

The site is underlain by competent ground conditions and is remote from steeper slopes and/or slopes prone to the development of slope instability features.

The low overall slope angles are negligible and underlying competent ground conditions in the vicinity of proposed lots should provide safe and stable building platforms with respect to slope stability conditions.

A safe and stable building platform is defined as having a low to negligible risk of failure over the lifetime of a dwelling and is assessed as a factor of safety where a quantitative slope stability assessment is undertaken. Given the low slope angles in the vicinity of the site, we consider that a qualitative assessment of slope stability (as provided above) is acceptable for defining risk for this site and that a more rigorous quantitative analysis is not required.

7.3 BUILDING PLATFORM DEVELOPMENT

A conceptual lot plan has been provided for the subdivision (Appendix A). Lots are a minimum 600m^2 and arranged in a typical layout for medium density residential subdivision. Based on this, we understand some earthworks will be undertaken, especially within the central portion of the subdivision in order to provide suitable grades for residential development and access. This will likely include a cut to fill in order to provide slope grades in the order of 8 to 15 degrees to the horizontal.

Lots 28 – 32 associated with the ephemeral overland flow paths will be managed by attenuating surface run off into the designated subdivision stormwater facility.

Section 8 provides recommendations on earthworks constraints.

7.4 BEARING CAPACITY

7.4.1 General

Bearing capacity is discussed in this report in terms of ultimate limit state design methods outlined in AS/NZS 1170. As such, in accordance with AS/NZS 1170, we have provided "ultimate" bearing capacity values and an appropriate "dependable" bearing capacity for foundation design. The dependable bearing capacity has been determined from a strength reduction factor of 0.5 (i.e. a factor of safety of 2) which is in general accordance with the requirements of AS/NZS 1170.

In addition, the 'Allowable Bearing Capacity', where the ultimate is factored by a safety of 3, is included for reference.

The bearing capacity has been determined from our interpretation of the engineering description of the soil conditions, observations from the test pits on the soil behaviour and relative density measurements based on the site-specific testing undertaken. The values presented take into consideration natural variability of ground strength likely between investigations undertaken and potential strength reduction associated with saturated soil conditions.

7.4.2 Shallow Pad/Strip Footings

Table 5 outlines design bearing capacities for a shallow pad/strip footing solution. The design capacities are based on a minimum foundation embedment depth of 450mm into competent ground. Competent material is considered the alluvium, glacial deposits or outwash deposits.

Table 5: Shallow Pad/Strip Footing Design Parameters

LOAD CASE	ULTIMATE BEARING CAPACITY	STRENGTH REDUCTION FACTOR	DEPENDABLE BEARING CAPACITY	(ALLOWABLE BEARING CAPACITY)
ULTIMATE LIMIT STATE DESIGN	300kPa	0.5	150kPa	100kPa

The embedment depth requirement for this foundation will be subject to formal engineering design and in general accordance to AS 2870 which is outlined in Section 7.6 of this report. In addition, the above parameters are considered appropriate for waffle slab-on-ground foundation solutions, subject to subgrade inspection.

7.4.3 Shallow Pile Foundations

Table 6 outlines design bearing capacities for a shallow pile foundation solution for light weight timber structures and appurtenant structures. The design capacities are based on a minimum foundation embedment depth of 450mm into competent ground, i.e. alluvium, glacial deposits or outwash deposits.

Table 6: Shallow Pile Foundation Design Parameters

END BEARING CASE				
LOAD CASE	ULTIMATE BEARING CAPACITY	STRENGTH REDUCTION FACTOR	END DEPENDABLE BEARING CAPACITY	(END ALLOWABLE BEARING CAPACITY)
ULTIMATE LIMIT STATE DESIGN	300kPa	0.5	150kPa	100kPa
AUGURED PILE SKIN FRICTION				
LOAD CASE	-	STRENGTH REDUCTION FACTOR	DEPENDABLE SKIN FRICTION	(ALLOWABLE SKIN FRICTION)
ULTIMATE LIMIT STATE DESIGN	-	0.5	15kPa	10kPa

The embedment depth requirement for this foundation will be subject to formal engineering design and in general accordance to AS 2870 which is outlined in Section 7.6 of this report.

7.4.4 Foundation Service Bridging

We recommend that where a service line and associated backfilled trench are located within a 45° loading line taken from the base of a load bearing structure foundation bridging is required.

Service line trenching and backfilling should be in accordance with recommendations provided in Section 8.3 of the report.

7.4.5 Retaining Walls

Engineered retaining walls will be required on site under the following circumstances:

- where the retention height is greater than 1.5m;
- where retaining wall supports any surcharged loads such as sloping ground and structure/traffic loads; and
- where retaining wall failure will affect the stability and integrity of adjacent structures and neighbouring properties.

Table 7 provides geotechnical parameters for the engineered retaining wall design as required:

Table 7: Retaining Wall Design Parameters

COHESION (C')	FRICTION ANGLE (⍰')	UNDRAINED SHEAR STRENGTH (C_U)	ULTIMATE BEARING CAPACITY (KPA)	UNIT WEIGHT (⍰)
0KPA	32^O	NA (GRANULAR MATERIAL)	300	$18KN/M^3$

All retaining walls should be constructed with appropriate toe drainage and backfilled to their full height with lightly compacted free draining granular material or other appropriate drainage solution. Toe drainage should be discharged at a point that will not impact or influence the construction works on site or alternatively be connected to the reticulated stormwater system.

7.5 GROUND SETTLEMENT

The proposed homesites are underlain by competent ground conditions. The competent ground conditions are considered to be at least normally consolidated and should accommodate low to moderate loads without inducing significant ground consolidation and associated differential ground settlement within Building Code limits (a maximum differential settlement ratio of 1 in 240).

As a prudent measure, however, ground loading constraints are recommended as follows:

- A maximum building UDL (Uniformly Distributed Load) of 15kPa (includes live + dead loads).
- A maximum footing width of 1.0m.
- A maximum fill depth of 1.5m.

Should the proposed development exceed these constraints, we recommend that a specific settlement analysis be undertaken for the development and may require more extensive investigations than that undertaken to date.

7.6 SOIL EXPANSIVITY

The site soil is considered not to be susceptible to the development of significant soil shrink/swell associated with changes in soil moisture content. Based on the logging of the test pits across the subdivision, we consider the site soil to be non-expansive to Class S according to AS 2870. The soil expansivity class is based on our experience of the type of soils encountered within the subdivision and is considered to provide a suitable qualitative assessment of soil shrink/swell.

Specific engineered foundation design to resist shrink/swell is therefore not required and is in compliance with NZS 3604:2011.

7.7 SEISMIC CONSIDERATIONS

7.7.1 Seismic Soil Class

Glacial and outwash deposits comprising SAND and sandy GRAVEL / gravelly SAND have been uniformly identified across the entire proposed subdivision to a maximum depth of 3.2m, as such, we consider the site sub soil Class D (deep soil) is appropriate in accordance with NZS1170.5.

7.7.2 Liquefaction

The site is identified on the QLDC hazard mapping as LIC1, nil to low potential of liquefaction. Based on the site investigations completed and the geological data for the site, we concur with the LIC1 classification on the grounds of the depressed groundwater regime, course soils and their high relative density.

7.7.3 Seismic Activity

The Queenstown and Wanaka region has been identified as prone to seismic activity and as such, an appropriate allowance for seismic loading should be made during detailed design of the proposed buildings, foundations, retention structures, earthworks and infrastructure.

8 SITE DEVELOPMENT CONSTRAINTS

8.1 GENERAL EARTHWORKS DISCUSSION

The proposed site development works may require excavation and or temporary batters prior to the construction of formal retaining structures and building platforms as well as access roads and driveways. As such, there is the risk of collapse of soil batters during construction especially if left unsupported for an extended period of time and or left exposed during prolonged period of rainfall.

The topsoil is considered unsuitable for reuse as an engineered fill, as is site won glacial till given the fine grained make up of material which has proven difficult to construct to an engineering standard due to moisture sensitivity. Outwash deposits on the other hand are likely to provide a source of suitable non-cohesive material for fill placement subject to its performance in context of NZS4431.

8.2 SITE PREPARATION

During the earthworks operations all topsoil and organic matter and other unsuitable materials should be removed from the construction areas in accordance with the recommendations of NZS 4431:1989. The subgrade should be inspected prior to fill being placed and or foundations being constructed to establish it has suitable bearing capacity and is clear of unsuitable materials.

Appropriate shallow graded sediment control measures should be installed during construction where rainwater and drainage run-off over exposed soils is likely. If slope gradients in excess of 5% are proposed in soils then the construction and lining of drainage channels is recommended, e.g. with geotextile and suitably graded granular material, or similarly effective armouring.

Exposure to the elements should be limited for all soils and covering the soils with polythene sheeting will reduce degradation due to wind, rain and surface run-off. Under no circumstances should water be allowed to pond or collect near or under a foundation or slab. This can be avoided with shaping of the subgrade to prevent water ingress or ponding.

If fill is utilised as bearing for foundations it should be placed and compacted in accordance with the recommendations of NZS 4431:1989 and certification provided to that effect.

The upper soils present at the site are prone to erosion, both by wind and water, and should be protected by hardfill capping or re-topsoiled/mulched and re-vegetated as soon as the finished batter or subgrade levels are achieved.

8.3 EXCAVATIONS

Recommendations for temporary and permanent slope batters are provided in Table 8 below. Slopes that are required to be steeper than those described below should be structurally retained or subject to specific geotechnical design.

All slopes should be periodically monitored during construction for signs of instability and excessive erosion, and, where necessary, corrective measures should be implemented to the satisfaction of a Geotechnical Engineer or Engineering Geologist. Should construction and earthworks be undertaken during the winter period, the frequency of the inspections should increase, with site inspections being made after any significant weather event.

Seepages are common in excavations completed in hillside areas and drainage measures, such as horizontal drains, may be required if excessive groundwater seepages are encountered during excavation. This may well be the case in the deeper excavations where groundwater is anticipated to be near or just above rockhead or at the contact between the glacial till and alluvial soils. The final design and location of all sub-soil drainage works should be confirmed during construction by a suitably qualified and experienced Geotechnical Engineer or Engineering Geologist.

Recommended temporary and permanent batter angles for cut slopes up to a maximum of 3.0m in both wet and dry conditions are presented below. The batters provided should be adhered to where more than one soil type is present within the slope or defaulted to the shallower angle where appropriate. The height of any permanent batter should be cognisant of QLDC's District Plan Section 22 – see Section 8.5 below.

Table 8: Batter angles for soil slopes

MATERIAL TYPE	RECOMMENDED MAXIMUM BATTER ANGLES FOR TEMPORARY CUT SLOPES FORMED IN SOILS		RECOMMENDED MAXIMUM BATTER ANGLES FOR PERMANENT CUT SLOPES FORMED IN DRY (DRAINED) SLOPES
	WET GROUND	DRY GROUND	
TOPSOIL	3H:1V	2.5H:1V	2H:1V (GRASSED/PLANTED)
ENGINEERED FILL	2H:1V	1H:1V	2H:1V (UNRETAINED, DRAINED)
ALLUVIUM	2H:1V	1H:1V	2H:1V OR BY ASSESSMENT
GLACIAL TILL	2H:1V	0.5H:1V	2H:1V OR BY ASSESSMENT

Inspections of soil cuts will be required during construction to confirm the above recommendations and based on the site observations a reduction in batter angles from those provided above may be required and conversely, if materials are preforming, may be steepened if site conditions and construction sequencing/programme are favourable.

8.4 ENGINEERED FILL SLOPES

As recommended in Table 8 above, unretained engineered fill slopes should be formed at 2H:1V (or flatter) providing they are well drained and compacted to the appropriate specification based on NZS4431. If steeper grades are required, the fill will require geogrid reinforcement to form slopes up to 45° but subject to specific engineering design from a chartered professional engineer.

8.5 QLDC SECTION 22

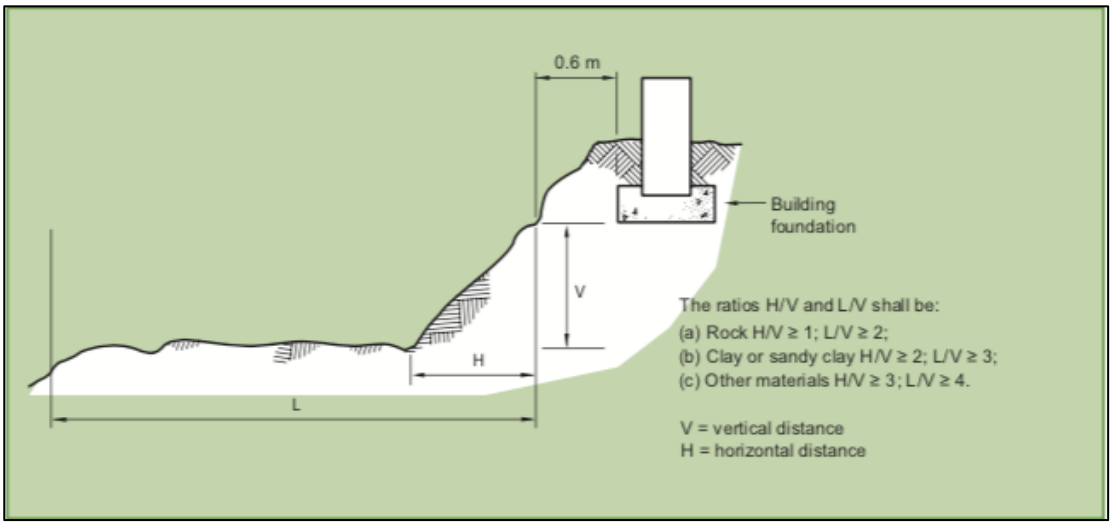
We recommend the following constraints for the construction of permanent and long-term site earthworks carried out the vicinity of the proposed dwelling in line with QLDC's District Plan Section 22 Earthworks Rules:

- The maximum height of any cut shall not exceed 2.4 metres.
- The maximum height of any fill shall not exceed 2 metres.
- The vertical height of any cut or fill shall not be greater than the distance of the top of the cut or the toe of the fill from the site boundary (see Interpretative Diagram 6 of Section 22), except where the cut or fill is retained, in which case it may be located up to the boundary, if less or equal to 0.5 metre in height.

8.6 FOUNDATION PROVISIONS (NZS3604)

With reference to NZS3604, Section 3.1.2 (b), any foundation for a building erected at the top of a bank, shall be 600mm behind the ground line as shown in the figure below. The horizontal distance (H) from the top to the bottom shall not exceed 3m. The slope beyond the bank shall not exceed 10° degrees for a distance of 10m.

Figure 3.1 After NZS3604



With reference to NZS3604, Section 3.1.2 (c) fill, including hard fill, placed over undisturbed ground or certified fill, shall not exceed 600mm in depth above natural ground level, if within 3m of a foundation. Where this condition cannot be met, the fill shall be tested and certified to be of appropriate density/strength.

8.7 CONSTRUCTION MONITORING AND CERTIFICATION

Any earthworks and placement of fill should be undertaken in general accordance of Queenstown Lakes District Council's Land Development and Subdivision Code of Practice (incorporating NZS4404) and NZS4431.

Of particular importance are the inspection and certification of the following:

- Subgrade inspection.
- Suitability of site won material for reuse and engineered fill.
- Performance of temporary cut batters.
- Foundation inspections.
- Fill >600mm depth or built as a slope >2H:1V.

8.8 SERVICES

We recommend that all underground services are backfilled with adequately compacted backfill (bedding <12mm size fraction) to minimise the risk of significant trench consolidation and settlement.

Trench excavations should be shored or battered appropriately in accordance with the OSH/DOL Approved Code of Practice for Safety in Excavations and Shafts for Foundations (April 2000).

The contractor is expected to employ the appropriate plant and machinery to undertake the excavation and retaining wall construction.

8.9 UNSUITABLE MATERIALS

Recommendations for foundation design provided in Section 7 of this report are based on foundations embedded within "good ground" according to NZS 3604:2011. In order to achieve "good ground" we recommend the following:

- All foundation excavations should be inspected by a suitably qualified person.
- Care should be taken to ensure that all unsuitable material such as the topsoil layer, weak ground, areas of non-engineered fill and or hard spots are removed from the building platform prior to building construction.
- The undercut for the building footprint should extend for a horizontal distance equivalent to the undercut depth beyond the footprint. The undercut should be backfilled with engineered fill up to the required formation level unless specified otherwise by a suitably qualified person.

9 STORMWATER MANAGEMENT

Stormwater disposal should be in compliance with the operative District & Regional Plans, the Building Code and recognised New Zealand standards and guidelines. In summary, this requires the following:

- Hydrogeological neutrality should be provided within receiving environments (such as overland flowpaths, streams and reticulated stormwater systems) with the addition of impervious surfaces. In addition, the disposal of stormwater should not provide a nuisance to neighbouring properties and public infrastructure.
- Stormwater should be managed in such a way as to avoid slope erosion, earthworks batters, retaining walls, building structures and effluent disposal areas.
- Stormwater should be managed in such a way as to have no significant effect on overall slope stability conditions.
- Stormwater should be directed to a public reticulated stormwater system where possible.
- Site development should be mindful of existing surface water features including overland flowpaths and appropriate remedial measures should be provided where required.

In particular, we note the following documents pertinent to stormwater management for the proposed development:

- New Zealand Building Code, Clause E1 'Surface Water': E1/VM1.
- New Zealand Water Environment Research Foundation (NZWERF): 'On-site Stormwater Management Guideline'.

10 CONSTRUCTION MANAGEMENT

10.1 NUISANCE TO EXISTING STRUCTURES AND DWELLINGS

The development proposed is bound by occupied dwellings and residential developments at various stages of construction. As such the following construction management issues should be appropriately addressed.

10.2 NOISE AND VIBRATION

The principal contractor should be fully cognisant of the QLDC requirements and take the appropriate measures to control the construction noise.

Conventional earthmoving equipment, such as hydraulic excavators, rollers and trucks will be required during the earthworks/fill placement and building platform construction. During compaction activities care should be taken to ensure that neighbouring properties are not adversely affected by ground vibrations.

10.3 DUST

The Hawea area is prone to strong prevailing winds, particularly during the spring and early summer months. As seen with other developments in the area, the soils can generate high levels of dust during excavation and filling works. It is important that dust suppression/wetting is employed to reduce the nuisance to neighbouring properties, impact on visibility for drivers and for the H&S of the construction and ground staff.

Regular damping with sprinklers is expected to be an effective measure to control airborne dust during construction. QLDC provide guidelines which should be adhered to.

10.4 EROSION AND SEDIMENT CONTROL

Given the property is largely open topography and contains no surface water features, erosion and sediment control are not perceived to be a significant hazard on site. However, standard options to control sediment run-off should be considered such as earth bunds, silt fences, hay bales, vegetation buffer strips and sediment ponds.

Details for the implementation of erosion and sediment control measures can be accessed at the following internet link:

http://www.aucklandcity.govt.nz/council/documents/district/Ann14.pdf

Further detail related to construction sites can be found at:

http://www.itd.idaho.gov/manuals/Online_Manuals/BMP/

11 QLDC LAND DEVELOPMENT & SUBDIVISION CODE OF PRACTICE

11.1 GENERAL

Section 2.4.4 of the QLDC Land Development and Subdivision Code of Practice (QLDC CoP) requires the developer of any subdivision to appoint a geo-professional to carry out the following functions from the planning to construction phases of the subdivision:

a) Check regional and district plans, records, and requirements prior to commencement of geotechnical assessment;

b) Prior to the detailed planning of any development, to undertake a site inspection and such investigations of subsurface conditions as may be required, and to identify geotechnical hazards affecting the land, including any special conditions that may affect the design of any pipelines, underground structures, or other utility services;

c) Before construction commences, to review the drawings and specifications defining any earthworks or other construction and to submit a written report to the TA on the foundation and stability aspects of the project (if required);

d) Before and during construction, to determine the extent of further geo-professional services required (including geological investigation);

e) Any work necessary to manage the risk of geotechnical instability during the construction process;

f) Before and during construction, to determine the methods, location, and frequency of construction control tests to be carried out, determine the reliability of the testing, and to evaluate the significance of test results and field inspection reports in assessing the quality of the finished work;

g) During construction, to undertake regular inspection consistent with the extent and geotechnical issues associated with the project;

h) On completion, to submit a written report (i.e. Geotechnical Completion Report) to the Territorial Authority (TA) attesting to the compliance of the earthworks with the specifications and to the suitability of the development for its proposed use including natural ground within the development area. Where NZS 4431 is applicable, the reporting requirements of that Standard shall be used as a minimum requirement.

11.2 APPLICABILITY OF THIS REPORT

This report has been written for the purposes of resource consent application and has addressed and completed items a) and b) from the above list.

On receiving Resource Consent Approval for the subdivision, a geo-professional shall be appointed by the developer to:

- Review the earthworks drawings and specifications prior to finalising the documentation for tendering and/or construction,
- To oversee the construction phase of the project including certification of fill; and

- Provide a Geotechnical Completion Report (GCR) and Schedule 2A in accordance with the QLDC CoP.

The GCR and Schedule 2A should detail the results of site observations, testing and monitoring during earthworks construction, confirm the stability of the finished earthworks, and identify any specific geotechnical design requirements that must be addressed in order to construct a building on site. Any identified specific design requirements will then be registered on the subject lots' 'Certificate of Title' and will need to be addressed during the building consent process.

The geo-professional completing the GCR and Schedule 2A which includes the certification of fill should in all cases be engaged by the developer not the contractor. It is also advisable that the geo-professional review the earthworks contract to assist in managing the developer's risk and ensuring that the contract is clear with respect to geotechnical risks and responsibilities during construction.

12 LIMITATIONS

12.1 GENERAL

Ground Consulting Ltd has undertaken this assessment in accordance with the brief as provided, based on the site and location as shown on Drawing 002. This report has been provided for the benefit of our client, and for the authoritative council to rely on for the purpose of processing the consent for the specific project described herein. No liability is accepted by this firm or any of its directors, servants or agents, in respect of its use by any other person, and any other person who relies upon information contained herein does so entirely at their own risk.

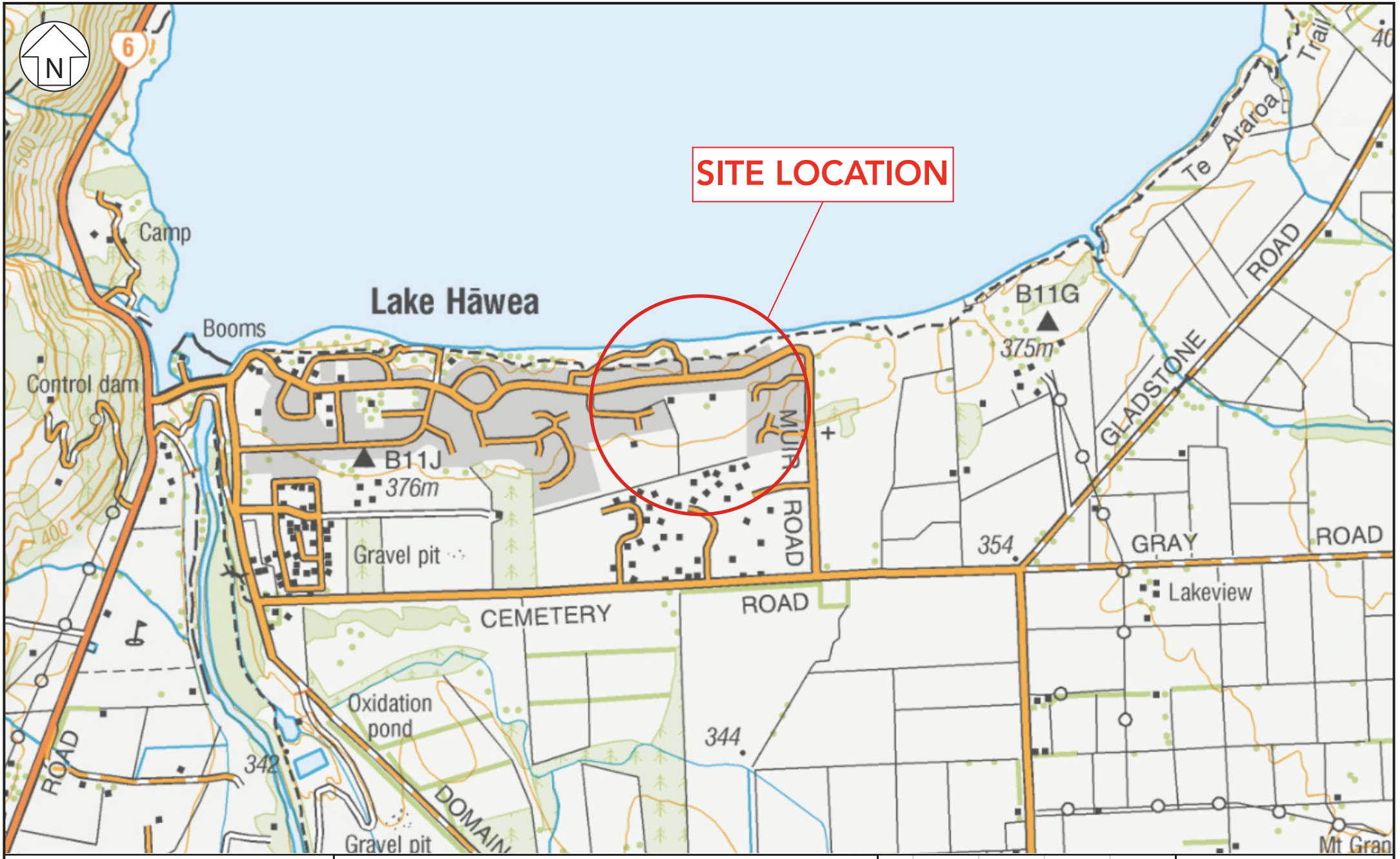
The sub-surface conditions have been extrapolated between the investigations undertaken. Whilst care has been taken to provide sufficient sub-surface information following best practice, no guarantee can be given on the validity of the inference made and it must be appreciated that actual conditions could vary from the assumed model.

12.2 FURTHER INVESTIGATIONS REQUIRED

This assessment has been undertaken for the proposed site development to date. Any structural changes, alterations and additions made to the proposed development should be checked by a suitably qualified person and may require further investigations and analysis.

Geotechnical inspections will be required during construction to assess site slopes, foundation excavations, retaining walls and other geotechnical aspects of the development. This is to ensure ground conditions encountered are in accordance with the findings of this assessment. If ground conditions differ from those presented in this report, advice on design and construction modifications should be sought from a suitably qualified person.

DRAWINGS



GCL Ground Consulting Ltd

WILLOWRIDGE DEVELOPMENTS LIMITED
c/o PATERSON PITTS GROUP

195 LAKE VIEW TERRACE, HAWEA

SITE LOCATION PLAN

Rev	Date	Status	Drafted	Reviewer
A	15/10/2019	Issued	S.F.	F.W.

File Ref. 5000/5160/R5160-1/R5160-1A-DRW001.ai

Scale (A4) 1:20,000

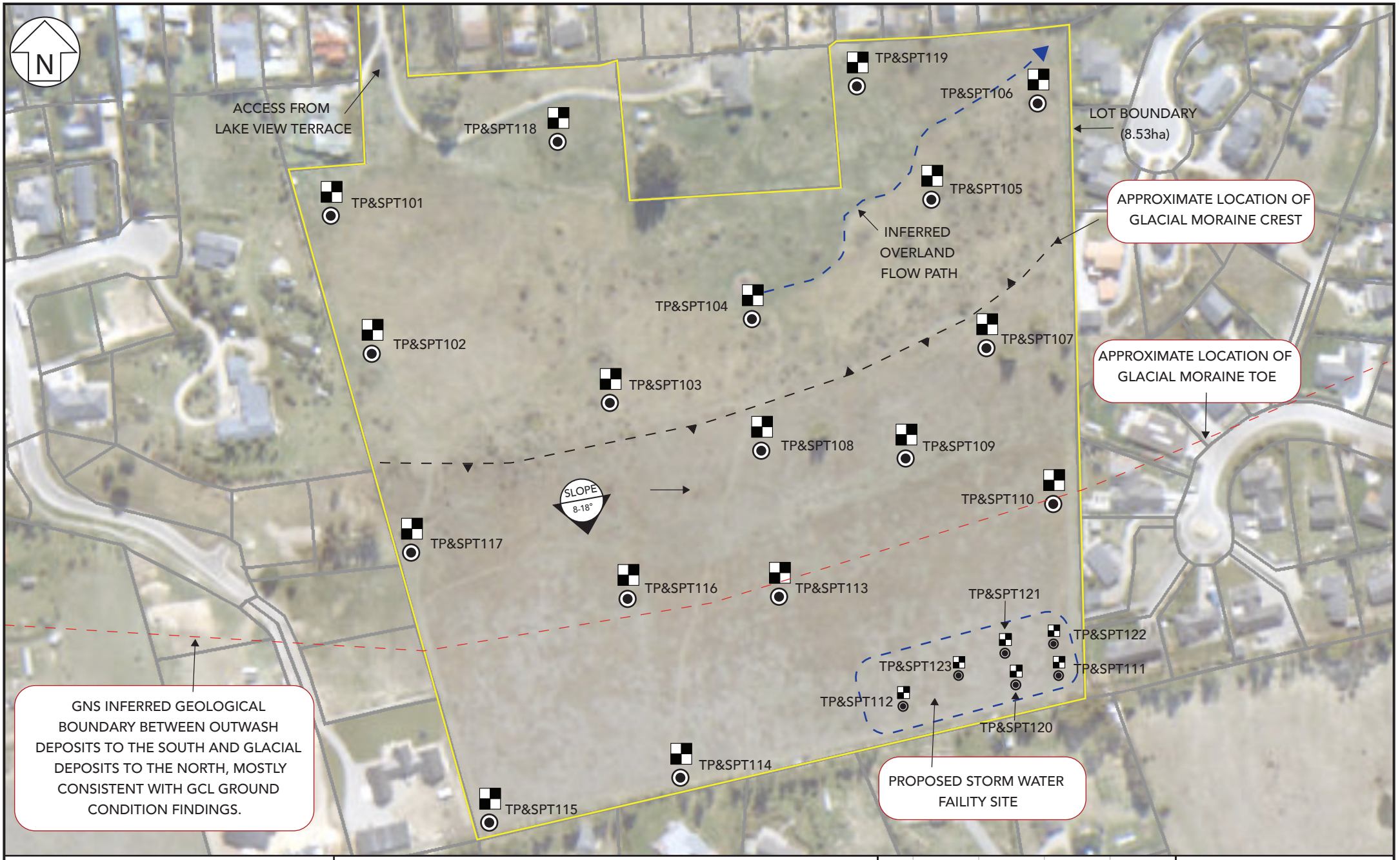
0 80 400 800m

Project No. 5160

Report Ref. R5160-1A

Drawing No. 001

Please use this report as a general guide only. This is not site specific.



GCL Ground Consulting Ltd

WILLOWRIDGE DEVELOPMENTS LTD
c/o PATERSON PITTS GROUP

195 LAKE VIEW TERRACE, HAWEA

SITE INVESTIGATION PLAN

Rev	Date	Status	Drafted	Reviewer
A	15/10/2019	Issued	S.F	F.W.

File Ref. 5000/5160/R5160-1A/R5160-1A-DRW002.ai

Scale (A4) 1:2000 (Approx.)

0 35 70

Project No. 5160

Report Ref. 5160-1A

Drawing No. 002

APPENDIX A: SUBDIVISION SCHEME PLAN

WANAKA
19 Reece Crescent
or P.O. Box 283
Wanaka 9343
T 03 443 0110
E wanaka@ppgroup.co.nz

PATERSONPITTSGROUP
Your Land Professionals
www.ppgroup.co.nz
0800 PPGROUP

Client & Location:
Orchard Road Holdings Limited
195 Lakeview Terrace
Lake Hawea

Purpose & Drawing Title:
Existing Ground Contours

Surveyed by:	-	Original Size:	Scale:
Designed by:	MJB	A3	1:1250 @ A3
Drawn by:	BTF		DO NOT SCALE
Checked by:	MJB		
Approved by:	MJB		

Job No:	DWG No:	Sheet No:	Revision No:	Date Created:
W6000	003	101	C	19/09/19

C:\12DS\DATA\WKSBSSVR02\W6000 - ORCHARD ROAD HOLDINGS LIMITED_10152\5 - DRAWINGS\1 - DWG\W6000 003 LOT 1 DP 300226 SCHEME.DWG

APPENDIX B: INVESTIGATION LOGS

INVESTIGATION LOG

TP&SPT101

Report Ref: R5160-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
Willowridge Developments Ltd c/o Paterson Pitts Group			GPSH

Location: 195 Lakeview Road, Hawea

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Samples	Depth (m)	Legend
TOPSOIL	TOPSOIL; dark brown. Loose to medium dense; dry to moist; contains roots and rootlets.			
ALLUVIAL DEPOSITS	Clayey sandy GRAVEL, with minor cobbles; light yellowish brown. Medium dense; dry; gravel, medium to coarse, subround to subangular; sand, fine to medium; cobbles, subround to subangular, up to 100mm; contains some rootlets throughout, sharp transition into underlying unit.			
GLACIAL DEPOSITS	SAND, with minor gravel, with trace cobbles; light grey to off white. Dense; dry; sand, fine; gravel, medium, subround to subangular; cobbles, subround to subangular, up to 150mm; Tightly packed excavates as clasts in part, gravel and cobbles sporadically distrubuted throughout. **End of Investigation: 2.5m Geology Established**		1 2	

Vane Shear Strength
Vane No:
Vane Size: 0mm
50 100 150 200

Values (kPa)

Scala Penetrometer (Blows / 100mm)
2 4 6 8 10 12 14 16 18

2
3
4
4
5
6
17

Groundwater

Investigation Information

Depth	2.5m	**Logged By**	SF	**Start Date**	18/09/19
Termination	ıogy Establis	**Checked By**	PF	**End Date**	19/09/19
Machine Used		**Test Pit Dimensions**		**Logged Date**	

Investigation Type

- ☐ Hand Auger (50mm)
- ☑ Test Pit
- ☐ Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

Log ref: R5160-1A TP&SPT101

INVESTIGATION LOG

TP&SPT102

Report Ref R5160-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
Willowridge Developments Ltd c/o Paterson Pitts Group			GPSH

Location 195 Lakeview Road, Hawea

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Samples	Depth (m)	Legend
TOPSOIL	TOPSOIL; dark brown. Loose to medium dense; dry to moist; contains roots and rootlets.			TS T
ALLUVIAL DEPOSITS	Clayey SAND, with some gravel, with minor cobbles; light yellowish brown. Loose; dry; sand, fine to medium; gravel, medium to coarse, subround to subangular; cobbles, subround to subangular, up to 100mm; contains some rootlets throughout.			
GLACIAL DEPOSITS	SAND, with minor gravel, with trace cobbles; light grey to off white. Dense; dry; sand, fine; gravel, fine to medium, subround to subangular; cobbles, subround to subangular, up to 150mm; Gravel and cobbles sporadically distrubuted throughout.		1 2	
	End of Investigation: 2.7m Geology Established			

Vane Shear Strength
Vane No:
Vane Size: 0mm
50 100 150 200

Values (kPa)

Scala Penetrometer (Blows / 100mm)
2 4 6 8 10 12 14 16 18

1 1 2 2 2 7 8 10

Groundwater

Investigation Information

Depth	2.7m	**Logged By**	SF	**Start Date**	18/09/19
Termination	ology Establis	**Checked By**	PF	**End Date**	19/09/19
Machine Used		**Test Pit Dimensions**		**Logged Date**	

Investigation Type

- ☐ Hand Auger (50mm)
- ☑ Test Pit
- ☐ Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

Log ref: R5160-1A TP&SPT102

INVESTIGATION LOG

TP&SPT103

Report Ref R5160-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
Willowridge Developments Ltd c/o Paterson Pitts Group			GPSH

Location 195 Lakeview Road, Hawea

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Samples	Depth (m)	Legend
TOPSOIL	TOPSOIL; dark brown. Loose to medium dense; dry to moist; contains roots and rootlets.			
ALLUVIAL DEPOSITS	Clayey sandy GRAVEL, with minor cobbles; light yellowish brown. Medium dense; dry; gravel, medium to coarse, subround to subangular; sand, fine to medium; cobbles, subround to subangular, up to 100mm; contains some rootlets throughout.			
GLACIAL DEPOSITS	Gravelly SAND, with minor cobbles, with trace boulders; light grey to off white. Dense; dry; sand, fine to medium; gravel, medium to coarse, subround to subangular; cobbles, subround to subangular, up to 200mm; boulders, subround to subangular, up to 400mm, semio sphercial shape; Tightly packed excavates as clasts in part, gravel and cobbles sporadically distrubuted throughout. **End of Investigation: 2.2m Geology Established**		1 2	

Vane Shear Strength
Vane No:
Vane Size: 0mm
50 100 150 200

Values (kPa)

Scala Penetrometer (Blows / 100mm)
2 4 6 8 10 12 14 16 18
1, 1, 4, 6, 9, 14

Groundwater

Investigation Information

Depth	2.2m	**Logged By**	SF	**Start Date**	18/09/19
Termination	ology Establis	**Checked By**	PF	**End Date**	19/09/19
Machine Used		**Test Pit Dimensions**		**Logged Date**	

Investigation Type

- ☐ Hand Auger (50mm)
- ☑ Test Pit
- ☐ Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

Log ref: R5160-1A TP&SPT103

INVESTIGATION LOG

TP&SPT104

Report Ref: R5160-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
Willowridge Developments Ltd c/o Paterson Pitts Group			GPSH

Location: 195 Lakeview Road, Hawea

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Samples	Depth (m)	Legend
TOPSOIL	TOPSOIL, with trace boulders; dark brown. Loose to medium dense; dry to moist; boulders, up to 400mm; contains roots and rootlets.			
ALLUVIAL DEPOSITS	Clayey sandy GRAVEL, with minor cobbles and boulders; light yellowish brown. Medium dense; dry; gravel, medium to coarse, subround to subangular; sand, fine to medium; cobbles, subround to subangular, up to 150mm, boulders, up to 400mm; contains some rootlets throughout.			
GLACIAL DEPOSITS	SAND, with some gravel and cobbles, with minor boulders; offwhite. Dense; dry; sand, fine to medium; gravel, medium to coarse, subround to subangular, cobbles, subround to subangular, up to 150mm; boulders, subround to subangular, up to 400mm; discrete concentrations of gravel within sand matrix.		1	
GLACIAL DEPOSITS	SAND, with minor gravel; light grey to off white. Dense; dry; sand, fine to medium; gravel, fine to medium, subround to subangular; Gravel and cobbles sporadically distrubuted throughout.		2	
	End of Investigation: 2.6m Geology Established			

Vane Shear Strength
Vane No:
Vane Size: 0mm
50 100 150 200

Values (kPa)

Scala Penetrometer
(Blows / 100mm)
2 4 6 8 10 12 14 16 18

Scala Penetrometer (Blows / 100mm)
3
3
5
2
3
5
6
14
16

Groundwater

Investigation Information

Depth	2.6m	**Logged By**	SF	**Start Date**	18/09/19
Termination	ology Establis	**Checked By**	PF	**End Date**	19/09/19
Machine Used		**Test Pit Dimensions**		**Logged Date**	

Investigation Type

- ☐ Hand Auger (50mm)
- ☑ Test Pit
- ☐ Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

Log ref: R5160-1A TP&SPT104

INVESTIGATION LOG

TP&SPT105

Report Ref R5160-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
Willowridge Developments Ltd c/o Paterson Pitts Group			GPSH

Location 195 Lakeview Road, Hawea

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Samples	Depth (m)	Legend
TOPSOIL	TOPSOIL; dark brown. Loose to medium dense; dry to moist; contains roots and rootlets.			TS T TS T
ALLUVIAL DEPOSITS	Clayey SAND, with minor gravel; light yellowish brown. Medium dense; sand, fine to medium; gravel, medium to coarse, subround to subangular; contains some rootlets throughout.			
GLACIAL DEPOSITS	SAND, with minor gravel, with trace silt and cobbles; light grey. Dense; dry; sand, fine to medium; gravel, fine to medium, subround to subangular; silt, evident in discrete laminations , cobbles, subround to subangular, up to 200mm; Clasts, sporadic distribution of coarser material .		1	
	Cobbly SAND, with minor gravel; yellowish offwhite. Dense; dry; sand, medium; cobbles, subround to subangular, up to 150mm; gravel, fine to medium, subround to subangular; appear that the relative density is decreasing with depth; gravel and cobbles sporadically distrubuted throughout.		2	
	End of Investigation: 2.3m Geology Established			

Vane Shear Strength
Vane No:
Vane Size: 0mm
50 100 150 200

Values (kPa)

Scala Penetrometer (Blows / 100mm)
2 4 6 8 10 12 14 16 18
2
2
6
9
4

Groundwater

Investigation Information

Depth	2.3m	**Logged By**	SF	**Start Date**	18/09/19
Termination	ology Establis	**Checked By**	PF	**End Date**	19/09/19
Machine Used		**Test Pit Dimensions**		**Logged Date**	

Investigation Type

- ☐ Hand Auger (50mm)
- ☑ Test Pit
- ☐ Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

Log ref: R5160-1A TP&SPT105

INVESTIGATION LOG

TP&SPT106

Report Ref: R5160-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
Willowridge Developments Ltd c/o Paterson Pitts Group			GPSH

Location: 195 Lakeview Road, Hawea

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)
TOPSOIL	TOPSOIL; dark brown. Loose to medium dense; dry to moist; contains roots and rootlets.	
ALLUVIAL DEPOSITS	Clayey sandy GRAVEL, with minor cobbles; light yellowish brown. Medium dense; dry; gravel, medium to coarse, subround to subangular; sand, fine to medium; cobbles, angular to subangular, up to 100mm, moderately weathered; contains some rootlets throughout.	
GLACIAL DEPOSITS	Gravelly SAND, with some cobbles, with trace boulders; light grey. Dense; dry; sand, fine to medium; gravel, medium to coarse, subround to subangular; cobbles, subround to subangular, up to 100mm; boulders, subround to subangular, up to 400mm; some clasting on excavation .	1
	SAND, with minor gravel; off white. Dense; dry; sand, fine; gravel, fine to medium, subround to subangular; gravel and cobbles sporadically distrubuted throughout.	
	SAND, with minor gravel; light grey. Dense; dry; sand, medium; gravel, fine to medium, subround to subangular; appears clean and less dense.	2
	SAND, with minor gravel; light yellowish offwhite. Dense; dry; sand, fine to medium; gravel, fine to medium, subround to subangular.	
	End of Investigation: 2.5m Geology Established	

Samples | Legend | Vane Shear Strength (Vane No: / Vane Size: 0mm; 50 100 150 200) | Values (kPa) | Scala Penetrometer (Blows / 100mm; 2 4 6 8 10 12 14 16 18) | Groundwater

Scala Penetrometer values: 1, 3, 5, 5, 4, 13

Investigation Information

Depth	2.5m	**Logged By**	SF	**Start Date**	18/09/19
Termination	ology Establis	**Checked By**	PF	**End Date**	19/09/19
Machine Used		**Test Pit Dimensions**		**Logged Date**	

Investigation Type

- ☐ Hand Auger (50mm)
- ☑ Test Pit
- ☐ Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

Log ref: R5160-1A TP&SPT106

INVESTIGATION LOG

TP&SPT107

Report Ref R5160-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
Willowridge Developments Ltd c/o Paterson Pitts Group			GPSH

Location 195 Lakeview Road, Hawea

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)
TOPSOIL	TOPSOIL; dark brown. Loose to medium dense; dry to moist; contains roots and rootlets.	
ALLUVIAL DEPOSITS	Clayey SAND, with some gravel, with trace cobbles; light yellowish brown. Loose; low plasticity; dry; sand, fine to medium; gravel, medium to coarse, subround to subangular; cobbles, subround to subangular, up to 100mm; contains some rootlets throughout.	
GLACIAL DEPOSITS	SAND, with minor gravel, with trace cobbles; light grey to off white. Dense; dry; sand, fine to medium; gravel, fine to medium, subround to subangular; cobbles, subround to subangular, up to 100mm, semi spherical; Tightly packed excavates as clasts in part, gravel and cobbles sporadically distrubuted throughout.	1
	SAND, with minor gravel, with trace cobbles and boulders; light yellowish offwhite. Dense; dry; sand, fine to medium; gravel, fine to medium, subround to subangular; cobbles, subround to subangular, up to 200mm, semi spherical, boulders, subround to subangular, up to 400mm, semi spherical; softer digging with depth.	2
	End of Investigation: 2.9m Geology Established	

Samples | Legend | Vane Shear Strength (Vane No: / Vane Size: 0mm; 50 100 150 200) | Values (kPa) | Scala Penetrometer (Blows / 100mm; 2 4 6 8 10 12 14 16 18) | Groundwater

Scala Penetrometer values: 1, 1, 2, 2, 2, 15

Investigation Information

Depth	2.9m	**Logged By**	SF	**Start Date**	18/09/19
Termination	ıogy Establis	**Checked By**	PF	**End Date**	19/09/19
Machine Used		**Test Pit Dimensions**		**Logged Date**	

Investigation Type

- ☐ Hand Auger (50mm)
- ☑ Test Pit
- ☐ Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

Log ref: R5160-1A TP&SPT107

INVESTIGATION LOG

TP&SPT108

Report Ref R5160-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
Willowridge Developments Ltd c/o Paterson Pitts Group			GPSH

Location 195 Lakeview Road, Hawea

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)
TOPSOIL	TOPSOIL; dark brown. Loose to medium dense; dry to moist; contains roots and rootlets.	
ALLUVIAL DEPOSITS	Clayey SAND, with some gravel; light yellowish brown. Medium dense; dry; sand, fine to medium; gravel, medium to coarse, subround to subangular; contains some rootlets throughout.	
GLACIAL DEPOSITS	SAND, with some cobbles, with minor gravel, with trace boulders; light grey. Dense; dry; sand, fine; cobbles, subround to subangular, up to 200mm; gravel, fine to medium, subround to subangular; boulders, up to 400mm; Tightly packed excavates as clasts in part, gravel and cobbles sporadically distrubuted throughout.	1
GLACIAL DEPOSITS	SAND, with minor gravel, with trace cobbles and boulders; light yellowish white. Dense; dry; sand, medium; gravel, fine to medium, subround; cobbles, subround to subangular, up to 200mm, boulders, subround to subangular, up to 400mm; noticeable decrease in density with depth, very gradational basal contact between subject unit and upper soil horizon.	2
	End of Investigation: 2.8m Geology Established	

Samples | Legend | Vane Shear Strength (Vane No: Vane Size: 0mm; 50 100 150 200) | Values (kPa) | Scala Penetrometer (Blows / 100mm; 2 4 6 8 10 12 14 16 18) | Groundwater

Scala Penetrometer values: 2, 4, 3, 2, 6

Investigation Information

Depth	2.8m	**Logged By**	SF	**Start Date**	18/09/19
Termination	ology Establis	**Checked By**	PF	**End Date**	19/09/19
Machine Used		**Test Pit Dimensions**		**Logged Date**	

Investigation Type

- ☐ Hand Auger (50mm)
- ☑ Test Pit
- ☐ Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

Log ref: R5160-1A TP&SPT108

INVESTIGATION LOG

TP&SPT109

Report Ref R5160-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
Willowridge Developments Ltd c/o Paterson Pitts Group			GPSH

Location 195 Lakeview Road, Hawea

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)
TOPSOIL	TOPSOIL; dark brown. Loose to medium dense; dry to moist; contains roots and rootlets.	
ALLUVIAL DEPOSITS	Clayey sandy, with some gravel and cobbles; light yellowish brown. Medium dense; saturated; sand, fine to medium; gravel, medium to coarse, subround to subangular, cobbles, subround to subangular, up to 100mm; contains some rootlets throughout.	
GLACIAL DEPOSITS	SAND, with minor gravel, with trace cobbles; light grey. Dense; dry; sand, fine; gravel, fine to medium, subround to subangular; cobbles, subround to subangular, up to 150mm; subtle sub horizontal thin bedding.	1
	SAND; offwhite. Dense; dry; sand, fine to medium.	2
	End of Investigation: 2.3m Geology Established	

Samples | Legend | Vane Shear Strength (Vane No: / Vane Size: 0mm; 50 100 150 200) | Values (kPa) | Scala Penetrometer (Blows / 100mm; 2 4 6 8 10 12 14 16 18) | Groundwater

Scala Penetrometer values: 1, 2, 2, 5, 5, 10

Investigation Information

Depth	2.3m	**Logged By**	SF	**Start Date**	18/09/19
Termination	ology Establis	**Checked By**	PF	**End Date**	19/09/19
Machine Used		**Test Pit Dimensions**		**Logged Date**	

Investigation Type

- ☐ Hand Auger (50mm)
- ☑ Test Pit
- ☐ Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

Log ref: R5160-1A TP&SPT109

INVESTIGATION LOG

TP&SPT110

Report Ref: R5160-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
Willowridge Developments Ltd c/o Paterson Pitts Group			GPSH

Location: 195 Lakeview Road, Hawea

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)
TOPSOIL	TOPSOIL; dark brown. Loose to medium dense; dry to moist; contains roots and rootlets.	
RESIDUAL DEPOSITS	Clayey gravelly SAND, with minor cobbles; light yellowish brown. Medium dense; dry; sand, fine to medium; gravel, medium to coarse, subround to subangular; cobbles, subround to subangular, up to 100mm; contains some rootlets throughout.	
GLACIAL DEPOSITS	Gravelly SAND, with minor cobbles; light grey. Dense; dry; sand, medium to coarse; gravel, fine to coarse, subround to subangular; cobbles, subround to subangular, up to 100mm; Tightly packed excavates as clasts in part,.	1
GLACIAL DEPOSITS	SAND, with some gravel; light yellowish white. Dense; dry; sand, fine to medium; gravel, medium to coarse, subround to subangular.	
OUTWASH DEPOSITS	Gravelly SAND, with minor cobbles; light grey. Medium dense; dry; sand, medium to coarse; gravel, fine to coarse, subround to subangular; cobbles, subround to subangular, up to 100mm; Tightly packed excavates as clasts in par	2
OUTWASH DEPOSITS	SAND, with minor gravel; light grey. Medium dense; moist; sand, medium to coarse; gravel, fine to coarse, subround to subangular; loosely to tightly packed.	
	End of Investigation: 2.4m Geology Established	

Vane Shear Strength — Vane No: — Vane Size: 0mm; 50 100 150 200

Values (kPa)

Scala Penetrometer (Blows / 100mm); 2 4 6 8 10 12 14 16 18

Scala Penetrometer values: 1, 1, 1, 2, 3, 6, 10, 10

Groundwater

Investigation Information

Depth	2.4m	**Logged By**	SF	**Start Date**	18/09/19
Termination	ıogy Establis	**Checked By**	PF	**End Date**	19/09/19
Machine Used		**Test Pit Dimensions**		**Logged Date**	

Investigation Type

- ☐ Hand Auger (50mm)
- ☑ Test Pit
- ☐ Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

Log ref: R5160-1A TP&SPT110

INVESTIGATION LOG

TP&SPT111

Report Ref: R5160-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
Willowridge Developments Ltd c/o Paterson Pitts Group			GPSH

Location: 195 Lakeview Road, Hawea

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Samples	Depth (m)	Legend	Vane Shear Strength (Vane No: / Vane Size: 0mm)	Values (kPa)	Scala Penetrometer (Blows / 100mm)	Groundwater
TOPSOIL	TOPSOIL; dark brown. Loose to medium dense; dry to moist; contains roots and rootlets.			TS T	50 100 150 200		2 4 6 8 10 12 14 16 18	
ALLUVIAL DEPOSITS	Clayey sandy GRAVEL; light yellowish brown. Medium dense; dry; gravel, medium to coarse, subround to subangular; sand, fine to medium; contains some rootlets throughout.						3 4 2 5 7	
OUTWASH DEPOSITS	Sandy GRAVEL, with minor cobbles, with trace boulders; light brown grey. Dense; dry to moist; gravel, fine to medium, subround to subangular; sand, fine; cobbles, subround to subangular, up to 150mm; boulders, subround to subangular, up to 400mm; coarse size fraction coated with clay, relative density increasing with depth.		1				11 10	
	Sandy GRAVEL, with minor cobbles, with trace boulders; offwhite. Dense; dry; gravel, medium to coarse, subround to subangular; sand, fine to medium; cobbles, subround to subangular, up to 150mm; boulders, subround to subangular, up to 400mm; more tightly packed version of upper unit, although pore space is still visible in clast hand specimen; *** Test performed at 2.1m depth below ground level - TP excavated from 2.1m to 3.0m on completion of soak assessment - No change in geology ***.		2					
	End of Investigation: 3m Geology Established							

Investigation Information

Depth	3m	**Logged By**	SF	**Start Date**	18/09/19
Termination	ıogy Establis	**Checked By**	PF	**End Date**	19/09/19
Machine Used		**Test Pit Dimensions**		**Logged Date**	

Investigation Type

- ☐ Hand Auger (50mm)
- ☑ Test Pit
- ☐ Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

Log ref: R5160-1A TP&SPT111

INVESTIGATION LOG

TP&SPT112

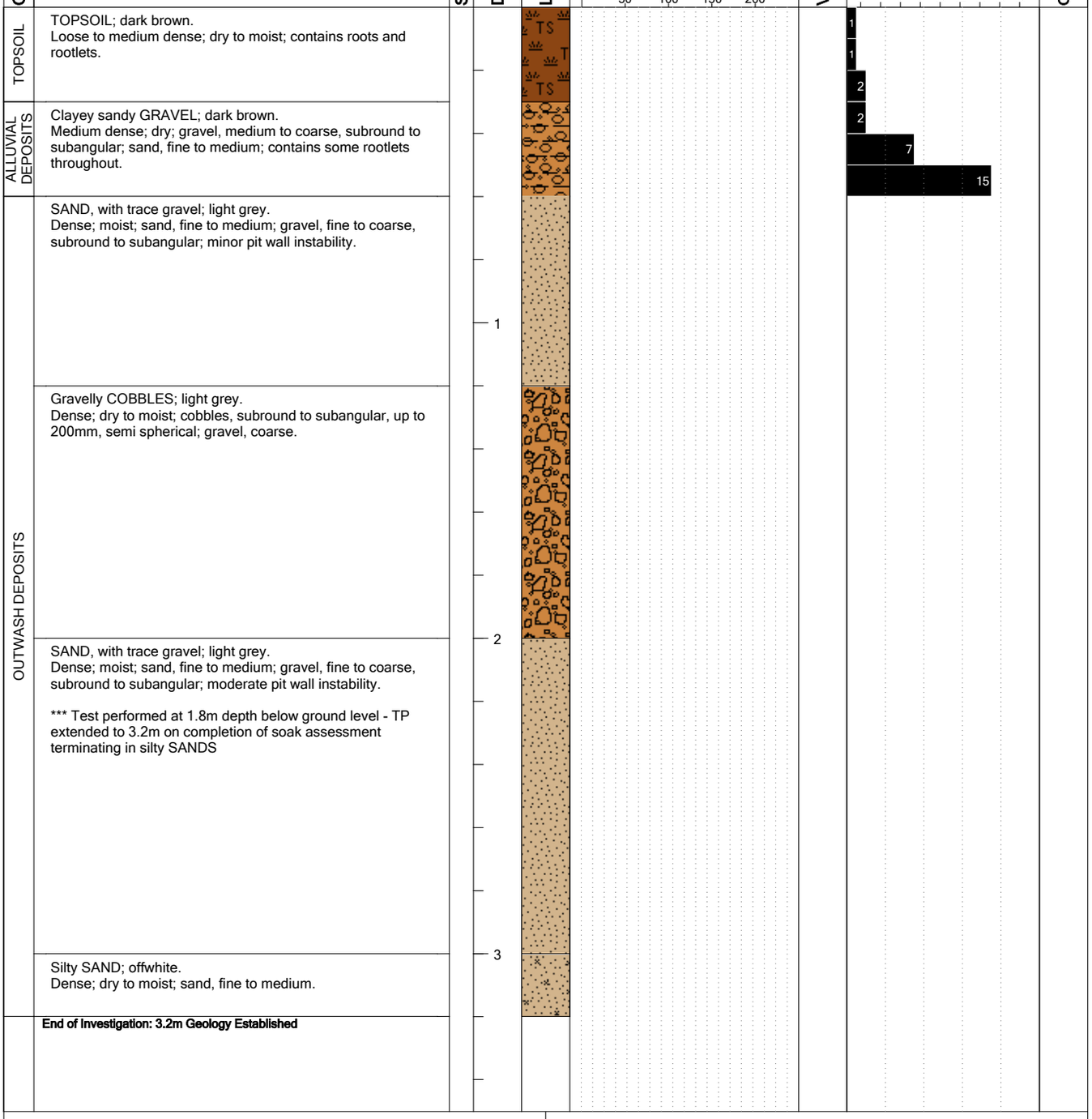
Report Ref: R5160-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
Willowridge Developments Ltd c/o Paterson Pitts Group			GPSH

Location: 195 Lakeview Road, Hawea

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)
TOPSOIL	TOPSOIL; dark brown. Loose to medium dense; dry to moist; contains roots and rootlets.	
ALLUVIAL DEPOSITS	Clayey sandy GRAVEL; dark brown. Medium dense; dry; gravel, medium to coarse, subround to subangular; sand, fine to medium; contains some rootlets throughout.	
OUTWASH DEPOSITS	SAND, with trace gravel; light grey. Dense; moist; sand, fine to medium; gravel, fine to coarse, subround to subangular; minor pit wall instability.	1
	Gravelly COBBLES; light grey. Dense; dry to moist; cobbles, subround to subangular, up to 200mm, semi spherical; gravel, coarse.	
	SAND, with trace gravel; light grey. Dense; moist; sand, fine to medium; gravel, fine to coarse, subround to subangular; moderate pit wall instability. *** Test performed at 1.8m depth below ground level - TP extended to 3.2m on completion of soak assessment terminating in silty SANDS	2
	Silty SAND; offwhite. Dense; dry to moist; sand, fine to medium.	3
	End of Investigation: 3.2m Geology Established	

Samples | Legend | Vane Shear Strength (Vane No: / Vane Size: 0mm; 50 100 150 200) | Values (kPa) | Scala Penetrometer (Blows / 100mm; 2 4 6 8 10 12 14 16 18) | Groundwater



Investigation Information

Depth	3.2m	**Logged By**	SF	**Start Date**	18/09/19
Termination	ology Establis	**Checked By**	PF	**End Date**	19/09/19
Machine Used		**Test Pit Dimensions**		**Logged Date**	

Investigation Type

- [ ] Hand Auger (50mm)
- [x] Test Pit
- [ ] Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

Log ref: R5160-1A TP&SPT112

INVESTIGATION LOG

TP&SPT113

Report Ref: R5160-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
Willowridge Developments Ltd c/o Paterson Pitts Group			GPSH

Location: 195 Lakeview Road, Hawea

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)
TOPSOIL	TOPSOIL; dark brown. Loose to medium dense; dry to moist; contains roots and rootlets.	
ALLUVIAL DEPOSITS	Clayey sandy GRAVEL, with minor cobbles; light yellowish brown. Medium dense; dry; gravel, medium to coarse, subround to subangular; sand, fine to medium; cobbles, subround to subangular, up to 100mm; contains some rootlets throughout.	
OUTWASH DEPOSITS	SAND; light grey. Medium dense to dense; dry to moist; sand, fine; subtle bedding, clasts in part.	1
	SAND, with some gravel; light grey. Medium dense to dense; dry to moist; sand, medium to coarse; gravel, fine to coarse; Loosely to tightly packed.	
	Silty SAND; offwhite; bedded. Medium dense to dense; moist; sand, fine to medium; laminated silts and sands.	
	SAND, with some gravel; light grey. Medium dense to dense; dry to moist; sand, medium to coarse; gravel, fine to coarse; Loosely to tightly packed.	2
	Silty SAND; offwhite; bedded. Medium dense to dense; moist; sand, fine to medium; laminated silts and sands.	
	SAND, with some gravel; light grey. Medium dense to dense; dry to moist; sand, medium to coarse; gravel, fine to coarse; Loosely to tightly packed.	
	End of Investigation: 2.7m Geology Established	

Samples | Legend | Vane Shear Strength (Vane No: / Vane Size: 0mm; 50 100 150 200) | Values (kPa) | Scala Penetrometer (Blows / 100mm; 2 4 6 8 10 12 14 16 18; 1, 1, 2, 3, 5, 9, 16) | Groundwater

Investigation Information

Depth	2.7m	**Logged By**	SF	**Start Date**	18/09/19
Termination	ology Establis	**Checked By**	PF	**End Date**	19/09/19
Machine Used		**Test Pit Dimensions**		**Logged Date**	

Investigation Type

- ☐ Hand Auger (50mm)
- ☑ Test Pit
- ☐ Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

Log ref: R5160-1A TP&SPT113

INVESTIGATION LOG

TP&SPT114

Report Ref R5160-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
Willowridge Developments Ltd c/o Paterson Pitts Group			GPSH

Location 195 Lakeview Road, Hawea

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Samples	Depth (m)	Legend
TOPSOIL	TOPSOIL; dark brown. Loose to medium dense; dry to moist; contains roots and rootlets.			
ALLUVIAL DEPOSITS	Clayey sandy GRAVEL; light yellowish brown. Medium dense to dense; dry; gravel, medium to coarse, subround to subangular; sand, fine to medium; contains some rootlets throughout.			
OUTWASH DEPOSITS	Sandy GRAVEL, with minor cobbles and boulders; dark grey. Dense; dry to moist; gravel, fine to coarse, subround to subangular; sand, medium to coarse; cobbles, subround to subangular, up to 150mm, boulders, subround to subangular, up to 300mm.		1	
	Silty SAND; light brown; bedded. Dense; moist; sand, fine to medium; Laminated silt and sand .		2	
	End of Investigation: 2.7m Geology Established			

Vane Shear Strength
Vane No:
Vane Size: 0mm
50 100 150 200

Values (kPa)

Scala Penetrometer
(Blows / 100mm)
2 4 6 8 10 12 14 16 18

1
1
5
14
10

Groundwater

Investigation Information

Depth	2.7m	**Logged By**	SF	**Start Date**	18/09/19
Termination	ology Establis	**Checked By**	PF	**End Date**	19/09/19
Machine Used		**Test Pit Dimensions**		**Logged Date**	

Investigation Type

- ☐ Hand Auger (50mm)
- ☑ Test Pit
- ☐ Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

Log ref: R5160-1A TP&SPT114

INVESTIGATION LOG

TP&SPT115

Report Ref
R5160-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
Willowridge Developments Ltd c/o Paterson Pitts Group			GPSH

Location
195 Lakeview Road, Hawea

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Samples	Depth (m)	Legend	Vane Shear Strength (Vane No: / Vane Size: 0mm)	Values (kPa)	Scala Penetrometer (Blows / 100mm)	Groundwater
TOPSOIL	TOPSOIL; dark brown. Loose to medium dense; dry to moist; contains roots and rootlets.			TS T	50 100 150 200		2 4 6 8 10 12 14 16 18	
ALLUVIAL DEPOSITS	Clayey sandy GRAVEL; light yellowish brown. Medium dense; dry; gravel, medium to coarse, subround to subangular; sand, fine to medium; contains some rootlets throughout.						1 2 5 7 12 10	
OUTWASH DEPOSITS	SAND, with some gravel; offwhite. Dense; dry to moist; sand, fine to coarse; gravel, fine to coarse, subround to subangular; Tightly packed.							
	Sandy GRAVEL, with minor cobbles, with trace boulders; dark grey. Dense; dry; gravel, fine to coarse, subround to subangular; sand, medium to coarse; cobbles, subround to subangular, up to 200mm; boulders, up to 400mm; discrete sub horizontal bedding - imbrication / size fraction sorting.		1 2					
	End of Investigation: 2.4m Geology Established							

Investigation Information

Depth	2.4m	**Logged By**	SF	**Start Date**	18/09/19
Termination	ıogy Establis	**Checked By**	PF	**End Date**	19/09/19
Machine Used		**Test Pit Dimensions**		**Logged Date**	

Investigation Type

- ☐ Hand Auger (50mm)
- ☑ Test Pit
- ☐ Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

Log ref: R5160-1A TP&SPT115

INVESTIGATION LOG

TP&SPT116

Report Ref
R5160-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
Willowridge Developments Ltd c/o Paterson Pitts Group			GPSH

Location
195 Lakeview Road, Hawea

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Samples	Depth (m)	Legend
TOPSOIL	TOPSOIL; dark brown. Loose to medium dense; dry to moist; contains roots and rootlets.			TS T
ALLUVIAL DEPOSITS	Clayey sandy GRAVEL; light yellowish brown. Medium dense to dense; dry; gravel, medium to coarse, subround to subangular; sand, fine to medium; contains some rootlets throughout.			
GLACIAL DEPOSITS	SAND, with some gravel, with minor cobbles; offwhite. Dense; dry; sand, medium; gravel, coarse, subround to subangular; cobbles, subround to subangular, up to 150mm; Tightly packed excavates as clasts in part, gravel and cobbles sporadically distrubuted throughout.			
	Sandy GRAVEL, with some cobbles, with minor boulders; offwhite. Dense; dry; gravel, medium to coarse, subround to subangular; sand, medium to coarse; cobbles, subround to subangular, up to 200mm; boulders, subround to subangular, up to 400mm, at 1.2m depth; some imbrication bedding and a couple of dark grey lenses within.		1 2	
	End of Investigation: 2.2m Geology Established			

Vane Shear Strength
Vane No:
Vane Size: 0mm
50 100 150 200

Values (kPa)

Scala Penetrometer
(Blows / 100mm)
2 4 6 8 10 12 14 16 18
1
1
3
5
10
10

Groundwater

Investigation Information

Depth	2.2m	**Logged By**	SF	**Start Date**	18/09/19
Termination	ıogy Establis	**Checked By**	PF	**End Date**	19/09/19
Machine Used		**Test Pit Dimensions**		**Logged Date**	

Investigation Type

- ☐ Hand Auger (50mm)
- ☑ Test Pit
- ☐ Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

Log ref: R5160-1A TP&SPT116

INVESTIGATION LOG

TP&SPT117

Report Ref R5160-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
Willowridge Developments Ltd c/o Paterson Pitts Group			GPSH

Location 195 Lakeview Road, Hawea

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)
TOPSOIL	TOPSOIL; dark brown. Loose to medium dense; dry to moist; contains roots and rootlets.	
ALLUVIAL DEPOSITS	Clayey SAND, with minor gravel and cobbles; light yellowish brown. Loose to medium dense; dry; sand, fine to medium; gravel, medium to coarse, subround to subangular, cobbles, subround to subangular, up to 200mm; contains some rootlets throughout.	
GLACIAL DEPOSITS	SAND, with minor gravel, with trace cobbles; offwhite. Dense; dry; sand, fine to medium; gravel, fine to medium, subround to subangular; cobbles, subround to subangular, up to 100mm, content increasing with depth; Tightly packed; gravel and cobbles sporadically distrubuted throughout.	1
	Sandy GRAVEL, with minor cobbles and boulders; light grey. Dense; dry; gravel, medium to coarse, subround to subangular; sand, medium to coarse; cobbles, subround to subangular, up to 200mm, boulders, subround to subangular, up to 300mm.	2
	End of Investigation: 2.2m Geology Established	

Samples | Legend | Vane Shear Strength (Vane No: Vane Size: 0mm; 50 100 150 200) | Values (kPa) | Scala Penetrometer (Blows / 100mm; 2 4 6 8 10 12 14 16 18) | Groundwater

Scala Penetrometer values: 1, 1, 3, 2, 2, 4, 1, 2, 12, 12

Investigation Information

Depth	2.2m	**Logged By**	SF	**Start Date**	18/09/19
Termination	ology Establis	**Checked By**	PF	**End Date**	19/09/19
Machine Used		**Test Pit Dimensions**		**Logged Date**	

Investigation Type

- ☐ Hand Auger (50mm)
- ☑ Test Pit
- ☐ Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

Log ref: R5160-1A TP&SPT117

INVESTIGATION LOG

TP&SPT118

Report Ref R5160-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
Willowridge Developments Ltd c/o Paterson Pitts Group			GPSH

Location 195 Lakeview Road, Hawea

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Samples	Depth (m)	Legend
TOPSOIL	TOPSOIL; dark brown. Loose to medium dense; dry to moist; contains roots and rootlets.			TS T
ALLUVIAL DEPOSITS	Clayey SAND, with minor gravel; light yellowish brown. Medium dense to dense; dry; sand, fine to medium; gravel, medium to coarse, subround to subangular; contains some rootlets throughout.			TS T
GLACIAL DEPOSITS	Silty SAND, with trace gravel; offwhite. Dense; dry; sand, fine; silt, slightly micaceous ; gravel, fine to medium, subround to subangular; Tightly packed excavates as clasts in part, mostly uniform material.		1 2	
	End of Investigation: 2.6m Geology Established			

Vane Shear Strength
Vane No:
Vane Size: 0mm
50 100 150 200

Values (kPa)

Scala Penetrometer
(Blows / 100mm)
2 4 6 8 10 12 14 16 18

1
2
3
5
13
10

Groundwater

Investigation Information

Depth	2.6m	**Logged By**	SF	**Start Date**	18/09/19
Termination	ology Establis	**Checked By**	PF	**End Date**	19/09/19
Machine Used		**Test Pit Dimensions**		**Logged Date**	

Investigation Type

- ☐ Hand Auger (50mm)
- ☑ Test Pit
- ☐ Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

Log ref: R5160-1A TP&SPT118

Log created: 10/8/2019 4:41:05 PM Page 1 of 1

INVESTIGATION LOG

TP&SPT119

Report Ref
R5160-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
Willowridge Developments Ltd c/o Paterson Pitts Group			GPSH

Location
195 Lakeview Road, Hawea

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Samples	Depth (m)	Legend	Vane Shear Strength (Vane No: / Vane Size: 0mm)	Values (kPa)	Scala Penetrometer (Blows / 100mm)	Groundwater
TOPSOIL	TOPSOIL; dark brown. Loose to medium dense; dry to moist; contains roots and rootlets.			TS			2	
ALLUVIAL DEPOSITS	Clayey sandy GRAVEL; light yellowish brown. Medium dense to dense; dry; gravel, medium to coarse, subround to subangular; sand, fine to medium; contains some rootlets throughout.						5 6	
GLACIAL DEPOSITS	Gravelly SAND, with minor cobbles, with trace boulders; offwhite. Dense; dry; sand, fine to medium; gravel, medium to coarse, subround to subangular; cobbles, subround to subangular, up to 150mm; boulders, up to 400mm, isolated boulder; some roots and rootlets.		1 2				10	
	End of Investigation: 2.2m Geology Established							

Vane Shear Strength: 50 100 150 200
Scala Penetrometer (Blows / 100mm): 2 4 6 8 10 12 14 16 18

Investigation Information

Depth	2.2m	**Logged By**	SF	**Start Date**	18/09/19
Termination	ıogy Establis	**Checked By**	PF	**End Date**	19/09/19
Machine Used		**Test Pit Dimensions**		**Logged Date**	

Investigation Type

- ☐ Hand Auger (50mm)
- ☑ Test Pit
- ☐ Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

Log ref: R5160-1A TP&SPT119

Log created: 10/8/2019 4:45:09 PM Page 1 of 1

INVESTIGATION LOG

TP&SPT120

GCL Ground Consulting Ltd

Report Ref
R5160-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
Willowridge Developments Ltd c/o Paterson Pitts Group			GPSH

Location
195 Lakeview Road, Hawea

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Samples	Depth (m)	Legend
TOPSOIL	TOPSOIL; dark brown. Loose to medium dense; dry to moist; contains roots and rootlets.			TS T TS T
ALLUVIAL DEPOSITS	Clayey sandy GRAVEL; light yellowish brown. Medium dense; dry; gravel, medium to coarse, subround to subangular; sand, fine to medium; contains some rootlets throughout.			GC
OUTWASH DEPOSITS	Sandy GRAVEL, with minor cobbles; light brown. Dense; dry; gravel, fine to coarse, subround to subangular; sand, fine to coarse; cobbles, subround to subangular, up to 150mm.			GP
	Gravelly SAND, with minor cobbles and boulders; offwhite. Dense; dry to moist; sand, fine to coarse; gravel, medium to coarse, subround to subangular; cobbles, subround to subangular, up to 150mm, boulders, subround to subangular, up to 400mm.		1	SP
	GRAVEL, with some sand, with minor cobbles; light grey. Dense; dry to moist; gravel, fine to medium, subround to subangular; sand, medium to coarse; cobbles, subround to subangular, up to 150mm; ironing staining on upper contact, clay coating on coarse size fraction. *** Test performed at 1.6m depth below ground level - TP excavated from 1.6m to 3.0m on completion of soak assessment - No change in geology ***.		2	GP
	End of Investigation: 3m Geology Established			

Vane Shear Strength
Vane No:
Vane Size: 0mm
50 100 150 200

Values (kPa)

Scala Penetrometer
(Blows / 100mm)
2 4 6 8 10 12 14 16 18
1
3
3

Groundwater

Investigation Information

Depth	3m	**Logged By**	SF	**Start Date**	19/09/19
Termination	ology Establis	**Checked By**	PF	**End Date**	19/09/19
Machine Used		**Test Pit Dimensions**		**Logged Date**	

Investigation Type

- ☐ Hand Auger (50mm)
- ☑ Test Pit
- ☐ Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

Log ref: R5160-1A TP&SPT120

INVESTIGATION LOG

TP&SPT121

Report Ref: R5160-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
Willowridge Developments Ltd c/o Paterson Pitts Group			GPSH

Location: 195 Lakeview Road, Hawea

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Depth (m)
TOPSOIL	TOPSOIL; dark brown. Loose to medium dense; dry to moist; contains roots and rootlets.	
RESIDUAL DEPOSITS	Clayey GRAVEL, with some sand; dark brown. Medium dense; dry; gravel, medium to coarse, subround to subangular; sand, fine to medium; contains some rootlets throughout.	
OUTWASH DEPOSITS	Sandy GRAVEL, with minor cobbles; ligth grey. Dense; dry; gravel, fine to medium, subround to subangular; sand, coarse; cobbles, subround to subangular, up to 100mm.	
	Sandy GRAVEL; offwhite. Dense; dry to moist; gravel, fine to coarse, subround to subangular; sand, fine to coarse.	1
	Sandy GRAVEL, with minor cobbles; light grey. Dense; dry to moist; gravel, fine, subround to subangular; sand, coarse; cobbles, subround to subangular, up to 100mm; ironing staining on upper contact, clay coating on coarse size fraction. *** Test performed at 1.6m depth below ground level - TP excavated from 1.6m to 3.0m on completion of soak assessment - No change in geology ***.	2
	End of Investigation: 3m Geology Established	

Samples | Legend | Vane Shear Strength (Vane No: / Vane Size: 0mm; 50 100 150 200) | Values (kPa) | Scala Penetrometer (Blows / 100mm; 2 4 6 8 10 12 14 16 18; 1, 2, 4, 15) | Groundwater

Investigation Information

Depth	3m	**Logged By**	SF	**Start Date**	19/09/19
Termination	ology Establis	**Checked By**	PF	**End Date**	19/09/19
Machine Used		**Test Pit Dimensions**		**Logged Date**	

Investigation Type

- [ ] Hand Auger (50mm)
- [x] Test Pit
- [ ] Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

Log ref: R5160-1A TP&SPT121

INVESTIGATION LOG

TP&SPT122

Report Ref R5160-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
Willowridge Developments Ltd c/o Paterson Pitts Group			GPSH

Location 195 Lakeview Road, Hawea

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Samples	Depth (m)	Legend	Vane Shear Strength (Vane No: / Vane Size: 0mm) 50 100 150 200	Values (kPa)	Scala Penetrometer (Blows / 100mm) 2 4 6 8 10 12 14 16 18	Groundwater
TOPSOIL	TOPSOIL; dark brown. Loose to medium dense; dry to moist; contains roots and rootlets.			TS T			1	
ALLUVIAL DEPOSITS	Clayey GRAVEL, with some sand; dark brown. Medium dense; dry; gravel, medium to coarse, subround to subangular; sand, fine to medium; contains some rootlets throughout.			TS T			2	
OUTWASH DEPOSITS	Sandy GRAVEL, with minor cobbles; offwhite. Dense; dry; gravel, fine to coarse, subround to subangular; sand, medium to coarse; cobbles, subround to subangular, up to 150mm; clay coating on coarse size fraction; *** Test performed at 1.6m depth below ground level - TP excavated from 1.6m to 3.0m on completion of soak assessment - No change in geology ***.		1				3	
	End of Investigation: 3m Geology Established		2					

Investigation Information

Depth	3m	**Logged By**	SF	**Start Date**	19/09/19
Termination	ıogy Establis	**Checked By**	PF	**End Date**	19/09/19
Machine Used		**Test Pit Dimensions**		**Logged Date**	

Investigation Type

- ☐ Hand Auger (50mm)
- ☑ Test Pit
- ☐ Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

Log ref: R5160-1A TP&SPT122

INVESTIGATION LOG

TP&SPT123

Report Ref R5160-1A

Client	Coordinates (NZTM2000)	Elevation	Location Method (±2m)
Willowridge Developments Ltd c/o Paterson Pitts Group			GPSH

Location 195 Lakeview Road, Hawea

Geology	Geological Interpretation (refer to separate Geotechnical and Geological Information sheet for further information)	Samples	Depth (m)	Legend	Vane Shear Strength (Vane No: / Vane Size: 0mm) 50 100 150 200	Values (kPa)	Scala Penetrometer (Blows / 100mm) 2 4 6 8 10 12 14 16 18	Groundwater
TOPSOIL	TOPSOIL; dark brown. Loose to medium dense; dry to moist; contains roots and rootlets.			TS T TS T			1 1 1 1	
ALLUVIAL DEPOSITS	Clayey sandy GRAVEL; dark brown. Medium dense; dry; gravel, medium to coarse, subround to subangular; sand, fine to medium; contains some rootlets throughout.						4 13	
OUTWASH DEPOSITS	SAND, with minor gravel; ligth grey. Dense; dry; sand, fine to coarse; gravel, fine to coarse, subround to subangular.						10	
	GRAVEL, with minor sand; offwhite. Dense; dry to moist; gravel, fine to coarse, subround to subangular; sand, fine to coarse.		1					
	GRAVEL, with minor sand; light grey. Dense; dry to moist; gravel, fine, subround to subangular; sand, coarse.							
	Sandy GRAVEL, with minor cobbles; ligt grey offwhite. Dense; dry to moist; gravel, fine to coarse, subround to subangular; sand, coarse; cobbles, subround to subangular, up to 150mm; *** Test performed at 1.7m depth below ground level - TP excavated from 1.7m to 3.0m on completion of soak assessment - No change in geology **.		2					
	End of Investigation: 3m Geology Established							

Investigation Information

Depth	3m	**Logged By**	SF	**Start Date**	19/09/19
Termination	ology Establis	**Checked By**	PF	**End Date**	19/09/19
Machine Used		**Test Pit Dimensions**		**Logged Date**	

Investigation Type

- ☐ Hand Auger (50mm)
- ☑ Test Pit
- ☐ Scala Penetrometer

Water Legend

- Standing Water Level
- Out flow
- In flow

Log ref: R5160-1A TP&SPT123

APPENDIX C: SITE PHOTOGRAPHS

TP101	
PIT EXCAVATION	ARISINGS
	

TP102	
PIT EXCAVATION	ARISINGS
	

TP103	
PIT EXCAVATION	ARISINGS
	

TP104	
PIT EXCAVATION	ARISINGS
	

TP105	
PIT EXCAVATION	ARISINGS
	

TP106	
PIT EXCAVATION	ARISINGS
	

TP107	
PIT EXCAVATION	ARISINGS
	

TP108	
PIT EXCAVATION	ARISINGS
	

TP109	
PIT EXCAVATION	ARISINGS
	

TP110	
PIT EXCAVATION	ARISINGS
	

TP111	
PIT EXCAVATION	ARISINGS
	

TP112	
PIT EXCAVATION	ARISINGS
	

TP113	
PIT EXCAVATION	ARISINGS
	

TP114	
PIT EXCAVATION	ARISINGS
	

TP115	
PIT EXCAVATION	ARISINGS
	

TP116	
PIT EXCAVATION	ARISINGS
	

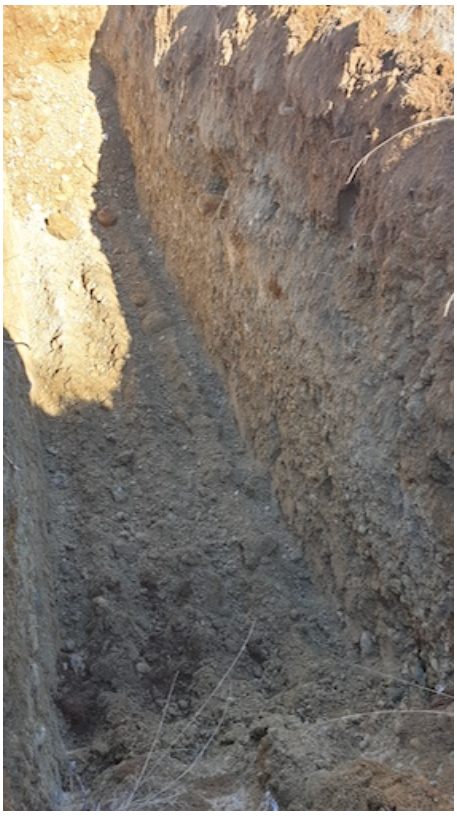
TP117	
PIT EXCAVATION	ARISINGS
	

TP118	
PIT EXCAVATION	ARISINGS
	

TP119	
PIT EXCAVATION	ARISINGS
	

TP120	
PIT EXCAVATION	ARISINGS
	

TP121	
PIT EXCAVATION	ARISINGS
	

TP122	
PIT EXCAVATION	ARISINGS
	

TP123	
PIT EXCAVATION	ARISINGS
	

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