

Before Queenstown Lakes District Council

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In the matter of            The Resource Management Act 1991

And                            The Queenstown Lakes District proposed District Plan Topic 13  
Queenstown Mapping

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**EVIDENCE OF PETER NICOLSON FOR**

Gertrude's Saddlery Limited (494) and Larchmont Developments Limited (527 and  
1281)

Dated 09 June 2017

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## **Qualifications and Experience**

- 1 My name is Peter James Nicolson. I am employed as a Senior Geologist at GeoSolve Ltd, Queenstown. I have approximately 5 years of experience in the engineering geology field, and approximately 25 years of experience in the fields of mining, exploration and general geology, both within New Zealand and internationally. I hold the qualification of Bachelor of Science (Geology), from the University of Canterbury, completing this course in 1983. I am a Member of the Australian Institute of Geoscientists, and am a Registered Professional Geoscientist with that institute.
- 2 I currently work for GeoSolve, and have been based in the Queenstown area for approximately 26 years. I have worked in the engineering geology sector in the Fiordland and Queenstown areas during part of this period, initially for the FDI JV on the 2<sup>nd</sup> Manapouri Tailrace Tunnel, for Tonkin & Taylor in Queenstown, as an independent contractor in and around Queenstown, and for GeoSolve Ltd more recently. Most of my more recent work has involved site investigations and geotechnical assessments at various levels for residential development, and rock hazard mapping for domestic and commercial developments. This recent work is relevant to the current site investigation carried out at 111 Atley Road Arthurs Point, Queenstown.
- 3 I have been instructed by Gertrude's Saddlery Limited to prepare evidence in relation to the District Plan Review Hearings and the submission to rezone land at 111 Atley Road Arthurs Point Queenstown from Rural Zone to Low Density Residential Zone. I attach my most recent report resulting from that work as Appendix [x].
- 4 I have read the Code of Conduct for Expert Witnesses in the Environment Court Practice Note 2014. This evidence has been prepared in accordance with it and I agree to comply with it. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

## **Summary of Evidence**

- 5 I undertook two site visits to 111 Atley Road (the Site) for the purposes of geotechnical investigations. The first was on 8 November 2016, when a high-level pre-purchase site walkover was carried out. The second site visit was made on 7 May 2017, to provide further information that may be relevant to broad-scale geomorphological mapping, to support the current plan change application for rezoning of the Site for residential purposes. Detailed LIDAR ("Light Detection and Ranging", a remote sensing application which uses airborne radar scanning to map the land surface)

topographic data was made available to support this phase, the result being a revision of the initial report on the Site and with some additional geological and geotechnical field data being recorded. It should be noted that the issued documents are based on preliminary, broad-scale geomorphological mapping, and further detailed assessments to accompany future resource consent applications will be required to confirm areas suitable for final platform locations, to identify building platform set-backs, and other site-specific concerns that may arise. This is standard practice in many areas of the Queenstown-Lakes District at the more detailed design and building phase of a development.

- 6 Both reports have been peer-reviewed by senior GeoSolve staff members prior to issuing, and a third, confirmatory site visit was also carried out on 7 June 2017 by Paul Faulkner, Senior Engineering Geologist with GeoSolve.
- 7 Based upon my preliminary findings from those site visits, and those from Paul Faulkner following his site visit, along with the standard GeoSolve practice of reviewing investigation data where applicable from nearby sites as part of a desktop study, I have reached the following conclusions in respect of the Site.
- 8 The Site is expected to comprise schist bedrock with overlying terrace alluvium and/or glacial deposits, in turn overlain by loess and thin colluvium (in localised areas), and by surficial topsoil. No active fault traces are known to exist in the immediate vicinity of the Site, however a severe seismic risk exists over the Wakatipu region as a whole, due to a high probability of rupture of the Alpine Fault occurring within the next 50 years.
- 9 In terms of natural hazards, potential slope stability hazards within or near the Site are confined to some areas located on or close to the southern boundary, where schist bluffs have formed due to historic and possibly more recent slips and/or rockfall, and an isolated area of slow soil creep close to this boundary was observed on the third (post report) site visit. Most of the southern property boundary is positioned at varying distances upslope of these bluffs. The northern part of the Site is within a 'nil to low risk liquefaction category', the southern in a "probably low risk" category. Site observations allow us to conclude that there is an overall nil to low risk of liquefaction.
- 10 Future residential development on the Site, to a low density residential level (LDR) of development, would not be impeded by any geotechnical issues observed on the Site, apart from some areas close to the southern boundary where bluffs have formed, and localised surficial instability has been recently noted. As site investigation to date has been preliminary only, future construction close to these areas will need to be assessed in detail on a

case-by case basis, and setback distances provided, or excluded areas identified, if necessary. The Site overall is considered suitable for LDR use, subject to standard site-specific engineering solutions applicable at the detailed design phase of future development and construction.

- 11 Geological conditions and associated risks are acceptable for the intended use of the Site, subject to the caveats mentioned above. As noted in the reports, detailed investigations will be required to finalise specific engineering requirements for future building areas.

A handwritten signature in black ink, appearing to read 'Peter Nicolson', with a long horizontal flourish extending to the right.

Peter Nicolson

**9 June 2017**

Attachments: Lr-160771.01 111AtleyRoad\_Plan Change Report.pdf

GeoSolve Ref: 160771.01

22 May 2017

Gertrude's Saddlery Ltd  
c/- [office@technz.co.nz](mailto:office@technz.co.nz)

Attention: Sandy Kong

Dear Sandy

## 111 Atley Road, Arthurs Point, Queenstown Geotechnical Assessment for Proposed Plan Change

### 1.0 Introduction

This letter details the results of geotechnical inspections and a desk top study that have been completed by Geosolve Limited for 111 Atley Road, Arthurs Point, Queenstown. This report is a revised version of the original report issued in November 2016.

The work described in this letter has been completed in accordance with the terms and conditions outlined in Geosolve proposal reference number pr160771.01 dated 17 May 2017.

The opinions and conclusions presented in this report are based on the following sources of information:

- Walkover inspections and mapping of the site by an engineering geologist;
- A review of historic information currently held on the Geosolve database for other sites in the local area;
- A review of the Queenstown Lakes District Council and Otago Regional Council Hazard Register Maps;
- A review of the published geological map, 'Institute of Geological & Nuclear Sciences Ltd, Geology of the Wakatipu, 1:25,0000 Geological Map 18', and;
- Lidar data showing site contours.

No intrusive investigations have been completed for this report and all opinions and conclusions that are presented in this report are preliminary in nature. The geotechnical conditions will need to be confirmed by site-specific investigations, engineering assessment and inspections during detailed design and construction by an appropriately qualified and experienced Geotechnical Engineer and/or Engineering Geologist.

## 2.0 Site Walkover Inspections

Geosolve completed an initial walkover inspection and mapping of the site on 7 November 2016, and a further site inspection on 7 May 2017.

The site is located on the northern side of the Shotover River at the southern end of Atley Road, Arthurs Point, Queenstown, see Figure 1 below.



Figure 1. Aerial view of proposed development site location.

The site comprises a partially developed subdivision, with some established dwellings and infrastructure in the northern areas, and large areas of undeveloped and forested slopes and terraces in the south and southeast areas. Current zoning is Low Density Residential in the northern third of the site, and Rural General in the larger, southern portion of the area. This report was commissioned to support a plan change submission in favour of including the total site area in the Low Density Residential zoning.

The topography of the proposed enlarged Low Density Residential development area comprises sub-horizontal to gently sloping river terraces, and an elevated schist hillock in the northeast of the site (see detailed LIDAR topography map Figure 1, Appendix A). The Shotover River is approximately 50-60 m in elevation below the main terrace levels. Slope angles vary from sub-horizontal to gently inclined (<5-12°) within the terraced areas, and between 40 and 60°+ within the bluff areas approaching the Shotover River, beyond the southern site boundary. Incipient and weakly incised dry

gullies are present in places throughout and below the bluffs area approaching the Shotover River. The larger of these gullies are likely to receive seasonal or periodic flows.

Schist bedrock outcrops can be seen throughout the site, in road cuts, in the bluff area and near the top of the schist hillock. The schist was observed as slightly weathered (and locally moderately weathered in the near surface), thinly foliated, and pelitic in texture, with foliation observed to dip 10-22° to the south. Joint and fracture sets in the schist were also noted in the bluffs area and in the extreme eastern corner of the area, which control some of the outcrop profiles. Three dominant joint sets were observed in the outcrops, dipping steeply NE and SE, and dipping more shallowly NE. The intersections of these sets at or near the face of the outcrops, combined with thinly spaced foliation has allowed some historic opening of defects and downslope deformation in places. Minor areas of locally derived displaced schist blocks were observed, immediately downslope of the larger outcrops in the bluffs area. However, no deep-seated slope instability was observed within the site boundary.

Terrace alluvium was observed to overlie the schist at one location in the road cut, and is also exposed in the northeast corner of the area, comprising brown, silty, sandy GRAVEL with minor cobbles to 100 mm in long dimension. Elsewhere, cobbles and boulders to 250 mm were noted in colluvial material on slopes. Locally, loess (silt) is observed to overlie the terrace alluvium.

### 3.0 Expected Geology

Published geological information (Institute of Geological and Nuclear Sciences (IGNS), 1:250,000 Geological Map 18, Geology of the Wakatipu) indicates the geological materials which are present beneath the site comprises glacial till.

No intrusive investigations have been completed for the purposes of this report; however, examination of local soil and rock exposures, and information contained on the Geosolve database has been reviewed. The site is expected to comprise schist bedrock with overlying terrace alluvium and/or glacial deposits and with surficial topsoil, and locally loess and colluvium.

No active fault traces are known to exist in the immediate vicinity of the site; however, a significant seismic risk exists in the region due to rupture of the Alpine Fault which runs along the west coast of the South Island. A high probability exists that an earthquake of magnitude 7.5 or greater will occur on the Alpine Fault within the next 50 years. An earthquake of this magnitude is expected to result in strong and prolonged ground shaking in the Central Otago region.

### 4.0 Hazards

#### Seismic

A severe seismic risk is present in the region as discussed in Section 3.0 and appropriate allowance should be made for seismic loading during detailed design of the proposed buildings, foundations and retaining walls.

## Slope Stability

No mapped existing slope stability hazards are present within the site boundary and none were observed during the site inspection. Minor localised and shallow gully erosion and small areas of rockfall within the steeper Shotover River banks, well outside the proposed development area, were observed. There was no deep seated, recent or active instability of the slopes within the development area observed during the site walkover.

## Liquefaction

The QLDC GIS mapping system indicates that the majority of proposed development area is within a nil to low risk of liquefaction category. The southern end of the outlined residential development area is categorised as probably low risk of liquefaction. Site observations, which indicate a relatively shallow depth to bedrock, and interpreted depth to water table, confirms that the risk of liquefaction is nil to low.

No other hazards were identified in close proximity to the site.

## 5.0 Groundwater

The regional groundwater level is expected to lie at depth below the development area. No shallow seepages were observed during the site inspection, however as has been observed elsewhere in the larger Wakatipu area, perched seepages may be encountered at shallow depths at the soil and rock contact, and this should be assessed and allowed for during any site excavations.

## 6.0 Future Residential Development

No geotechnical issues were identified during the site walkover inspection, which would prevent the outlined residential development area from being developed under a low density residential zoning classification. The site consists of sub-horizontal to gently sloping terraced areas, and moderately sloping elevated hillocks and ridges, which subject to normal site engineering, would appear to be suitable for residential use.

Glacial till (if present), alluvium and schist bedrock should provide adequate bearing for a residential dwelling. Local thin areas of surficial loess and colluvium are not suitable as a standard foundation bearing material, and will likely need to be removed from footing and pad footprints, or specific design provided. Bearing capacity should be assessed by a chartered professional geotechnical engineer once development proposals are defined at the detailed design stage. If the foundation spans soft soils and rock, there is the potential for differential settlement.

A site-specific geotechnical investigation to confirm the shallow ground conditions for foundation design is recommended. In addition, if significant excavations are proposed, particularly in close proximity to site boundaries and steep slopes, it is recommended that a site specific geotechnical investigation and assessment, which incorporates intrusive ground investigations (test pits/ pilot cuts), be completed as part of the detailed design phase of any future development.



The outlined residential development area comprises sub-horizontal to gently sloping terraces and a schist hillock. Beyond the southern site boundary of the residential development area the ground becomes steeply sloping down towards the Shotover River. Steep slopes ( $40^{\circ}+$ ) are also present within and beyond the site boundaries in the eastern corner of the development area. Site-specific setback calculations may be required if development is proposed close to steep slopes.

Prior to any development of the site, the loess, colluvium and topsoil along with any organic matter and other unsuitable materials should be removed from the construction areas in accordance with the recommendations of NZ 4431:1989.

Future development will need to consider stability of temporary cut slopes during excavation of building platforms. Temporary excavations in soil will need to be made at appropriate batter angles (for example 2:1 (horizontal to vertical) for topsoil and colluvium soils and 1:1 (H:V) for glacial till and alluvial gravel soils in dry condition). If temporary batters cannot be achieved within the site boundaries temporary retaining will be required during construction.

Excavations in schist bedrock can become unstable due to the orientation of foliation, and the fractured nature of the rock mass. To ensure suitable stability is maintained all cuts will need to be formed at safe batter angles or artificially supported, i.e. retaining walls, or for rock cuts shotcrete, rock bolts and anchors and/or props may be appropriate. Pilot cuts, staged excavation and/or ongoing geotechnical inspections may be required to ensure a satisfactory level of slope stability is maintained at all times. The schist foliation has been observed to be dipping out of the slope (to the south) at  $10-22^{\circ}$ . This has locally influenced hillslope development over time, as evidenced by dip slopes observed in some places. This foliation orientation may influence the stability of some south-facing excavations. Secondary defects (joints/fractures) in the schist have also been observed within and close to the development area. These also have the potential to cause local instability, and it is recommended that site-specific geotechnical observations be made during rock excavations to identify any issues related to these defects.

Perched groundwater seepages are common on hillsides in the Wakatipu area, particularly at the soil-schist bedrock interface. Groundwater may be intercepted during excavation for a building platform. Sub-soil drainage measures, such as horizontal drains, are sometimes required to ensure long-term geotechnical stability of the site is maintained. It is recommended that allowance be made in the construction programme and budget for sub-soil drainage measures. This should be confirmed by site inspections during earthworks construction.

Due to the severe seismic setting, it is recommended the engineering design of any future development be completed by an appropriately qualified and experienced chartered professional engineer.

## 7.0 Report Closure

This report has been prepared for the benefit of Gertrude's Saddlery Ltd with respect to the particular brief given to us and it may not be relied upon in any other context or for any other purpose without our prior review and written agreement.

Please don't hesitate to contact us if you have any questions on the content of this letter.

Report Prepared By:



.....  
Peter Nicolson  
Senior Geologist

Reviewed for GeoSolve Ltd by:



.....  
Paul Faulkner  
Senior Engineering Geologist



GEOTECHNICAL ENGINEERING ● ENGINEERING GEOLOGY ● HYDROGEOLOGY ● HYDROLOGY ● PAVEMENTS

# Appendix A: Site Plan and Cross Sections

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Regional Office: 829 Frankton Road, Frankton Marina, Queenstown, 9300 ● PO Box 1780 Queenstown  
● Phone 64 3 451 0172

email [admin@geosolve.co.nz](mailto:admin@geosolve.co.nz)



LEGEND	
	Minor LIDAR contour (0.5m Interval)
	Major LIDAR Contour (5.0m interval)

CLIENT REVIEW 05.10.16

**Clark Fortune McDonald & Associates**  
 Licensed Cadastral Surveyors - Land Development - Planning Consultants  
 309 Lower Shotover Road, P.O. Box 553 Queenstown  
 Tel. (03)441-6044, Fax (03)442-1066, Email admin@cfma.co.nz  
 Shop 2, Otago House, 475 Moray Place, P.O. Box 5960  
 Tel. (03)470-1582, Fax (03)470-1583, Email admin@cfma.co.nz

Rev.	Date	Revision Details	By
		SCHIST BEDROCK OUTCROPS	
		TERRACE ALLUVIUM	
		FILLED GROUND	

→ (P) PHOTO NO & DIRECTION

### COMPILED TOPOGRAPHIC PLAN OF LOTS 2 & 7 DP 307630 & PT SEC 1 SO 24070

SCHIST FOLIATION  
 SCHIST JOINT/FRACTURE  
 BLUFFS / STEEP SLOPE  
 30° SLOPE ANGLE (AVERAGED)

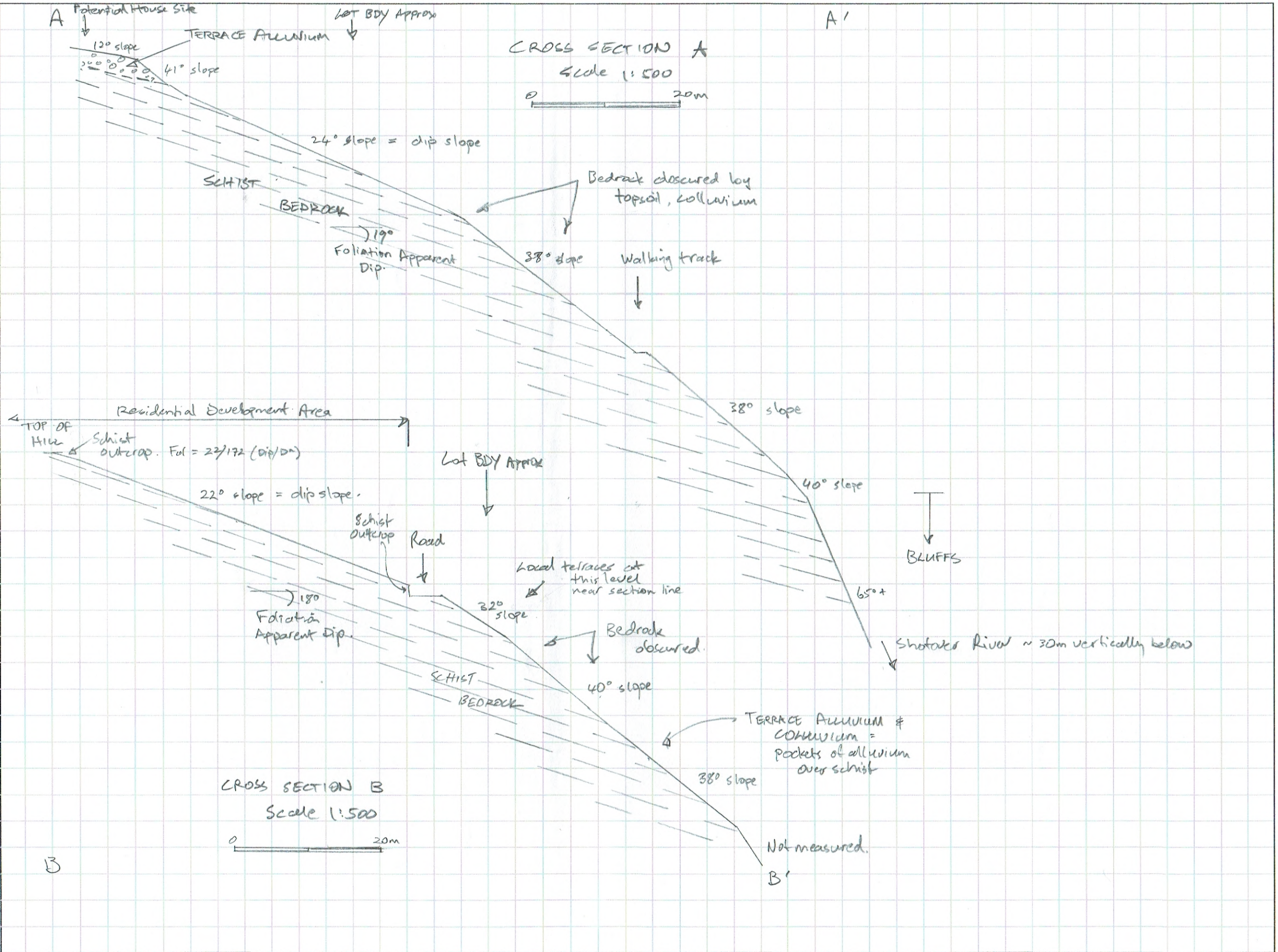
160771. SITE PLAN. 8/11/16. REVISED 7/5/17  
 111 ATLEY ROAD, ARTHURS POINT, QUEENSTOWN

Client		SWANN	
Surveyed	Signed	Date	Job No.
-	-	-	12704
Drawn	Signed	Date	Scale
RWB	-	05.10.16	1:1000 @ A1
Designed	Signed	Date	Datum & Level
-	-	-	Mt Nic 2000 & MSL
			Rev.
			01

Notes:  
 All dimensions shown are in meters unless shown otherwise.  
 Any person using Clark Fortune McDonald drawings and other data accepts the risk of:  
 - Using the drawings and other data in electronic form without requesting and checking them for accuracy against the original hard copy versions.  
 - Ensuring the information is the most recent issue.  
 - Copyright in this drawing is reserved.

Job Number 160771  
 Page 111  
 Revision  
 Date  
 Check by

Project 111 ATLEY ROAD, QUEENSTOWN  
 Part of structure CROSS SECTIONS A + B  
 Date 8/11/16  
 Calc by PN  
 Drawing Ref Fig 11





GEOTECHNICAL ENGINEERING ● ENGINEERING GEOLOGY ● HYDROGEOLOGY ● HYDROLOGY ● PAVEMENTS

## Appendix B: Site Photos

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Regional Office: 829 Frankton Road, Frankton Marina, Queenstown, 9300 ● PO Box 1780 Queenstown  
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email [admin@geosolve.co.nz](mailto:admin@geosolve.co.nz)



Photo 1: View east, northeast corner of site, buildable terrace, gently sloping.



Photo 2: View SW, schist outcrop in northeast corner of site. South dipping foliation, main NW-trending joint set controls face profile.



Photo 3: View SW, northeast corner of site. Loess (silt) over terrace alluvium. Loess is ca 0.5m thick.



Photo 4: View north, northeast corner of site. Terrace, showing old trench draining to the right.





Photo 5: View SW, southern part of site. WSW-trending terrace.



Photo 6: View west, main part of terrace shown in Photo 5.



Photo 7: View NW, terrace, partially cleared. Atley Road in centre right (obscured).



Photo 8: View north, terrace area bordered by gentle slopes. Atley Road in centre right (obscured).



Photo 9: View east, potential buildable, elongate terrace.



Photo 10: View west, bluffs area, showing joint sets.



Photo 11: View north, weathered terrace alluvium in bank above road cut. Overlies schist.