

The Property Group
Level 3 / Five Mile Centre
36 Grant Road, Frankton, Queenstown
By Email: wmurray@propertygroup.co.nz

Our Reference: P-002185
20 October 2023

Attention: Werner Murray

Ladies Mile Extension Preliminary Geotechnical Report For Plan Change Application

1. Introduction

This letter report has been prepared to present the results of desk study and site walk over in relation to the Te Pūtahi Ladies Mile Zone Ladies Mile Development, Queenstown. The purpose of this letter is to support a submission to have the Te Pūtahi Ladies Mile Zone extended to include the property at 63 Lower Shotover Road, Lower Shotover, Queenstown.

Our scope has included reviewing existing available geotechnical information and providing comment on the geotechnical suitability of the property to be included in the Ladies Mile plan change / rezoning.

2. Proposed Extension Area

Based on The Property Group Submission document¹, an application is being made to extend the Te Pūtahi Ladies Mile Zone to the west to include several parcels of land. The specific details of each lot are presented in Table 1 of The Property Group Submission document¹. The approximate extents of the proposed extension is presented in blue in Figure 1 below.

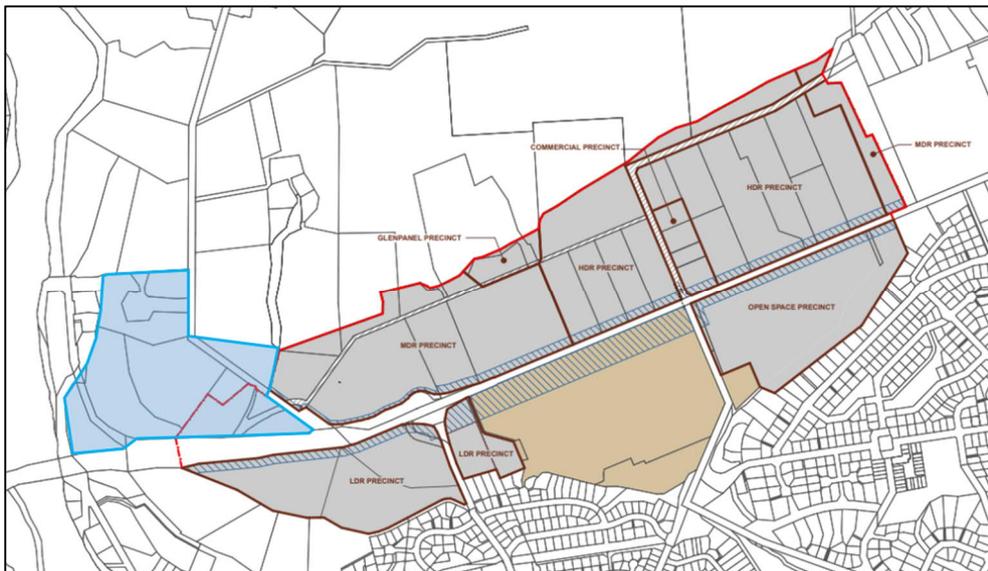


Figure 1: Proposed Extension Area (blue)

¹ VARIATION TO QUEENSTOWN LAKES PROPOSED DISTRICT PLAN - 49 TE PŪTAHI LADIES MILE ZONE. Submitted by Anna Hutchinson, Tim Hutchinson, and John Tavendale as trustees of the Anna Hutchinson Family Trust ("Submitter").

3. Background

QLDC is proposing to rezone the Ladies Mile area to Medium Density Residential (MDR) and Low-Density Residential (LDR) Precincts as outlined on Figure 1 above, and the subject site – 63 Lower Shotover Road (being Lot 2 DP 310444, Lot 3 DP 310444, Lot 3 DP 516751, and Lot 2 DP 516751), has been omitted from being rezoned. We understand the site was included in earlier iterations but are unaware of the reason for its removal.

A Preliminary Geotechnical Assessment for the Ladies Mile Masterplan Area, that included the 63 Lower Shotover Road property, has previously been carried out by Geosolve. The findings of their investigation are presented in their report dated in December 2020².

4. Site Description

The site is located to the west of Lower Shotover Road and north of the Frankton-Ladies Mile Highway approximately 9km north east of Queenstown. The site is occupied by two residential properties at the northern corner, and a single residential property, and cemetery, at the south eastern corner. The remainder of the property is grassed and used for agricultural purposes with several patches of mature trees, typically along fence lines. Spence Road runs along the southern and western border boundary of the proposed extension area, and Lower Shotover Road borders and crosses the eastern border of the extension area.

Topography at the site is characterised by three river terraces at approximately RL 375 m, RL 355 m, and RL 340 m separated by steep and moderately steep slopes (Between ~15° and ~35°). Topography within each river terrace is typically gently undulating with an overall gentle slope towards the south or south west.

5. Published Geology and Geological Setting

The site is situated in the Wakatipu basin within the Southern Alps. The region has a significant glacial history and has been formed by multiple advances and retreats of glaciers during the Pleistocene epoch. According to published geological sources³, the most recent glacial event ended approximately 18,000 years ago. Glaciations have deposited glacial till, glacial outwash, and lake sediment on top of the exposed schist bedrock. Throughout interglacial periods, the primary geomorphological processes have involved the erosion of the schist bedrock and the deposition of glacial deposits. These processes are further characterised by the accumulation of alluvial gravels through local watercourses, and the deposition of lacustrine sediments during phases of elevated lake levels.

Based on a preliminary review of the published GNS geological maps⁴ (see Figure 2 below) for the area, the upper part of the site is expected to be underlain by Late Pleistocene glacier deposits (yellow) comprising generally unweathered, unsorted to sorted, loose sandy gravel, silt, and sand (till). The lower portion of the site is expected to be underlain by Holocene fan deposits (off white) comprising loose, commonly angular, boulders, gravel, sand, and silt. The site is expected to be underlain by Aspiring Lithologic Association TZIV pelitic schist (blue) (Rakaia Terrane basement schist rock), at depth.

² Geosolve. Preliminary Geotechnical Assessment. Ladies Mile Masterplan Area, Queenstown. Ref: 200353. Dated December 2020.

³ DJA Barrell. GNS Science. General distribution and characteristics of active faults and folds in the Queenstown Lakes and Central Otago districts, Otago. GNS Science Consultancy Report 2018/207. Dated March 2019.

⁴ GNS Webmap. <https://data.gns.cri.nz/geology/>



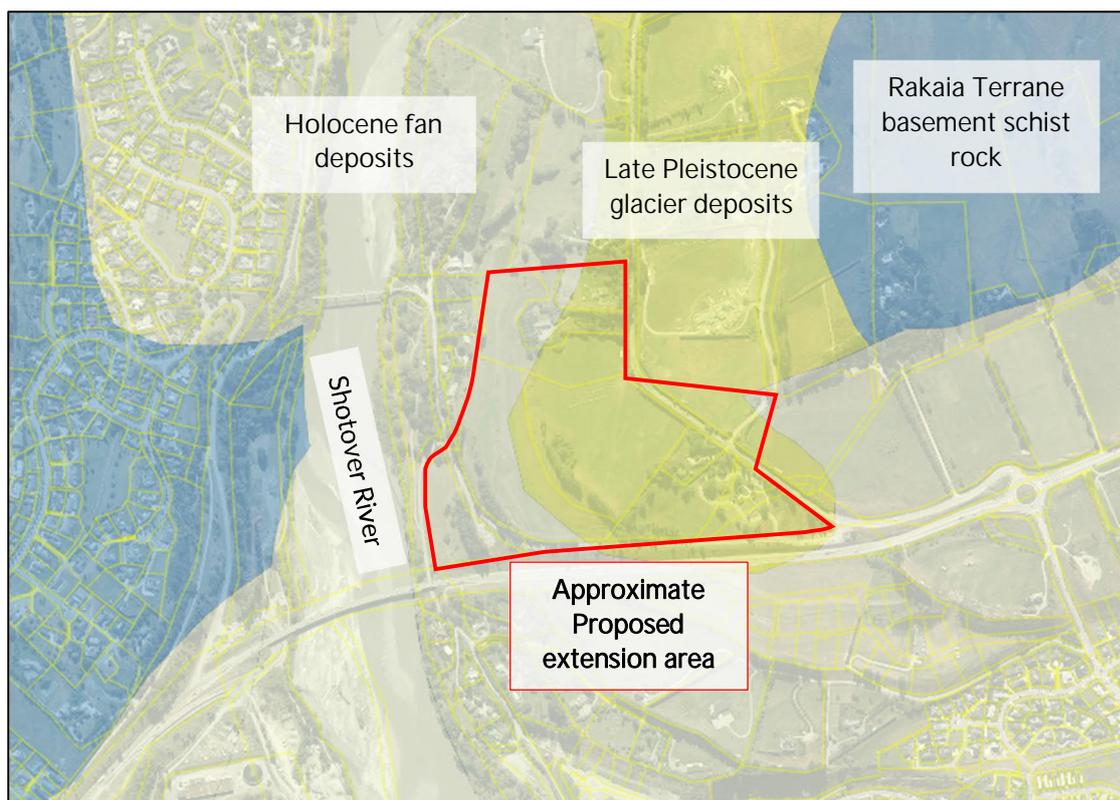


Figure 2: Published Geological Map (Source: GNS Webmaps)

Based on a review of the GNS Active Faults Database⁵ there are no active fault traces within the immediate vicinity of the property. However there is a significant seismic risk of strong ground shaking from the Alpine Fault approximately 80 km to the north-west. The Alpine Fault is expected to produce magnitude 8 earthquakes with a recurrence interval of 330 years. The probability of an Alpine Fault earthquake occurring in the next 50 years is about 28 percent⁶. The Cardrona and Nevis Faults, with recurrence intervals between 5,000 to 10,000 years are approximately 12 km to the east of the site.

In addition to the above, a published map of the surficial geology of the area⁷ has been reviewed. An excerpt from this map is presented as Figure 3 below. The surficial geology mapped is similar to the above GNS published geology, and indicates the site is underlain by Glacial deposits to the north east (Late Pleistocene glacier deposits), and Terrace Alluvium (Holocene fan deposits) across the remainder of the site.

⁵ GNS Science. New Zealand Active Faults Database. Surface Traces of Onshore Active Faults at a Scale of 1:250k. <https://data.gns.cri.nz/af/>

⁶ <https://www.gns.cri.nz/our-science/land-and-marine-geoscience/our-plate-boundary/alpine-fault>.

⁷ Barrell, D J A, Riddolls, B W, Riddolls, P M, Thomson, R, 1994. Surficial geology of the Wakatipu Basin, Central Otago, New Zealand. Institute of Geological & Nuclear Sciences science report 94/39. 31 p., 2 maps.

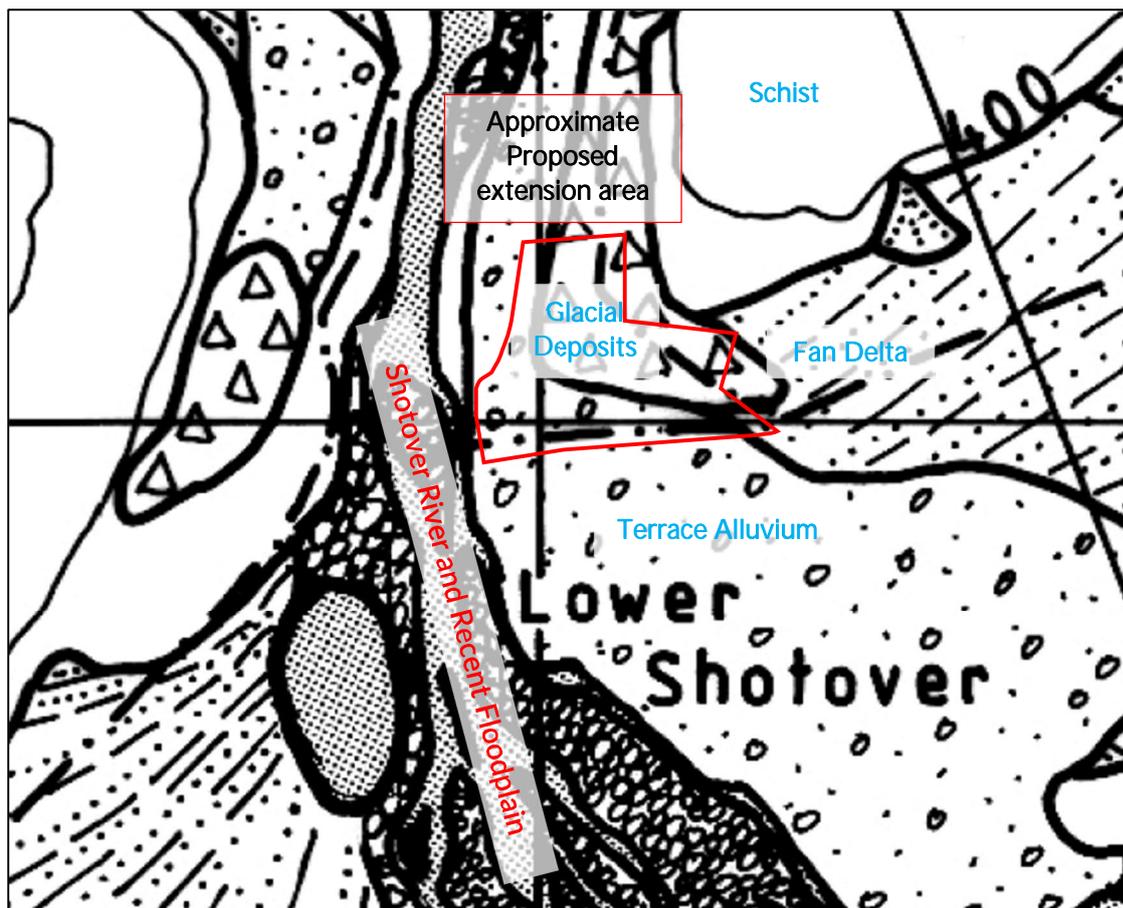


Figure 3: Mapped surficial geology of the Ladies Mile area⁷

6. Historical Investigations

Historical geotechnical investigation data from the New Zealand Geotechnical Database (NZGD) within the investigation area has been reviewed. Previous investigations include:

- Three test pits along Lower Shotover Road for the purpose of pavement investigations carried out by Beca on 8 September 2022. The pits were excavated to between 0.5 and 0.6 m bgl and encountered between 200 to 400 mm of chipseal and basecourse, overlying 100 to 300 mm of Alluvium, comprising silty sandy gravel, and silty sand.
- Two water bores were drilled by McMillan drilling in March 2016, one at the north western corner of the proposed extension area and one near the eastern boundary, adjacent to Lower Shotover Road. The boreholes were drilled to 70 and 83.57 m bgl respectively and encountered sand and gravel mixtures overlying schist rock at 4.8 and 7.6 m bgl. The north western borehole was dry to full depth at 70 m bgl, and the eastern borehole had a recorded standing groundwater level at 23.81 m bgl.

The locations of the historical investigations are presented on Figure 2185-G01 attached in Appendix A, and the investigation logs are attached in Appendix B.

Geosolve have previously carried out a Preliminary Geotechnical Assessment to enable comment on the subsurface conditions and expected geotechnical issues for the Ladies Mile masterplan area. The findings of their investigation are presented in their report dated in December 2020². The southern half of the current proposed extension area was included in the focus area of their study and was described at the "Western slopes and terraces" area. Their report inferred the subsurface conditions expected in this area to comprise:

- Topsoil, overlying;
- Localised colluvium (within sloping areas only), overlying;
- Loess silt, overlying;
- Up to approximately 1 m of localised floodplain deposits, overlying;
- Deltaic/alluvial sand, gravel and silt deposits with varying fractions of each constituent material.

The report also comments on the "Existing landslide feature" mapped on the QLDC hazard maps. The feature is presented in blue on Figure 2185-G01 attached in Appendix A. Geosolve conclude it is likely that the landslide feature shown on the QLDC hazard map is the result of an error during compilation.

7. Initia Site Walkover and Observations

A site walk over was carried out by an Initia Senior Engineering Geologist on 17 October 2023. No intrusive investigations were completed; however, inspection of local soil and rock exposures were carried out where available. The exposure locations with a brief description of the geological unit observed is presented on Figure 2185-G01 attached in Appendix A.

The following observations were made during the site walkover:

- The site is characterised by a series of historical river terraces.
- Surface outcrops typically comprised of the following sequence of geological units:
 - o **SILT** – Logged as non-plastic, stiff to very stiff, moist, brown SILT with some clay.
 - o **LOESS** – Logged as non-plastic, very stiff, dry, light brown, SILT.
 - o **GRAVEL** – Logged as brownish grey silty sandy GRAVEL with some cobbles up to 100mm dia. The gravels comprised rounded shist.
 - o **SCHIST** – Highly weathered, very weak to weak, SCHIST. Foliation typically dipped between 25-35° to the west and southwest.

We note that the above units are typical of materials encountered in landforms dominated by fluvial processes. These materials are not associated with landslide features. The locations where each of the above units were observed in outcrop is presented on Figure 2185-G01 attached in Appendix A.

- No visible signs of active, deep-seated instability (e.g. tension cracking, slumping, scarps, toe heave) were observed within the proposed extension area.
- Landscaping features such as farm fences, small garden fences, and steps across the property showed no signs of movement.
- An external appraisal of the existing building at 63a Lower Shotover Road indicated it was in good condition with no sign of deformation associated with land instability.
- No active fault traces were observed at the site or in the immediate vicinity.
- No active springs or seepage was observed, indicating groundwater is at depth.
- A fill stockpile, likely for the purpose of roading aggregate, was observed at the south western corner of Spence Road.

Historical Aerial Imagery

A review of the historical aerial imagery available on Retrolens was carried out. The images dated back to 1956 and indicate the site has been used for agricultural purposes since.

The 1964 photo clearly shows the undulating topography but we do not consider this to be associated with global slope instability or other geotechnical hazards.



8. Geotechnical Considerations

Preliminary conclusions relating the geotechnical suitability for development of residential property on the subject site are outline below.

Slope Stability

No evidence of global stability issues were identified. In particular we concur with the conclusion of Geosolve that the mapped instability feature on the QLDC hazard map does not appear to be related to any actual feature on site and may have been a compilation error. The site is considered to be geotechnically suitable for residential development, noting additional geotechnical investigations and analysis will be required at the subdivision design and resource consent stage. Detailed slope stability analysis should be carried out on proposed building platforms near the crest or toe of any river terrace riser or other significant slope.

Rock Fall

Several schist rock outcrops were observed on the subject site. Minor fretting and rock fall may occur in localized areas; however, we expect the risk to be low and isolated to only a few areas. A rock fall assessment should be carried out for any developments proposed beneath schist rock faces.

Groundwater

Ground water is expected to be at depth and is unlikely to be encountered during construction of a typical residential development.

Liquefaction

Given the significant depth to groundwater, the risk of liquefaction at the site is considered to be very low. No specific measures to address liquefaction risks are expected to be necessary at either subdivision or individual lot development stages.

Foundations

Provided all topsoil and soft or unsuitable material is removed prior to construction of the foundations, the site is expected to be suitable to support one to two story residential developments on shallow foundations. Dwellings founded on the surficial silts may have a reduced bearing capacity, however deepened foundations or earth working/removal of the silt could easily be undertaken if necessary to address this. If higher bearing capacities are required minor ground improvements could be considered, or foundations could be extended or piled to bear on the gravels or schist bedrock.

Multi story buildings are also expected to be feasible, provided the foundations are extended or piled to bear on the gravel or schist bedrock.

Geotechnical investigations specific to individual lot developments will be required to assess the achievable bearing capacities and provide foundation recommendations.

9. Further Work

If the proposed extension is added to the Ladies Mile Development area, site specific geotechnical investigations, analysis and reporting should be carried out at the subdivision design consent stage to confirm suitable building platform locations for individual lots, together with any necessary geotechnical inputs for roading and civil infrastructure.

Geotechnical investigations may comprise test pits to identify the nature and composition of subsoils at shallow depths, and / or deeper machine boreholes.



As discussed above, slope stability analysis of building platforms will be required where in proximity to the crest or toe of existing slopes on site, in particular the terrace risers.

10. Conclusions

A preliminary geotechnical assessment has been carried out for a proposed extension area to the Ladies Mile development. We note that no intrusive investigations were completed as part of this study, and site specific geotechnical investigations will be required for any proposed future development.

No major geotechnical issues were identified during the desk study and site walk over, and we consider that future Medium Density Residential and Low-Density Residential developments are geotechnically feasible at the site.

11. Applicability

This letter has been prepared for The Property Group, with respect to the brief provided to us. The advice and recommendations presented in this report should not be applied to any other project or used in any other context without prior written approval from Initia Limited.

Report prepared by:



Andrew Klahn
Senior Engineering Geologist

Report authorised by:



Matt Wansbone
Senior Geotechnical Engineer, Director

Attached:

- Appendix A: Site Plan
- Appendix B: Historical Investigation Logs



Appendix A: Site Plan

LEGEND

HISTORICAL INVESTIGATIONS

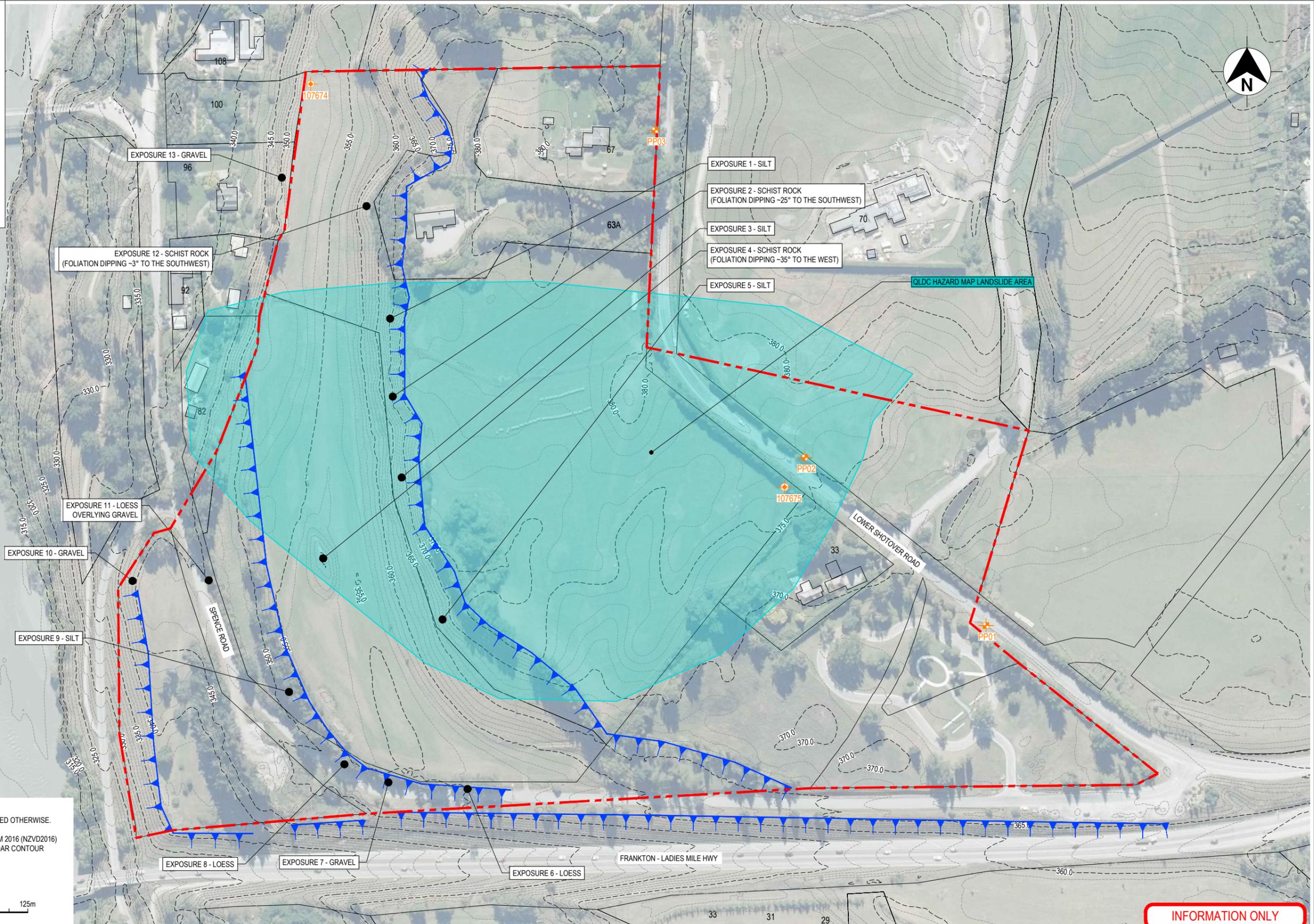
- TEST PIT (BECA - 08 SEP 2022)
PP01
- WATER BORE (MCNEIL DRILLING - MAR 2016)
107674

SITE BOUNDARY

EXISTING GROUND CONTOUR (0.5m INTERVAL)

QLDC HAZARD MAP LANDSLIDE AREA (PLEASE REFER TO SECTION 8 - SLOPE STABILITY, OF THE REPORT FOR DISCUSSION OF THIS ANOMALY)

RIVER TERRACE CREST



NOTES

- ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
- COORDINATE DATUM: LINDIS PEAK 2000
- LEVEL DATUM: NEW ZEALAND VERTICAL DATUM 2016 (NZVD2016)
- AERIAL IMAGE, PROPERTY BOUNDARY AND LIDAR CONTOUR TAKEN FROM LINZ DATA.

SCALE A3 1:2500

0 25 50 75 100 125m

INFORMATION ONLY

NOT FOR CONSTRUCTION				
<small>THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION UNLESS SIGNED AS APPROVED</small>				
APPROVED:				
A	FIRST ISSUE (19/10/2023)	AK	GG	AK
Rev	Revision Description	Designed	Drawn	Checked
		Scale	AS SHOWN	Original Size A3



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THE PROPERTY GROUP

TE PŪTAHI LADIES MILE ZONE EXTENSION

GEOTECHNICAL INVESTIGATION LOCATION PLAN

Initial Project ref:	P002185
Figure Number	2185-G01
Revision	A

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D:\INITIA\LIMITED\INITIA LIMITED TEAM SITE - 2100-2185-402185 - LADIES MILE EXTENSION\CAD2 - WORKING FILES\2185-G01.DWG - 10/19/2023 11:50 AM

Appendix B: Historical Investigation Logs



Test Pit Log

Test Pit ID: **PP03**
Sheet 1 of 1

Project: Lower Shotover Road Upgrade - Pavement Investigations	Project number: 3338150/200
Site location: Lower Shotover Road	Client: Queenstown Lakes District Council
Location: Lower Shotover Road	Coordinate system: NZTM2000
	Vertical datum: NZVD 2016
	Ground level (mRL): 379.00
	Location method: hhGPS/Webmap estimation
	Northing: 5008696.3
	Easting: 1266160.2

Groundwater (m)	In Situ Tests		Samples	Depth (m)	RL (m)	Graphic Log	Soil/ Rock Description	Geological Unit
	Su (kPa)	Scata blows/50mm						
							CHIPSEAL (40 mm thickness)	Fill
							[BASECOURSE] Tightly packed, fine to coarse sandy cobbly GRAVEL; minor silt; grey; moist, well graded.	
							[SUBGRADE] Tightly packed, silty, fine to medium sandy GRAVEL; minor silt; grey; moist, well graded.	Alluvium
			B	0.5	378.5		0.50m - End of test pit, Hole terminated at target depth.	
				1.0	378.0			
				1.5	377.5			

Date started: 08/09/2022	Logged by: OM	Comments:
Vane ID: N/A	Contractor: Forbes Earthworks Ltd	Test pit terminated at 0.50 m bgl, target depth.
Vane type: N/A	Equipment: Yanmar ViO20-6	Groundwater not encountered.
Vane width: N/A	Method: TP	Location by hhGPS to an accuracy of +/- 3 m according to the NZ Transverse Mercator Projection (2000). Elevation estimated from webmap to an accuracy of +/- 3 m according to the NZ Vertical Datum (2016).
Face orientation: N/A		

For Explanation of Symbols and Abbreviations See Key Sheet



McNeill Drilling Company Ltd - Alex
 (49 Boundary Road)
 PO Box 95
 ALEXANDRA 9340

LABORATORY ANALYSIS REPORT

#65035

Friday, 18 March 2016

ATTENTION: Christine B

Your Order #:- P65071 . Job Start 8/03/16 16:32:47

LAB. REF.	Sample Taken:	Sample Description		c o m m e n t s			
		Test start:	Test complete:	ANALYSIS	RESULT	Analytical Method	Detection Limits
98082	07/03/16 21:00	Family Trust ~ Bore Water	 (Citilab to include explanatory notes with report). Email report to admin@mcneillnz.com			
		11/03/16 11:18:12	11/03/16 15:25:18	Acidity Requires CO2	10 g/m ³ as CaCO ₃	APHA 2310, B	5 g/m ³ as CaCO ₃
		9/03/16 16:52:33	9/03/16 17:01:05	Alkalinity to pH 4.5	150 g/m ³ as CaCO ₃	APHA 2320, B	1 g/m ³ as CaCO ₃
		9/03/16 16:52:36	9/03/16 17:01:08	Alkalinity to pH 8.3	<1 g/m ³ as CaCO ₃	APHA 2320, B	1 g/m ³ as CaCO ₃
		11/03/16 11:18:20	16/03/16 16:41:56	Bromide (IC)	<0.1 g/m ³	APHA4110, B	0.03 g/m ³
		11/03/16 11:18:20	16/03/16 16:45:30	Chloride (IC)	13 g/m ³	APHA4110, B	0.05 g/m ³
		11/03/16 11:18:13	11/03/16 15:29:07	Colour (Hazen) *	7.5 Hazen	Lovibond Comparator	2.5° Hazen
		9/03/16 16:52:48	9/03/16 17:05:22	Conductivity @ 25°C	39 mS/m	APHA 2510, B	0.03 mS/m
		11/03/16 11:18:19	16/03/16 16:40:54	Fluoride (IC)	0.13 g/m ³	APHA4110, B	0.03 g/m ³
		11/03/16 11:18:14	18/03/16 11:35:22	Total Hardness By Calculation	162.5 g/m ³ as CaCO ₃	APHA 2340, C	1 g/m ³ as CaCO ₃
		9/03/16 16:52:32	9/03/16 17:02:45	pH	7.75 @ 20°C	APHA 4500 - H+, B	0.02 pH unit
		11/03/16 11:18:18	16/03/16 16:41:54	Phosphate (IC) *	<0.1 g/m ³	APHA4110, B	0.4 g/m ³
		15/03/16 14:33:20	16/03/16 16:42:00	Phosphate-P (IC) *	<0.05 g/m ³	APHA4110, B	0.2 g/m ³
		11/03/16 11:18:21	16/03/16 16:45:36	Sulphate (IC)	28 g/m ³	APHA4110, B	0.03 g/m ³
		11/03/16 11:18:11	11/03/16 15:32:49	Turbidity - class 1	130 NTU	APHA 2130, B	0.05 NTU
		9/03/16 11:00:03	18/03/16 11:35:20	Arsenic-Total	0.042 g/m ³	APHA 3125, B	0.001 g/m ³
		9/03/16 10:59:57	18/03/16 11:35:19	Calcium-Total (ICP)	55.0 g/m ³	APHA 3125, B	0.001 g/m ³
		9/03/16 10:59:47	18/03/16 11:35:18	Iron-Total (ICP)	10.0 g/m ³	APHA 3125, B	0.005 g/m ³
		9/03/16 10:59:59	18/03/16 11:35:31	Magnesium-Total (ICP)	6.08 g/m ³	APHA 3125, B	0.002 g/m ³
		9/03/16 10:59:48	18/03/16 11:35:32	Manganese-Total (ICP)	0.309 g/m ³	APHA 3125, B	0.0003 g/m ³
		11/03/16 11:18:17	16/03/16 16:41:40	Nitrate (IC)	0.09 g/m ³	APHA4110, B	0.03 g/m ³
		15/03/16 14:33:19	15/03/16 14:43:09	Nitrate-N (IC)	0.02 g/m ³	APHA4110, B	0.01 g/m ³
		8/03/16 16:36:30	10/03/16 11:06:48	E. coli (Quanti-Tray)	1.0 MPN/100 mL	MIMMS 5th Ed, 11A1.1	1.0 MPN/100 mL

20/03/16 09:23:31 1of6 #65035~ FormName:LAR,Issue#:12_101004,Approved:GKM.

10 Tahuna Rd, P.O. Box 781, Dunedin 9054
 Telephone (03) 455 7938, Fax (03) 455 7940
 Email: mail@citilab.co.nz
 Website: www.citilab.co.nz

NZGD ID: Other_107675

NZGD ID: Other_107675



Analyst's Comments:

These samples were collected by yourselves and analysed as received at the laboratory. The detection limits given are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Units: In accordance with modern practice the previous 'mg/L' is now expressed as the equivalent 'g/m³'.

Dr. Frank Ho
Lab Services Manager (LAS)



Citilab is accredited by International Accreditation New Zealand (IANZ). The tests reported here have been performed in accordance with its terms of accreditation - with exception of any marked *, which are not within Citilab's scope.

Jess Laursen
Microbiology Technician (LAS)

Client Name:	family trust		Home No.	033185838
Address	63 lower shotover Rd		Cell No.	0274320124
	Queens town		Consent No.	Rm 15.332.01
Grid Reference	E-1265929	N-5008717		

Driller	Neil Summers		
Machine/Rig:	DR24	Fleet No.	232
Drill Method:	Dual rotary Dth		
Bore diameter mm	150mm		
Start date:	4/3/16	Finish Date:	4/3/16
Development Hours:	Development Method:		
Screen Slot:	mm ID	mm OD	mm
PVC slotted	Top	Bottom	m
Total casing used:	m		Total Depth: 70 m
Sump length:	m		Sump Diameter: mm
Test Pumping	Air lifted	Pumped	Rate: LPS
Test Pump period	Hrs		Pump intake: m
Bacterial Water test	Yes	No	
Chemical Water test	Yes	No	
Casing top sealed	Yes	No	
Impervious seal at ground	Yes	No	
Over Drilled	Yes	No	m

Comments: all gear removed from Hole.
 Dry Hole.
 Bore log
 0-0.3 topsoil
 0.3-2 Sand
 2-4.8 very severely Gravel
 4.8-70 Rock Schist

